Prepared for:
City of Oshkosh
Oshkosh, Wisconsin

Prepared by:
AECOM
Middleton, Wisconsin
60268145
December 2014

City of Oshkosh Citywide Stormwater Quality Management Plan Update

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Prepared for the:

City of Oshkosh
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ACKNOWLEDGEMENTS

AECOM, acknowledges with appreciation, the efforts and assistance on this project from the City of Oshkosh

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List of Abbreviations & Acronyms

BMP – Best Management Practice
DP – Dissolved Phosphorus
FCA – Fish Consumption Advisory
GIS – Geographic Information System
MS4 – Municipal Separate Storm Sewer System
NRCS – Natural Resource Conservation Service
O&M – Operation and Maintenance
PCB – Polychlorinated Biphenyl
PP – Particulate Phosphorus
TMDL – Total Maximum Day Loads
TP – Total Phosphorus
TSS – Total Suspended Solids
USDA – United States Department of Agriculture
USEPA – United States Environmental Protection Agency
USGS – United States Geological Survey
WDNR – Wisconsin Department of Natural Resources
WinSLAMM – Windows Source Loading and Management Model
WPDES – Wisconsin Pollutant Discharge Elimination System

Throughout this document the terms “WPDES permit,” “Stormwater Permit,” and “MS4 permit” are used interchangeably to refer to the Wisconsin Department of Natural Resources (WDNR) General Permit to discharge under the Wisconsin Pollutant Discharge Elimination System (WPDES) Permit No. WI-S050075-2. This general permit regulates all discharge from the Municipal Separate Storm Sewer System (MS4) owned and operated by the City of Oshkosh.

Executive Summary

Introduction

Federal and state regulations require communities in Wisconsin to manage the pollution from their municipal separate storm sewer system (MS4). In December 2008, the City of Oshkosh's Citywide Stormwater Management Plan (2008 Plan) was finalized. The 2008 Plan was created to help comply with these regulations.

Since the 2008 Plan finalization, numerous updates have been made to both the guidance from the Wisconsin Department of Natural Resource (WDNR) and the computer model used for the study. Additionally, with the future establishment of total maximum daily loads (TMDLs) for the Upper Fox River watershed, the current guiding stormwater quality requirements will change. With these changes in mind, in 2012, the City of Oshkosh (the City) contracted with AECOM to conduct an update to the Citywide Stormwater Management Plan (2013 Plan Update).

This report documents the methodology and results of the 2013 Plan Update.

Stormwater Pollution Regulations

The City of Oshkosh is subject to stormwater pollution regulations as described in the State of Wisconsin Administrative Code sections NR 216 and NR 151. The regulations require the City to apply for and receive coverage under the Wisconsin Pollutant Discharge Elimination System (WPDES) permit system. In January, 2007, the City received formal notification from the WDNR that their stormwater permit was in effect.

The purpose of the NR 216 and NR 151 regulations is to reduce pollution from urban stormwater that will otherwise enter the state's lakes, rivers, streams, and wetlands. The WPDES permit describes six minimum measures (as set forth originally by the United States Environmental Protection Agency – USEPA) that are required of the City relative to stormwater management. To comply with the minimum standards, the City must develop and implement the following programs:

1. Public education and outreach program
2. Public involvement and participation program
3. Illicit discharge detection and elimination (program and ordinance)
4. Construction site pollution control (ordinance)
5. Post-construction site stormwater management (ordinance)
6. Pollution prevention (reduce stormwater pollution from municipal operations and the citywide storm sewer system)

As part of item 6, the WDNR requires that the City reduce stormwater pollution from its "Municipal Separate Storm Sewer System – MS4." The language in the City's WPDES permit states:

> ***"2.7.1*** *To the maximum extent practicable, implementation of stormwater management practices necessary to achieve a 20% reduction in the annual average mass of total suspended solids discharging from the MS4 to surface waters of the state as compared to implementing no stormwater management controls, by March 10, 2008. The permittee may elect to meet the 20% total suspended solids standard on a watershed or regional basis by working with other permittee(s) to provide regional treatment that collectively meets the standard.*

Note: Pursuant to s. NR 151.13(2), Wis. Adm. Code, the total suspended solids reduction requirement increases to 40% by March 10, 2013. However, the implementation date of this requirement was recently delayed by the State of Wisconsin Legislature."

When TMDLs are calculated for the Upper Fox River watershed, additional reduction targets will be established.

Stormwater Pollution Modeling

The WDNR outlines the procedures to quantify pollution from the MS4 and to quantify the pollution reduction achieved by the existing Best Management Practices (BMPs). Using a computer simulation model, the stormwater pollution from the City is calculated. A total loading value for the pollutants - Total Suspended Solids (TSS) and Total Phosphorus (TP) - is computed. Currently, pollution reduction requirements only apply to TSS. Using the model, the following conditions were determined:

1. The amount of pollution from the City's stormwater conveyance system under a "base" condition. The base condition is defined as the pollution that is generated if none of the City's existing BMPs are in place. This is the same as a "no management" condition. The base condition pollution value determined in this step is the target which the amount of pollution reduction is measured from.

2. The amount of pollution reduction from the City's current stormwater BMPs. The City currently uses street cleaning, grass swales, stormwater lift station sumps, biofiltration devices, and wet detention basins to reduce stormwater pollution. This step establishes the status of pollution reduction the City is currently achieving.

Results of the Stormwater Pollution Modeling

The results of the pollution modeling are summarized in the following Table ES-1. The table displays the results of the base and existing conditions modeling for the MS4.

Table ES-1
MS4 Annual Loading Results

Existing BMPs	Area (ac)	TSS (tons)				TP (lbs)			
		Base	Existing	Percent Reduction	Citywide Percent Reduction	Base	Existing	Percent Reduction	Citywide Percent Reduction
Street Cleaning	5,838	870	721	17%	7.8%	4992	4430	11%	5.1%
Airport Swales	480	25	0.2	99%	1.3%	206	1	99%	1.9%
City Swales	520	84	9	89%	3.9%	441	50	89%	3.6%
Catch Basins	1,051	147	101	31%	2.4%	946	744	21%	1.9%
Structural BMPs	2,725	431	165	62%	13.9%	2330	1282	45%	9.6%
None: No BMP	2,600	355	354	0%	0.0%	2007	2006	0%	0.0%
Total	**13,213**	**1,912**	**1,351**	**-**	**29%**	**10,923**	**8,515**	**-**	**22%**

Included in the project area are a number County-owned parcels. Specifically: Winnebago County Fairgrounds, Winnebago County Community Park, Winnebago County Landfill, Winnebago County Sheriff's Department / Solid Waste Transfer Station / County Highway Department parcel and Wittman Regional Airport. In addition, areas covered by the University of Wisconsin – Oshkosh Campus are also included in the project area. The City is working with the University and County on individual Memorandums of Understanding (MOU) to confirm inclusion of lands in MS4 water quality analysis and maintenance responsibilities. Conversations to this point between the City and the owning agency have initially identified the City as the agency to take on responsibility for inclusion of the identified areas in the City's MS4 analysis. However, since the MOU documents are not yet in place, areas are quantified separately in Table ES-2. The City will formally take credit for the County-owned parcels once the MOU's are signed.

Table ES-2
Summary of MS4 Area Percent Removal by MS4/Owning Agency

Municipality	Area (ac)	TSS (tons)				TP (lbs)			
		Base	Existing	% Reduction	% of Citywide Reduction	Base	Existing	% Reduction	% of Citywide Reduction
City of Oshkosh	11,515	1,775	1,288	27%	25.5%	9,952	7,793	22%	19.8%
Winnebago County	1,515	106	35	67%	3.7%	788	550	30%	2.2%
University of Wisconsin - Oshkosh	183	31	28	9%	0.1%	183	172	6%	0.1%
Total	**13,213**	**1,912**	**1,351**	**-**	**29%**	**10,923**	**8,515**	**-**	**22%**

The results of the pollution modeling show the City is reducing TSS by 26% and TP by 20% citywide, meeting and exceeding the current 20% TSS reduction requirement. There currently is not a TP reduction requirement, however, this pollutant (as a measure of nutrient loading) has been reported in previous water quality analyses and the future TMDLs will establish TP limits.

Limitations of this Study

1. The purpose of this document is to help the City meet the federal and state regulatory program requirements for stormwater pollution reduction. Flooding issues related to stormwater conveyance system capacity, or the local river flood elevations, were not evaluated as part of this study and are evaluated by the City through other studies and where practical, multi-purpose facilities are considered.

2. This document is a planning level study. Information used to develop the results was based on available data sources and limited field investigation. The study provides City decision makers a sound basis for proceeding with a stormwater management program to meet federal and state stormwater pollution regulations. Structural projects explored as a result of this study should include detailed engineering and design.

1.0 Introduction

The City of Oshkosh contracted with AECOM to develop a Citywide Stormwater Management Plan, which was finalized in December 2008. The original plan (2008 Plan) documented the City's base pollution load, the pollution reduction achieved by best management practices (BMPs) in place at the time and the steps that needed to be taken to achieve the 20 and 40 percent goals.

Since the original 2008 Plan was finalized, numerous updates have been made to both the guidance from the Wisconsin Department of Natural Resources (WDNR) that describes how the analysis must be done and also to the computer model used for the calculations. Additionally, with the future establishment of total maximum daily loads (TMDLs) for the Upper Fox River watershed, the current stormwater quality requirements will change. With these changes in mind, the City contracted with AECOM in 2012 to conduct an update to the 2008 Plan.

The City of Oshkosh is regulated under a state-administered program that requires certain stormwater pollution control activities. The authority and details of the program in Wisconsin are described in the State's Administrative Code sections NR 216 and NR 151 and within the City's WPDES General (Stormwater) Permit. These current and pending regulations are described in more detail in Section 3 of this report.

This 2013 Plan Update includes stormwater pollution analyses for three conditions:

1. Base Condition:

    a. MS4 - This is a "no controls" condition which reflects the stormwater pollution generated from the City of Oshkosh under the land use as of October 1, 2004. This scenario does not account for the pollution management measures that the City currently employs.

    b. TMDL - This is a "no controls" condition which reflects the stormwater pollution generated from the City of Oshkosh under the current land use as of November 2013. This scenario does not account for the pollution management measures that the City currently employs.

2. Existing Managed Condition: The existing managed condition reflects the stormwater pollution generated by the City using the land use established in the no controls condition and accounts for the reduction in that pollution due to the stormwater pollution management activities currently employed by the City.

3. Proposed Managed Condition: The proposed managed condition reflects the future stormwater pollution condition accounting for the stormwater pollution management practices and the recommended additional practices.

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2.0 Project Setting

2.1 Overview

The City of Oshkosh is located on the western shore of Lake Winnebago in eastern Wisconsin. The City's 2010 population is reported at 66,083. All communities with a population greater than 10,000 people or in urbanized areas with a population density of at least 1,000 person per square mile are subject to stormwater management regulations as administered by the WDNR. Wisconsin's stormwater regulations are described in the Administrative Code sections NR 216 and NR 151. Under this regulatory program, the City was issued a stormwater discharge permit from the WDNR. The City received their permit coverage in January 2007. The permit defines the actions required of the City to remain in compliance. Additionally, with the future establishment of total maximum daily loads (TMDLs) for the Upper Fox River watershed, the current stormwater quality requirements will change. TMDLs are established for impaired waters to identify pollutant loads and reductions necessary to remove the conditions causing the impairment to make them "fishable and swimmable" as defined by the Clean Water Act. Details on these regulations are discussed in Section 3 of this report.

2.2 Water Resources

The City of Oshkosh is located within the Upper Fox River Management Unit, based on the WDNR's classification system. The most significant surface water resources of the project area include: Fox River (between Lake Butte des Morts and Lake Winnebago), Lake Butte des Morts, Lake Winnebago, Sawyer Creek, and Campbell Creek. There are also a number of minor waterways within the project area. The rivers and creeks and all surface runoff from the city ultimately flow into Lake Winnebago. The major water resources are described below. Figure 2-1 displays the project area and impaired waterbodies.

2.2.1 Sawyer Creek

Sawyer Creek's headwaters originate approximately 3.5 miles southwest of the City of Oshkosh and flows through the city to the Fox River. West of the city the watershed is mostly flat to undulating, agricultural lands. The lower 3.4 miles flows through the City of Oshkosh and is highly channelized. The watershed is ranked "high" by the WDNR for nonpoint source impacts. This ranking is based on the intensity of agricultural land uses in the upper portion of the watershed, and the urban land uses (City of Oshkosh) in the lower reaches.

Sawyer Creek is identified as a warm water sport fishery water body; however this stream has not been assessed to determine if it is meeting that classification. Based on the 2013 GIS file provided by the City, the city has identified 43 municipal storm sewer outfalls leading directly to Sawyer Creek. Within the city of Oshkosh, Sawyer Creek is subject to frequent flooding and the city is conducting studies to better manage flooding along this stream.

2.2.2 Campbell Creek

Campbell Creek is located almost entirely within the city limits of Oshkosh, and is tributary to the Fox River. The headwaters of the creek are southwest of the city (west of USH 41); however the creek's watershed is almost totally urban land use. Within the city, the creek is almost entirely channelized and/or contained within a storm sewer system, which discharges on the north side of

Witzel Ave. The watershed is ranked "high" by the WDNR for nonpoint source impacts (from urban stormwater).

2.2.3 Fox River

Within the project area, the Fox River is the connection between Lake Butte Des Morts and Lake Winnebago. River levels are controlled by the Lake Winnebago level, which in turn is controlled by the dam system at the lake's outlet in Neenah / Menasha. The river is listed as a "warm water sport fishery" and it provides an important passage for sturgeon from Lake Winnebago to the upper reaches of the Fox River/Wolf River system for spawning. The river also provides an important recreational boating access between Lake Winnebago and the upper Fox River/Wolf River lakes.

A portion of the river from approximately Highway 45 downstream to the confluence with Lake Winnebago is listed on the State of Wisconsin Impaired Waters List. The EPA identifies impaired waters as, "waters that are too polluted or otherwise degraded to meet the water quality standard," (EPA, 2013 reference: http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/index.cfm). As required by the Clean Water Act, water quality standards are set by the WDNR to protect waters from pollution. To identify impaired waters, the DNR monitors waterways and compares the results to the water quality standards. A water is considered impaired if it "does not support full use by humans, wildlife, fish and other aquatic life and it is shown that one or more of the pollutant criteria are not met" (WDNR, 2013 reference: http://dnr.wi.gov/topic/impairedwaters/impairments.html).

The identified impairments are for aquatic toxicity. The identified pollutant sources are contaminated sediments, and an historic coal tar site. The Fox River receives stormwater runoff from the City of Oshkosh via 59 identified outfalls, based on the 2013 GIS outfall shapefile.

2.2.4 Lake Butte des Morts

Lake Butte des Morts is a shallow lake upstream from Lake Winnebago on the Upper Fox River. The lake encompasses about 13.8 square miles and has a maximum depth of 9 feet. Stormwater from the City of Oshkosh discharges to the most southeastern portion of the lake, near the lake's outlet to the Fox River. The lake is classified as supporting a warm water and forage fishery (northern pike, largemouth bass, sturgeon, and pan fish).

The lake is listed on the State of Wisconsin Impaired Waters List. The identified impairments are for low dissolved oxygen, eutrophication, and a fish consumption advisory. The identified pollutants are mercury, PCBs, phosphorus, and sediment. The lake also has non-native aquatic species such as: zebra mussels and Eurasian milfoil. Based on the 2013 GIS file provided by the City, there are 10 identified municipal storm sewer outfalls from the City of Oshkosh to the lake.

2.2.5 Lake Winnebago

Lake Winnebago ultimately receives all the surface runoff from the City of Oshkosh and makes up the eastern boundary of the City. The lake covers over 200 square miles (the largest lake in Wisconsin) and has a maximum depth of only 21 feet. The major inlet to the lake is the Fox River at Oshkosh, and the outlet is the Fox River at Neenah and Menasha. The lake is highly eutrophic and supports large populations of rough fish. Sport fish populations include walleye, northern pike, musky, large-mouth bass, and small mouth bass. The lake also supports a world class population of sturgeon.

The lake is listed on the State of Wisconsin Impaired Waters List. The identified impairments are for low dissolved oxygen, eutrophication, and a fish consumption advisory. The identified pollutants are mercury, PCBs, phosphorus, and sediment. There are 146 municipal storm sewer outfalls leading directly to Lake Winnebago, based on the 2013 GIS shapefile.

3.0 Water Quality Regulations and TMDLs

There are two main regulatory components for urban stormwater pollution for municipalities in Wisconsin; WPDES permits, and TMDLs. The WPDES permit includes requirements for “six minimum control measures” to improve stormwater discharge quality.

In addition to the requirements of the WPDES permit, TMDLs are being developed for impaired waterbodies throughout the State of Wisconsin. A TMDL places a limit on the amount of pollution that can be discharged into an impaired waterbody. The WDNR is responsible for the development and implementation of TMDLs within the State of Wisconsin as delegated by the Environmental Protection Agency. When pollution reduction targets are developed through the TMDL process, they are automatically incorporated into the WPDES permit.

3.1 WPDES Permit Requirements

The City of Oshkosh is regulated by the WDNR for the control of stormwater pollution. The City has been issued an “NR 216 permit” or “WPDES Permit” as a Phase II Community. The NR 216 permit went into effect in January 2007.

In Wisconsin, Administrative Code section NR 216 governs the urban stormwater regulations. The stormwater regulatory program is commonly referred to as the “NR 216 program.” The NR 216 program is administered by the WDNR. Administrative Code section NR 216 was finalized in July 2004. A companion Administrative Code section NR 151 contains runoff management performance standards that are referenced by the City’s permit. These stormwater regulations apply to all areas identified by the USEPA as urban areas (based on the 2000 census) and to cities or villages with a population of 10,000 or a density of 1,000 person per square mile or greater.

Six minimum standards are required of the City relative to stormwater management. To comply with the minimum standards, the City developed and implemented the following programs:

1. Public education and outreach program
2. Public involvement and participation program
3. Illicit discharge detection and elimination (program and ordinance)
4. Construction site pollution control (ordinance)
5. Post-construction site stormwater management (ordinance)
6. Pollution prevention (reduce stormwater pollution from municipal operations and the citywide storm sewer system)

The City’s original permit had no TP removal requirement and required a 20% TSS reduction by 2008 and 40% by 2013. However, in 2011 the state legislature delayed the 40% TSS reduction requirement. As noted previously, when pollution reduction targets are developed through the TMDL process, they are incorporated into the WPDES permit. Most of this report will focus on the WPDES permit requirements; however, a portion of this report will focus on the anticipated implementation of TMDLs. Details on the methods and results of this analysis are described in Chapter 4.0.

3.2 TMDL Requirements

3.2.1 TMDL Background

A TMDL is defined by the WDNR, as "an analysis used to calculate a pollutant budget: sources of pollutants are identified and then reductions are given to various sources in order to meet water quality standards," (source: WDNR Wisconsin Total Maximum Daily Loads). An alternative way of stating this is, "A TMDL is the amount of a pollutant a waterbody can receive and still meet water quality standard," (source: WNDR, 2012 reference: http://dnr.wi.gov/topic/TMDLs/index.html). The Clean Water Act requires that the WDNR develop TMDLs for impaired waters. The first TMDL in Wisconsin was developed in 2000, and as of the date of this study, 30 TMDLs have been developed and approved in Wisconsin (source: http://dnr.wi.gov/topic/tmdls/tmdlreports.html). The development process is ongoing in several waterbodies including the Upper Fox/Wolf River watershed.

A TMDL fact sheet which was prepared by the WDNR with additional background and information on TMDLs is included in Appendix A and is briefly summarized in the following report sections.

3.2.1.1 TMDL Development Process

The development of a TMDL begins with a data collection period, during which, the waterbody is monitored to identify the current pollution loadings and water flow, along with other pertinent data. Using the monitoring data, a computer model is used to simulate the processes in the waterbody and determine the existing pollution loads and to calculate the load reductions needed to meet the water quality standards for the waterbody.

From this point the TMDL can be broken into allocations of pollutants that are assigned to pollutant generators. This process is often expressed as a formula:

TMDL = Wasteload Allocation (WLA) + Load Allocation (LA) + Margin of Safety (MOS)

The WLA is the total allowable pollutant load from point sources, such as waste-water treatment plants, industrial facilities, confined animals feeding operations, and MS4s. The LA is the total allowable pollutant load from non-point sources, such as agricultural runoff and non-regulated urban areas. A margin of safety is also included in the TMDL. Within the total WLA, individual contributors (such as the City of Oshkosh MS4) are assigned a specific allocation.

As part of a TMDL a waterbody may also be broken into segments, or reaches. Each reach is assigned its own wasteload and load allocations for tributary areas.

3.2.1.2 TMDL Implementation

The implementation process begins following the development of a TMDL. There is some uncertainty surrounding the implementation of TMDLs. Because Lake Winnebago contains such a large ultimate watershed, a number of stakeholders will be subject to this TMDL. These stakeholders include agricultural landowners, public point sources (MS4s and waste-water treatment plants), private point sources (such as a manufacturing facility), and Department of Transportation lands (highways). The implementation process and requirements for each stakeholder are still evolving.

The WDNR is currently developing guidance documents for the implementation of TMDLs within MS4s. The document will provide general guidance for MS4s regarding steps to be taken for planning, implementing, and stormwater pollution modeling related to TMDLs. Based on a review of the guidance document (included in Appendix A), the implementation of TMDLs will include the following requirements:

- The pollution reduction requirements included in the TMDL will be incorporated into the City's WPDES permit.
- The first WPDES permit issued following the approval of a TMDL will include a requirement to prepare a stormwater management plan for how the TMDL will be met. This report will form the starting point for such an analysis and will be modified as needed in the future. The stormwater management plan will include a schedule for meeting TMDL requirements and a schedule of interim benchmarks.
- The schedule for meeting TMDL requirements will be flexible and it is anticipated that at least 15-years will be allowed for compliance with a TMDL. During this time continual progress towards meeting the TMDL is expected. The City will need to track this progress and provide periodic submittals to the WDNR, most likely through the current annual reporting process.

The ultimate goal of implementing a TMDL is to improve water quality so that the waterbody meets the applicable water quality standards. This is determined by on-going monitoring and assessment of the waterbody. If a TMDL is implemented and water quality standards are not met, additional evaluation will be needed and further pollutant reductions may be required.

4.0 Stormwater Pollution Analysis

For the purpose of this report, stormwater pollution is defined as contaminates found in urban surface runoff, including: sediment, nutrients, organic compounds, pathogens, and heavy metals. Stormwater pollution can have significant negative impacts on receiving waters, often exceeding the impact of traditional point-source discharges (factories, wastewater treatment plants, etc.) typically associated with surface water pollution. Therefore, an assessment of stormwater pollution is an important part of watershed planning. Under the current permit requirements, "stormwater pollution" reductions are measured by sediment or total suspended solids (TSS) control. In the future, TMDLs will expand this definition and measurement.

This report documents the water quality analysis conducted for the City of Oshkosh following the standard MS4 water quality analysis guidelines and TMDL analysis guidelines.

4.1 Input

4.1.1 Hydrologic Basins

For the update analysis, the City sent AECOM the most recent file of the hydrologic basins. AECOM compiled the watershed data from the detailed study areas performed throughout the City with the most recent file of the hydrologic basins. This file was then modified to make sure that the watersheds did not overlap one another or have gaps. The project area was divided into 1,504 hydrologic units, or basins, and 106 watersheds for the water quality analysis. Typically, in watersheds where a detailed study was performed by AECOM, basins were delineated to each manhole and the watersheds were delineated to each storm sewer outfall. With the exception of defining the drainage area for relatively small BMPs, the data was not revised.

The watershed name is from the previous citywide GIS file. In general, the watershed name is the name of the street where the storm sewer outfall is located. This naming convention is from the previous citywide GIS file.

Figure 4-1 displays the hydrologic units used as part of this study. Hydrologic basins may extend beyond the municipal boundary but for the purposes of this report, only the area within the city limits are reported on.

4.1.2 Land Use

4.1.2.1 General Background

The type and distribution of land use has a major impact on the hydrology and urban stormwater pollution within a watershed. The volume and rate of stormwater runoff increases as the percentage of impervious surfaces (streets, parking lots, roofs, etc.) in an area increases. The amount of impervious surface, in turn, is related to land use. As development occurs, the impervious area generally increases, often significantly. Land use also plays an important role in determining the types and amounts of pollutants that are carried by runoff.

Highly urbanized commercial and industrial areas usually contain a large percentage of impervious area and generate high amounts of a variety of pollutants. These pollutants include sediment, nutrients, bacteria, metals, and toxic substances. Less intensive development, such as low to medium density residential development, contains a moderate amount of impervious area and generates lower levels of most pollutants.

4.1.2.2 MS4 Land Use

A map of existing (October 1, 2004) land use was developed based on information from several sources. The land use coverage created for the 2008 Plan was used as a starting point. This land use data was then revised based on aerial photos and the City staff's knowledge of the area. The land use categories were then organized into groups suitable for the stormwater pollution analysis.

Figure 4-2 shows existing land use conditions used for the pollution analysis. Table 4-1 summarizes the existing land use within the entire municipal boundary as of October 2004.

Table 4-1
Existing Land Use Summary
(Land Use as of October 1, 2004)

Analyzed Area	Area (ac)	Area (%)
Commercial		
Airport	897	5.1
Downtown	266	1.5
Shopping Center	278	1.6
Strip Commercial	904	5.2
Office Park	54	0.3
Industrial		
Light	1,322	7.5
Medium	445	2.5
Institutional		
Hospital	87	0.5
Miscellaneous Institutional	981	5.6
School	274	1.6
University of Wisconsin-Oshkosh	192	1.1
Open Space		
Cemetery	206	1.2
Park	1,095	6.3
Railroad	122	0.7
Open Space Undeveloped	110	0.6
Residential		
High Density no Alleys	1,278	7.3
High Density with Alleys	11	0.1
Medium Density no Alleys	3,210	18.3
Medium Density with Alleys	19	0.1
Low Density	641	3.7
Mobile Home	46	0.3

Table 4-1 (continued) Existing Land Use Summary (Land Use as of October 1, 2004)		
Residential (continued)		
Multi-Family no Alleys	771	4.4
Multi-Family with Alleys	2	0.0
Analyzed Area Sub-Total	13,213	75.0
Areas Not Included		
Agriculture	1,991	11.4
County Right of Way	70	0.4
Quarry – Industrial Permitted	111	0.6
Open Space > 5 acres	1,132	6.5
WisDOT Right of Way	468	2.7
Water	535	3.1
Areas Not Included Sub-Total	4,307	25.0
Total Municipal Area	**17,520**	**100**

4.1.2.3 TMDL Land Use

A map of existing (2013) land use was developed based on information from several sources. The land use coverage created for the WPDES Permit requirements was used as a starting point. Land use coded as agriculture and open space undeveloped greater than 5 acres based on the year 2004 was checked to determine whether this is still accurate. The land use was revised to current conditions if development has occurred on these parcels

Figure 4-3 shows existing land use conditions (as of December 2013) used for the baseline pollution analysis for the future TMDL. Table 4-2 summarizes the existing land use within the entire municipal boundary based on 2013 information.

Table 4-2
Existing Land Use Summary
(Land Use as of 2013)

Analyzed Area	Area (ac)	Area (%)
Commercial		
Airport	897	5.1
Downtown	266	1.5
Shopping Center	282	1.6
Strip Commercial	909	5.2
Office Park	146	0.8

Table 4-2 (continued)
Existing Land Use Summary
(Land Use as of 2013)

Industrial		
Light	1,414	8.1
Medium	445	2.5
Institutional		
Hospital	87	0.5
Miscellaneous Institutional	981	5.6
School	274	1.6
University of Wisconsin-Oshkosh	192	1.1
Open Space		
Cemetery	206	1
Park	1,095	6
Railroad	122	1
Open Space Undeveloped	1,238	7
Residential		
High Density no Alleys	1,278	7.3
High Density with Alleys	11	0.1
Medium Density no Alleys	3,210	18.3
Medium Density with Alleys	19	0.1
Low Density	664	3.8
Mobile Home	46	0.3
Multi-Family no Alleys	864	4.9
Multi-Family with Alleys	2	0.0
Analyzed Area Sub-Total	14,648	84.0
Areas Not Included		
Agriculture	1,688	9.6
County Right of Way	70	0.4
Quarry – Industrial Permitted	111	0.6
Open Space > 5 acres	-	-
WisDOT Right of Way	468	2.7
Water	535	3.1
Areas Not Included Sub-Total	2,872	16.0
Total Municipal Area	**17,520**	**100**

4.1.3 Precipitation

Precipitation data is one of the parameters used in the stormwater pollution model: Windows Source Load and Management Model (WinSLAMM). When modeling stormwater pollution loadings, cumulative runoff and pollution loads from the more frequent and smaller rain events are more important than the pollution from the less frequent larger rain events. This is because the more frequent events generate the majority of the volume of stormwater runoff and pollutant loads in any given year; therefore, modeling simulations are performed with rainfall records for a representative time period.

Current guidance from the WDNR stipulates that rainfall records for a five-year period should be used. Rainfall input files have been developed for several locations throughout the State of Wisconsin, and the WDNR specifies that the file developed for a location closest to the project area be used in the analysis. Thus, the Green Bay five-year rainfall file for rain events between 1968 and 1972 was used for the stormwater pollution modeling in Oshkosh.

4.1.4 Soils

Soil properties influence the volume and rate of runoff generated from rainfall events. Soils that allow rainfall to freely drain into the ground (sandy soils) will result in lower runoff rates and volumes. Soils that restrict the infiltration of rainfall into the ground (clayey soils) will cause higher runoff rates and volumes. The United States Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) classifies soils based on their runoff potential into Hydrologic Groups A, B, C, or D. Soils in Hydrologic Group A have a high infiltration capacity and low runoff potential (generally sandy or gravelly soils). Conversely, Group D soils have a low infiltration capacity and a high runoff potential (generally soils with high clay content).

According to the NRCS Soil Survey, the project area consists of mostly Group C soils. There is a mixture of the other soils found in the remaining areas of the City. NRCS Soil Survey information shows that these soils exhibit a wide range of properties and infiltration ability. The NRCS Soil Surveys were developed to summarize soil characteristics. Actual soil conditions for a specific location can vary from the general (mapped) condition. WinSLAMM requires inputs characterizing the soil type of the study area. Allowable inputs in the WinSLAMM model are; “Sandy,” “Silty,” or “Clayey.” For this analysis, soils in Hydrologic Group A were assumed to be “Sandy,” soils in Hydrologic Group B were assumed to be “Silty,” and soils in Hydrologic Group C or D were assumed to be “Clayey.” Within the analyzed area of the City of Oshkosh approximately 98 percent of soils are classified as “Clayey”, 1.6 percent are classified as “Silty”, and 0.1 percent are classified as “Sandy.”

Figure 4-4 displays the NRCS hydrologic group classification of soils located within the City of Oshkosh.

4.2 MS4 Analysis

4.2.1 Project Area

The project area for purposes of the stormwater pollution analysis is based on the regulatory requirements of NR 216 and the policy memorandum (memo) developed by the WDNR. (See Appendix A for the WDNR policy memos.) The regulations and policy memos describe the areas of the City that fall into three categories: 1) areas that must be included in the pollution analysis, 2) areas that are exempt from the pollution analysis, and 3) optional areas for the analysis. The project area for the pollution analysis includes all lands within the municipal boundary (as of

November, 2013) that generate surface runoff to the City's stormwater conveyance system (sometimes called the Municipal Separate Storm Sewer System – MS4) and are not excluded from the analysis as allowed by WDNR policy memos.

NR 216 only regulates stormwater quality that is discharged from the City's stormwater conveyance system. The conveyance system includes the City-owned or City-managed stormwater pipes, ditches, streets, gutters, stormwater basins, detention areas, or other constructed systems for conveying stormwater runoff to a lake, river, or wetland. Certain lands within the City were excluded from the stormwater pollution analysis because these areas are not regulated by NR 216 or are regulated under their own NR 216 permit. The areas excluded from the stormwater pollution analysis for the City of Oshkosh include:

1. Undeveloped land greater than five acres as of October 1, 2004.
2. Lands within the City zoned agriculture and under agricultural conditions as of October 1, 2004.
3. Lands within the Wisconsin Department of Transportation right-of-way (as identified on the WDOT State Trunk Highway Map for Winnebago County as either: a) Designated Freeway, or b) State Trunk Highway (Maintained & Traveled)).
4. Lands within the Winnebago County Right-of-Way as provided by the County as their MS4 area of responsibility.
5. Lands within the Quarry that is Industrial Permitted.

Included in the project area are a number of parcels currently located in the Town of Algoma. The City has a boundary agreement with Algoma. These parcels are "islands" fully surrounded by the City. They are located north of Waukau Avenue. In addition, several County-owned properties are included based on discussion and draft agreements with the County. Specifically: Winnebago County Fairgrounds, Winnebago County Community Park, Winnebago County Landfill, Winnebago Count Sheriff's Department / Solid Waste Transfer Station / County Highway Department parcel and Wittman Regional Airport. Areas covered by the University of Wisconsin – Oshkosh Campus are also included in the project area based on discussion and draft agreements with the University.

Figure 4-5 shows the areas removed from the stormwater pollution analysis based on the MS4 requirements.

4.2.2 Methodology

To analyze stormwater pollution loads for the City of Oshkosh's urban areas, a computer simulation model: WinSLAMM, Version 10.0, was used. WinSLAMM was originally developed by the WDNR and is now licensed by PV & Associates. (See www.winslamm.com for more information). It is the most widely used model in Wisconsin to assess urban stormwater pollution loads.

The project area, as described in Section 4.2.1, was determined based on WDNR guidelines to meet the compliance requirements of Administrative Code NR 216.07(6). In keeping with the WDNR guidelines for conducting the analysis and defining the Base or "no BMP" condition, the following steps were completed.

A geographical information system (GIS) database was created containing information pertaining to stormwater pollution in the City of Oshkosh. Information in the database includes:

- Hydrologic basins, or subbasins
- Soil type
- Land use as of October 2004
- Land use as of October 2010
- Drainage type (curb & gutter or swale)
- Entities within the municipal boundary (regulated industrial properties, Winnebago County, Town of Algoma, University of Wisconsin – Oshkosh, Wittman Regional Airport, and County or Wisconsin Department of Transportation right-of-ways)
- Existing grass swales
- Existing street cleaning schedule
- Existing structural BMPs (wet detention basins, stormwater lift stations with sumps, biofiltration devices and catch basins)

WinSLAMM requires input files that describe characteristics of the project area. Land uses within the city were assigned one of several WinSLAMM "standard land uses," each of which has a set proportion of roof, driveway, road, and open space areas. This approach eliminates the need to delineate all the different types of pervious and impervious areas for each individual parcel in the city limits. The model utilizes several different land characteristics, management practices, and pollutant and rainfall data base files to complete the simulation. The pollutant files are based on United Stated Geological Service (USGS) and WDNR runoff monitoring that, with the site specific land characteristics and other files, results in statistical pollutant loadings under various conditions as described later in this report.

The following support parameter files were used in WinSLAMM version 10.0 for this analysis:

- *WisReg – Green Bay Five Year Rainfall.ran* – Approved five-year average rainfall distribution for the Green Bay area
- *WI_GEO02.ppdx* – Pollutant probability distribution file
- *v10 WI_SL06 Dec06.rsv* – Runoff coefficient file
- *WI_AVG06.pscx* – Particulate solids concentration file
- *WI_Res and Other Urban Dec06.std* – Street delivery file for residential and other urban land uses
- *WI_Com Inst Indust Dec06.std* – Street delivery file for commercial, institutional and industrial land uses
- *Freeway Dec06.std* – Street delivery file for freeway land uses

WinSLAMM was run, and pollution loads were calculated for each land use and subbasin. The pollutants analyzed for this project were TSS and total phosphorus (TP).

4.2.3 Results: Base Conditions

The MS4 base conditions analysis (October 1, 2004, land use conditions with no BMPs) was run in WinSLAMM to provide a baseline with which to compare the existing conditions analysis. The results of this analysis are shown in Table 4-3. The City's base TSS load is 1,912 tons per year. The City of Oshkosh's base TP load is 10,923 pounds per year.

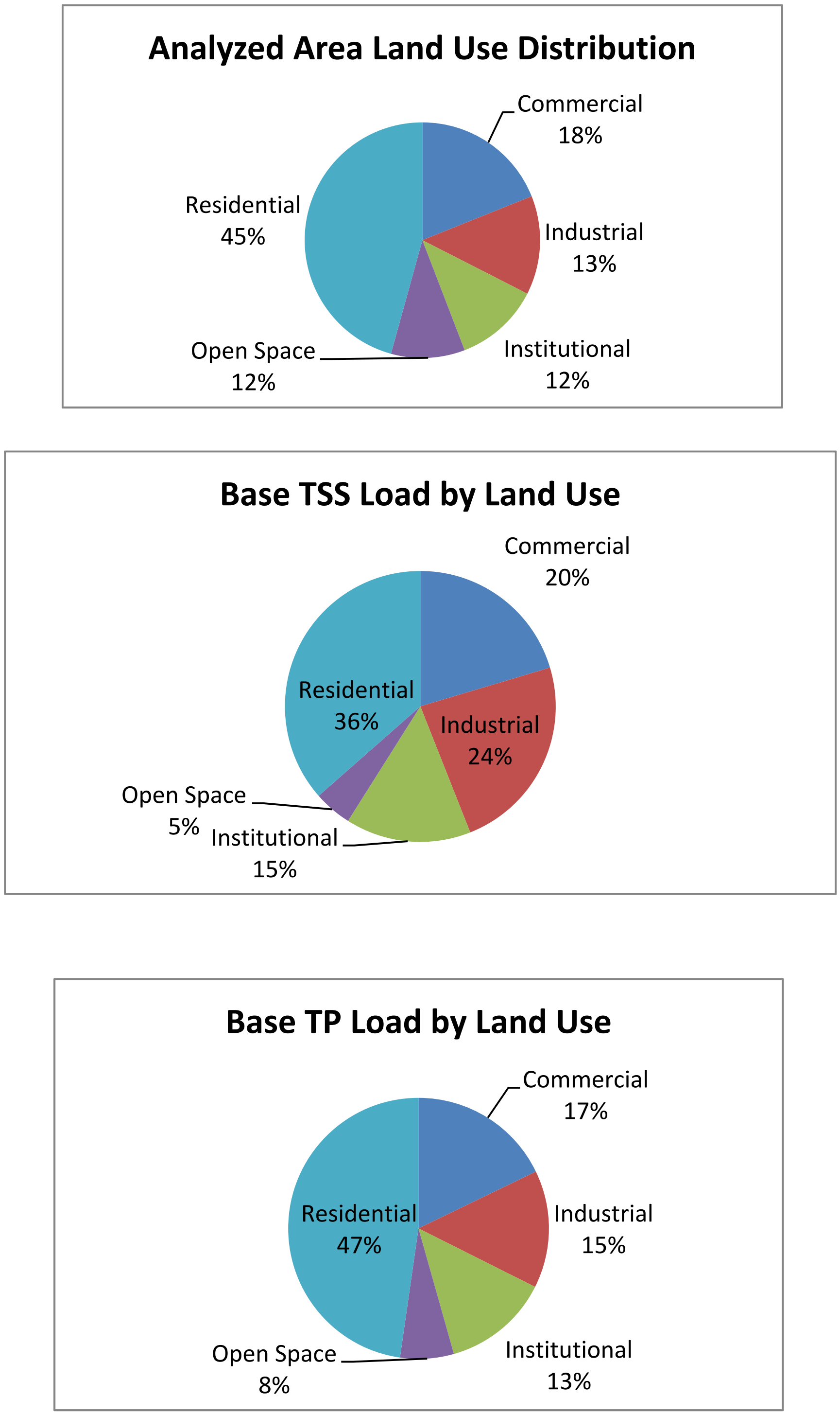
Figure 4-6a shows a graphical representation of the City's base TSS load relative to its land use. Figure 4-6b shows a graphical representation of the City's base TP load relative to its land use. It is significant to note that although the commercial and industrial areas together make up about 31 percent of the analyzed area, they account for about 44 percent of the TSS pollution generated in the City. It is commonly found that the more highly urbanized land uses (commercial and industrial) produce a higher quantity of stormwater pollutants on a per acre basis compared with other urban land uses, such as residential. Appendix B contains a list of the base pollution loads for each watershed. Figure 4-7a displays the total amount of TSS generated within each watershed on a per acre basis. Figure 4-7b displays the total amount of TP generated within each watershed on a per acre basis.

Table 4-3
Base Conditions Pollutant Load by Land Use

Land Use	Area		TSS		TP	
	(acres)	(%)	(tons/yr)	(%)	(lbs/yr)	(%)
Commercial						
Airport	897	6.8	46	2.4	385	3.5
Downtown	266	2.0	52	2.7	265	2.4
Shopping Center	278	2.1	54	2.8	229	2.1
Strip Commercial	900	6.8	228	11.9	969	8.9
Office Park	54	0.4	10	0.5	47	0.4
Sub-Total	*2,395*	*18*	*390*	*20*	*1,896*	*17*
Industrial						
Light	1,346	10.2	349	18.3	1,243	11.4
Medium	436	3.3	102	5.3	342	3.1
Sub-Total	*1,783*	*13*	*451*	*24*	*1,585*	*15*
Institutional						
Hospital	87	0.7	16	0.9	87	0.8
Miscellaneous Institutional	981	7.4	191	10.0	915	8.4
School	277	2.1	47	2.5	277	2.5
University of Wisconsin-Oshkosh	183	1.4	31	1.6	183	1.7
Sub-Total	*1,527*	*12*	*286*	*15*	*1,463*	*13*
Open Space						
Cemetery	206	1.6	14	0.7	131	1.2
Park	1,095	8.3	68	3.6	616	5.6
Railroad	122	0.9	3	0.1	36	0.3
Open Space Undeveloped	110	0.8	3	0.1	32	0.3
Sub-Total	*1,534*	*12*	*87*	*5*	*814*	*7*

Table 4-3 Base Conditions Pollutant Load by Land Use						
Residential						
High Density no Alleys	1,278	9.7	181	9.5	1,296	11.9
High Density with Alleys	11	0.1	2	0.1	12	0.1
Medium Density no Alleys	3,210	24.3	350	18.3	2,670	24.4
Medium Density with Alleys	19	0.1	3	0.1	19	0.2
Low Density	641	4.9	51	2.7	435	4.0
Mobile Home	46	0.3	5	0.3	35	0.3
Multi-Family no Alleys	767	5.8	105	5.5	696	6.4
Multi-Family with Alleys	2	0.0	0	0.0	2	0.0
Sub-Total	*5,975*	*45*	*697*	*36*	*5,165*	*47*
Total	**13,213**	**100**	**1,912**	**100**	**10,923**	**100**

Figure 4-8
MS4 Land Use and TSS Load Distributions



4.3 MS4 Existing Management Conditions

Once the base load was established, the City's existing BMPs were evaluated. The City's existing practices include street cleaning, grass swale drainage, stormwater pump station maintenance, and structural BMPs (including water quality wet detention basins, biofiltration devices, and catch basins).

4.3.1 Street Cleaning

At the time of the 2008 Plan, street sweeping was conducted on the majority of the streets every other week, and in the downtown area, once per week, spring through fall. Since the completion of the 2008 study, the City has implemented an enhanced street cleaning program. The enhanced program is an intensive weekly cleaning frequency for the first six weeks after spring snow melt. Then during the remaining cleaning season, the City performs street cleaning of the majority of City Streets every other week spring through fall. The downtown streets are cleaned at a weekly frequency. The areas that drain to streets without curbs were removed from the street cleaning analysis. The 2012 and 2013 street reconstruction plans were incorporated into the existing curb data. The existing conditions accounts for streets constructed as of the 2013 construction season. Parking density refers to the number of vehicles parked per curb mile and the parking controls factor refers to the ability of the street cleaning machinery to reach the curb (and not drive around vehicles during the cleaning operation). The City uses vacuum assisted, high efficiency, street cleaners and mechanical broom sweepers, as needed.

Parking densities and parking controls were defined as follows:

- Central Business District and UW-Oshkosh Campus – "Extensive Short Term" with parking controls,
- Cemetery, Golf Courses; Suburban Residential Office Parks, Shopping Center – "None" with parking controls, and
- Residential (high, medium and low density); Parks; Industrial (light and medium); Strip Commercial – "Light" with parking controls

In existing conditions, street cleaning accounts for a 7.8 percent reduction in TSS and a 5.1 percent reduction in TP. Figure 4-9 illustrates where street cleaning credit was taken and where street cleaning is conducted, but credit is not taken. Credit was taken for approximately 5,838 acres of the analyzed area that the City sweeps.

4.3.2 Catch Basins with Sumps

During road reconstruction projects, the city installs catch basins with sumps as part of the storm sewer drainage system to help reduce stormwater pollution. The 2012 and 2013 street reconstruction plans were incorporated into the existing catch basin data. The existing conditions accounts for catch basins constructed as of the 2013 construction season. WinSLAMM was used to analyze the pollution reduction achieved by catch basins. Inputs into the WinSLAMM model for catch basins include:

- Density = 1.6 catch basins per acre
- Surface area = 6.0 square feet
- Outlet pipe diameter = 12 inches
- Sump depth = 18 inches
- Annual cleaning

The catch basin density was calculated by counting the number of catch basins within Oshkosh and dividing by the drainage areas treated by the catch basins. Other inputs are based on the average, or typical, parameters for a catch basin within the City. The catch basin area includes areas treated by only catch basins or catch basins and street cleaning. Approximately 1,051 acres within the analyzed area are treated by catch basins. A 2.4 percent citywide TSS reduction and 1.9 percent city TP reduction is achieved by the catch basins.

4.3.3 Grass Swales

4.3.3.1 Grass Swale Infiltration Rate Testing

A limited number of properties and roadways in the City have grass swale drainage systems. These systems are included as existing BMPs. The City provided information for the location and characterization of the swales.

The pollution reduction criteria for the swales is based on a site inspection of the representative geometries, tested infiltration rates based on soil mapping data, and WDNR guidelines. The default infiltration rates are generally conservative. Therefore, infiltration testing was performed on the grass swales within the City to determine a more accurate infiltration rate.

Summary of Methods

Prior to conducting the field infiltration testing, initial work was done to select suitable sites for testing that would best represent the various conditions of the City's grass swale system. These initial steps included:

1. Using GIS to review land use and hydrologic soil group data to determine a proposed number of test sites. Ten proposed infiltration testing sites were chosen. The criteria for choosing the sites were based on a proportional representation of the different land use and hydrologic soil groups present in the City.
2. Creating maps identifying the approximate locations of the proposed sites relative to both land use coverage and soil mapping. The maps were submitted to WDNR for review along with an email describing the proposed test sites and the infiltration testing procedures.
3. Upon approval from WDNR, the test sites were finalized.

The field infiltration testing occurred on October 3 and October 4, 2012.

The field testing was conducted following the guidance provided by the WDNR at the time of testing, specifically:

- WDNR memo dated 4/24/08: "Process to Assess and Model Grass Swales for ss.NR151.13(2) and NR 216.07(6), Wis. Adm. Code – Total Suspended Solids Reduction;" and
- WDNR memo dated 8/02/08: "Errata for Process to Assess and Model Existing Grass Swales (TSS Reduction) Modifications to Double-Ring Infiltrometer Test Procedures in Technical Standard 1002."

Photographs of the field infiltration testing are provided in Appendix C. Maps showing infiltration testing locations compared to both soil coverage and land use in the City are also included on Figures 1 and 2 in Appendix C.

Results of Testing

Upon completion of the field infiltration testing, all results were tabulated and graphed to compare elapsed time with infiltration rate, measured in inches per hour. The tables and graphs detailing the raw field data for each test site are found in Appendix C.

In order to arrive at a single value for the infiltration rate at a site, a “best fit line” was created from the data from each test site. The infiltration rate at hour two (2) of testing was compiled for each site. A geometric mean value of 2.86 in/hr (dynamic rate) was calculated from the data. This value was approved by the WDNR on April 4, 2013. The email correspondence from the WDNR approving the rate, and all other relevant documentation regarding the swale infiltration rate testing, can be found in Appendix C.

For modeling purposes in WinSLAMM, the dynamic infiltration rate is used in accordance with WDNR guidelines. The dynamic rate is calculated by dividing the static rate in half. Table 4-4 shows the infiltration rates for each test location in the City and the calculated geometric mean.

Table 4-4
Infiltration Rate Results per Test Site and Average Rate

Location	Test #	Static Infiltration Rate* (in/hr)	Dynamic Infiltration Rate (in/hr)	City Average** Dynamic Rate (in/hr)
Edgewood Lane	1***	34.30	17.15	2.86
STH 41 (north of STH 45)	2	0.76	0.38	
Olson Ave	3	4.53	2.27	
Sherman Rd	4	3.95	1.98	
Hwy 41 and Witzel Ave	5	0.24	0.12	
9th Ave	6	34.30	17.15	
S. Washburn St	7	1.05	0.53	
Poberezny Rd	8	12.50	6.25	
W. 28th Ave	9***	34.30	17.15	
STH 45	10	21.60	10.80	

*Value from best fit curve at 2 hours

**Geometric Mean

*** Infiltration rates at test locations #1 and #9 were too high to measure with available equipment. The infiltration rate at these locations was set to that of test location #6, which had a high, but measurable, infiltration rate.

4.3.3.2 Grass Swale WinSLAMM Modeling

Following the completion of the grass swale testing, the grass swale data for the City of Oshkosh was compiled for modeling. Only grass swales that were in good condition and that would remain rural cross sections were included in the analysis.

Inputs used to analyze the swales include:

- Infiltration rate based on values from infiltration testing taken in October 2012.
- Swale Classification: The swales were classified into ten different types depending on their cross section geometry, longitudinal slope, and region.
- Side slopes, bottom widths, and grass height were determined based on field observations.
- Longitudinal slopes and swale densities were measured using GIS.
- If the swales had a longitudinal slope greater than 4 percent, they were removed from the swale analysis. Grass swales with slopes greater than 4 percent are no longer efficient because of the increased velocity of the stormwater runoff.

Table 4-5 displays the swale type and geometric features associated with it. Figure 4-10 illustrates the swales that were included in the analysis and the sites chosen for infiltration testing. Figure 4-11 displays the grass swale drainage area by the swale type.

Table 4-5
Grass Swale Characteristics

Grass Swale Type	Total Length (ft)	Typical Bottom Width (ft)	Typical Side Slope (_ ft H:1 ft V)	Typical Longitudinal Slope (ft/ft)	Dynamic Infiltration Rate (in/hr)
1	14,280	3	4.5	0.011	17.15
2	45,070	6	6.5	0.005	0.38
3	33,070	4	5	0.006	2.27
4	45,810	2	4	0.006	1.98
5	6,560	4	4	0.006	0.12
6	18,270	2	4	0.004	17.15
7	9,240	2	6	0.008	0.53
8	58,390	2	6	0.008	6.25
9	10,630	4	6	0.006	17.15
10	10,770	2	4	0.006	10.80

The modeled swale area includes any street cleaning and catch basins upstream of the swales.

City swales treat approximately 520 acres of the analyzed area. They reduce Citywide TSS loads by 75 tons, or 3.9 percent, and the TP load by 391 lbs, or 3.6 percent.

4.3.4 Structural Best Management Practices

A number of structural best management practices (BMPs) exist within the City of Oshkosh. These include wet detention basins, biofilters, and stormwater lift stations. Sixty-one structural BMPs were included in the existing conditions model. These were included because they treat stormwater pollution from lands within the MS4 regulated area.

Several BMPs were not included in the WinSLAMM analysis because: 1) they treat areas of new development (post October, 2004) and are not included in the regulated area as described in a WDNR policy memo dated November 24, 2010, 2) they are dry basins that do not achieve any stormwater quality benefits, or 3) they are privately owned and a maintenance agreement would be difficult to obtain.

Each existing structural BMP in the regulated area was analyzed using WinSLAMM version 10.0. Table 4-6 shows the effectiveness of the existing structural BMPs.

For the stormwater basins that had a downstream BMP with a greater efficiency, the overall watershed efficiency was applied to the entire basin. This is because the downstream BMP includes the entire drainage area, including that of the upstream BMP, so the end level of treatment can be applied to all tributary land areas.

The City has two stormwater lift stations. Each pump station contains a considerable sized sump. The stormwater lift station sumps are modeled as catch basins with sumps in WinSLAMM version 10.0. The modeled stormwater lift stations include any street cleaning and catch basins upstream.

The structural BMPs treat approximately 2,725 acres of the analyzed area. They reduce Citywide TSS loads by 266 tons, or 13.9 percent, and the TP load by 1,048 lbs, or 9.6 percent.

Figure 4-12 shows the location and drainage area of the City's structural BMPs.

Table 4-6
Structural BMP Pollution Reductions

BMP Name	Analyzed Drainage Area	Base TSS Load	Existing TSS Load	TSS Control	TSS Load Removed by BMPs	Base TP Load	Existing TP Load	TP Control	TP Load Removed by BMPs
	(ac)	(tons/yr)	(tons/yr)	%	(tons/yr)	(lbs/yr)	(lbs/yr)	%	(lbs/yr)
Biofilters									
400 E. Main Parking Lot	1.6	0.3	0.3	41	0.1	1.6	1.6	35	0.6
City Hall Bio	2.0	0.4	0.4	65	0.3	2.0	2.0	53	1.1
Morton Pharmacy	4.2	1.1	1.1	40	0.4	3.9	4.5	32	1.5
Otter Ave	0.8	0.2	0.2	43	0.1	0.8	0.8	26	0.2
The Rivers Biofilter	1.8	0.5	0.2	38	0.1	1.6	1.6	32	0.5
UWO Biofilter #11	2.2	0.4	0.4	37	0.1	2.2	2.2	28	0.6
UWO Biofilter #18	0.9	0.2	0.2	46	0.1	0.9	0.9	40	0.4
UWO Biofilter #23	1.1	0.2	0.2	43	0.1	1.1	1.1	33	0.4
UWO Biofilter #25	0.6	0.1	0.1	48	0.0	0.6	0.6	40	0.2
UWO Biofilter #27	1.3	0.2	0.2	45	0.1	1.2	1.2	37	0.5
UWO Biofilter #29	0.6	0.1	0.1	43	0.0	0.6	0.6	36	0.2
UWO Biofilter #30	5.7	1.0	1.0	15	0.1	5.7	5.7	10	0.6
UWO Biofilter #34	0.6	0.1	0.1	46	0.0	0.6	0.6	38	0.2
UWO Biofilter #34S	0.5	0.1	0.1	49	0.0	0.5	0.5	39	0.2
Lift Station									
Melvin Ave	110.8	13.9	13.9	30	4.2	98.8	98.8	21	20.7
E Nevada Ave[1]	94.7	11.0	11.0	26	2.9	80.2	80.2	17	13.6
Non-Regional Wet Detention Basins									
1200 Koeller St[3]	6.3	1.1	0.6	43	0.5	4.8	3.1	35	1.7
2800 N. Main St Redevelopment	11.8	3.0	3.0	68	2.0	10.7	10.7	47	5.0
Aurora Medical Center	35.8	6.8	6.8	82	5.6	36.0	36.0	68	24.5
Bergstrom Auto	9.1	1.7	1.7	75	1.3	7.5	7.5	63	4.7
Blue Rock Properties	5.5	1.4	1.4	84	1.2	5.1	5.1	65	3.3
Cobblestone Inn	3.6	0.9	0.9	88	0.8	3.9	3.9	75	2.9
Community Church Inc.	20.3	3.9	3.9	78	3.0	18.6	18.6	64	11.9
Deerfield Village	4.3	1.1	1.1	74	0.8	4.0	4.0	55	2.2
EAA 1	4.3	0.8	0.8	94	0.8	4.0	4.0	84	3.3
EAA 2	3.3	0.6	0.6	95	0.6	3.1	3.1	81	2.5
EAA 3	68.2	8.5	8.5	68	5.8	51.0	51.0	54	27.5
EAA 5	14.2	1.8	1.8	96	1.7	10.1	10.1	72	7.2
Evergreen Manor Inc.	3.0	0.4	0.4	80	0.3	2.7	2.7	60	1.6
Mercy Hospital South Basin	10.5	2.0	2.0	77	1.5	10.5	10.5	64	6.7
Mercy Hospital Tower Basin	7.7	1.4	1.4	83	1.2	7.7	7.7	69	5.3
Multi Bldg. LLC[3]	5.1	1.3	0.5	64	0.8	4.6	2.5	45	2.1
N. Shore Preserve Central Basin	13.5	1.3	1.3	33	0.4	10.1	10.1	21	2.1
N. Shore Preserve East Basin	19.1	1.6	1.6	30	0.5	13.3	13.3	19	2.5
N. Shore Preserve West Basin North	2.2	0.2	0.2	61	0.1	1.8	1.8	55	1.0
N. Shore Preserve West Basin South	3.9	0.4	0.4	33	0.1	3.3	3.3	23	0.8
New Life Church Basin 1, 2, & 4	9.2	1.8	1.8	87	1.6	8.5	8.5	62	5.3
New Life Church Basin 3	10.9	2.1	2.1	92	1.9	10.1	10.1	75	7.6
NW Ind. Park	2.9	0.7	0.7	98	0.7	2.5	2.5	44	1.1
Oshkosh Truck	23.1	5.5	5.5	74	4.0	18.6	18.6	64	11.8
Planeview Gas Station	7.6	1.9	1.9	8	0.2	8.2	8.2	5	0.4
Quail Run Farms Basin A	10.8	0.9	0.9	81	0.7	7.5	7.5	57	4.3
Quail Run Farms Basin B	8.4	0.7	0.7	81	0.6	6.0	6.0	50	3.0
Sawyer Creek	91.7	11.5	11.5	93	10.7	77.9	77.9	69	53.7
Sioux Prop. Man. Inc.	2.3	0.6	0.6	100	0.6	2.5	2.5	100	2.5
Target Complex	19.3	3.9	3.9	71	2.8	16.8	16.8	60	10.1
Turn Key Auto	1.3	0.3	0.3	88	0.3	1.4	1.4	76	1.0
Village Green East	15.1	1.8	1.8	92	1.7	12.9	12.9	63	8.1
Village Green West	7.1	0.8	0.8	96	0.8	6.1	6.1	64	3.9
Washburn St	50.8	12.3	12.3	64	7.9	53.3	53.3	51	27.2
Winnebago Cty Mental Health (contains Main Park Basin and Coughlin Park Basin)	458.9	44.1	44.1	73	32.2	314.4	314.4	47	147.7

Table 4-6
Structural BMP Pollution Reductions

BMP Name	Analyzed Drainage Area	Base TSS Load	Existing TSS Load	TSS Control	TSS Load Removed by BMPs	Base TP Load	Existing TP Load	TP Control	TP Load Removed by BMPs
	(ac)	(tons/yr)	(tons/yr)	%	(tons/yr)	(lbs/yr)	(lbs/yr)	%	(lbs/yr)
Winnebago Cty Sheriff's Dept (contains Hwy Dept, Sheriff's Dept, and State Prison)	74.6	13.6	13.6	78	10.6	67.8	67.8	47	31.9
Regional Wet Detention Basins									
Armory Area[2]	386.9	86.6	86.6	95	82.3	350.7	350.7	79	277.1
City Hall Underground Storage	106.9	15.6	15.6	34	5.3	104.3	104.3	24	25.0
Fair Acres	93.0	16.3	16.3	71	11.6	89.1	89.1	56	49.9
Mercy Hospital North Basin	47.5	6.4	6.4	73	4.7	41.7	41.7	53	22.1
North High School Area	77.1	9.0	9.0	86	7.8	63.7	63.7	67	42.7
Oakwood Road	47.5	11.9	11.9	82	9.8	42.8	42.8	64	27.4
South Park	629.3	108.0	108.0	22	23.8	562.4	562.4	16	90.0
Westhaven Club House	72.6	7.4	7.4	95	7.0	56.2	56.2	68	38.2

[1] Assumed a sump depth of 1.25 feet

[2] Armory wet detention basin has an efficiency of 95% TSS and 79% TP. However, a flow split west of USH 41 diverts 40% of the stormwater runoff flows north away from the Armory wet detention basin. Including this untreated stormwater in the WinSLAMM model produces an overall removal rate of 68% TSS and 51% TP.

[3] Upstream of the Armory wet detention basin, which has a higher efficiency. For the stormwater basins that had a downstream BMP with a greater efficiency, the end level of treatment was applied to all tributary land areas.

4.3.5 Results: Existing Conditions

The MS4 results using October 1, 2004, land use and applying all existing stormwater BMPs show citywide reductions of 29% TSS and 22% TP. The locations of all the existing BMPs are shown graphically on Figure 4-13. Table 4-7 includes a summary of the existing management conditions. The existing management practices result in a TSS load reduction of 561 tons annually and a TP load reduction of 2,408 pounds annually.

Note: Results below are displayed by most-downstream BMP. Because WinSLAMM version 10.0 allows BMPs to be run in series, it is less useful to break out reductions by specific BMP categories, but rather by the final downstream BMP for any given drainage area. For example, the results for regional wet detention basins show the reductions for all areas that drain to a regional wet detention basin as the last point of treatment. These areas may include other upstream BMPs that impact the results.

Table 4-7
MS4 Base and Existing Pollution Load Summary
Results by Most-Downstream BMP

Existing BMPs	Area (ac)	TSS (tons)				TP (lbs)			
		Base	Existing	Percent Reduction	Citywide Percent Reduction	Base	Existing	Percent Reduction	Citywide Percent Reduction
Street Cleaning	5,838	870	721	17%	7.8%	4,992	4,430	11%	5.1%
Airport Swales	480	25	0.2	99%	1.3%	206	1	99%	1.9%
City Swales	520	84	9	89%	3.9%	441	50	89%	3.6%
Catch Basins	1,051	147	101	31%	2.4%	946	744	21%	1.9%
Structural BMPs	2,725	431	165	62%	13.9%	2,330	1,282	45%	9.6%
None: No BMP	2,600	355	354	0%	0.0%	2,007	2,006	0%	0.0%
Total	**13,213**	**1,912**	**1,351**	**-**	**29%**	**10,923**	**8,515**	**-**	**22%**

Appendix B contains a table showing the existing conditions pollutant loads by watershed and the pollution removal by watershed. Figure 4-14a displays the existing conditions TSS load per acre by land use. Figure 4-14b displays the existing conditions TP load per acre by land use. Figure 4-15a displays the existing conditions TSS load per acre by watershed. Figure 4-15b displays the existing conditions TP load per acre by watershed.

Included in the project area are a number County-owned parcels. Specifically: Winnebago County Fairgrounds, Winnebago County Community Park, Winnebago County Landfill, Winnebago County Sheriff's Department / Solid Waste Transfer Station / County Highway Department parcel and Wittman Regional Airport. In addition, areas covered by the University of Wisconsin – Oshkosh Campus are also included in the project area. The City is working with the University and County on individual Memorandums of Understanding (MOU) to confirm inclusion of lands in MS4 water quality analysis and maintenance responsibilities. Conversations to this point between the City and the owning agency have initially identified the City as the agency to take on responsibility for inclusion of the identified areas in the City's MS4 analysis. However, since the MOU documents are not yet in place, areas are quantified separately in Table 4-8. Specific BMP reductions are noted in Table 4-6 and 4-7.

Table 4-8
Summary of MS4 Area Percent Removal by MS4/Owning Agency

Municipality	Area (ac)	TSS (tons)				TP (lbs)			
		Base	Existing	% Reduction	% of Citywide Reduction	Base	Existing	% Reduction	% of Citywide Reduction
City of Oshkosh	11,515	1,775	1,288	27%	25.5%	9,952	7,793	22%	19.8%
Winnebago County	1,515	106	35	67%	3.7%	788	550	30%	2.2%
University of Wisconsin - Oshkosh	183	31	28	9%	0.1%	183	172	6%	0.1%
Total	**13,213**	**1,912**	**1,351**	**-**	**29%**	**10,923**	**8,515**	**-**	**22%**

4.4 TMDL Analysis

To prepare for the anticipated TMDL, the City of Oshkosh annual pollutant loadings were modeled under an additional scenario:

1. Base Conditions: Existing land use conditions with no BMPs applied.
2. Existing Conditions: Existing land use conditions with BMPs applied.

4.4.1 Project Area

All of the lands within the municipal boundary of the City of Oshkosh as of this report were analyzed with the exceptions described in this section.

Figure 4-16 displays lands designated as TMDL Excluded Areas. These areas are required or optionally allowed for exclusion by the WDNR when conducting citywide water quality analyses for TMDL related drainage areas. The primary difference between the MS4 and TMDL excluded areas is that the MS4 analysis excludes open space undeveloped areas greater than 5 acres in size, while the TMDL analysis includes these areas. Additionally, the MS4 excluded areas are identified based on land use as it was in 2004, while the TMDL excluded areas are determined based on existing land use at the time the TMDL is developed.

The following list summarizes the lands excluded from the TMDL analysis in accordance with current WDNR TMDL analysis guidance (Appendix A).

- WDOT Right-of-Way
- County Right-of-Way
- Land use for agriculture
- Quarry – Industrial Permitted

4.4.2 Methodology

As with the MS4 analysis, WinSLAMM version 10.0 was used.

In additions, a GIS database was created containing information pertaining to stormwater pollution in the City of Oshkosh. Information in the database includes:

- Subbasins
- Soil Type
- Existing Land Use

4.4.3 Results: Base Conditions

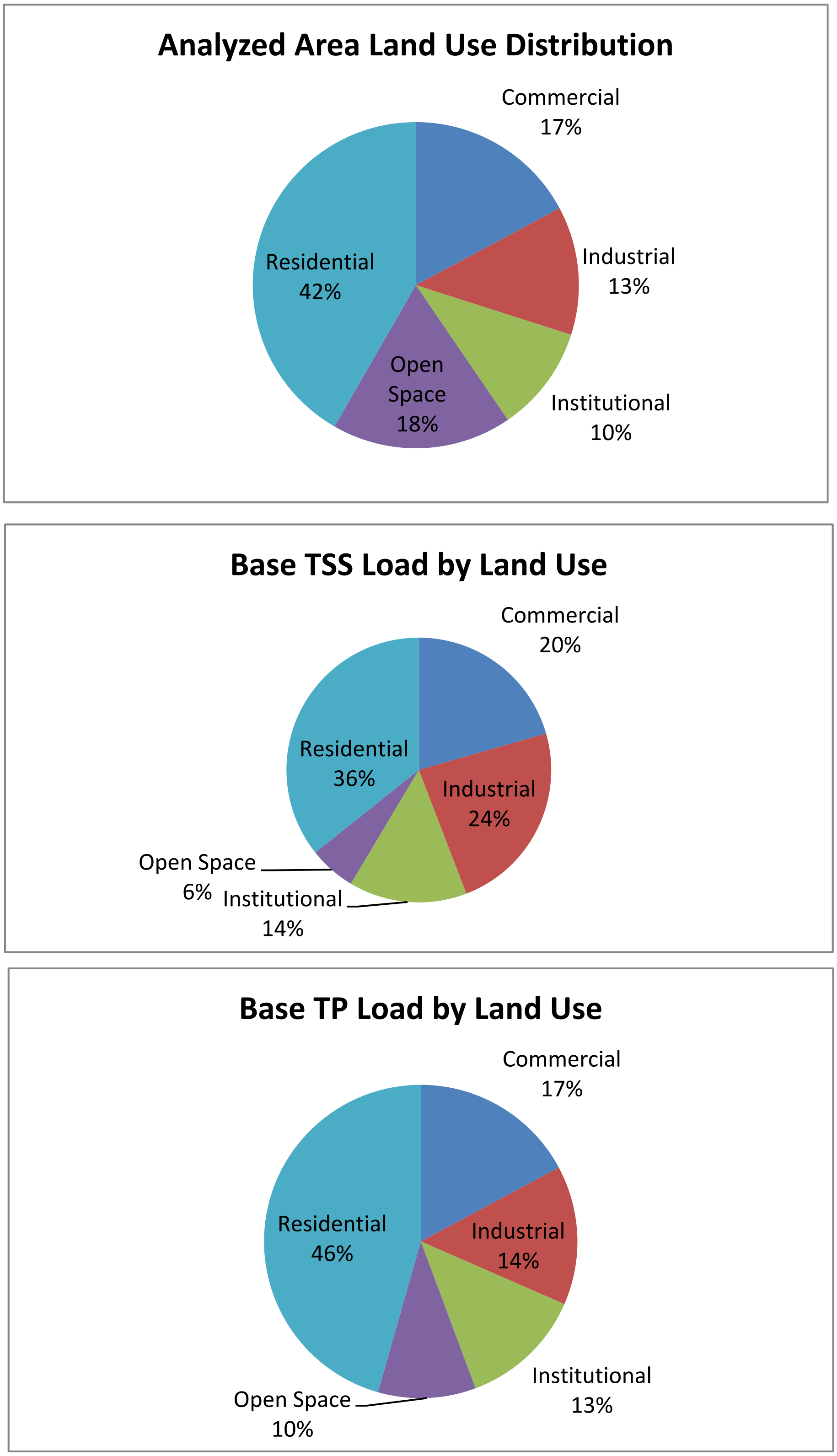
The TMDL base conditions analysis (existing land use conditions with no BMPs) was run in WinSLAMM to provide a baseline.

Table 4-9 shows the City's base pollution loads by land use. Figure 4-17 shows a graphical representation of the City's base TSS load relative to its land use. It is significant to note that although the commercial and industrial areas together make up about 30 percent of the analyzed area, they account for about 44 percent of the TSS pollution in the City. It is commonly found that the more highly urbanized land uses (commercial and industrial) produce a higher quantity of stormwater pollutants on a per acre basis compared with other urban land uses such as residential. Appendix B contains a list of the base pollution loads for each watershed. Figure 4-18a displays the total amount of TSS generated in base conditions per acre by land use. Figure 4-19a displays the total amount of TSS generated within each subbasin on a per acre basis. Figure 4-18b displays the total amount of TP generated base conditions per acre by land use. Figure 4-19b displays the total amount of TP generated within each subbasin on a per acre basis.

Table 4-9
TMDL Base Conditions Pollutant Load by Land Use

Land Use	Area		TSS		TP	
	(acres)	(%)	(tons/yr)	(%)	(lbs/yr)	(%)
Commercial						
Airport	897	6.1	46	2.3	385	3.3
Downtown	266	1.8	52	2.6	265	2.3
Shopping Center	282	1.9	54	2.7	232	2.0
Strip Commercial	909	6.2	230	11.5	979	8.5
Office Park	146	1.0	28	1.4	127	1.1
Sub-Total	*2,500*	*17*	*410*	*21*	*1,989*	*17*
Industrial						
Light	1,414	9.7	367	18.4	1,305	11.3
Medium	445	3.0	104	5.2	349	3.0
Sub-Total	*1,859*	*13*	*471*	*24*	*1,654*	*14*
Institutional						
Hospital	87	0.6	16	0.8	87	0.8
Miscellaneous Institutional	981	6.7	191	9.6	915	7.9
School	274	1.9	47	2.4	274	2.4
University of Wisconsin-Oshkosh	192	1.3	33	1.7	193	1.7
Sub-Total	*1,534*	*10*	*288*	*14*	*1,470*	*13*
Open Space						
Cemetery	206	1.4	14	0.7	131	1.1
Park	1095	7.5	68	3.4	616	5.3
Railroad	122	0.8	3	0.1	36	0.3
Open Space Undeveloped	1,238	8.5	30	1.5	365	3.2
Sub-Total	*2,661*	*18*	*114*	*6*	*1,147*	*10*
Residential						
High Density no Alleys	1,278	8.7	181	9.1	1,296	11.2
High Density with Alleys	11	0.1	2	0.1	12	0.1
Medium Density no Alleys	3,210	21.9	350	17.6	2,670	23.2
Medium Density with Alleys	19	0.1	3	0.1	19	0.2
Low Density	664	4.5	53	2.6	451	3.9
Mobile Home	46	0.3	5	0.2	35	0.3
Multi-Family no Alleys	864	5.9	118	5.9	785	6.8
Multi-Family with Alleys	2	0.0	0	0.0	2	0.0
Sub-Total	*6,094*	*42*	*712*	*36*	*5,269*	*46*
Total	**14,648**	**100**	**1,996**	**100**	**11,530**	**100**

Figure 4-17
TMDL Land Use, TSS, and TP Load Distributions



4.4.4 Results: Existing Conditions

Once the base load was established, the City's existing BMPs were evaluated. The existing conditions analysis for the TMDLs is essentially the same approach as taken in the MS4 analysis. The only difference being the different excluded areas.

The TMDL results using November 2013 land use and applying all existing stormwater BMPs show city reductions of 29% TSS and 22% TP. This is essentially the same cumulative citywide result as the MS4 analysis although individual BMP total reduction may vary slightly. Despite a larger analyzed area in the TMDL analysis, there is little difference between the reductions in the TMDL and MS4 analyses. This is because of the extensive BMP coverage in the City of Oshkosh. Table 4-10 includes a summary of the existing management conditions for the TMDL analysis. The existing management practices result in a TSS load reduction of 588 tons annually and a TP load reduction of 2,501 pounds annually.

Note: Results below are displayed by most-downstream BMP. Because WinSLAMM version 10.0 allows BMPs to be run in series, it is less useful to break out reductions by specific BMP categories, but rather by the final downstream BMP for any given drainage area. For example, the results for regional wet detention basins show the reductions for all areas that drain to a regional wet detention basin as the last point of treatment. These areas may include other upstream BMPs that impact the results.

Table 4-10
TMDL Base and Existing Pollution Load Summary
Results by Most-Downstream BMP

Existing BMPs	Area (ac)	TSS (tons)				TP (lbs)			
		Base	Existing	Percent Reduction	Citywide Percent Reduction	Base	Existing	Percent Reduction	Citywide Percent Reduction
Street Cleaning	6,111	899	752	16%	7.4%	5,143	4,589	11%	4.8%
Airport Swales	480	25	0.1	99%	1.2%	206	77	63%	1.1%
City Swales	663	89	10	89%	4.0%	490	54	89%	3.8%
Catch Basins	1,083	152	104	31%	2.4%	972	764	21%	1.8%
Structural BMPs	2,848	443	167	62%	13.8%	2,401	1,238	48%	10.1%
None: No BMP	3,463	388	388	0%	0.0%	2,318	2,318	0%	0.0%
Total	**14,648**	**1,996**	**1,421**	**-**	**29%**	**11,530**	**9,040**	**-**	**22%**

Appendix B contains a table showing the existing conditions pollutant loads by watershed and the pollution removal of each BMP by watershed. Figure 4-20a displays the existing conditions TSS load per acre by land use. Figure 4-20b displays the existing conditions TP load per acre by land use. Figure 4-21a displays the existing conditions TSS load per acre by watershed. Figure 4-21b displays the existing conditions TP load per acre by watershed.

As discussed previously, included in the project area are a number of areas currently County-owned properties. Specifically: Winnebago County Fairgrounds, Winnebago County Community Park, Winnebago County Landfill, Winnebago Count Sheriff's Department / Solid Waste Transfer Station / County Highway Department parcel and Wittman Regional Airport. In addition, areas covered by the University of Wisconsin – Oshkosh Campus are also included in the project area. The City is working with the University and County on a MOU and has included these areas in the

City's MS4 analysis. However, since the MOU documents are not yet in place, these areas are quantified separately in Table 4-11

Table 4-11
Summary of TMDL Area Percent Removal by MS4/Owning Agency

Existing BMPs	Area (ac)	TSS (tons)				TP (lbs)			
		Base	Existing	% Reduction	% of Citywide Reduction	Base	Existing	% Reduction	% of Citywide Reduction
City of Oshkosh	12,530	1,848	1,339	28%	25.5%	10,434	8,332	20%	18.2%
Winnebago County	1,935	117	55	53%	3.1%	913	541	41%	3.2%
University of Wisconsin - Oshkosh	183	31	27	13%	0.2%	183	167	9%	0.1%
Total	**14,648**	**1,996**	**1,421**	**-**	**29%**	**11,530**	**9,040**	**-**	**22%**

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5.0 Stormwater Pollution Reduction Analysis

The TMDL currently under development could require higher removal rates than those currently being achieved by the City. This section describes a number of additional BMPs that were analyzed in attempt to quantify the extent and cost of BMPs that could be necessary to obtain compliance.

5.1 Methodology

Using WinSLAMM and other available information a variety of potential BMPs were evaluated in an attempt to quantify the extent and cost of BMPs. Structural (wet detention basins, biofilters, rain gardens, catch basins, and engineered swales) BMPs were evaluated.

5.1.1 Identify and Evaluate Structural BMPs to Reduce TSS

A variety of structural BMPs were evaluated to quantify the extent and cost. The general process for evaluating potential sites for new structural BMPs employed the following measures:

- Retro-fitting existing dry detention basins to wet stormwater quality basins
- Construction of new wet stormwater quality basins in undeveloped lands, or open spaces near storm sewer outfalls
- Re-development of lands. These lands will be required to reduce post-construction TSS by 40 percent and is included in the City's overall TSS reduction requirement.
- Catch basins with sumps constructed during street reconstruction projects
- Conversion of existing swale drainage systems to engineered swales
- Incorporation of biofiltration into the landscape for treatment of areas that produce large loads of pollutants

5.1.1.1 Retro-fitting Existing Dry Detention Basins

A review of existing dry detention basins was conducted to determine the feasibility of converting these basins into wet stormwater quality basins for the 2008 Plan. A list of dry basins located within the city was provided to AECOM by City of Oshkosh staff. This list was reviewed and evaluated for the practicality of retro-fitting the dry detention basins for the 2013 Plan update. Basins with small drainage areas, or a small size were removed from consideration because the conversion would be impractical. The remaining basins were analyzed for their feasibility along with other potential BMP sites as described on Table 5-2.

5.1.1.2 Catch Basins

The city already has a number of catch basins with sumps and plans to continue installing catch basins during street reconstruction projects. To assess the estimated pollution reduction from future installation of catch basins, the pollution reduction of catch basins recently installed was assessed. The following steps were taken:

- Measured length of 2012-2013 street reconstruction projects – 5.9 miles
- Measured area draining to catch basins in 2012-2013 street reconstruction projects – 110 acres
- Determined average drainage area per mile of roadway – 19 acres/mile
- Determined tons of TSS removed per acre of drainage area – 0.04 tons/acre*
- Determined lbs of TP removed per acre of drainage area – 0.19 lbs/acre*
- Estimated drainage area of future road reconstruction projects given an estimated 16.5 miles of roadway to be reconstructed from 2014-2017– 308 acres
- Applied tons of TSS removed per acre to estimated future drainage area to determine TSS reduction from future catch basins – 12.4 tons
- Applied lbs of TP removed per acre to estimated future drainage area to determine TP reduction from future catch basins – 57.1 lbs

*The tons of TSS removed per acre was calculated by dividing the total citywide TSS removed from the existing catch basins by the total citywide catch basin drainage area. This method was also used to determine the pounds of TP removed per acre of drainage area.

It is estimated that future catch basin installation from 2014-2017, will remove an approximate annual TSS pollutant load of 12.4 tons, or approximately 0.7 percent of the City’s total pollutant load. It is estimated that future catch basin installation will remove an approximate annual TP pollutant load of 57.1 lbs, or approximately 0.5 percent of the City’s total pollutant load Costs of installing the catch basins are assumed to be incidental to the street reconstruction program.

5.1.1.3 New Wet Detention Stormwater Quality Basins

The use of new wet detention basins for improved stormwater quality was evaluated on a site by site basis to assess the feasibility of each site. Sites for potential wet detention basins were selected in the 2008 plan by first evaluating, through aerial photography, open space located within subbasins producing large loadings of pollutants. Following this, open spaces located in other areas of the city were evaluated. City staff also provided input on sites they recommended for consideration. The evaluation of retro-fitting dry detention basins into wet basins was also included in this process. This list was revised for the 2013 plan update. A total of 9 sites were removed from the analysis since the 2008 plan. Table D-1 in Appendix D, illustrates the sites that were removed from the 2008 plan for the 2013 plan update.

<u>Basin Sizing</u>

For each of the sites selected preliminary calculations were completed to determine the size of basin that would be required for the drainage basin it would serve. The permanent pool size required to achieve an 80 percent TSS reduction was calculated using Appendix A of WDNR

Technical Standard 1001. The basin was sized to treat water from the entire drainage area, including areas not analyzed, and areas outside of the City. Areas outside of the city or that were not analyzed were assumed to be open space undeveloped in this analysis. The next step was to assume that a total area twice the size of the permanent pool area would be needed to construct the wet detention basin. If the selected site had an available area that was equal to, or larger than the area needed to construct the basin it was assumed that a basin achieving 80 percent TSS reduction could be constructed. If the area available at the site was smaller, an estimated percent control was calculated based on additional information from WDNR Technical Standard 1001 and assuming a linear relationship.

After the proposed TSS removal rate was found, the TP removal rate was assumed based on the TSS removal rate. A generic model was created in WinSLAMM to evaluate the drainage area of the proposed basins per 100 acres. Then the basin was sized for 80% TSS removal to find the correlated TP removal rate. A TP removal rate of 74% was determined for the TSS removal rate of 80%. This number was then averaged with the DOT accepted TSS to TP removal rate ratio. The accepted TSS/TP ratio used by the WisDOT is for every 40% TSS removed, there is 27% TP removed. This equates to 80/54 ratio. Averaging the two methods, results in a TP removal rate of 64%. Therefore 64% was used to prorate the TP rate for the proposed wet detention basins.

Wet Detention Basin Evaluation

The initial 20 sites were evaluated with City staff and a final list of 12 sites was selected. Some sites were eliminated from consideration for reasons such as; public acceptability concerns, stream navigability problems, or contaminated soil (old landfill) concerns. Table D-2 displays the sites removed from analysis and information regarding the sites can be found in Appendix D. If conditions change, such as WDNR allowing wet detention basins to be constructed in-line with navigable streams, these projects could be considered in the future.

The final list of 12 sites was evaluated based on a number of factors to determine the feasibility of each site. For each factor, the sites were assigned a score. Sites with the highest score were determined to be the most feasible. The feasibility factors are described in Table 5-1, along with the scoring values for each factor. The results of the scoring process are shown in Tables 5-2A and 5-2B. Appendix D contains more detailed information on all the potential wet detention basin sites evaluated.

Of the 12 sites evaluated there are 6 sites that have overlapping drainage areas. By selecting the sites which receive the highest scores in these areas a total of 9 sites could be constructed. These 9 sites represent the wet detention basins that are proposed for construction. All sites that were evaluated are described further in Appendix D. A map is provided showing the drainage area, location, and approximate permanent pool footprint of each site.

The 9 proposed sites are projected to achieve an approximate annual TSS reduction of 216 tons and a TP reduction of 948 pounds, which is 12 percent and 9 percent respectively of the City’s base load.

All 12 final sites are displayed on Table 5-2A and Table 5-2B. The final sizing, scoring, and other data pertaining to each site is also displayed. The table displays information from the planning level study conducted at this time. Additional study and design will be required for each site in order to construct the project and to further determine the amount of TSS and TP reduction that will be achieved and/or the size of basin that is required. It is possible that more sites or fewer sites will be needed depending on the results of more detailed studies of proposed project sites.

Table 5-1
BMP Feasibility Evaluation Factors & Scoring Values

Evaluation Factor	Scoring
(1) Pollution Control: The quantity of pollutant (sediment) controlled through a BMP was estimated using various sources including WinSLAMM analyses, WDNR documents, and other literature values.	High (10 pts) > 20 tns/yr Med. (5 pts) <20, > 10 tns/yr Low (0 pts) < 10 tns/yr
(2) Capital Cost: The initial land acquisition costs plus the construction costs make up this category. For each BMP these costs are estimated using various references, unit costs, comparisons to like projects, and discussions with city staff.	High (10 pts) < $300,000 Med (5 pts) < $1,000,000, > $300,000 Low (0 pts) > $1,000,000
(3) Cost per Unit of Pollutant Controlled: The cost-effectiveness of each practice is defined as the Capital Cost of each practice, divided by tons of pollution removed by each practice on an annual basis (#2 / #1 above).	High: (10 pts) < $35,000/tn Med (5 pts) > $35,000 /tn < $70,000/tn Low (0 pts) > $70,000/tn
(4) Flood Control: Management practices that address both pollutant control and flood control will likely receive higher support from local residents. The scoring of this factor is based on the city staff's knowledge of flooding control needs for the BMP site and if the BMP can help meet flood control goals.	Yes: (10 pts): enhanced flood control potential Some: (5 pts): minimal flood control potential No: (0 pts) no flood control potential or need
(5) Land Ownership: Land currently under city ownership is more suitable for BMP installation for economic and administrative reasons. Other open space land may rank high depending on the potential for easement or land purchase from other public or private owners.	High (10 pts): city owned Med (5 pts): other public owner Low (0 pts): privately owned
(6) Green Space: Best management practices can be designed to enhance open space aesthetics, wildlife habitat, and other recreational uses. Management practices located in existing green space areas are easier to construct because existing structures do not need to be removed.	Yes: (10 pts): existing green space at BMP site No: (0 pts): no existing green space at BMP site
(7) Public Acceptability: Certain types of BMPs may not be perceived as acceptable by the public because of aesthetic, recreational, safety, or other reasons. The scoring for this category is based on city staff's knowledge of overall citizens' viewpoints.	High (10 pts): high public acceptance. Low (0 pts): low public acceptance
(8) Comments: Other issues may be considered depending on the proposed BMP site. Issues such as environment history, safety, historical significance, or aesthetics may influence the desirability (feasibility) of a BMP for a specific site.	The issues are summarized in a Comments column.

Table 5-2A
Physical Characteristics of Potential Wet Detention Basins

Proposed BMP ID	Subbasin	Address	Common Name	Practice	Total Drainage Area to BMP (acres)	Analyzed Area within Drainage Area (acres)	Analyzed Area TSS Load (tons/yr)	Analyzed Area TP Load (lbs/yr)	Available Land (acres)	Proposed Basin Area (acres)	Required Device Surface Area (80% Control) (acres)	Required Land (80% Control) (acres)	Estimated TSS Control (%)	Estimated TP Control (%)
4	Stringham Creek1	1300 Georgia St	South Park Basins Expansion	Retrofit	718	659	114	588	12.0	6.00	10.2	20.5	68.6	54.9
35	Sawyer Creek2	S Westhaven Dr	Westhaven Golf Course - West Basin	New Basin	261	258	22	179	65.9	2.10	2.1	4.2	80.0	64.0
5	Stringham Creek1	W S Park Ave	South Park Quarry Basin	New Basin	235	193	38	182	1.5	1.5	3.9	7.7	37.4	30.0
36	Libbey Ave / Nicolet Ave	N Main St	Libby Ave / N Main St	New Basin	383	310	55	282	3.5	3.50	5.1	10.2	67.0	53.6
7	Sawyer Creek2	Pheasant Creek Dr	Pheasant Creek Dry Basin	Retrofit	69	69	7	55	3.0	0.62	0.6	1.1	80.0	64.0
26	Anchorage Ct	E Murdock & Bowen St	Bowen Street	New Basin	340	340	42	301	2.2	1.10	4.5	8.9	56.2	45.0
26-1	Anchorage Ct	E Murdock & Bowen St	Bowen Street	New Basin	340	340	42	301	0.8	0.40	4.5	8.9	20.3	16.3
6	Omro Rd	Washburn St	Washburn St / Westowne Ave Basin	Retrofit	77	54	13	56	0.6	0.30	1.3	2.6	54.0	43.2
31	Campbell Creek	9th Ave & Washburn St	9th and Washburn	New Basin	287	275	31	212	11.1	8.8	8.8	10.6	83.8	61.6
16	Sawyer Creek2	2155 S Oakwood Rd	Miles Kimball Dry Basin	Retrofit	40	40	5	23	13.0	0.90	0.6	1.2	80.0	64.0
15	Sunnyview Rd North	4660 Sherman Rd	Island View Estates Dry Basin	Retrofit	49	24	2	17	15.2	0.36	0.4	0.8	80.0	64.0
29	Sawyer Creek2	3000 W 20th Ave	Oakwood & 20th / Fox Tail Ln	New Basins (2)	207	148	23	123	7.0	3.16	2.7	5.3	80.0	64.0

(Shaded) BMP not proposed because it is part of another drainage area, These BMPs serve as an alternate location if other BMPs cannot be constructed

Table 5-2B
Wet Detention Basin Scoring and Ranking

Proposed BMP ID	Subbasin	Address	Common Name	Practice	Pollution Control: (1) TSS (tons/yr)	Pollution Control: TP (lbs/yr)	Pollution Control: Score	Cost: (2) Land + Construction Cost	Cost: Score	Cost: Annual Maintenance Cost	Cost: (3) Cost per Unit of Control ($/ton)	Cost: Score	(4) Flood Control: Yes/No	(4) Flood Control: Score	(5) Ownership: Owner	(5) Ownership: Score	(6) Open Space: Yes/No	(6) Open Space: Score	(7) Public Acceptability: Score	Total: Score
4	Stringham Creek1	1300 Georgia St	South Park Basins Expansion	Retrofit	78.1	323	10	$1,990,000	0	$20,900	$25,000	10	Some	5	City	10	Yes	10	5	55
5	Stringham Creek1	W S Park Ave	South Park Quarry Basin	New Basin	14.1	55	5	$475,000	5	$1,700	$34,000	10	Yes	10	Private	0	Yes	10	10	50
35	Sawyer Creek2	S Westhaven Dr	Westhaven Golf Course - West Basin	New Basin	17.5	114	5	$892,000	5	$8,300	$18,000	10	Yes	10	Private	0	Yes	10	5	45
31	Campbell Creek	9th Ave & Washburn St	9th and Washburn	New Basin	19.2	50	5	$3,927,000	0	$11,700	$204,000	0	Yes	10	City	10	Yes	10	10	45
7	Sawyer Creek2	Pheasant Creek Dr	Pheasant Creek Dry Basin	Retrofit	5.6	35	0	$262,000	10	$3,400	$47,000	5	Yes	10	Private	0	Yes	10	5	40
36	Libbey Ave / Nicolet Ave	N Main St	Libby Ave / N Main St	New Basin	37.0	161	10	$3,729,000	0	$12,800	$101,000	0	Yes	10	Private	0	Yes	10	5	35
26	Anchorage Ct	E Murdock & Bowen St	Bowen Street	New Basin	23.4	135	10	$1,862,000	0	$5,000	$80,000	0	Yes	10	Private	0	Yes	10	5	35
26-1	Anchorage Ct	E Murdock & Bowen St	Bowen Street	New Basin	8.5	49	0	$695,000	5	$2,800	$82,000	0	Yes	10	Private	0	Yes	10	5	30
6	Omro Rd	Washburn St	Washburn St / Westowne Ave Basin	Retrofit	0.5	157	0	$187,000	10	$2,400	$359,000	0	No	0	Private	0	Yes	10	10	30
16	Sawyer Creek2	2155 S Oakwood Rd	Miles Kimball Dry Basin	Retrofit	4.3	15	0	$362,000	5	$4,400	$84,000	0	No	0	Private	0	Yes	10	5	20
15	Sunnyview Rd North	4660 Sherman Rd	Island View Estates Dry Basin	Retrofit	1.7	11	0	$172,000	10	$2,600	$103,000	0	No	0	Private	0	Yes	10	0	20
29	Sawyer Creek2	3000 W 20th Ave	Oakwood & 20th / Fox Tail Ln	New Basins (2)	18.5	79	5	$1,172,000	0	$11,700	$63,000	5	No	0	City / Private	0	Yes	10	0	20

(Shaded) BMP not proposed because it is part of another drainage area, These BMPs serve as an alternate location if other BMPs cannot be constructed

5.1.1.4 Planned Redevelopment

There are a number of areas within the city that are proposed for redevelopment through the City's redevelopment plan. These sites will be required to achieve a 40 percent (or greater) TSS load reduction, under the City's Post-Construction Stormwater Management Ordinance and/or NR 151, when construction takes place. A 40 percent TSS load reduction was applied to these sites as a proposed management practice. These sites do not have a specific timeline for when re-development will occur. A majority of the planned redevelopment sites are located in the downtown area. A map displaying the location of the planned downtown redevelopment areas can be found as Figure 5-1. A total of approximately 129 acres are planned for redevelopment, achieving a 40 percent reduction over these areas will results in a removal of 11 tons of TSS annually, which is the equivalent of a 0.6 percent reduction Citywide. The accepted WisDOT TSS to TP removal rate of 27 percent was applied to find a removal of 65 lbs of TP annually, which is equivalent to 0.6 percent reduction Citywide.

5.1.1.5 Engineered Swales

Another BMP that was evaluated for pollution removal is engineered swales. Engineered swales consist of excavating approximately 3 feet below an existing swale, placing an underdrain pipe, and replacing the native soil with an engineered soil. The underdrain pipe is then connected to an existing storm sewer. Because of the need for an underdrain engineered swales cannot be constructed in all areas where swales currently exist. The city evaluated existing swale locations and determined where engineered swales are feasible. In these areas the conversion of traditional swales to engineered swales was evaluated using WinSLAMM. Engineered swales were not looked at in areas where the existing traditional swales were achieving a removal rate greater than 80% TSS reduction. A total of 38 acres could be treated resulting in a potential TSS removal of 8 tons per year, or 0.4 percent of the City's base load. In addition, 36 lbs of TP would potentially be removed by the engineered swales or 0.3 percent of the City's base load. The sites identified would require approximately 12,000 feet of engineered swales. Engineered swales have a cost estimated to be $9,000 per 100 feet of swale. This equates to an approximate cost of $1 million. The cost would be approximately $134,600 per ton of TSS removed.

5.1.1.6 Biofiltration

AECOM has evaluated the feasibility of incorporating biofilters or rain gardens into selected areas of the City. The first phase of this analysis evaluated the use of rain gardens to treat runoff from residential rooftops. A WinSLAMM model was created to evaluate the size and depth of rain garden needed to achieve a 40% removal rate for a standard land use of medium residential. Since these rain gardens experience greater than 24 hours of ponding, it is recommended that wet prairie plants are to be used. In addition, it is recommended that the rain gardens be designed with a depth of 0.2 feet, so the plants will not be completely inundated with runoff. Table 5-3 summarizes the analysis.

Table 5-3 **Rain Garden Annual TSS Removal (per 100 acres)**					
Ratio of Rain Gardens per Parcel	Number of Rain Gardens	% TSS Reduction	Tons TSS Removed	% TP Reduction	Lbs TP Removed
Every House	400	2.9%	0.32	3.4%	2.80
50% of Houses	200	1.8%	0.20	2.1%	1.74
25% of Houses	100	1.1%	0.11	1.2%	1.00
Assumptions:					
1) Medium density residential - no alleys land use					
2) Average TSS loading (per SLAMM) = 11 tons TSS / 100 acres / year					
3) Average TP loading (per SLAMM) = 416 lbs / 100 / 5					
4) 1/4 of each treated parcel's roof drains to rain garden					
5) Rain garden design parameters - footprint = 100 sq. ft. - 0.2 feet depression - Infiltration rate = 0.07 in / hr - Planted with Wet Prairie Plants					

The next step in the analysis determined the size of a biofilter required to treat one acre of a specified land use. Biofilters would be incorporated into the landscape to treat runoff from source areas that produce large amounts of pollutants. Thus, this analysis focused on commercial, institutional, and industrial land uses. Examples of locations that biofilters could be placed in these areas are in parking lot islands, along the edge of parking lots, and within road medians. Table 5-4 below describes the results of the biofilters analysis.

Table 5-4 **Biofiltration Annual TSS Removal**					
Land Use	% TSS Reduction *	% TP Reduction*	Tons TSS Removed (per acre of Land Use)	Lbs TP Removed (per acre of Land Use)	Biofilter Size (sq. ft.)
Shopping Center	80%	79%	0.16	0.65	425
Light Industrial	81%	78%	0.21	0.72	325
School	80%	76%	0.14	0.76	250
Assumptions:					
1) Biofilters sized to treat 1 acre of selected land use					
2) Biofilter Design: - total depth = 7.0' - sand storage depth = 3.0' - rock storage depth = 0.5' - engineered soil depth = 3' - standpipe at 6.75' depth - perforated underdrain at 3.0' depth * Reductions determined from WinSLAMM version 10.0.					

To further evaluate the feasibility and practicality of the use of biofilters in accomplishing the Citywide pollution reduction requirements a brief cost analysis was completed. Also determined was the amount of pollution that could be removed with varying levels of biofilter implementation within various land uses. The results of this analysis are displayed in Table 5-5.

Table 5-5
Potential Citywide Biofilter Treatment Level $ Costs

Land Use	Acres NOT Otherwise Treated with Structural BMPs	TSS Control with Variable Treatment Levels (tons/year)					Cost / Biofilter	Cost / tn**
		10%	25%	50%	75%	100%		
Med. Density Residential	1,913	21	52	104	157	209	$2,300	$ 84,231
Commercial	575	14	35	70	104	139	$7,000	$115,619
Industrial	891	24	61	122	183	244	$6,000	$87,563
Institutional	778	15	37	75	112	150	$5,000	$103,943

** Biofilter costs are based on a rate of $18.50 per SF (Source: "Rain Gardens, A how-to manual for homeowners"; UWEX Publication GWQ037 and Applied Ecological Services Rain Garden Design Publication)

Biofilters can be used to achieve the TSS and TP reduction that is required after other BMPs are implemented. A key to the success of biofilters is long term maintenance. This analysis does not specify the additional amount of biofilters needed nor the individual locations for biofilter installation. Biofilters can be used to help achieve future goals once the TMDLs are established.

6.0 Results

Once the TMDL requirements are established, the City can complete the following steps to meet the reduction goals:

1. Continue construction of catch basins during street reconstruction process.
2. Construct additional wet detention basins (currently nine basins are identified for implementation).
3. Obtain required TSS reductions in planned redevelopment areas.
4. Construct engineered swales in 2 locations previously described.
5. Construct biofilters to treat industrial lands to reach the established reductions goals.

The location of proposed BMPs can be seen as Figure 5.2 at the end of the report. Table 6-1 summarizes the pollutant removal from each of the BMP types within the MS4 area.

6.1 TSS Reduction cost

Table 6-2 displays the estimated cost for the projects proposed in this plan. These cost estimates were determined using a planning level analysis. All cost estimates are in 2013 dollars. It is likely that the final cost of projects will vary significantly once more detailed information is gathered on each site. A schedule displaying a proposed construction timeline and costs for each year is included as part of this report in Appendix E. The unit costs shown in Table 6-3 were used to determine the cost estimates in Tables 5-2B, 5-5, and 6-2.

Table 6-1
Summary of Existing and Proposed Management Practices
TSS Reductions for the MS4 Area

Stormwater Management Scenario	TSS Control		Cumulative TSS Controlled	TP Control		Cumulative TP Controlled
	(tons/yr)	% Reduction	%	(lbs/year)	% Reduction	%
Base Condition = 1,912 tons/year TSS						
Base Condition = 10,923 lbs/year TP						
Existing Best Management Practices						
Street Cleaning	149	8%	8%	562	5%	5%
Airport Swales	24	1%	9%	205	2%	7%
City Swales	75	4%	13%	391	4%	11%
Catch Basins	46	2%	15%	202	2%	12%
Structural BMPs	266	14%	29%	1,048	10%	22%
Sum of Existing Conditions	**560**		**29%**	**2,408**		**22%**
Potential Best Management Practices						
Catch basins (2014-2017)	12	0.6%	0.6%	57	0.5%	0.5%
Proposed Wet Detention Basins	216	11.3%	11.9%	948	9.1%	9.6%
Engineered Swales	8	0.4%	12.3%	36	0.3%	9.9%
Planned Redevelopment	11	0.6%	12.9%	65	0.6%	10.6%
Biofilters	TBD	TBD	TBD	TBD	TBD	TBD
Sum of Proposed Conditions	**248**		**12.9%**	**1,106**		**10.6%**
Combined Existing & Proposed Management Practices	**808**		**41.9%**	**3,514**		**32.6%**

Table 6-2
Proposed BMP Costs

Project		**Estimated Land Acquisition Cost**	**Estimated Construction Cost**	**Estimated Total Cost**	**Cost Per Ton TSS Removed**	**Estimated Annual Maintenance Cost**
Proposed Detention Basin						
ID	Location/Common Name					
4	South Park Pond Expansion [1]	$0	$1,990,000	$1,990,000	$25,000	$20,900
5	South Park Quarry Basin	$410,000	$286,000	$696,000	$50,000	$3,900
6	Washburn St/Westowne Ave Basin	$47,000	$140,000	$187,000	$313,000	$2,400
7	Pheasant Creek Dry Basin	$20,000	$242,000	$262,000	$43,000	$3,400
15	Island View Estates Dry Basin	$12,000	$160,000	$172,000	$88,000	$2,600
16	Miles Kimball Dry Basin	$29,000	$333,000	$362,000	$72,000	$4,400
26	Bowen Street	$1,463,000	$399,000	$1,862,000	$71,000	$5,000
29	Oakwood & 20th / Fox Tail Ln	$36,000	$1,069,000	$1,105,000	$53,000	$11,700
31	9th & Washburn	$1,200,000	$2,727,000	$3,927,000	$204,000	$11,700
35	Westhaven Golf Course - West Basin	$168,000	$724,000	$892,000	$42,000	$8,300
36	Libby Ave/N Main St [1]	$2,550,000	$1,179,000	$3,729,000	$101,000	$12,800
26-1	Bowen Street	$1,463,000	$172,000	$1,635,000	$172,000	$2,800
Engineered Swales			$1,068,000	$1,068,000	$134,600	$26,400
Biofilters	-	TBD	TBD	TBD	TBD	TBD
Total		**$7,398,000**	**$10,489,000**	**$17,887,000**	**$1,368,600**	**$116,300**

[1] These ponds will also provide both water quality and peak flow benefits. The estimated costs include those costs associated with building a complete water quality pond. Additional costs may be incurred to add peak flow reduction benefits into the construction of the pond.

Table 6-3 Unit Costs for BMP Construction and Maintenance Estimating	
Construction Unit Costs	• Excavation = $13.50 / cu. yd. • Seeding = $1.15 / sq. yd. • Wetland Planting = $0.83 / sq. yd. • Erosion Matting = $2.50 / sq. yd. • Storm Sewer = $140.00 / lineal foot. • Inlet / Outlet Structure = $15,000 each • Biofilter Plants = $7.50/ sq. ft. • Drain Tile = $15.00 / lineal foot • Engineered Soil = $36.00 / cu. yd. • Pea Gravel = $34.75 / cu. yd • Mason Sand = $18.00 / cu. yd
Land Acquisition Costs	• Commercial Land = $653,000 / acre (Sites #12, 26, 26-1, 29a, 31) • Residential Land = $90,000 / acre (Site #5) • Easement Only Needed = $16,250 / acre (Sites #2, 6, 7, 15, 16, 18) • Golf Course Land = $22,388 / acre (Sites #34, 35) • Open Space = $40,000 (Site #31, #36)
Engineered Swales	• Construction Costs: $8,900 / lineal foot • Annual Maintenance: $220 / 100 lineal foot
Biofilters	• Construction Costs: $6,000 each • Annual Maintenance: $500 each
Other Costs	• A 25% contingency / engineering design costs was added to the estimated capital costs for each practice.

Appendix A

Wisconsin Department of Natural Resources Documents

General WDNR Policy

Wet Detention Pond
(1001)

Wisconsin Department of Natural Resources
Conservation Practice Standard

I. Definition

A permanent pool of water with designed dimensions, inlets, outlets and storage capacity, constructed to collect, detain, treat and release stormwater runoff.

II. Purposes

The primary purposes of this practice are to improve water quality and reduce peak flow.

III. Conditions Where Practice Applies

This practice applies to urban sites where stormwater runoff pollution due to particulate solids loading and attached pollutants is a concern. It also applies where increased runoff from urbanization or land use change is a concern. Site conditions must allow for runoff to be directed into the pond and a permanent pool of water to be maintained.

This standard establishes criteria for ponds to detain stormwater runoff, although some infiltration may occur. In some instances, detention ponds may present groundwater contamination risks, and this standard sets criteria for determining when liners may be necessary to address risks to groundwater. Where the detention pond will be discharging to an infiltration practice, see WDNR Conservation Practice Standards 1002-1004.

Application of this standard is not intended to address flood control. Modifications to the peak flow criteria or additional analysis of potential flooding issues may be needed or required by local authorities. For ponds used during the construction period, see WDNR Conservation Practice Standard 1064, Sediment Basin.

This practice provides a method to demonstrate that a wet detention pond achieves the total suspended solids (TSS) reduction and peak flow control required by NR 151.12, Wis. Adm. Code, for post-construction sites. Pollutant loading models such as SLAMM, P8, DETPOND or equivalent methodology may also be used to evaluate the efficiency of the design in reducing TSS.

IV. Federal, State and Local Laws

The design, construction and maintenance of wet detention ponds shall comply with all federal, state and local laws, rules or regulations. The owner/operator is responsible for securing required permits. This standard does not contain the text of any federal, state or local laws governing wet detention ponds.

The location and use of wet detention ponds may be limited by regulations relating to stormwater management, navigable waters (Ch. 30, Wis. Stats.), floodplains, wetlands, buildings, wells and other structures, or by land uses such as waste disposal sites and airports. The pond embankment may be regulated as a dam under Ch. 31, Wis. Stats., and further restricted under NR 333, Wis. Adm. Code, which includes regulations for embankment heights and storage capacities.

V. Criteria

The following minimum criteria apply to all wet detention pond designs used for the purposes stated in Section II of this standard. Use more restrictive criteria as needed to fit the conditions found in the site assessment.

A. Site Assessment – Conduct and document a site assessment to determine the site characteristics that will affect the placement, design, construction and maintenance of the pond. Document the pond design. Items to assess include:

1. At the pond site, on a site map:

   a. Identify buildings and other structures, parking lots, property lines, wells, wetlands, 100-year floodplains, surface

[1] Words in the standard that are shown in italics are described in X. Definitions. The words are italicized the first time they are used in the text.

drains, navigable streams, known drain tile, roads, and utilities (both overhead and buried) showing elevation contours and other features specified by the applicable regulatory authority.

b. Show location of soil borings and test pits on site map, characterize the soils, *seasonally high groundwater level*[1], and *bedrock* conditions to a minimum depth of 5 feet below the proposed bottom of the pond or to bedrock, whichever is less. Conduct one test pit or boring per every 2 acres of permanent pool footprint, with a minimum of two per pond. Include information on the soil texture, color, structure, moisture and groundwater indicators, and bedrock type and condition, and identify all by elevation. Characterize soils using both the USDA and USCS classification systems.

Note: USCS characterization is used for soil stability assessment while USDA soil characterization identifies the soil's potential permeability rate.

c. Investigate the potential for *karst features* nearby.

2. In the watershed, on a watershed map:

a. Identify predominant soils, the drainage ways, navigable streams and floodways, wetlands, available contour maps, land cover types and known karst features. Identify the receiving surface waters, or whether the drainage basin drains directly to groundwater.

b. Show channels and overland flow before and after development, contours, and property lines.

c. Refer to the Tc (time of concentration) flow paths and subwatershed boundaries used in runoff calculations.

B. Pond Design – Properly designed wet detention ponds are effective at trapping smaller particles, and controlling peak flows (see App. C, Figures 1-3).

1. Water Quality – Pollutant reduction (TSS and phosphorus) is a function of the permanent pool area and depth, the outlet structure and the active storage volume. The following criteria apply:

a. Permanent Pool – The elevation below which runoff volume is not discharged and particles are stored.

i. Design ponds to include a permanent pool of water. The surface area of the permanent pool is measured at the invert of the lowest outlet. The minimum surface area of the permanent pool must address the total drainage area to the pond.

Note: Use App. A for the initial estimate of the permanent pool area based on drainage area. Prorate values for mixed land uses.Use Equation 1 to solve for q_o and iterate as needed.

ii. The permanent pool surface area is sized based on the particle size and the peak outflow during the 1-yr., 24-hour design storm using Equation 1:

$$\mathbf{S_a = 1.2 * (q_o / \mathit{v}_s)} \quad \text{[Equation 1(a)]}$$

or

$$\mathbf{q_o = (\mathit{v}_s * S_a) / 1.2} \quad \text{[Equation 1(b)]}$$

Where:

$\mathbf{S_a}$ = Permanent pool surface area measured at the invert of the lowest outlet of the wet detention pond (square feet)

$\mathbf{q_o}$ = Post-construction peak outflow (cubic feet/second) during the 1-yr., 24-hour design storm for the principal outlet

$\boldsymbol{v_s}$ = Particle settling velocity (feet/second)

1.2 = EPA recommended safety factor

iii. Particle settling velocities (v_s) shall be based on representative particle sizes for the desired percent TSS reduction.

- 80% (3 micron): $v_s = 1.91 \times 10^{-5}$ ft./sec.
- 60% (6 micron): $v_s = 7.37 \times 10^{-5}$ ft./sec.
- 40% (12 micron): $v_s = 2.95 \times 10^{-4}$ ft./sec.

Note: Particle settling velocities were calculated assuming a specific gravity of 2.5, a water temperature of 50 degrees Fahrenheit (10 degrees C) and a kinematic viscosity of 0.01308 $cm.^2/sec.$ (Pitt, 2002). The calculations also assume discrete and quiescent settling conditions per Stoke's Law.

b. Active Storage Volume – Volume above the permanent pool that is released slowly to settle particles. Calculate the volume with the following method:

Use a hydrograph-producing method, such as the one outlined in Natural Resources Conservation Service, Technical Release 55 (TR-55), to determine the storage volume for detention ponds. This can be accomplished by using App. B where:

$\mathbf{q_o}$ = Peak outflow during the 1-yr., 24-hour design storm for the principal outlet calculated using Equation 1 (see V.B.1.a.ii).

$\mathbf{q_i}$ = Calculated post-construction peak inflow or runoff rate during the 1-yr., 24-hour design storm.

$\mathbf{V_R}$ = Calculated volume of runoff from the 1-year, 24-hour design storm for the entire contributory area.

$\mathbf{V_S}$ **=** The required active storage volume determined using App. B.

Note: This method may require iterative calculations.

c. Safety – Include a safety shelf (or aquatic shelf) that extends a minimum of 8 ft. from the edge of the permanent pool waterward with a slope of 10:1 (horizontal:vertical) or flatter. The maximum depth of the permanent pool of water over the shelf shall be 1.5 ft.

d. Depth – The average water depth of the permanent pool shall be a minimum of 3 ft., excluding the safety shelf area and sediment storage depth.

e. Length to Width – Maximize the length to width ratio of the flow path to prevent short-circuiting and dead zones (areas of stagnant water). See Section VII, Considerations D and N for options to prevent short circuiting.

f. Sediment Storage – After all construction has ceased and the contributory watershed has been stabilized, one of the following applies:

i. A minimum of 2 ft. shall be available for sediment storage (for a total of 5 ft. average depth, excluding the safety shelf area). For ponds greater than 20,000 sq. ft., 50% of the total surface area of the permanent pool shall be a minimum of 5 ft. deep. For ponds less than 20,000 sq. ft., maximize the area of 5 ft. depth.

ii. Modeling shows that for 20 years of sediment accumulation, less than 2 ft. sediment storage is needed (not to be less than 0.5 feet).

iii. A minimum of 4 ft. shall be available for sediment storage if the contributory area includes cropland not stabilized by any other practice, such as strip cropping, terraces and conservation tillage.

For information on sediment storage in forebays, see Section VII, Consideration C.

Note: Municipalities that use sand in the winter may consider increasing the sediment storage depth.

g. Side Slopes Below Safety Shelf – All side slopes below the safety shelf shall be 2:1 (horizontal:vertical) or flatter as required to maintain soil stability, or as required by the applicable regulatory authority.

h. Outlets – Wet detention ponds shall have both a principal outlet and an emergency spillway.

i. Prevent Damage – Incorporate into outlet design trash accumulation preventive features, and measures for preventing ice damage and scour at the outfall. Direct outlets to channels, pipes, or similar conveyances designed to handle prolonged flows.

ii. Principal Water Quality Outlet – Design the outlet to control the proposed 2-yr., 24-hour discharge from the pond within the primary principal outlet without use of the emergency spillway or other outlet structures. If a pipe discharge is used as the primary principal outlet, then the minimum diameter shall be 4 inches. Where an orifice is used, features to prevent clogging must be added.

iii. Backward Flow – Any storm up to the 10-yr., 24-hour design storm shall not flow backward through the principal water quality outlet or principal outlet. Flap gates or other devices may be necessary to prevent backward flow.

iv. Emergency Spillway – All ponds shall have an emergency spillway. Design the spillway to safely pass peak flows produced by a 100-yr., 24-hour design storm routed through the pond without damage to the structure. The flow routing calculations start at the permanent pool elevation.

v. Peak Flow Control – Design the peak flow control to maintain stable downstream conveyance systems and comply with local ordinances or conform with regional stormwater plans where they are more restrictive than this standard. At a minimum:

a) The post-development outflow shall not exceed pre-development peak flows for the 2-yr., 24-hour design storm.

b) Use a hydrograph-producing method such as TR-55 for all runoff and flow calculations.

c) When pre-development land cover is cropland, use the runoff curve numbers in Table 1, unless local ordinances are more restrictive**.**

d) For all other pre-development land covers, use runoff curve numbers from TR-55 assuming "good hydrologic conditions."

e) For post-development calculations, use runoff curve numbers based on proposed plans.

Note: Local ordinances may require control of larger storm events than the 2-yr., 24-hour storm. In these cases, additional or compound outlets may be required.

Table 1 - Maximum Pre-Development Runoff Curve Numbers for Cropland Areas

Hydrologic Soil Group	A	B	C	D
Runoff Curve Number	55	69	78	83

2. Other Pond Criteria

a. Inflow Points – Design all inlets to prevent scour during peak flows produced by the 10-yr., 24-hr. design storm, such as using half-submerged inlets, stilling basins and rip-rap. Where infiltration may initially occur in the pond, the scour prevention device shall extend to the basin bottom.

b. Side Slopes **–** All interior side slopes above the safety shelf shall be 3:1 (horizontal:vertical), or flatter if required by the applicable regulatory authority.

c. Ponds in Series – To determine the overall TSS removal efficiency of ponds in series, the design shall use an *approved model* such as DETPOND or P8, that can track particle size distribution from one pond to the next.

d. Earthen Embankments – Earthen embankments (see App. C, Figure 3) shall be designed to address potential risk and structural integrity issues such as seepage and saturation. All constructed earthen embankments shall meet the following criteria.

i. Vegetation – Remove a minimum of 6 in. of the parent material (including all vegetation, stumps, etc.) beneath the proposed base of the embankment.

ii. Core Trench or Key-way – For embankments where the permanent pool is ponded 3 ft. or more against the embankment, include a core trench or key-way along the centerline of the embankment up to the permanent pool elevation to prevent seepage at the joint between the existing soil and the fill material. The core trench or key-way shall be a minimum of 2 ft. below the existing grade and 8 ft. wide with a side slope of 1:1 (horizontal:vertical) or flatter. Follow the construction and compaction requirements detailed in V.B.2.d.iii below for compaction and fill material.

iii. Materials – Construct all embankments with non-organic soils and compact to 90% standard proctor according to the procedures outlined in ASTM D-698 or by using compaction requirements of USDA Natural Resources Conservation Service, Wisconsin Construction Specification 3. Do not bury tree stumps, or other organic material in the embankment. Increase the constructed embankment height by a minimum of 5% to account for settling.

iv. Freeboard – Ensure that the top of embankment, after settling, is a minimum of 1 vertical foot above the flow depth for the 100-yr., 24-hr. storm.

v. Pipe Installation, Bedding and Backfill – If pipes are installed after construction of the embankment, the pipe trench shall have side slopes of 1:1 or flatter. Bed and backfill any pipes extending through the embankment with embankment or equivalent soils. Compact the bedding and backfill in lifts and to the same standard as the original embankment.

vi. Seepage – Take measures to minimize seepage along any conduit buried in the embankment. Measures such as anti-seep collars, sand diaphragms or use of bentonite are acceptable.

vii. Exterior side slopes shall be 2:1 (horizontal:vertical) or flatter, with a minimum top width of the embankment of 4 ft., or 10 ft. if access for maintenance is needed. The embankment must be designed for slope stability.

e. Topsoil and Seeding – Spread topsoil on all disturbed areas above the safety shelf, as areas are completed, to a minimum depth of 4 inches. Stabilize according to the permanent seeding criteria in WDNR Conservation Practice Standard 1059, Seeding for Construction Site Erosion Control.

f. Liners – Use the Liner Flowchart in App. D to determine when a liner is needed. For types of liners, see the Liner Flowchart and specifications in App. D. If a liner is used, provide a narrative that sets forth the liner design and construction methods.

Note: Some municipalities have wellhead protection areas and all municipalities have source water protection areas delineated by WDNR. Consult with the local community about when a liner will be needed if located within one of these areas.

g. Depth to Bedrock – The separation distance from the proposed bottom of a wet detention pond to bedrock will determine which of the following apply:

i. If the separation distance is a minimum of 5 ft. and the soil beneath the pond to bedrock is 10% fines or more, refer to the Liner Flowchart to determine if a liner may be needed for reasons other than proximity to bedrock;

ii. If the separation distance is a minimum of 3 ft. and the soil beneath the pond to bedrock is 20% fines or more, refer to the Liner Flowchart to determine if a liner may be needed for reasons other than proximity to bedrock;

iii. If conditions in (i) or (ii) are not met, then a Type B liner is required at a minimum. Refer to the Liner

Flowchart to determine if a Type A liner may be needed for reasons other than proximity to bedrock (see liner specifications in App. D);

iv. If blasting in bedrock is performed to construct a wet detention pond in bedrock, then a Type A liner is required (see liner specifications in App. D) and an engineering design must be conducted.

h. Separation from Wells – Wet detention ponds shall be constructed 400 feet from community wells (NR 811, Wis. Adm. Code) and 25 feet from non-community and private wells (NR 812, Wis. Adm. Code).

Note: The 25 foot setback from non-community and private wells is a final construction distance. This may not be sufficient to prevent running over the well with heavy equipment during construction of the pond.

i. Wetlands – For wet detention ponds that discharge to wetlands, use level spreaders or rip-rap to prevent channelization, erosion and reduce sedimentation in the wetlands.

j. Off-site runoff – Address off-site runoff in the design of a wet detention pond.

k. Aerators/Fountains – If an aerator or fountain is desired for visual and other aesthetic effects (aerators designed to mix the contents of the pond are prohibited) they must meet one of the first two items (i – ii), and items (iii) and (iv) below.

i. Increase the surface area of the wet detention pond beyond the area needed to achieve compliance with a stormwater construction site permit. The increase in surface area is equal to or greater than the *area of influence* of the aerator/fountain. Use an aerator/fountain that does not have a *depth of influence* that extends into the sediment storage depth (see App. E, Figure 4).

ii. For wet detention ponds where the surface area is no more than required to meet the stormwater construction site permit conditions, the depth of influence of the device cannot extend below the sediment storage elevation. Include in the design an automatic shut-off of the aerator/fountain as the pond starts to rise during a storm event. The aerator/fountain must remain off while the pond depth returns to the permanent pool elevation and, further, shall remain off until such time as required for the design micron particle size to settle to below the draw depth of the pump. (See V.B.1.a.iii for the design micron particle sizes that correlate with a TSS reduction.)

iii. Aerator/fountains are not allowed in wet detention ponds with less than a 5 ft. permanent pool designed depth.

iv. Configure the pump intake to draw water primarily from a horizontal plane so as to minimize the creation of a circulatory pattern from bottom to top throughout the pond.

VI. Operation and Maintenance

Develop an operation and maintenance plan that is consistent with the purposes of this practice, the wet detention pond's intended life, safety requirements and the criteria for its design. The operation and maintenance plan will:

A. Identify the responsible party for operation, maintenance and documentation of the plan.

B. Require sediment removal once the average depth of the permanent pool is 3.5 ft. At a minimum, include details in the plan on inspecting sediment depths, frequency of accumulated sediment removal, and disposal locations for accumulated sediment (NR 500, Wis. Adm. Code).

C. Include inlet and outlet maintenance, keeping embankments clear of woody vegetation, and providing access to perform the operation and maintenance activities.

D. Identify how to reach any forebay, safety shelf, inlet and outlet structures.

E. Address weed or algae growth and removal, insect and wildlife control and any landscaping practices.

F. If a liner is used, show how the liner will be protected from damage during sediment removal or when the liner is undergoing repair.

G. Prohibit excavation below the original design depth unless geotechnical analysis is completed in accordance with V.A.1.b & c.

VII. Considerations

Consider the following items for all applications of this standard:

A. Additional conservation practices should be considered if the receiving water body is sensitive to temperature fluctuations, oxygen depletion, excess toxins or nutrients.

B. To prevent nuisance from geese, consider not mowing around the pond perimeter. To maximize safety and pollutant removal, consider spreading topsoil along the safety shelf to promote plant growth.

C. For ease of maintenance, a sediment forebay should be located at each inlet (unless inlet is < 10% of total inflow or an equivalent upstream pretreatment device exists) to trap large particles such as road sand. The storage volume of the sediment forebay should be consistent with the maintenance plan, with a goal of 5%-15% of the permanent pool surface area. The sediment forebay should be a minimum depth of 3 ft. plus the depth for sediment storage.

D. The length to width ratio of the flow path should be maximized with a goal of 3:1 or greater. The flow path is considered the general direction of water flow within the pond, including the permanent pool and forebay.

E. Consider providing additional length to the safety shelf, above or below the wet pool elevation, to enhance safety.

F. To prevent damage or failure due to ice, all risers extending above the pond surface should be incorporated into the pond embankment.

G. The use of underwater outlets should be considered to minimize ice damage, accumulation of floating trash or vortex control.

H. Watershed size and land cover should be considered to ensure adequate runoff volumes to maintain a permanent pool.

I. Aesthetics of the pond should be considered in designing the shape and specifying landscape practices. Generally, square ponds are aesthetically unappealing.

J. If downstream flood management or bank erosion is a concern, consider conducting a watershed study to determine the most appropriate location and design of stormwater management structures, including consideration of potential downstream impacts on farming practices and other land uses.

K. For wet detention ponds with surface area more than 2 acres or where the fetch is greater than 500 feet, consider reinforcing banks, extending the safety shelf, vegetating the safety shelf or other measures to prevent erosion of embankment due to wave action.

L. To prevent failure, consider reinforcing earthen emergency spillways constructed over fill material to protect against erosion.

M. All flow channels draining to the pond should be stable to minimize sediment delivery to the pond.

N. Baffles may be used to artificially lengthen the flow path in the pond. In some designs, a circular flow path is set up in a pond even when the inlet and outlet are next to each other and no baffles are used. Then the flow path can be calculated using the circular path.

O. Consider using low fertilizer inputs on the embankments and collecting the clippings.

P. Consider providing a method to facilitate dewatering during accumulated sediment removal.

Q. Consider using backflow preventers to minimize fish entrapment.

R. Consider providing a terrestrial buffer of 10-15 feet around the pond if it has low or no embankments.

S. Consider a hard surface for the bottom of the forebay to ease sediment removal.

T. Use of algaecides, herbicides or polymers to control nuisance growths or to enhance sedimentation must receive a permit under NR 107, Wis. Adm. Code. Contact the appropriate DNR specialist.

U. Consider additional safety features beyond the safety shelf where conditions warrant them.

V. Consider vegetative buffer strips along drainage ways leading to the detention pond to help filter pollutants.

W. After the site assessment is complete, review and discuss it with the local administering agency at a pre-design conference to determine and agree on appropriate pond design for the site.

X. Design so that the 10-yr., 24-hour design storm does not flow through the emergency spillway. The 10-yr. design criteria protects the embankment from premature failure due to frequent or long-duration flows through the emergency spillway.

Y. Where practical, construct the emergency spillway on original grade.

Z. Conduct a groundwater boring to 15 feet below the pond and consider the historic "mottling marks" in assessing groundwater levels.

AA. For partially or fully submerged inlet pipes, consider using pipe ties or some other method to keep pipes from dislodging during frost movement.

BB. Consider employing a geotechnical engineer if stability of the embankment is a concern and to justify slopes steeper than 2.5:1.

CC. Assess potential environmental hazards at the site from previous land uses. The assessment should use historical information about the site to determine if the potential for environmental hazard exists, e.g., contaminated soils, contaminated groundwater, abandoned dumps or landfills. Contaminated areas can be located by reviewing the Bureau of Remediation and Redevelopment Tracking System (BRRTS), the DNR Registry of Waste Disposal Sites in Wisconsin and the Solid and Hazardous Waste Information System (SHWIMS) available through the WDNR website.

DD. Consider direct and indirect impacts to area wetland hydrology and wetland hydroperiod due to area hydrologic modifications that result from routing wetland source waters through a wet detention pond or releasing the discharge from a wet detention pond directly into a wetland.

EE. Consider conducting more than one test pit or boring per every 2 acres of permanent pool footprint, with a minimum of two per pond, if more are needed to determine the variability of the soil boundary or to identify perched water tables due to clay lenses. For the soils analysis, consider providing information on soil thickness, groundwater indicators—such as soil mottle or redoximorphic features—and occurrence of saturated soil, groundwater or disturbed soil.

FF. Where the soils are fine, consider groundwater monitoring if the groundwater table is less than 10 feet below the bottom of the wet pond because the water table may fluctuate seasonally. Other impacts on the groundwater table elevation may be from seasonal pumping of irrigation wells or the influence of other nearby wells. Monitoring or modeling may be necessary in these situations to identify the groundwater elevation.

GG. For additional guidance on seepage control for embankments, consult sections V.B.1.c and V.B.1.e(2) of NRCS Conservation Practice Standard 378, Pond, particularly if a wet detention pond's embankment is considered to be a dam.

VIII. Plans and Specifications

Plans and specifications shall be prepared in accordance with the criteria of this standard and shall describe the requirements for applying the practice to achieve its intended use. Plans shall specify the materials, construction processes, location, size and elevations of all components of the practice to allow for certification of construction upon completion.

IX. References

Center for Watershed Protection, *Stormwater BMP Design for Cold Climates*, December 1997.

R. Pitt and J. Voorhees, *The Design and Use of Detention Facilities for Stormwater Management Using DETPOND*, 2000.

United States Department of Agriculture, Natural Resources Conservation Service, Conservation Practice Standard 378, *Pond*, July 2001.

United States Department of Agriculture, Natural Resources Conservation Service, *Engineering Field Handbook.*

United States Department of Agriculture, Natural Resources Conservation Service, *Ponds – Planning, Design, Construction*, Agriculture Handbook 590, revised September 1997.

United States Department of Agriculture, Natural Resources Conservation Service, Technical Release 55, *Urban Hydrology for Small Watersheds*.

United States Department of Agriculture, Natural Resources Conservation Service, *Wisconsin Field Office Technical Guide, Section IV.*

United States Department of Commerce, Weather Bureau, *Rainfall Frequency Atlas of the United States, Technical Paper 40*.

University of Wisconsin – Extension, *The Wisconsin Storm Water Manual, Part Four: Wet Detention Basins*, Publication No. G3691-P.

Wisconsin State Legislature, Revisor of Statutes Bureau, *Wisconsin Administrative Code*; for information on the codes of state agencies, including WDNR, see http://www.legis.state.wi.us/rsb/code.htm.

X. Definitions

Approved Model (V.B.2.c) – A computer model that is used to predict pollutant loads from urban lands and has been approved by the applicable regulatory authorities. SLAMM and P8 are examples of models that may be used to verify that a detention pond design meets the desired total suspended solids reduction.

Area of Influence (V.B.2.k.i) – The area of influence of an aerator/fountain is a function of the circular area of impact of the return water and the mixing area of the pump, whichever is greater.

Bedrock (V.A.1.b) – Consolidated rock material and weathered in-place material with > 50%, by volume, larger than 2 mm in size.

Depth of Influence (V.B.2.k.i) – The depth of influence of an aerator/fountain is a function of the impact depth of the return water and the draw depth of the pump, whichever is greater.

Karst Feature (V.A.1.c) – An area or surficial geologic feature subject to bedrock dissolution so that it is likely to provide a conduit to groundwater. May include caves, enlarged fractures, mine features, exposed bedrock surfaces, sinkholes, springs, seeps, swallets, fracture trace (linear feature, including stream segment, vegetative trend and soil tonal alignment), Karst pond (closed depression in a karst area containing standing water) or Karst fen (marsh formed by plants overgrowing a karst lake or seepage area).

Seasonally high groundwater level (V.A.1.b) – The higher of either the elevation to which the soil is saturated as observed as a free water surface in an unlined hole, or the elevation to which the soil has been seasonally or periodically saturated as indicated by soil color patterns throughout the soil profile.

Appendix A—Calculation of Preliminary Permanent Pool Surface Area for TSS Reduction [1]

Land Use/Description/Management[2]	Total Impervious (%)[3]	80% Minimum Surface Area of the Permanent Pool (% of Watershed Area)	60% Minimum Surface Area of the Permanent Pool (% of Watershed Area)
Residential • < 2.0 units/acre (>1/2 acre lots) (low density • 2.0 - 6.0 units/acre (medium density) • > 6.0 units/acre (high density)	8 - 28 >28 -41 >41 - 68	0.7 0.8 1.0	0.3
Commercial/Office Park/Institutional/Warehouse/Industrial/Manufacturing/Storage[4] (Non-retail related business, multi-storied buildings, large heavily used outdoor parking areas, material storage, or manufacturing operations	<60 60-80 80-90 >90	1.8 2.1 2.4 2.8	0.6
Parks/Open Space/Woodland/Cemeteries	0-12	0.6	0.2
Highways/Freeways (Includes right-of-way area) • Typically grass banks/conveyance • Mixture of grass and curb/gutter • Typically curb/gutter conveyance	<60 60-90 >90	1.4 2.1 2.8	1.0

[1] Multiply the value listed by the watershed area within the category to determine the minimum pond surface area. Prorate for drainage areas with multiple categories due to different land use, management, percent impervious, soil texture, or erosion rates. For example, to achieve an 80% TSS reduction, a 50 acre (residential, 50% imperviousness) x 0.01 (1% of watershed from table) = 0.5 acre + 50 acres (office park, 85% imperviousness) x 0.024 (2.4% of watershed) = 1.2 acre. Therefore 0.5 acre + 1.2 acre = 1.7 acres for the minimum surface area of the permanent pool.

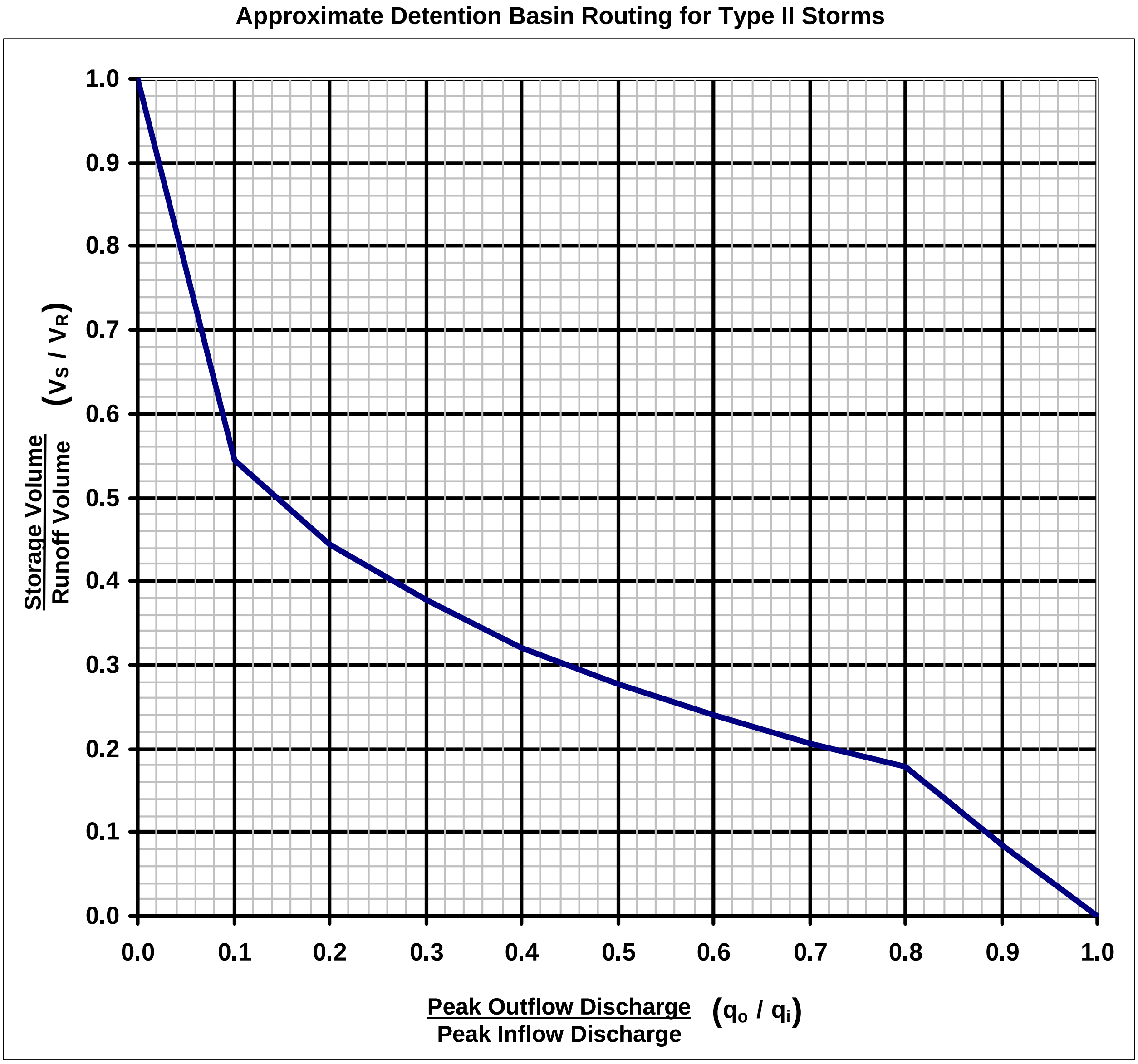
[2] For offsite areas draining to the proposed land use, refer to local municipalities for planned land use and possible institutional arrangements as a regional stormwater plan.

[3] Impervious surfaces include rooftops, parking lots, roads, and similar hard surfaces, including gravel driveways/parking areas.

[4] Category includes insurance offices, government buildings, company headquarters, schools, hospitals, churches, shopping centers, strip malls, power plants, steel mills, cement plants, lumber yards, auto salvage yards, grain elevators, oil tank farms, coal and salt storage areas, slaughter houses, and other outdoor storage or parking areas.

Source: This table was modified from information in "The Design and Use of Detention Facilities for Stormwater Management Using DETPOND" by R. Pitt and J. Voorhees (2000).

Appendix B



Source: Technical Release 55, United States Department of Agriculture, Natural Resources Conservation Service, Washington, D.C. 1986. NRCS Bulletin No. WI-210-8-16 (Sept. 12, 1988) amended the TR-55 routing graph for Type II storms to include flows outside the original range.

Appendix B (cont'd.)

Rainfall Quantities:

Table 2 provides a summary of the 1-year, 24-hour rainfall totals using NRCS mandated TP-40, which has not been updated since 1961. Table 3 provides a summary of more current data from the Rainfall Frequency Atlas of the Midwest published in 1992. Local requirements may dictate the use of one dataset over the other.

Table 2 – Rainfall for Wisconsin Counties for a 1-year, 24-hour Rainfall[1]

Inches of Rainfall	County
2.1 in.	Door, Florence, Forest, Kewaunee, Marinette, Oconto, Vilas
2.2 in.	Ashland, Bayfield, Brown, Calumet, Douglas, Iron, Langlade, Lincoln, Manitowoc, Menominee, Oneida, Outagamie, Price, Shawano, Sheboygan
2.3 in.	Barron, Burnett, Dodge, Fond du Lac, Green Lake, Marathon, Milwaukee, Ozaukee, Portage, Racine, Rusk, Sawyer, Taylor, Washburn, Washington, Waukesha, Waupaca, Waushara, Winnebago, Wood
2.4 in.	Adams, Chippewa, Clark, Columbia, Dane, Dunn, Eau Claire, Jackson, Jefferson, Juneau, Kenosha, Marquette, Pepin, Pierce, Polk, Rock, St. Croix, Walworth
2.5 in.	Buffalo, Green, Iowa, La Crosse, Monroe, Richland, Sauk, Trempealeau, Vernon
2.6 in.	Crawford, Grant, Lafayette

[1]TP – 40: Rainfall Frequency Atlas of the United States, U.S. Department of Commerce Weather Bureau.

Table 3 - Rainfall for Wisconsin Counties for a 1-year, 24-hour Rainfall[2]

Zone	Inches of Rainfall	County
1	2.22	Douglas, Bayfield, Burnett, Washburn, Sawyer, Polk, Barron, Rusk, Chippewa, Eau Claire
2	2.21	Ashland, Iron, Vilas, Price, Oneida, Taylor, Lincoln, Clark, Marathon
3	1.90	Florence, Forest, Marinette, Langlade, Menominee, Oconto, Door, Shawano
4	2.23	St. Croix, Dunn, Pierce, Pepin, Buffalo, Trempealeau, Jackson, La Crosse, Monroe
5	2.15	Wood, Portage, Waupaca, Juneau, Adams, Waushara, Marquette, Green Lake
6	1.96	Outagamie, Brown, Kewaunee, Winnebago, Calumet, Manitowoc, Fond du Lac, Sheboygan
7	2.25	Vernon, Crawford, Richland, Sauk, Grant, Iowa, Lafayette
8	2.25	Columbia, Dodge, Dane, Jefferson, Green, Rock
9	2.18	Ozaukee, Washington, Waukesha, Milwaukee, Walworth, Racine, Kenosha

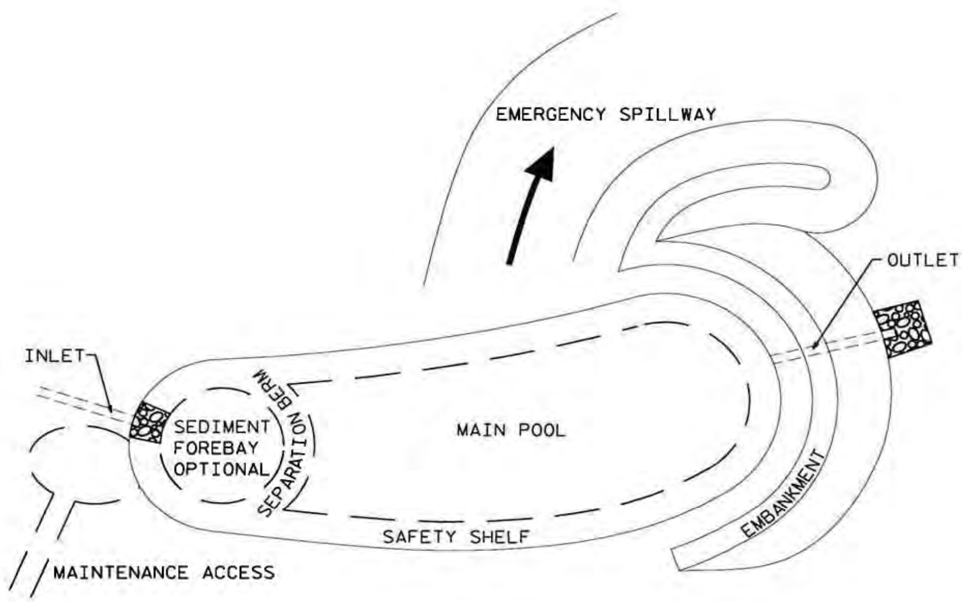
[2]Bulletin 71: Rainfall Frequency Atlas of the Midwest, Midwest Climate Center and Illinois State Water Survey, 1992.

Appendix B (cont'd.)

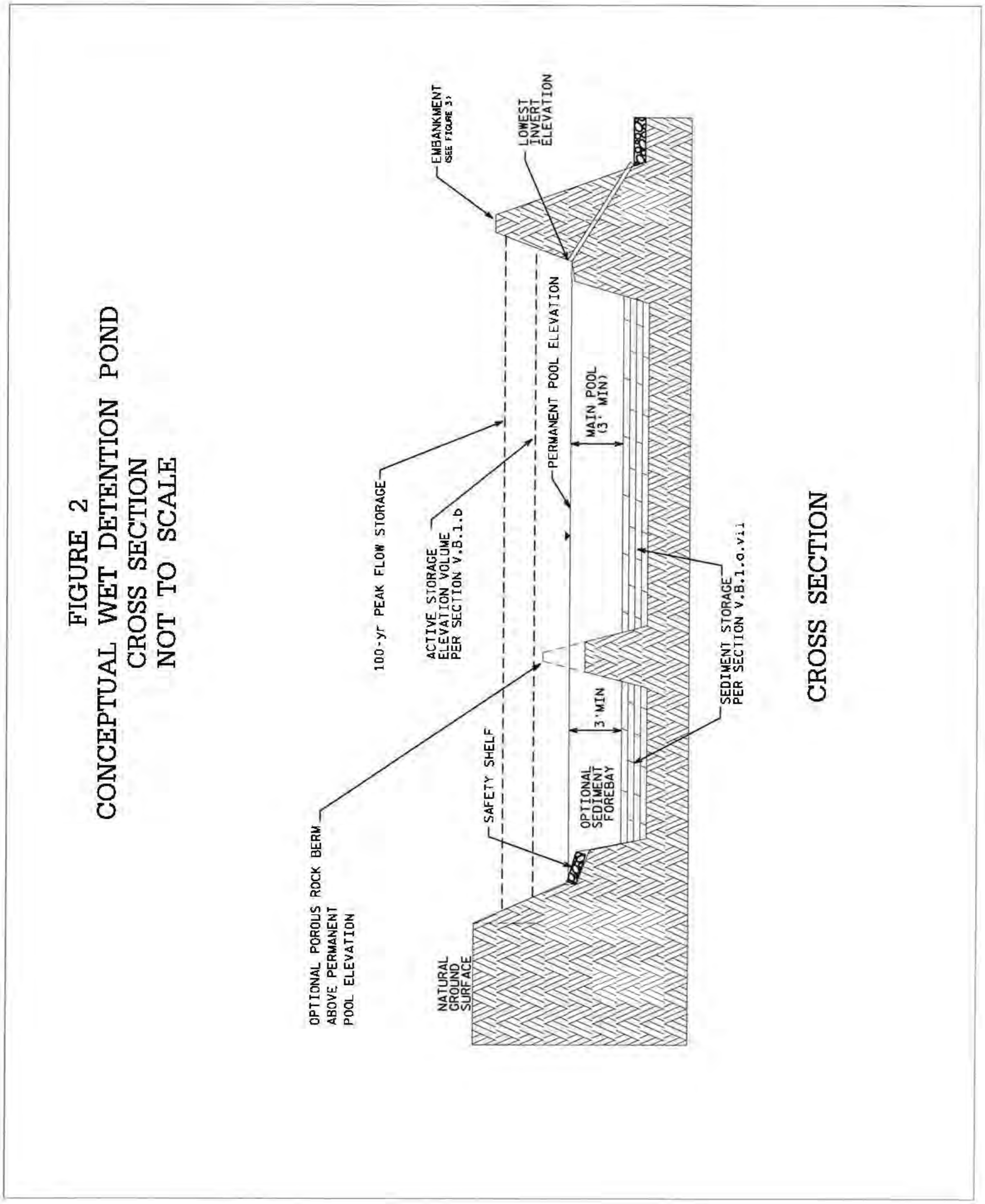
Table 4 – Runoff for Selected Curve Numbers and Rainfall Amounts[1]											
	Runoff Depth in Inches for Curve Number of:										
Rainfall (inches)	50	55	60	65	70	75	80	85	90	95	98
1.9	0.00	0.01	0.04	0.11	0.20	0.33	0.50	0.72	1.01	1.39	1.68
1.96	0.00	0.01	0.05	0.12	0.23	0.36	0.54	0.77	1.06	1.44	1.73
2.1	0.00	0.02	0.08	0.16	0.28	0.43	0.62	0.87	1.18	1.58	1.87
2.15	0.00	0.03	0.09	0.18	0.30	0.46	0.66	0.91	1.22	1.63	1.92
2.18	0.00	0.03	0.10	0.19	0.31	0.47	0.68	0.93	1.25	1.65	1.95
2.2	0.00	0.04	0.10	0.19	0.32	0.48	0.69	0.94	1.27	1.67	1.97
2.21	0.00	0.04	0.10	0.20	0.32	0.49	0.69	0.95	1.28	1.68	1.98
2.22	0.00	0.04	0.10	0.20	0.33	0.49	0.70	0.96	1.28	1.69	1.99
2.23	0.01	0.04	0.11	0.20	0.33	0.50	0.71	0.97	1.29	1.70	2.00
2.25	0.01	0.04	0.11	0.21	0.34	0.51	0.72	0.98	1.31	1.72	2.02
2.3	0.01	0.05	0.12	0.23	0.36	0.54	0.75	1.02	1.35	1.77	2.07
2.4	0.02	0.07	0.15	0.26	0.41	0.59	0.82	1.10	1.44	1.87	2.17
2.5	0.02	0.08	0.17	0.30	0.46	0.65	0.89	1.18	1.53	1.96	2.27
2.6	0.03	0.10	0.20	0.34	0.50	0.71	0.96	1.26	1.62	2.06	2.37
[1]NRCS TR-55, Equations 2-1 to 2-4 used to determine runoff depths.											

Appendix C—Pond Geometry

FIGURE 1
CONCEPTUAL WET DETENTION POND
PLAN VIEW
NOT TO SCALE



Appendix C—Pond Geometry (cont'd.)



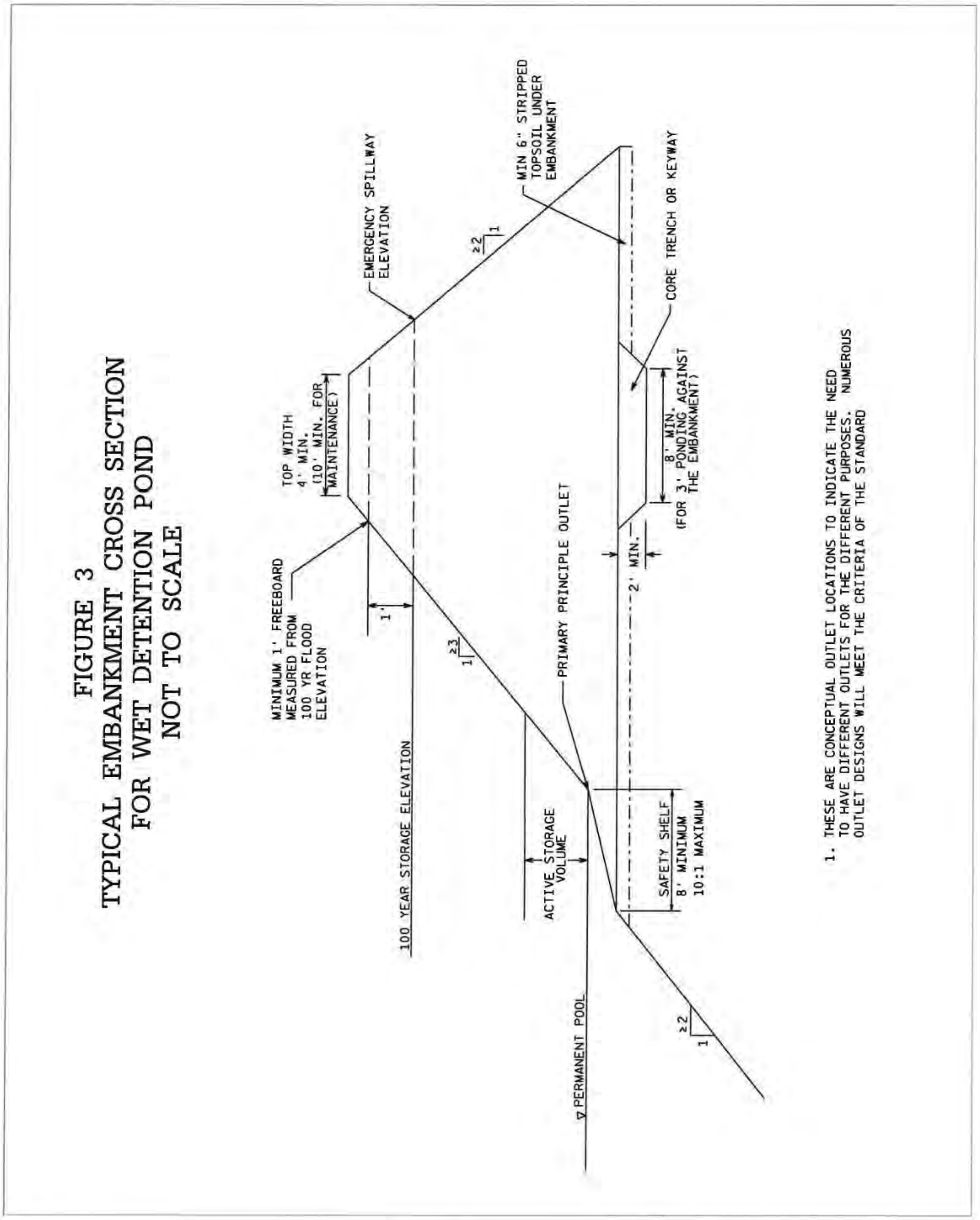


FIGURE 3
TYPICAL EMBANKMENT CROSS SECTION
FOR WET DETENTION POND
NOT TO SCALE
MINIMUM 1' FREEBOARD MEASURED FROM 100 YR FLOOD ELEVATION
TOP WIDTH 4' MIN. (10' MIN. FOR MAINTENANCE)
EMERGENCY SPILLWAY ELEVATION
MIN 6" STRIPPED TOPSOIL UNDER EMBANKMENT
1'
≥3
1
≥2
1
100 YEAR STORAGE ELEVATION
ACTIVE STORAGE VOLUME
PRIMARY PRINCIPLE OUTLET
∇ PERMANENT POOL
SAFETY SHELF
8' MINIMUM
10:1 MAXIMUM
2' MIN.
8' MIN.
(FOR 3' PONDING AGAINST THE EMBANKMENT)
CORE TRENCH OR KEYWAY
1. THESE ARE CONCEPTUAL OUTLET LOCATIONS TO INDICATE THE NEED TO HAVE DIFFERENT OUTLETS FOR THE DIFFERENT PURPOSES. NUMEROUS OUTLET DESIGNS WILL MEET THE CRITERIA OF THE STANDARD

Appendix D—Pond Liner Design, Decision Flowchart

Pond Liner Design Specifications for Three Levels of Liners

A. Type A Liners—for sites with the highest potential for groundwater pollution. They include:
   - Clay (natural soil, not bentonite)
   - High Density Polyethylene (HDPE)
   - Geosynthetic Clay Liners (GCL)

   1. Clay liner criteria (essentially the same as the clay below landfills but not as thick):
      a. 50% fines (200 sieve) or more.
      b. An in-place hydraulic conductivity of 1 x 10^{-7} cm./sec. or less.
      c. Average liquid limit of 25 or greater, with no value less than 20.
      d. Average PI of 12 or more, with no values less than 10.
      e, Clay installed wet of optimum if using standard Proctor, and 2% wet of optimum if using modified Proctor.
      f. Clay compaction and documentation as specified in NRCS Wisconsin Construction Specification 300, Clay Liners.
      g. Minimum thickness of two feet.
      h. Specify method for keeping the pool full or use of composite soils below liner.
   2. HDPE liner criteria:
      a. Minimum thickness shall be 60 mils.
      b. Design according to the criteria in Table 3 of the NRCS 313, Waste Storage Facility technical standard.
      c. Install according to NRCS Wisconsin Construction Specification 202, Polyethylene Geomembrane Lining.
   3. GCL liner criteria:
      a. Design according to the criteria in Table 4 of NRCS 313, Waste Storage Facility technical standard.
      b. Install according to NRCS Wisconsin Construction Specification 203, Geosynthetic Clay Liner.

B. Type B Liners—for sites with medium potential for groundwater pollution or where need for a full pool level is high. They include:
   - All liners meeting Type A criteria
   - Clay
   - HDPE
   - Polyethylene Pond Liner (PPL)

   1. Clay liner criteria:
      a. 50% fines (200 sieve) or more.
      b. An in-place hydraulic conductivity of 1 x 10^{-6} cm./sec. or less.
      c. Average liquid limit value of 16 or greater, with no value less than 14.
      d. Average PI of 7 or more with no values less than 5.
      e. Clay compaction and documentation as specified in NRCS Wisconsin Construction Specification 204, Earthfill for Waste Storage Facilities.
      f. Minimum thickness of two feet.
      g. Specify method for keeping the pool full or use of composite soils below liner.
   2. HDPE liner criteria:
      a. Minimum thickness shall be 40 mils.
      b. All other criteria same as for Type A HDPE liner.
   3. PPL liner criteria:
      a. Minimum thickness shall be 30 mils.
      b. All other criteria same as for Type A HDPE liner.

C. Type C Liners—for sites with little potential for groundwater pollution or where the need for a full pool is less important. They include:
   - All liners meeting Type A or B criteria
   - Silts and clays
   - HDPE (<40 mil)
   - PPL (20-24 mil)
   - PVC (30-40 mil)
   - EPDM (45 mil)

   1. Silt/Clay liner criteria:
      a. 50% fines (200 sieve), or 20% fines and a PI of 7.
      b. Soil compaction and documentation as specified in NRCS Wisconsin Construction Specification 204, Earthfill for Waste Storage Facilities.
      c. Minimum thickness of two feet.
      d. Specify method for keeping the pool full or use of composite soils below liner.

D. Liner Elevation—All liners must extend above the permanent pool up to the elevation reached by the 2-yr., 24-hour storm event.

E. For synthetic liners, follow the manufacturers' recommendations for installation.

Appendix E—Aerators/Fountains

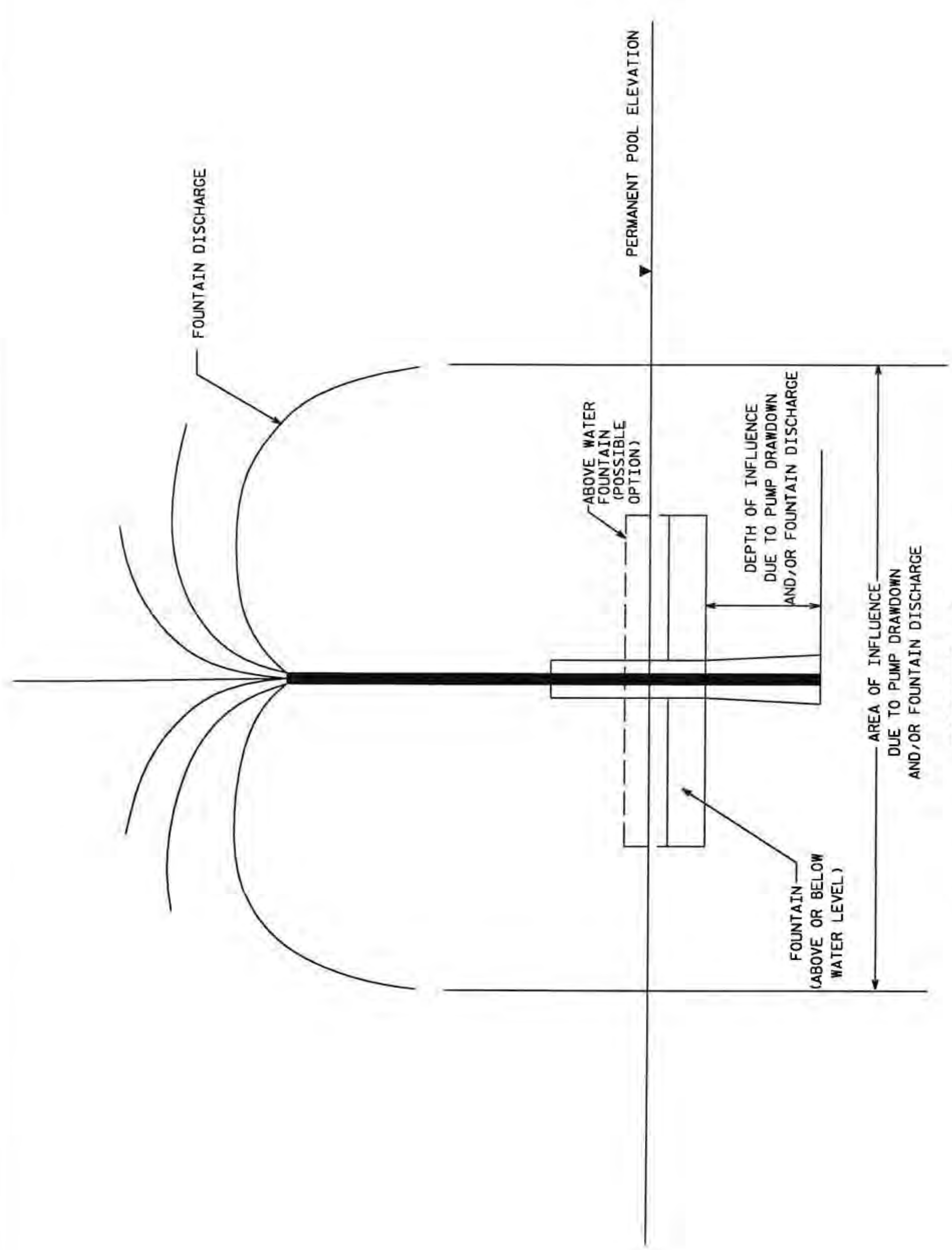


FIGURE 4
AERATORS/FOUNTAIN DETAIL
(NOT TO SCALE)

Wisconsin Total Maximum Daily Loads

TMDLs

WHAT IS A TMDL?
A TMDL is an analysis used to calculate a pollutant budget: sources of the pollutants are identified and then reductions are given to the various sources (municipalities, industries, agriculture) in order to meet water quality standards. Everyone living and working in TMDL watersheds can come together to implement the water quality goals outlined in the TMDL report. The end results are better habitat for fish and aquatic life and increased usage of our waters for swimming and boating.

TMDLs can be expressed through a formula:

WLA + LA + MOS = TMDL

- WLA or Wasteload Allocation refers to the pollutant load from point sources: industrial and municipal treatment plants, municipal stormwater, CAFOs, etc.
- LA or Load Allocation refers to nonpoint sources such as: runoff from residential yards, parking lots, agricultural fields and barnyards.
- MOS or Margin of Safety refers to the level of uncertainty in the analysis.

Cleaner rivers, streams and lakes ensure quality of life benefits, which lead to the desirability to work and live in Wisconsin. Tourists and visitors are attracted to the number of and health of our wonderful water resources.




Putting the TMDL Concept into Perspective

The science behind a TMDL can be mind boggling! For comparison, imagine a TMDL like a budget plan for your family, where you currently spend $2500 on monthly expenses, but are trying to save money for vacation and have to reduce this amount by $500.

Total Maximum Daily Loads FAQ

Why do we need to create TMDLs?

Wisconsin is required by the Clean Water Act to develop TMDLs for all waters on our Impaired Waters List. EPA oversees the federal TMDL program, while Wisconsin is currently granted authority to implement our own program.

What is an "impaired" water?

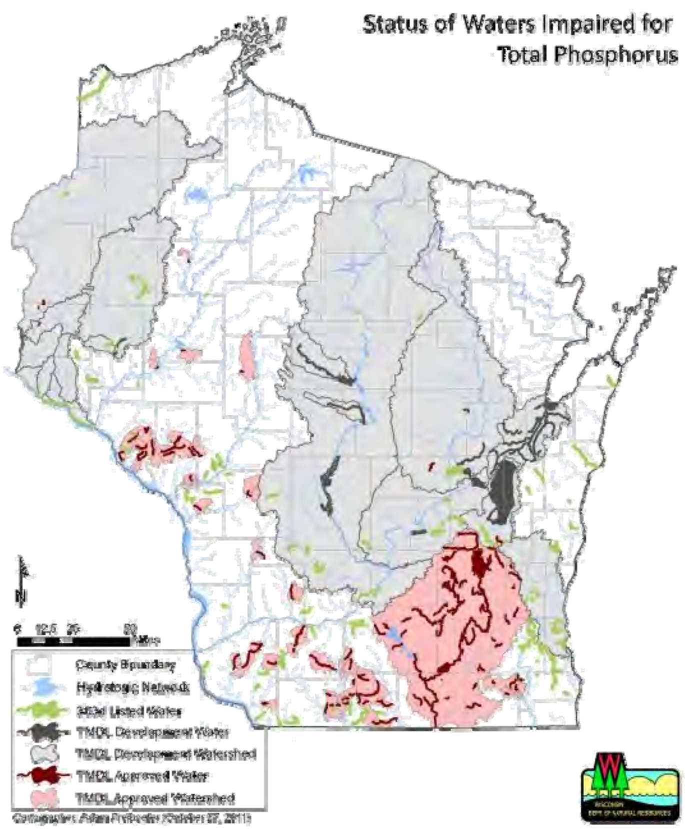
Every 2 years, Wisconsin drafts the Integrated Report which includes the Impaired Waters List. This list (a.k.a. the 303(d) list) includes, rivers, streams and lakes that are not meeting water quality standards or designated uses and submits the list to U.S. EPA for approval.

How many TMDL analyses are supposed to be completed in a year in Wisconsin?

Wisconsin has an agreement with EPA to develop 80 TMDLs per year. EPA develops our pace or the number of TMDL "beans" based on the number of waters on our list, divided on average by 8-13 years. One TMDL is equivalent to one water segment matched with the pollutant of concern (for example, a lake impaired by phosphorus would count for 1 TMDL). Wisconsin developed it's first TMDL in 2000, but has been behind in achieving our goal of 80 because WDNR lacks the proper monitoring data needed to develop TMDLs, especially on more complex watersheds.

Public input is both required and highly recommended. Engaging partners early in the process is essential to move the project forward. Stakeholder involvement during TMDL development and implementation is the key to the success in meeting our water quality goals.

Where are TMDLs currently being developed? (see map)



Do TMDLs create new rules or regulations?

TMDLs do not create new water quality standards or any rules. WDNR uses the current rules in our existing programs to implement TMDLs (NR 217, NR 216, NR 151, etc.).

Are implementation plans a required component of TMDLs?

Implementation plans are not required for TMDLs to be approved by EPA, but they do require a section entitled "reasonable assurance" which provides the public with the understanding that DNR has existing programs that can

For more information visit the WDNR website: http://dnr.wi.gov and search topic "TMDL".

The attached guidance, “*TMDL Development and Implementation Guidance: Integrating the WPDES and Impaired Waters Programs, Edition No. 2*”, was developed for use by Department staff when making decisions related to implementing requirements from USEPA-approved Total Maximum Daily Loads (TMDLs) in Wisconsin Pollutant Discharge Elimination System (WPDES) permits.

Section 303(d) of the Clean Water Act requires states to develop TMDLs to address waterbody impairments. TMDLs include wasteload allocations (WLAs) for point source dischargers, which then must be accounted for in WPDES permits. The attached document, therefore, provides guidance for staff to help them consistently implement WLA-derived limits and related conditions in WPDES permits.

This guidance was developed by a team of TMDL and WPDES program staff from DNR offices around the state over about the last 6 months. Draft guidance has been made available to WPDES staff for their input and the Department is now soliciting comments from external stakeholders as well. Once the 21 day notice period is complete, all comments will be considered, revisions will be made to the guidance as needed, and final guidance will be made available to the appropriate internal and external stakeholders.

Comments related to this draft guidance document should be sent to:
DNRTMDL-WPDESGUIDANCECOMMENTS@wisconsin.gov

BUREAU OF WATER QUALITY
PROGRAM GUIDANCE

WASTEWATER POLICY & MANAGEMENT TEAM
WATER RESOURCES POLICY & MANAGEMENT TEAM

TMDL Development and Implementation Guidance: Integrating the WPDES and Impaired Waters Programs Edition No. 3

November 6, 2013

Guidance Number: 3400-2013-02

This document is intended solely as guidance, and does not contain any mandatory requirements except where requirements found in statute or administrative rule are referenced. This guidance does not establish or affect legal rights or obligations, and is not finally determinative of any of the issues addressed. This guidance does not create any rights enforceable by any party in litigation with the State of Wisconsin or the Department of Natural Resources. Any regulatory decisions made by the Department of Natural Resources in any matter addressed by this guidance will be made by applying the governing statutes and administrative rules to the relevant facts.

APPROVED:

Susan L Sylvester

Susan L. Sylvester
Director, Bureau of Water Quality

November 6, 2013
Date

Table of Contents

1 Introduction

Section 303(d) of the Clean Water Act requires delegated states to determine on a biennial basis whether water bodies are impaired (not meeting designated uses or water quality criteria). One of the underlying goals of the Clean Water Act is to restore all impaired waters so they meet applicable water quality standards. One of the key tools to meet this goal is the development of a total maximum daily load (TMDL). A TMDL is developed after consideration of all sources of pollution to an impaired waterbody and is stated as the amount of a pollutant that the waterbody can assimilate and not exceed water quality standards.. Pollutant loads are determined in consideration of in-water targets that must be met for the waterbody to respond. Targets may be based on promulgated numeric water quality criteria (e.g., dissolved oxygen > 5.0 mg/L; *E. coli* bacteria < 235 cfu/100 ml) or may be based on narrative water quality criteria developed in consideration of local data and/or nearby reference sites.

Once targets are set for a waterbody, the TMDL is established by allocating the allowable load between the point sources (WLA) and the nonpoint sources (LA) with a small amount of the total load set aside as a margin of safety (MOS). Thus, three components make up a TMDL: WLA + LA + MOS.

- The wasteload allocation (WLA) is the total allowable pollutant load from all point sources (e.g. municipal, industrial, CAFOs, MS4 stormwater). Reserve capacity may either be built into the WLA or be a separate component of the total loading capacity to allow for future growth in the watershed.
- The load allocation (LA) is the allowable pollutant load from non-point sources (agricultural, CAFO off-site landspreading, residential runoff, etc.). Natural sources (e.g., runoff from undisturbed areas) are typically covered under the load allocation, and whenever possible NPS loads and natural background loads should be distinguished.
- The margin of safety (MOS) accounts for uncertainty in modeling and calculating WLAs and LAs.

By federal law, TMDLs must be expressed as a daily load. However, a TMDL may also reflect monthly, annual and seasonal loads needed to meet applicable water quality standards. For more information related to TMDL development, including a list of USEPA approved TMDLs, visit: http://dnr.wi.gov/topic/tmdls/. See also section 4.3 on p. 16.

TMDL-WPDES Issues

Federal and state regulations require implementation of TMDLs to meet water quality standards where there are implementation mechanisms (i.e., Wisconsin Pollutant Discharge Elimination System (WPDES) permits in place and supported by law. For point source discharges, WLAs delineated in the TMDL need to be expressed in each permit as a water quality-based effluent limit. In order to address topics related to the implementation of state and federally approved TMDLs in WPDES permits, the "TMDL Implementation Guidance Team" (guidance team) was formed. Based on discussions with regional and central office staff, this guidance team developed a list of issues related to issuing WPDES permits in areas where TMDLs have been approved. The following guidance is intended to address issues related to "traditional" wastewater permits, that is, not stormwater or CAFO permits. Department staff are developing separate TMDL implementation guidance that will address stormwater and CAFO permitting issues.

This guidance document, while comprehensive, is meant to be dynamic - updated as program needs dictate. This is due in part to the experience the WDNR will gain as we implement TMDLs and the guidance in this document. This 2013 edition constitutes the second release of this guidance document. Any guidance written prior to this date is no longer appropriate for use in the TMDL-WPDES implementation program.

Contributors to this document (editions #1 and #2):

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Thanks also to Water Quality and Watershed Management staff statewide, DNR Legal Services staff, and United State Environmental Protection Agency (USEPA) Region 5 (Permits, TMDL, & Legal staff) who shared their questions and comments with the guidance team. Your input was essential to creating a detailed guidance document that will lead to more effective TMDL development and implementation.

Further guidance development is planned to address issues not yet covered by this document. Department staff and others that use this document should contact Water Resources, Wastewater, or Runoff Management PMT members if they wish to suggest issues that may need to be addressed in future revisions or additions to this document.

2 Overarching Issues

Section 2 addresses topics that are related to both the development and implementation of TMDLs in WPDES permits. Subjects such as regulatory authority, processes for implementation, and public input opportunities are covered.

2.1 DNR Authority for Development & Implementation of TMDLs

Section 303(d) of the Clean Water Act requires three steps:

- Identify waters that are impaired (after the application of technology and water quality-based effluent limitations).
- Prioritize waters, taking into consideration the severity of their pollution.
- Establish TMDLs for these waters at levels necessary to meet applicable water quality standards, accounting for seasonal variations and with a margin of safety to reflect lack of certainty about dischargers and water quality.

Under s. 303(e) of the Clean Water Act, states are required to develop plans for all waters. The plans should include, among other things, (1) discharge limits as stringent as the requirements of its water quality standards and (2) TMDLs. USEPA guidance has proposed that states complete TMDLs within 8 to 13 years of listing the waterbody on the s. 303(d) list. As the complexity of TMDLs grows nationwide, USEPA is setting TMDL quotas with the state to help them keep on pace. Wisconsin's TMDL "quota" changes each federal fiscal year (FY), but was 40 TMDLs per year in FY 2013 (TMDLs are counted by stream reach and individual pollutant). This number changes as TMDLs are developed and new waters are listed. Once USEPA approves a TMDL, WPDES permits that are issued or reissued must be consistent with the TMDL WLA.

Wisconsin administrative rules that apply to establishing TMDLs, which along with applicable statutes are summarized in Appendix C. Chapters 283, Wis. Stats., and NR 121, Wis. Adm. Code, specifically address TMDLs and statewide Areawide Water Quality Management Plans (AWQMP. Section 283.83(1)(c), Wis. Stats., requires TMDLs to be included in AWQMPs. Section 283.31(3), Wis. Stats., requires permits to include effluent limitations necessary to avoid exceeding TMDLs established pursuant to s. 283.83(3), Wis. Stats. Section, NR 121.05(1)(e), Wis. Adm. Code, reflects the statute by requiring TMDLs in AWQMPs for each water quality limited segment. Together s. 283.83(3), Wis. Stats., and ch. NR 121, Wis. Adm. Code, establish the procedure to formally approve a TMDL as an amendment to the AWQMP. Chapter NR 212, Wis. Adm. Code, contains requirements for WLAs and corresponding WQBELs for BOD in specific stretches of the Wisconsin and Lower Fox Rivers.

2.2 TMDLs & Areawide Water Quality Management Plans

Areawide Water Quality Management Plans (a.k.a. Basin Plans) are a required part of the Clean Water Act, which is reflected in ch. NR 121, Wis. Adm. Code. The Department updates Areawide Water Quality Management Plans through a continually updated computer database (Waterbody Assessment, Tracking, and Electronic Reporting System (WATERS)). Separate from the plan update process is the plan amendment process. Historically, plan amendments have been used for key management actions with significant regulatory or grant implications. A plan amendment is a specific document that is officially added to the AWQMP plan through public review and approval by the DNR and USEPA. Examples of documents handled this way historically are Priority Watershed Plans and Sewer Service Area Plans. For more details on watershed planning consult http://intranet.dnr.state.wi.us/int/water/wm/wadrs/planning/. TMDL development and implementation may also occur on a smaller scale than the AWQMP for a basin (e.g., HUC-10 or HUC-12 watersheds). The smaller scale watershed TMDLs would also be amended to the original AWQMP.

Once a draft TMDL is reviewed by internal DNR staff and USEPA, a public informational hearing is held to meet the public input expectations of the AWQMP amendment process. The DNR public notices a public comment period of at least 30 days and the date(s) of the public informational hearing. DNR staff review all comments received during the public comment period and information hearing. If significant changes to the TMDL are made during this first step, the TMDL will go through the initial steps of the process again, and be re-submitted for public comment. However, if no significant changes are made, the TMDL is officially approved with the Water Quality Bureau Director's signature, and then submitted to USEPA for their approval.

With USEPA's approval, the TMDL is considered final and automatically updated to the AWQMP pursuant to ch. NR 121, Wis. Adm. Code, as shown in the flow diagram on page 8. Once the TMDL is approved, all issuances and reissuance of WPDES permits for point sources addressed by the TMDL need to be consistent with the WLAs in the TMDL.

The preamble in the Federal Register establishing 40 CFR 130.6 (50 FR 1779) clearly states that when a TMDL is approved by USEPA, the AWQMP are considered automatically updated and approved. Therefore, once a TMDL is approved, the WLAs contained in the TMDL are also incorporated into the federally approved AWQMP.

The steps are as follows (and also reflected in the flow diagram on page 8):

Step 1. Prepare Draft TMDL

Step 2. Internal & USEPA Review; revise TMDL

Step 3. Schedule public informational hearing, prepare Public Notice and Press Release

Step 4. Post TMDL on web, start formal comment period (minimum of 30 days) and hold public informational hearing(s)

Step 5. Receive and respond to public comments

If significant changes are needed to TMDL return to Step 2. If no significant changes move to Step 6.

Step 6. Bureau Director signs TMDL; TMDL is sent to USEPA for approval. [1]

Step 7. USEPA reviews the TMDL.[2] Under 40 CFR 130.7(d)2., USEPA must either approve or disapprove the TMDL. If it is disapproved, USEPA must propose a revised TMDL.

Step 8. Once DNR receives signed approval from USEPA, TMDL is automatically updated as amendment to the AWQMP.

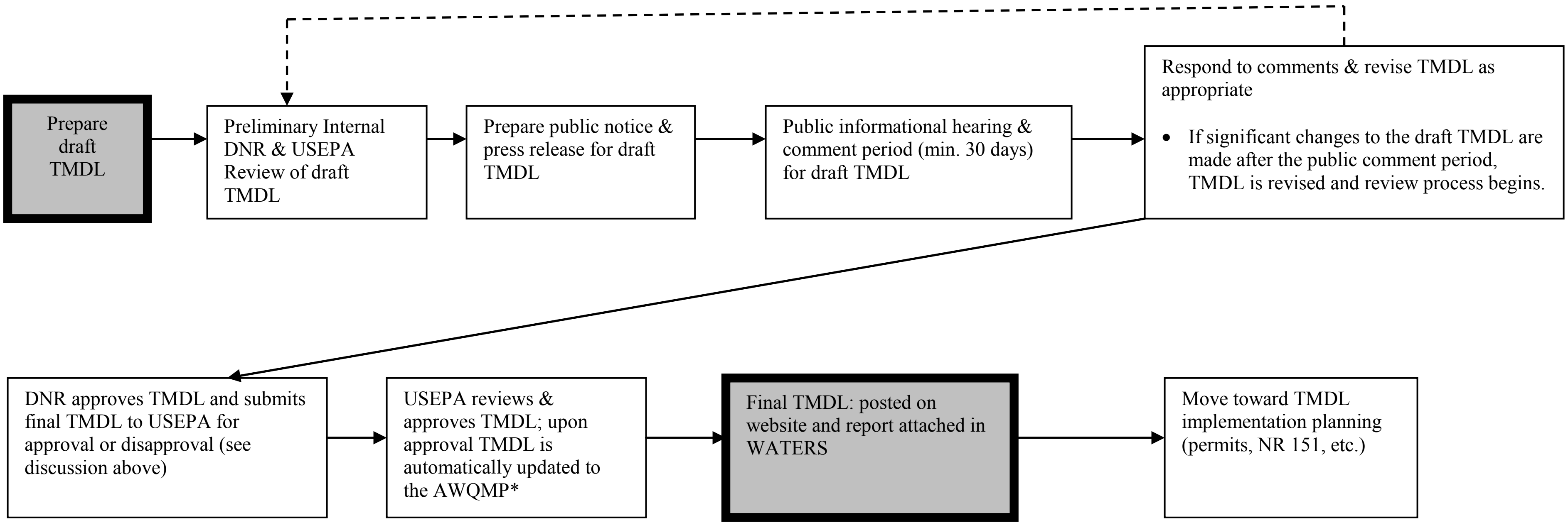
Step 9. TMDL is posted on DNR website as state and federally approved, and updated to the WATERS database.

Step 10. Implementation planning continues.

[1] Constituents questioning when to challenge the state approved TMDL should consult with outside legal counsel or refer the inquiry to DNR legal staff. See also p. 11 for more discussion of this topic.

[2] Affected party may challenge USEPA decision in federal court (5 USC s. 702). If challenge is successful, TMDL comes back to USEPA. USEPA may request state's assistance to help address issues outlined in the court decision.

Process for Approval of a TMDL and amending the Areawide Water Quality Management Plan



The process for amending TMDLs to AWQMPs will be the same for designated and nondesignated areas of the state as outlined in the flow diagram shown on page 8. In designated areas, AWQMPs are prepared by a designated planning agency such as a regional planning commission rather than DNR. Ideally, the planning agency for designated areas of the state will be involved in the development of TMDLs in its area. At a minimum, designated planning agencies will be solicited for participation in creating the draft TMDL.

As mentioned previously, according to federal regulations USEPA must either approve or disapprove the TMDL. If it is disapproved, USEPA must propose a revised TMDL. Should this happen and it is not possible to coordinate AWQMP plan update into USEPA's process, a separate AWQMP process might be necessary.

2.3 TMDLs & the Wisconsin Environmental Policy Act (WEPA)

Chapter NR 150, Wis. Adm. Code, specifies the level of Environmental Analysis and Review for various Department Actions. Section NR 150.03(6)(b)5, addresses adoption and revision of Areawide Water Quality Management Plans. Item d. in that section refers to "Other plan elements that would predetermine future department actions under ss. 281.41 *[plans and specs for WWTP modifications]* and 283.31 *[WPDES permit procedures]*, Wis. Stats., or ch. NR 110.08 (4) which require conformance to the areawide plan." Revising an AWQMP to include any of the elements listed in item d., including TMDLs, is considered to be a Type III action. Type III actions require issuance of a news release or other public notification under ch. NR 150.21,but do not require preparation of an environmental assessment or impact statements.

2.4 The TMDL Development and Implementation Process

The following is a graphic overview of the steps in the TMDL development and implementation process (see the flowchart on page 10). However, issues such as DNR staffing, other competing workloads, etc., may alter this process. DNR can elect to develop joint or separate nonpoint and point TMDL implementation plans and amend them to the AWQMP. WPDES permit recommendations formally amended to the AWQMP must be incorporated into all permits issued in the watershed, according to s. 283.31(3)(e), Wis. Stat. This is a mechanism for settling permit issues that affect multiple dischargers in the watershed.

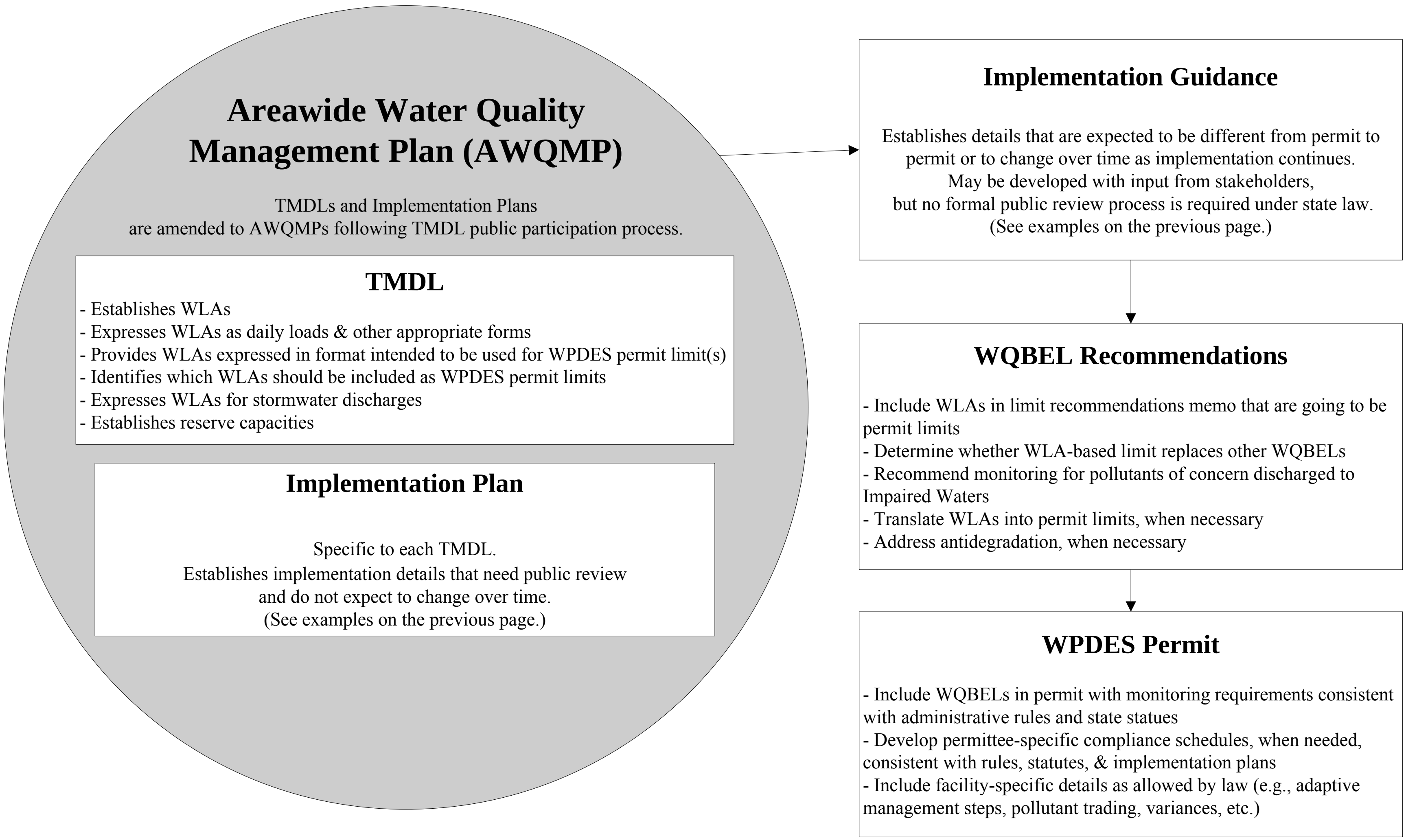
Implementation Plan Examples:

- Justifies permit limits expressed in forms other than daily maximum & monthly/weekly averages
- Describes use of water quality trading framework
- Establishes principles for access to reserve capacity (how it will be allocated, etc.)
- Provides a general timeframe for compliance with WLA consistent with applicable administrative rules
- Indicates whether affected permits will be issued at the same time and, if so, how (e.g., allow some permits to expire/ modify others so all permits may be reissued at once)
- Describe TMDL specific requirement for WPDES regulated landspreading activities
- Provides details on conveyance of general WPDES permit coverages
- Recommends approaches for ensuring WLAs for stormwater are implemented through WPDES permits.

Implementation Guidance Examples (this document is an example):

- Establishes statewide guidance for implementing TMDLs in permits (this document is an example)
- Establishes statewide guidance for water quality trading
- Establishes statewide guidance for watershed permitting
- Establishes statewide guidance for TMDL implementation planning

NOTE: The needs of each TMDL may change how certain steps are implemented.


Areawide Water Quality Management Plan (AWQMP)
TMDLs and Implementation Plans are amended to AWQMPs following TMDL public participation process.
TMDL
- Establishes WLAs
- Expresses WLAs as daily loads & other appropriate forms
- Provides WLAs expressed in format intended to be used for WPDES permit limit(s)
- Identifies which WLAs should be included as WPDES permit limits
- Expresses WLAs for stormwater discharges
- Establishes reserve capacities
Implementation Plan
Specific to each TMDL.
Establishes implementation details that need public review and do not expect to change over time.
(See examples on the previous page.)
Implementation Guidance
Establishes details that are expected to be different from permit to permit or to change over time as implementation continues.
May be developed with input from stakeholders,
but no formal public review process is required under state law.
(See examples on the previous page.)
WQBEL Recommendations
- Include WLAs in limit recommendations memo that are going to be permit limits
- Determine whether WLA-based limit replaces other WQBELs
- Recommend monitoring for pollutants of concern discharged to Impaired Waters
- Translate WLAs into permit limits, when necessary
- Address antidegradation, when necessary
WPDES Permit
- Include WQBELs in permit with monitoring requirements consistent with administrative rules and state statues
- Develop permittee-specific compliance schedules, when needed, consistent with rules, statutes, & implementation plans
- Include facility-specific details as allowed by law (e.g., adaptive management steps, pollutant trading, variances, etc.)

2.5 Including TMDL-derived Limits in WPDES Permits

Once a TMDL has been approved by USEPA, all WPDES permits issued from that point forward must be consistent with the TMDL. See Section 4 for more detailed discussions regarding the expression of TMDL-derived limits in WPDES permits.

2.6 Administrative or Legal Review of TMDL Provisions

Opportunities for administrative and judicial review of TMDLs and implementation plans are available.

- *State Approval of TMDL & Areawide Water Quality Management Plan Amendment*: Affected or interested entities should consult with their own legal counsel regarding the appropriate time and forum for seeking review of a TMDL. It should be noted that a TMDL is not final until USEPA approves it. Once DNR submits its proposed TMDL to USEPA,USEPA must approve or disapprove the TMDL within 30 days (see 40 CFR 130.7(d)2). Refer to the diagram on page 8 that outlines the process for developing TMDLs and incorporating TMDLs into an AWQMP.

- *Federal Approval of TMDL*: The parts of a TMDL that are reviewed and acted on by USEPA may be challenged at the federal level. Provisions that appear in the TMDL but are not mandatory from a federal perspective (e.g. some implementation issues) are not part of USEPA's approval authority and therefore are not subject to federal appeal because, in essence, the federal government will render no opinion on them. USEPA has stated that it reviews the following when reviewing a TMDL:

    - Submittal Letter
    - Identification of watershed, pollutants of concern, pollutant sources and ranking
    - Applicable water quality standards and numeric targets
    - Loading Capacity
    - Load Allocations, Wasteload Allocations and Margin of Safety
    - Seasonal Variation
    - Reasonable Assurances
    - Public Participation
    - Technical Analyses and Supporting Documentation

- *WPDES Permit Issuance/Reissuance*: The permittee or a third party may adjudicate the terms and conditions of a WPDES permit pursuant to section 283.63, Wis. Stats, which states that any permit applicant, permittee, affected state or five or more persons may secure a review by the department of the reasonableness of or necessity for any term or condition of any issued, reissued or modified permit, or any water quality-based effluent limitation established under s. 283.13(5), Wis. Stats. However, all WPDES permits must be consistent with the federally approved TMDL and the AWQMP, including wasteload allocations pursuant to the TMDL.

    TMDL decisions included in the AWQMP amendment (e.g., WLAs specified in the TMDL) may not be challenged under s. 283.63, Wis. Stats., when they are incorporated into a WPDES permit because the public already had an opportunity to challenge those decisions when the TMDL was approved and the AWQMP was amended. Other determinations that were not included in the AWQMP amendment (e.g., the translation of a WLA into an effluent limitation) may be challenged at the time of permit reissuance or modification pursuant to s. 283.63, Wis. Stats.

3 TMDL Development

Section 3 addresses topics associated with the development of TMDLs, as they relate to the implementation of TMDL requirements in WPDES permits. This section is not intended to be a comprehensive guide to TMDL development. (More comprehensive guidance on that subject is being developed elsewhere.) Subjects such as methods for determining wasteload allocations and expressing them in the TMDL are covered here.

3.1 The "Daily" in Total Maximum Daily Load

All allocations (load and wasteload allocations) must be expressed in the TMDL in terms of daily time increments, because of a federal court decision[1]. If consistent with the applicable water quality standard (WQS), allocations may also be expressed as minimum, maximum, or average daily loads. For example, a TMDL for pH may include both minimum and maximum values, which is consistent with how the applicable WQS for the parameter pH is expressed (commonly as a range). Further, allocations may be expressed in terms of differing maximum daily values depending on the season of the year, stream flow (e.g., wet vs. dry weather conditions) or other factors. In certain circumstances, or where the applicable water quality criteria are expressed as a long-term average, it may be appropriate for the TMDL to also include WLAs expressed as weekly, monthly, seasonal, annual, or other appropriate time increments. It is often helpful to express WLAs in ways (in addition to daily) that will be incorporated into WPDES permits. See Section 4.6 for guidance on how to express WLAs as permit limits.

[1] "*Establishing TMDL "Daily" Loads in Light of the Decision by the US Court of Appeals for the D.C. Circuit in Friends of the Earth, Inc. vs. USEPA, et al., No. 05-5015, April 25, 2006, and Implications for NPDES Permits.*" USEPA Memo, Benjamin H. Grumbles, Assistant Administrator, November 15, 2006.

3.2 Determining Allocations for a TMDL

Allocations are based on water quality standards and appropriate flow conditions determined for that waterbody or watershed. If numeric water quality standards do not exist for the pollutant of concern, water quality targets may be based on other existing standards or narrative standards. Water Evaluation Section staff will work with contractors or identified project managers to select allocation methods from those identified by USEPA in the development of draft TMDLs. The chosen procedures should be shared with DNR program staff and technical teams internally and externally, as appropriate.

3.3 Methods Available for Developing WLAs

Methods used for deriving WLAs in TMDLs depend on the scale of the project, size of the watershed, number of permitted entities, and other factors. USEPA's *Technical Support Document for Water Quality-based Toxics Control* (EPA/505/2-90-001, 3/91; http://www.epa.gov/npdes/pubs/owm0264.pdf) lists 19 different allocation schemes for developing WLAs. However, a proportional allocation method is the most popular and, in the absence of detailed cost data, the most equitable method. A proportional allocation method sets allocations proportional to a baseline load. For example, the baseline load for a WPDES permittee could be the current discharge load or permitted discharge load of the pollutant addressed by the TMDL.

3.4 Interim Wasteload Allocations

Interim wasteload allocations are not usually provided in a TMDL. TMDLs have to be written to meet water quality standards. Therefore, the WLA and LA must reflect what is needed to meet the water quality standards addressed by the TMDL.

3.5 TMDL Development & Permitting Workload

In the future, selection of TMDL projects may be based on permitting needs. Currently, however, selection of TMDLs are determined by the amount of data, local interest, and resources available for a particular water body or watershed. If a permittee would like to discharge or increase discharge to an impaired water, a TMDL is needed for the pollutant of concern and the facility must meet the requirements of the TMDL to be allowed to discharge.

4 TMDL-WPDES Implementation

Section 4 addresses topics related to TMDL implementation in WPDES permits. Subjects such as expressing WLAs as permit limits, compliance schedules, variances & adjudications, and others are covered.

4.1 WPDES Permits Must Be Consistent With The TMDL

All WPDES permits must be consistent with point source wasteload allocations (WLAs) included in state and USEPA approved TMDLs . The Department may modify a permit to include TMDL-derived limits or include TMDL-derived limits when the permit is reissued. Department staff should consult the amended Areawide Water Quality Management Plan (AWQMP) and the TMDL implementation plan to determine which permit action is appropriate. Once a TMDL has been approved, however, effluent limits or other requirements consistent with the TMDL must be included in the permits of those point sources addressed by the TMDL.

Alternatively, different permit alternatives (e.g., watershed permitting) could be considered for TMDL implementation. The Department is considering separate guidance for alternate permitting approaches.

4.2 General Permits, Impaired Waters & TMDLs

Since general permits cover facilities in watersheds across the state, there needs to be permit language that requires facilities to implement measures consistent with TMDLs. Proposed permit and fact sheet language is shown below, which can be used in some general permits written for traditional wastewater discharges (not stormwater or CAFO). Permits staff may choose to modify this language, if the standard language below does not seem to apply to certain general permitting situations (e.g., in the case of the pit trench/dewatering general permit, most discharges occur for less than one year) or where the TMDL specifies individual wasteload allocations for general permit holders. More examples of permit language that addresses impaired waters and TMDLs can also be found in recently reissued general permits.

Proposed Permit Language

1.1 Impaired Waters & TMDL Requirements for Surface Water Discharges

1.1.1 Report Discharge to an Impaired Surface Water. The permittee shall report, on the annual discharge monitoring report**,** whether the facility has a detectable pollutant of concern discharge to an impaired surface water on the 303(d) list or a surface water with a State and USEPA approved Total Daily Maximum Load (TMDL) allocation.

Note: The section 303(d) list of Wisconsin impaired surface water bodies may be obtained by contacting the Department or by searching for the section 303(d) list on the Department's Internet site. The Department updates the section 303(d) list approximately every two years. The updated list is effective upon approval by USEPA. The current section 303(d) list can be found here: http://dnr.wi.gov/topic/impairedwaters/.

1.1.2 TMDL Implementation. Facilities discharging a pollutant of concern to an impaired water for which there is an approved Total Maximum Daily Load (TMDL) under this permit must implement treatment/control measures which ensure the discharges of the pollutant of concern meet the applicable WLA in the TMDL. Existing discharges covered under this permit shall comply with any allocation granted to general permit discharges in any State and USEPA approved TMDLs established for the water body receiving the discharge that is in effect on the start date of this permit.

Note: A "pollutant(s) of concern" means a pollutant that is contributing to the impairment of a water body. State and Federal Approved TMDLs can be identified by contacting the Department, or by searching for the State and Federal Approved TMDL list on the Department Internet site. A list of State and Federal Approved TMDLs in Wisconsin can be found here: http://dnr.wi.gov/topic/tmdls/.

1.1.3 New or Increased pollutant discharge to a 303(d) listed impaired surface water. A permittee may not establish a new wastewater discharge of a pollutant of concern to an impaired water body or significantly increase an existing discharge of a pollutant of concern to an impaired water body unless the new or increased discharge does not contribute to the receiving water impairment, or the discharge is consistent with a State and Federal approved total maximum daily load (TMDL) allocation for the impaired water body. Any new or significantly increased pollutant of concern discharge to an impaired surface water authorized under this general permit shall be consistent with the wasteload allocation for general permittees within the basin.

Proposed Fact Sheet Language

Total Daily Maximum Load (TMDL) Implementation. Facilities discharging under this general permit shall comply with the allocation in any State and Federally Approved Total Daily Maximum Load (TMDL) established for the water body receiving the discharge that is in effect on the start date of this permit.

Note: A "pollutant(s) of concern" means a pollutant that is contributing to the impairment of a water body. State and Federal Approved TMDLs can be identified by contacting the Department, or by searching for the State and Federal Approved TMDL list on the Department Internet site. A list of State and Federal Approved TMDLs in Wisconsin can be found here: http://dnr.wi.gov/topic/tmdls/.

New or Increased Discharges. In general, 40 CFR 122.4, prohibits the issuance of a WPDES permit to a new discharger that will contribute to a violation of a water quality standard in a 303(d) listed water. Also, an increased discharge of a pollutant of concern that would cause or contribute to a violation of a water quality standard in a 303(d) listed water is not to be allowed. Therefore, this general permit specifies that a permittee may not establish a new pollutant of concern discharge to a 303(d) listed impaired water body or significantly increase the discharge of a pollutant of concern to an impaired water body unless the new or increased discharge does not contribute to the receiving water impairment, or the new discharge is consistent with a Department finalized total maximum daily load (TMDL) allocation for the impaired water body. Any new or increased pollutant of concern discharge to an impaired surface water authorized under this general permit shall be consistent with the wasteload allocation for general permittees discharging to an impaired receiving water.

This general permit cannot be used if this requirement is not met for a new discharger. For a new operation requesting coverage under this general permit, the Department will evaluate the proposed new pollutant discharge amount and receiving water to determine if the above requirement can be met. A variety of options may be available to insure any proposed new discharger does not contribute to the receiving water impairment such as on-site capture of the pollutant of concern, an alternate discharge location, wastewater reuse opportunities, directing the discharge to a seepage area, enhanced treatment options so the discharge would meet the water quality standard, etc.

If an existing discharger would propose a significant increase in a pollutant of concern discharge to an impaired water body, evaluation of the proposed increase would begin via notification to the Department of a planned change under standard requirement 5.6 of the permit. Upon notification of the proposed increase, the Department would evaluate the proposed increased pollutant discharge amount and receiving water to determine if the discharge change would be within the wasteload allocation to general permittees discharging to the surface water. If necessary, a variety of options may be available to insure any proposed increased discharge does not contribute to the receiving water impairment such as on-site capture of the pollutant of concern, an alternate discharge location, wastewater reuse opportunities, directing the discharge to a seepage area, enhanced treatment options so the discharge would meet the water quality standard, etc.

Alternate Permit needed to meet TMDL. If the Department notifies a general permit applicant that the pollutant of concern discharge would not meet the requirements of a state and USEPA approved TMDL allocation, the permittee would need to submit an application for a site specific individual WPDES permit or an alternate general permit that specifies the additional pollutant controls necessary to comply with the TMDL. The alternate permit may require the permittee to submit a proposed TMDL implementation plan to the Department. The proposed TMDL implementation plan shall specify feasible additional management practices, pollution prevention activities, and wastewater treatment improvements that can be implemented to meet the wasteload allocation.

Note: The section 303(d) list of Wisconsin impaired surface water bodies may be obtained by contacting the Department or by searching for the section 303(d) list on the Department's Internet site. The Department updates the section 303(d) list approximately every two years. The updated list is effective upon approval by USEPA. The current section 303(d) list can be found here: http://dnr.wi.gov/topic/impairedwaters/.

Recommendations for Discharges to 303(d) Listed Impaired Surface Waters – If a facility discharges a pollutant of concern to an 303(d) listed impaired water body, the permittee is encouraged to minimize the pollutant discharge as part of an overall state effort to reduce the pollutant loading to the water body. Wisconsin water impairments are primarily due to excessive sediment, phosphorus and mercury levels which are normally very low or non-detectable in wastewater discharges.

Since the 303(d) impaired waters list is updated every 2 years, the permittee is encouraged to check in the third year of the permit term whether the permittee discharges wastewater to a section 303(d) listed impaired water body. If so, the permittee is encouraged to evaluate whether additional control measures and practices could be used to voluntarily minimize, with the goal of elimination, the discharge of pollutant(s) of concern that contribute to the impairment of the water body. The permittee should keep a record of the amount of pollutant discharge reduction that has been voluntarily achieved. The exact amount of pollutant reduction needed will be legally established in the State and Federal Approved Total Daily Maximum Load (TMDL) allocation established for the discharge.

4.3 Finding Information About Approved TMDLs

There are four ways to determine if a TMDL has been approved for a particular waterbody:

- DNR web site
- WATERS (Water Assessment, Tracking & Electronic Reporting System)
- WT Webviewer (Intranet Surface Water Data Viewer)
- EPA's Assessment TMDL Tracking and Implementation System (ATTAINS) web site.

Instructions on how to access TMDL information using these sources are included in Appendix A.

WLAs from approved TMDLs can be obtained by downloading the TMDL reports from the DNR web site, WATERS, or USEPA's Assessment TMDL Tracking and Implementation System (ATTAINS) web site. Instructions on how to access WLAs using these data sources are included in Appendix A.

4.4 Finding Information About Impaired Waters

Impaired waters information may be accessed in three ways:

- DNR web site
- WATERS (Water Assessment, Tracking & Electronic Reporting System)
- WT Webviewer (Intranet Surface Water Data Viewer)

Instructions on how to access impaired waters information using these sources are given in Appendix B.

4.5 Finding Information About Implementation of a TMDL

Information pertaining to TMDL implementation may appear in any of 4 locations:

- The TMDL itself,
- NR 217.16 for phosphorus
- The amended AWQMP, or
- The implementation guidance.

Generally, TMDL implementation information will be organized as follows:

- Those issues which require USEPA approval will appear in the TMDL. (Refer to p. 11 for a list of items that USEPA reviews.)
- Additional implementation detail may be included in the amended AWQMP when implementation affects multiple WPDES permits.
- Guidance on implementation issues where the flexibility to adjust to changing conditions and science will be needed should be established in a DNR guidance document (such as this document).

4.6 Expression of TMDL-derived Effluent Limits in WPDES Permits

In general, wasteload allocations (WLAs) specified in approved TMDLs are to be expressed in WPDES permits as water quality-based effluent limits (WQBELs) [40 CFR 122.44 (d)(1)(vii)(B) and s. 283.31(3)(d), Wis. Stats.]. Limit calculators should include applicable TMDL-derived WQBELs in their recommendation memos for WPDES permit issuance and facility planning. In cases where local conditions are not adequately addressed by a TMDL-derived WQBEL, more stringent limitations based on other WQBEL procedures, such as those for phosphorus in NR 217.13, Wis. Adm. Code, may be included in the permit (see Section 4.7 for more information).

Permit limits must be consistent with the assumptions and requirements of the TMDL, but need not be identical to TMDL WLAs [40 CFR 122.44(d)(1)(vii)(B)]. Typically, TMDL WLAs may not be used directly as permit limits for the reasons explained below.

Section 40 CFR 122.45 (d) specifies that unless impracticable, permit effluent limits must be expressed as weekly and monthly averages for publicly owned treatment works and as daily maximums and monthly averages for all other continuous discharges. A continuous discharge is a discharge which occurs without interruption throughout the operating hours of the facility, except for infrequent shutdowns for maintenance, process changes, or other similar activities (40 CFR 122.2). Expression of TMDL-derived effluent limits for non-continuous discharges are discussed at the end of this section (see page 31).

For continuous discharges, unless determined to be impracticable, permit limits derived from TMDL WLAs need to be expressed as specified by 40 CFR 122.45 (d). Justifications of impracticability may be made case-by-case and included in the permit's fact sheet, or may be made for a category of discharges. As an example of the latter, the Department has demonstrated the impracticability of expressing WQBELs for total phosphorus (TP) as specified by 40 CFR 122.45 (d). The following table is taken from the phosphorus limit impracticability demonstration and indicates how WQBELs for TP shall be expressed in WPDES permits, according to that demonstration.

Table 1. Expression of WQBELs for Total Phosphorus in WPDES Permits

Total Phosphorus WQBEL	Rivers and streams, and impoundments, lakes and reservoirs with average water residence times of less than one year	Impoundments, lakes and reservoirs with average water residence times of greater than or equal to one year
Greater than 0.3 mg/L	Express WQBELs as a monthly average	Express WQBELs as a monthly average
Less than or equal to 0.3 mg/L	With the exceptions addressed below[1,2], express WQBELs as a six-month average (May 1 – Oct 31 and Nov 1 –April 30) and a monthly average limit of 3 times the calculated concentration limit in ss. NR 217.13 and NR 217.14.	With the exceptions addressed below[1,2], express WQBELs as a six-month average (May 1 – Oct 31 and Nov 1 –April 30) <u>or</u> as an annual average, and a monthly average limit of 3 times the calculated concentration limit in ss. NR 217.13 and NR 217.14

[1] Atypical or uncommon situations will be addressed on a case-by-case basis. These include discharges to small inland lakes with water residence times of less than one year where it is possible that a six month averaging period may not be appropriate and a monthly average limit calculated under ss. NR 217.13 and NR 217.14 may instead be necessary.

[2] For approved TMDLs, the expression of limits must be consistent with the assumptions and requirements of the TMDL, but not greater than the periods expressed above.

Different TMDLs may express WLAs for point sources differently. For example, in addition to the required daily loads, the Lower Fox River and Red Cedar TMDLs include WLAs expressed as annual loads, while the Rock River TMDL includes WLAs expressed as monthly loads. The St. Croix TMDL WLAs include a combination of individual and aggregate WLAs. These TMDLs are used below as examples of how staff may derive permit effluent limits from WLAs. Other TMDLs which have WLAs expressed as either annual or monthly loads can follow the relevant example for converting WLAs into permit limits.

There may be methods other than those described in this guidance that are more appropriate for use in specific situations when deriving effluent limits based on TMDL WLAs. If staff decide that other methods are more appropriate, they should contact the Point Source TMDL Implementation Coordinator (Kari Fleming: kari.fleming@wisconsin.gov), so that these alternate approaches can be documented for future reference and considered during updates to this guidance document. Decisions that are made contrary to the guidance suggested here should also be clearly documented in WQBEL memos and/or permit fact sheets so others can tell why decisions were made.

4.6.1 Lower Fox River TMDL

The Lower Fox River (LFR) TMDL expresses TP and total suspended solids (TSS) WLAs as maximum annual loads (pounds per year) and maximum daily loads (pounds per day). The daily WLA for a point source equals the annual WLA divided by the number of days in the year. The daily WLA is actually an annual average. Since the derivation of daily WLAs from annual WLAs does not take effluent and monitoring variability into consideration, effluent limits set equal to annual and daily WLAs, when the latter is expressed as a daily maximum, are not consistent. That is, if the daily WLA is expressed as a daily maximum effluent limit, the permittee would have to maintain an annual effluent load two to three times less than (more restrictive than) the annual WLA, which is inconsistent with the assumptions and requirements of the TMDL. Therefore, maximum daily TP and TSS WLAs from the Lower Fox River TMDL should not be used directly as permit effluent limits. Neither should maximum annual TP and TSS WLAs from the LFR TMDL be used directly as permit effluent limits, since these limits would be inconsistent with 40 CFR 122.45 (d) and the phosphorus limit impracticability demonstration as discussed above.

Total Phosphorus Limits

For TP, the impracticability demonstration specifies monthly average permit effluent limits when WLAs equate to a TP effluent concentration greater than 0.3 mg/L, and six-month average limits and monthly average limits equal to 3 times the six-month average limits when WLAs equate to a TP effluent concentration equal to or less than 0.3 mg/L. Staff should use the effluent flow specified by s. NR 217.13 (1)(c), Wis. Adm. Code, and the annual WLA for a point source to determine the equivalent effluent concentration. To calculate monthly average and six-month average permit limits, it is recommended that the limit calculator convert the annual WLA to an annual average and multiply the annual average by the multipliers specified in Table 2 on page 22 and the footnotes and information following the table.

For example, Green Bay Metropolitan's Green Bay Facility has an annual average design flow of 49.2 MGD and a maximum annual WLA of 17,349 pounds TP per year.

TP Equivalent Effluent Concentration = 17,349 lbs/yr ÷ (365 days/yr * 49.2 MGD * 8.34) = 0.12 mg/L

Since the equivalent effluent concentration is less than 0.3 mg/L, a six-month average and monthly average permit limit should be derived from the annual WLA. To do so, divide the annual WLA by 365 days per year and multiply the result by 1.11.

TP 6-Month Average Permit Limit = (17,349 lbs/yr ÷ 365 days/yr) * 1.11 = 52.8 lbs/day

The six-month average effluent limit should be expressed in pounds per day and applied to the periods of May 1 through October 31 and November 1 through April 30. A monthly average effluent limit of three times the six-month average effluent limit, or 158 pounds TP per day, should accompany the six-month average effluent limit in the permit.

The multiplier of 1.11 used above was taken from Table 2 on page 22. The effluent monitoring frequency that will be required when the TMDL-derived permit limit is in effect should be used to select the multiplier. A monitoring frequency for TP of daily is specified in the Green Bay Facility's current WPDES permit and is not anticipated to change when the TMDL-derived TP permit limit becomes effective. Therefore, daily monitoring is used to select the multiplier.

To derive permit limits from TMDL WLAs, an estimate of the coefficient of variation (CV) for the regulated parameter once the permittee complies with the limit is necessary. If information on the future effluent variability is available, staff should base the CV on that information. For example, when the variability of measurements of the regulated parameter in the effluent is not likely to change once the permittee complies with the limit, current effluent data may be used to estimate the CV. Lacking information on future effluent variability, the default CV of 0.6 should be used. It is recommended that the following formula be used to calculate the CV for each effluent parameter:

CV = standard deviation of mass effluent data ÷ mean of mass effluent data

Staff should use only those effluent sample results greater than the limit of detection when calculating the CV. If effluent monitoring has been performed for less than one year or there are fewer than 24 effluent sample results greater than the limit of detection, assume a CV of 0.6.

To calculate permit limits using a CV other than 0.6, it is recommended that staff use the equations provided in Table 5-2 of USEPA's TSD. An Excel spreadsheet is also available to derive multipliers for CVs other than 0.6.

As noted above, the CV anticipated to be present when the TMDL-derived TP permit limit is being met should be used to select the multiplier. The CV for the Green Bay Facility's TP discharge currently equals approximately 0.8, but should not be used to select the multiplier. The Department anticipates that the addition of wastewater treatment to achieve the TMDL-derived permit limit will reduce effluent variability with respect to TP. While the Department anticipates that the CV will decrease, it does not have a good estimate of the future CV and, therefore, the default CV of 0.6 is used to select the multiplier. Note that the multiplier from Table 2 for a 6-month average limit with daily monitoring equals 1.11, as used in the above example.

For a second example, the Sherwood Wastewater Treatment Facility has an annual average design flow of 0.259 MGD and a maximum annual WLA of 295 pounds TP per year.

TP Equivalent Effluent Concentration = 295 lbs/yr ÷ (365 days/yr *0.259 MGD *8.34) = 0.37 mg/L

Since the equivalent effluent concentration is greater than 0.3 mg/L, the WLA should be expressed as a monthly average effluent limit as specified in the phosphorus impracticability demonstration. To calculate a monthly average effluent limit for TP, first divide the annual WLA by 365 days per year and then multiply the result by 1.59. Express the monthly average limit in pounds per day.

TP Monthly Average Permit Limit = (295 lbs/yr ÷ 365 days/yr) * 1.59 = 1.29 lbs/day

The multiplier of 1.59 was taken from the Table 2 on page 22. The CV of the Sherwood Wastewater Treatment Facility's mass discharge of TP is approximately 1.0, but is anticipated to decrease with the addition of wastewater treatment necessary to meet the TMDL-derived permit limit. Lacking a better estimate of the future CV, the default CV of 0.6 is used to select the multiplier.

A TP monitoring frequency of twice weekly is specified in the Sherwood Wastewater Treatment Facility's current WPDES permit and is not anticipated to change when the TP permit limit becomes effective. Therefore, twice weekly monitoring is used to select the multiplier to calculate the monthly average permit limit.

Total Suspended Solids Limits

Since the Department has not demonstrated that the application of 40 CFR 122.45 (d) is impracticable with respect to TSS permit effluent limits, limits for TSS should be expressed in permits for continuous discharges as weekly and monthly averages for publicly owned treatment works and as daily maximums and monthly averages for all other point sources.

To calculate monthly average, weekly average, and daily maximum TSS limits for dischargers covered by the LFR TMDL, staff should first divide the maximum annual WLA by 365 days per year and then multiply the result by the multiplier from the Table 2, on page 22. Express all limits in pounds per day.

For example, the Green Bay Metropolitan's Green Bay Facility has an annual WLA of 354,861 pounds TSS per year, a CV for the mass discharge of TSS equal to 0.5, and a permit-required monitoring frequency of daily for TSS.

TSS Monthly Average Permit Limit = (354,861 lbs/yr ÷ 365 days/yr) * 1.23 = 1,196 lbs/day

TSS Weekly Average Permit Limit = (354,861 lbs/yr ÷ 365 days/yr) * 1.52 = 1,478 lbs/day

The current monitoring frequency and CV were used to select the multipliers used above. The daily monitoring frequency is not likely to change once the TMDL-derived permit limits are effective. Similarly, the current CV of 0.5 is not likely to increase when treatment is provided to reduce the discharge of either TP or TSS. Lacking a better estimate of the CV once the TMDL-derived permit limits are in effect, the current value is used. The equations provided in Table 5-2 of USEPA's TSD were used to calculate the multipliers. Note that should the Green Bay Metropolitan Sewerage District demonstrate that the CV will change when additional treatment for either TP or TSS is provided, TSS limits may be recalculated.

For a second example, the Georgia-Pacific, Day Street Mill has an annual WLA of 105,698 pounds TSS per year, a CV for the mass discharge of TSS equal to 0.6, and a permit-required monitoring frequency for TSS of five times per week.

TSS Monthly Average Permit Limit = (105,698 lbs/yr ÷ 365 days/yr) * 1.35 = 391 lbs/day

TSS daily Maximum Permit Limit = (105,698 lbs/yr ÷ 365 days/yr) * 3.11 = 901 lbs/day

The current monitoring frequency and CV were used to derive the multipliers used above. While a monitoring frequency of daily should be considered when the permit is reissued, the monitoring frequency is not changed for this example. The current CV of 0.6 equals the default CV of 0.6. An estimate of the CV once TMDL-derived permit limits are in effect is not available. The multipliers are taken from Table 2, on page 22.

The above guidance for expressing LFR TMDL WLAs as permit limits is based on USEPA's statistical method for deriving water quality-based effluent limits as presented in 5.4 and 5.5 of the *Technical Support Document for Water Quality-based Toxics Control* (EPA/505/2-90-001). Other methods may be used, if deemed appropriate by the Department. Staff should contact the Point Source TMDL Implementation Coordinator (Kari Fleming: kari.fleming@wisconsin.gov) when discussing other approaches.

USEPA's statistical method for permit limit derivation is summarized below in a table of WLA multipliers. Select the appropriate multiplier from the following table using the effluent monitoring frequency for the regulated pollutant that will be in effect once the permit limit for the pollutant becomes effective.

Table 2. Multipliers for Permit Effluent Limits Derived from Annual WLAs Using a Coefficient of Variation (CV) of 0.6

Effluent Monitoring Frequency	6-Month Average Permit Limits	Monthly Average Permit Limits	Weekly Average Permit Limits	Daily Maximum Permit Limits
Daily	1.11	1.28	1.64	3.11
6 Times per Week	1.12	1.32	1.70	3.11
5 Times per Week	1.13	1.35	1.78	3.11
4 Times per Week	1.14	1.40	1.90	3.11
3 Times per Week	1.17	1.47	2.07	3.11
Twice per Week	1.21	1.59	2.37	3.11
Weekly or Less	1.30	1.90	3.11	3.11

Assumptions used in the derivation of the multipliers in the above table include use of the log-normal distribution, equating the long-term average equal to the maximum annual WLA divided by the number of days in the year, a coefficient of variation (CV) of 0.6, and a 99th percentile level (0.01 probability basis). For the Lower Fox TMDL, annual WLAs are calculated from a five-year average of effluent flow for each point source (2003 through 2007), which makes the annual WLA divided by the number of days in a year a good estimate of the long-term average.

EPA's TSD recommends that permit limits be derived using an effluent monitoring frequency of no less than four times per month. Consequently, the above table does not provide multipliers for monitoring frequencies less than weekly. If the permit-required monitoring frequency once the TMDL-derived permit limit is in effect is less than weekly, a multiplier for weekly monitoring should be used to derive the permit limit.

Reducing the monitoring frequency to produce a less restrictive permit effluent limit is discouraged. Monitoring should not be reduced to a frequency less than that specified in the Department's February 2003 draft guidance (W:\TMDL_Implementation\Guidance\WPDES_Guidance\Monitoring Freq.pdf).

Apply the 2003 guidance to both municipal and industrial permits. USEPA's guidance for reducing monitoring frequencies may be used to determine whether a monitoring frequency reduction is appropriate (http://water.epa.gov/scitech/swguidance/standards/criteria/nutrients/upload/Interim-Guidance-for-Performance-Based-Reductions-of-NPDES-Permit-Monitoring-Frequencies.pdf), but reductions should remain within Department guidance.

Although LFR TMDL limits for TSS aren't being expressed as annual limits in the permits, it is recommended that permits require permittees to calculate and report rolling 12-month sums of total monthly loads for TP and TSS. Total monthly loads should be calculated by multiplying the monthly average discharge concentration (mg/L) by the total flow for the month (MG/month) and by the conversion factor of 8.34. Sum the total monthly loads from the most recent twelve months. Rolling 12-month sums may be compared directly to the annual WLA.

During each permit reissuance process subsequent to the effective date of the TMDL-derived permit limit, limit calculators should evaluate whether or not the annual WLA is being achieved. For example, review the rolling 12-month sums reported by the permittee and compare them to the annual WLA. If the annual WLA is not being met, the limits calculator should consider recalculating permit limits in order to make them more restrictive. Calculating a coefficient of variation from effluent data collected following the effective date of the TMDL-derived permit limit, increasing the monitoring frequency, or using a different probability basis should be considered.

4.6.2 Rock River TMDL

The Rock River TMDL (RR TMDL) expresses TP and TSS WLAs as maximum monthly loads in pounds per month for each calendar month and maximum daily loads in pounds per day for each calendar month. The phosphorus limit impracticability demonstration suggests that permit effluent limits for TP should be expressed as monthly average effluent limits when WLAs equate to a TP effluent concentration greater than 0.3 mg/L, and as 6-month average limits and monthly average limits equal to 3 times the 6-month average limits when WLAs equate to a TP effluent concentration equal to or less than 0.3 mg/L. However, the agreement also recommends that the expression of limits be consistent with the assumptions and requirements of the TMDL. Since the RR TMDL expresses TP WLAs as a monthly load for each month of the year, monthly phosphorus limits should be included in permits. Converting monthly WLAs to six-month average permit limits is inconsistent with the assumptions and requirements of the TMDL. Therefore, TP permit limits derived from RR TMDL WLAs for point sources should be expressed only as monthly average limits.

To convert a maximum monthly WLA for phosphorus to a monthly average permit limit, simply divide the WLA by the number of days in the month and express the resulting limit in units of pounds per day. Repeat the calculation for each month of the year since the RR TMDL provides a different WLA for each month.

For example, the August TP WLA for the Edgerton Wastewater Treatment equals 76.27 pounds per month. The August permit limit is calculated below. Remember that monthly average permit limits must be calculated for all twelve months.

TP Monthly Average Permit Limit for August = (76.27 lbs/Aug. ÷ 31 days/Aug.) = 2.46 lbs/day

No exceptions to the above procedures are recommended when the permit contains concentration limits for TP based on s. NR 217.13 and mass limits for TP based on RR TMDL WLAs. Concentration limits must comply with ch. NR 217 and the phosphorus limit impracticability demonstration. Mass limits from the TMDL should follow the above guidance.

Since the Department has not demonstrated that weekly and monthly average limits are impracticable with respect to TSS, effluent limits for TSS should be expressed in permits as weekly and monthly averages for publicly owned treatment works and as daily maximums and monthly averages for all other point sources.

To derive a monthly average TSS permit limit from a monthly WLA, divide the TSS WLA by the number of days in the month and multiply the result by 2,000 pounds per ton to convert the WLA from tons per day to pounds per day. Express the monthly average effluent limit in units of pounds per day. Repeat the calculation for each month of the year since the Rock River TMDL provides a different WLA for each month.

When a daily maximum TSS effluent limit is necessary, the daily WLA from the RR TMDL is used as the permit limit, after converting from tons per day to pounds per day. An attempt was made in the RR TMDL to make monthly and daily WLAs consistent with respect to effluent and monitoring variability using USEPA's statistical method. Therefore, meeting either limit should result in compliance with the other, and neither limit is more restrictive than the other.

When a weekly average permit effluent limit is required for TSS, the limit is derived from the RR TMDL monthly WLA and the appropriate multiplier from Table 3, on page 25. For example, the January TSS WLA for the Arlington Wastewater Treatment Facility equals 0.29 tons. Arlington's permit requires TSS monitoring twice weekly and the current coefficient of variation (CV) of Arlington's mass discharge of TSS is approximately 1.2. The January monthly average permit limit is calculated below.

TSS Monthly Average Permit Limit for January =

(0.29 tons/Jan. * 2,000 lbs/ton) ÷ 31 days/Jan. = 19 lbs/day

To derive a weekly average TSS permit limit, multiply the monthly average TSS effluent limit as calculated above by 1.48, the multiplier specified by Table 3, on page 25, for twice weekly monitoring, and express the limit in units of pounds per day. Repeat the calculation for each month of the year.

For example, using Arlington's January TSS monthly average permit limit of 19 lbs/day as calculated above, the weekly average permit limit for January is calculated below.

TSS Weekly Average Permit Limit for January = 19 lbs/day * 1.48 = 28 lbs/day

The effluent monitoring frequency that will be required when the TMDL-derived TSS permit limit is in effect should be used to select the multiplier. While a more frequent monitoring frequency should be considered when the permit is reissued with TMDL-derived TSS limits, the monitoring frequency is not changed for this example. That is, the multiplier in the above calculation was selected using a monitoring frequency of twice weekly.

The CV anticipated to be present when the TMDL-derived TSS permit limit is being met should be used to select the multiplier. Arlington's current CV of 1.2 should not be used to select the multiplier. The Department anticipates that the addition of treatment to achieve the TMDL-derived permit limit for TP or TSS will reduce effluent variability with respect to TSS. While the Department anticipates that the CV for TSS will decrease, it does not have a good estimate of the future CV and, therefore, the default CV of 0.6 is used to select the multiplier.

For a second example, the May TSS WLA for Grande Cheese in Brownsville equals 0.97 tons per month. Grande's current permit requires TSS monitoring twice per week. Grande's monthly average and daily maximum TSS permit limits for May are calculated below.

TSS Monthly Average Permit Limit for May =
(0.97 tons/May. * 2,000 lbs/ton) ÷ 31 days/May = 63 lbs/day

TSS Daily Maximum Permit Limit for May =
0.07 tons/day * 2,000 lbs/ton = 140 lbs/day

EPA's statistical method for deriving water quality-based effluent limits as presented in 5.4 and 5.5 of the *Technical Support Document for Water Quality-based Toxics Control* (EPA/505/2-90-001) should be used to convert RR TMDL WLAs for TSS to weekly average permit limits. In this guidance, USEPA's statistical method for permit limit derivation from monthly WLAs is summarized in the following table of multipliers. Select the appropriate multiplier from the following table using the effluent monitoring frequency for TSS that will be in effect once the TMDL-derived TSS permit limit becomes effective. A default CV of 0.6 was used to construct the table since the TSS CV that will occur during compliance with TMDL-derived TSS permit limits will not be known in most cases. Multiply the TMDL-derived monthly average limit times the multiplier from the table to calculate week average and daily maximum permit limits.

Table 3. Multipliers for Permit Effluent Limits Derived from Monthly WLAs Using a Coefficient of Variation (CV) of 0.6

Effluent Monitoring Frequency	Weekly Average Permit Limits
Daily	1.28
6 Times per Week	1.29
5 Times per Week	1.32
4 Times per Week	1.36
3 Times per Week	1.41
Twice per Week	1.48
Weekly or Less	1.64

Assumptions used in the derivation of the multipliers in the above table include use of the log-normal distribution, a coefficient of variation (CV) of 0.6, and a 99th percentile level (0.01 probability basis).

To derive weekly TSS permit limits from TMDL monthly WLAs, an estimate of the CV for the regulated parameter or pollutant once the permittee complies with the limit is necessary. If information on future effluent variability is available, staff should base the CV on that information. For example, if the variability of measurements of the regulated parameter or pollutant in the effluent is not likely to change once the permittee complies with the limit, current effluent data may be used to estimate the CV. Lacking information on future effluent variability, the default CV of 0.6 should be used. Use the following formula to calculate the CV:

CV = standard deviation of mass effluent data ÷ mean of mass effluent data

Staff should use only those effluent sample results greater than the limit of detection when calculating the CV. If effluent monitoring has been performed for less than one year or there are fewer than 24 effluent sample results greater than the limit of detection, assume a CV of 0.6.

To calculate multipliers using a CV other than 0.6, it is recommended that staff use the equations provided in Table 5-3 of USEPA's TSD. An Excel spreadsheet is also available to perform the calculations.

In the TSD,USEPA recommends that permit limits should be derived using an effluent monitoring frequency of no less than four times per month. Consequently, the above table does not provide multipliers for monitoring frequencies less than weekly.

Reducing the monitoring frequency to produce a less restrictive permit effluent limit is discouraged. Monitoring should not be reduced to a frequency less than that specified in the DNR's February 2003 draft guidance (W:\TMDL_Implementation\Guidance\WPDES_Guidance\Monitoring Freq.pdf). Apply the 2003 guidance to both municipal and industrial permits. USEPA's guidance for reducing monitoring frequencies may be used to determine whether a monitoring frequency reduction is appropriate (http://water.epa.gov/scitech/swguidance/standards/criteria/nutrients/upload/Interim-Guidance-for-Performance-Based-Reductions-of-NPDES-Permit-Monitoring-Frequencies.pdf), but reductions should remain within Department guidance.

The above guidance for expressing RR TMDL WLAs as permit limits is based on USEPA's statistical method for deriving water quality-based effluent limits as presented in 5.4 and 5.5 of the *Technical Support Document for Water Quality-based Toxics Control* (EPA/505/2-90-001). Other methods may be used, if deemed appropriate by the Department. Staff should contact the Point Source TMDL Implementation Coordinator (Kari Fleming: kari.fleming@wisconsin.gov) when discussing other approaches. Decisions that are made contrary to the guidance suggested here should also be clearly documented in WQBEL memos and/or permit fact sheets so others can tell why decisions were made.

4.6.3 Lake St. Croix TMDL

The Lake St. Croix TMDL was prepared in partnership with the Minnesota Pollution Control Agency, St. Croix Basin Water Resources Planning Team, and Wisconsin Department of Natural Resources. USEPA approved the TMDL on August 8, 2012. A copy of the final TMDL report is available at http://www.pca.state.mn.us/index.php/view-document.html?gid=18417 .

The Lake St. Croix TMDL establishes TP WLAs to meet an in-lake water quality standard of 40 µg/L. The WLAs do not address WQS for tributaries to Lake St. Croix, however. Therefore, in addition to implementing the TMDL, limit calculators should evaluate the need for TP WQBELs to protect the immediate receiving water for discharges to a tributary of Lake St. Croix.

The Lake St. Croix TMDL establishes WLAs for 12 point sources in Wisconsin (see Table 4 on page 28) and an aggregate loading cap for 12 additional Wisconsin point sources (see Table 5 on page 28). The TMDL states that point sources covered by the aggregate loading cap will be deemed as meeting the aggregate

WLA as long as the sum of effluent loads from all 12 point sources remains under the aggregate load cap. According to the TMDL's implementation recommendations, when the total loading from all 12 point sources equals or exceeds 85 percent of the aggregate loading cap, permittees exceeding their individual share of the aggregate loading cap should receive individual WLAs.

Therefore, individual WLAs will not be included initially in the permits of those facilities covered by the TMDL's aggregate loading cap. However, the first permit reissuance after August 8, 2012 should contain requirements for monitoring effluent TP and calculating and reporting monthly TP loads and 12-month rolling sums of monthly TP loads. Monthly loads are calculated using the monthly average TP concentration and the total flow for the month.

Reissued permits for those facilities covered by the TMDL's aggregate loading cap should also include the following reopener clause, which uses the Village of Clayton as an example:

> The Village of Clayton is included in a group of permitted facilities subject to an aggregate phosphorus wasteload allocation of 6932 pounds per year (3151 kg/year) under the Lake St. Croix Total Maximum Daily Load (TMDL) report. Compliance with the wasteload allocation is required upon reissuance. The Village will be considered in compliance with its Lake St. Croix TMDL allocation if the phosphorus discharged from the facility is less than the permittee's individual allocation (528 pounds per year (240 kg/year)) OR the total annual loading from all permittees in the aggregate category is less than the aggregate allocation. For example, if the Village exceeds its individual allocation but the aggregate allocation is not exceeded, the Village is still in compliance with this permit.
>
> **Total Monthly Discharge:** = monthly average concentration (mg/L) x total flow for the month (MG/month) x 8.34.
>
> **Total Annual Discharge** = sum of total monthly discharges for the calendar year.

The Department will total 12-month rolling sums from all 12 facilities covered by the aggregate loading cap. Should the total of 12-month sums exceed 5,904 lbs (i.e., 85 percent of 3,151 kg/yr from Table 5 on page 28), the Department will modify or reissue the permits of those permittees exceeding their individual share of the aggregate loading cap to include TMDL-derived permit limits. (See the guidance below for converting WLAs to permit limits.) After permit modification or reissuance to include individual WLAs, the Department will reduce the aggregate loading cap by an amount equal to the sum of WLAs included in the modified or reissued permits, and continue to track the total of 12-month rolling sums from the remaining permittees covered by the aggregate loading cap.

Table 4. Lake St. Croix TMDL WLAs for Point Sources

Facility	Permit Number	Concentration Assumption (mg/L)	Design Flow (MGD)	WLA (kg/yr)	WLA (lbs/day)
Hudson WWTF	0024279	0.6	3.25	2,694	16.3
River Falls WWTP	0029394	0.6	3.17	2,628	15.9
New Richmond WWTF	0021245	0.6	1.73	1,434	8.7
Osceola, Village of	0025020	1.0	0.750	1,036	6.3
Amery, City of	0020125	1.0	0.535	739	4.5
St. Croix Falls, City of	0020796	1.0	0.496	685	4.1
Hammond	0024171	1.0	0.450	622	3.8
Clear Lake, Village of	0023639	1.0	0.404	558	3.4
Grantsburg, Village of	0060429	1.0	0.380	525	3.2
Somerset WWTF	0030252	1.0	0.375	518	3.1
Luck, Village of	0021482	1.0	0.364	503	3.0
Burnett Dairy Cooperative	0039039	1.0	0.250	345	2.1

Table 5. Facilities Eligible for Lake St. Croix TMDL Aggregate Loading Cap

Facility	Permit Number	Concentration Assumption (mg/L)	Design Flow (MGD)	WLA (kg/yr)	WLA (lbs/day)
Frederic	0029254	3.5	0.185	895	5.4
Star Prairie WWTF	0060984	3.5	0.154	745	4.5
T. Thompson Hatchery	0049191	0.1	2.208	305	1.8
Deer Park WWTF	0025356	3.5	0.051	247	1.5
WI DNR Osceola Fish Hatchery	0004197	0.1	1.77	245	1.5
Clayton, Village of	0036706	2.0	0.087	240	8.7*
Webster, Village of	0028843	2.0	0.085	235	8.5*
Amani Sanitary District	0031861	2.0	0.032	88	3.2*
Advanced Food Products	0039781	0.1	0.401	55	0.3
W DNR St. Croix Falls Hatchery	0004201	0.1	0.344	48	0.3
Lakeside Foods, INC.	0002836	0.1	0.316	44	0.3
Emerald Dairy	0059315	Load estimate		4	0.02
			Aggregate Loading Cap	3,151	18.9

*WLAs for these intermittent dischargers are 6 times greater than WLAs for a continuous discharger. Consequently, the median number of days per year these facilities may discharge TP at a rate equal to the total daily WLA is 61 days.

The Lake St. Croix TMDL expresses WLAs for TP as maximum annual loads (kilograms per year) and maximum daily loads (pounds per day), which equal the maximum annual loads divided by the number of days in the year. Total phosphorus WQBELs for point sources covered by the Lake St. Croix TMDL should be derived in the same manner as permit limits for point sources covered by the Lower Fox River TMDL. That is, consistent with the WI/USEPA impracticability demonstration, TP limits should be expressed as a monthly average when WLAs equate to a TP effluent concentration greater than 0.3 mg/L, and as a six-month average and monthly average equal to 3 times the six-month average limit when WLAs equate to a TP effluent concentration equal to or less than 0.3 mg/L.

To calculate monthly average and six-month average permit limits, multiply the daily WLA from the Lake St. Croix TMDL by the multipliers specified in Table 2 on page 22 and the footnotes and information following the table. Compare the concentration assumption for the point source, as provided by the Lake St. Croix TMDL and presented in Table 4, on page 28, to 0.3 mg/L to determine the appropriate form of the limits.

For example, Table 4 provides a concentration assumption of 0.6 mg/L and a daily WLA of 16.3 lbs/day for the Hudson WWTF. Hudson's current permit requires TP effluent monitoring 5 times per week. The coefficient of variation (CV) for TP effluent data (lbs/day) collected by Hudson during the period from January 1, 2009 through July 31, 2012 equals 0.69.

Since the concentration assumption exceeds 0.3 mg/L, only a monthly average permit limit is calculated. Lacking an estimate of the CV for the period when Hudson complies with the TMDL-derived permit limit, the default CV of 0.6 is used to select the multiplier. To calculate a monthly average effluent limit for TP, multiply Hudson's daily WLA of 16.3 lbs/day by 1.35. (Remember that the daily WLA is the Annual WLA divided by the number of days in the year.) Express the monthly average limit in pounds per day. That is,

TP Monthly Average Permit Limit = 16.3lbs/day * 1.35 = 22.0 lbs/day

For a second example, assume that the total load for all 12 permittees eligible for the aggregate loading cap exceeds 5,904 lbs/year and that Star Prairie WWTF's TP load exceeds the facility's WLA of 745 kg/yr. Table 5 (page 28) provides a concentration assumption of 3.5 mg/L and a daily WLA of 4.5 lbs/day. The current permit requires monthly TP effluent monitoring. The CV for TP effluent data (lbs/day) collected by Star Prairie during 2010 equals 0.78.

Since the concentration assumption exceeds 0.3 mg/L, only a monthly average permit limit is calculated. Lacking an estimate of the CV for the period when Star Prairie complies with the TMDL-derived permit limit, the default CV of 0.6 is used to select the multiplier. To calculate a monthly average effluent limit for TP, multiply Star Prairie's daily WLA of 4.5 lbs/day by 1.90. Express the monthly average limit in pounds per day. That is,

TP Monthly Average Permit Limit = 4.5 lbs/day * 1.90 = 8.55 lbs/day

Since WLAs are expressed as annual loads (kg/yr), permits with TMDL-derived monthly average permit limits should require the permittee to calculate and report rolling 12-month sums of total monthly loads for TP. Total monthly loads should be calculated by multiplying the monthly average discharge concentration (mg/L) by the total flow for the month (MG/month) and by the conversion factor of 8.34. Sum the total monthly loads from the most recent twelve months. Rolling 12-month sums may be compared directly to the annual WLA.

During the permit reissuance process subsequent to the effective date of the TMDL-derived permit limit, limits calculators should evaluate whether or not the annual WLA is being achieved. For example, review the rolling 12-month sums reported by the permittee. If the annual WLA is not being met, the limits calculator should consider recalculating permit limits. Calculating a CV from effluent data collected following the effective date of the TMDL-derived permit limit, increasing the monitoring frequency, or using a probability basis of 95 percent should be considered.

Should TMDL-derived permit limits for any of the three intermittent discharges listed in Table 5 (page 28) become necessary, follow the instructions provided on page 31 for non-continuous discharges.

The above guidance for expressing Lake St. Croix TMDL WLAs as permit limits is based on USEPA's statistical method for deriving water quality-based effluent limits as presented in 5.4 and 5.5 of the *Technical Support Document for Water Quality-based Toxics Control* (EPA/505/2-90-001). Other methods may be used, if deemed appropriate by the Department. Staff should contact the Point Source TMDL Implementation Coordinator (Kari Fleming: kari.fleming@wisconsin.gov) when discussing other approaches. Decisions that are made contrary to the guidance suggested here should also be clearly documented in WQBEL memos and/or permit fact sheets so others can tell why decisions were made.

4.6.4 Tainter Lake and Lake Menomin (Red Cedar River) TMDL

USEPA approved the Tainter Lake/Lake Menomin TMDL in Sept 2012. The TMDL report is located at: http://basineducation.uwex.edu/lowerchip/redcedar/pdf/TainterLake_and_LakeMenominPhosphorus_TMDLsJuly12Draft.pdf.

The Tainter Lake and Lake Menomin (TL/LM) TMDL establishes TP WLAs to reduce the loading to the Lakes by 65 percent. The WLAs do not address water quality standards for tributaries to the Lakes including the Red Cedar River. Therefore, in addition to implementing the TMDL, limit calculators should evaluate the need for TP WQBELs to protect immediate receiving waters.

The TL/LM TMDL expresses WLAs for TP as maximum annual loads (pounds per year) and maximum daily loads (pounds per day), which equal the maximum annual loads divided by the number of days in the year. Total phosphorus WQBELs for point sources covered by the TL/LM TMDL should be derived in the same manner as permit limits for point sources covered by the Lower Fox River TMDL. That is, consistent with the WI/USEPA impracticability demonstration, TP limits should be expressed as a monthly average since the TL/LM TMDL WLAs are derived on an effluent concentration of 1 mg/L or greater.

To calculate monthly average permit limits, multiply the daily WLA from the TL/LM TMDL by the multipliers specified in Table 2 on page 22 and the footnotes and information following the table (Remember that the daily WLA equals the annual WLA divided by the number of days in the year.)

For example, the daily WLA for the Boyceville WWTF equals 1.83 lbs/day. Boyceville's current permit requires weekly TP effluent monitoring. The CV for TP effluent data (lbs/day) collected by Boyceville during the period from October 1, 2009 through September 30, 2012 equals 0.45.

On the assumption that Boyceville is currently complying with the TMDL-derived permit effluent limit, the current CV is used to select the multiplier. The monthly average effluent limit for TP equals Boyceville's daily WLA of 1.83 lbs/day multiplied by 1.64. This multiplier was derived using the spreadsheet for calculating multipliers with CV's other than 0.6. Express the monthly average limit in pounds per day. That is,

TP Monthly Average Permit Limit in lbs/day = 1.83lbs/day * 1.64 = 3.00 lbs/day

Since the 4-day P_{99} of Boyceville's TP discharge equals 1.72 lbs/day, which is less than the TMDL-derived limit of 3.00 lbs/day, the assumption that Boyceville is complying with the WLA-derive effluent limit is correct and use of a CV of 0.45 is appropriate.

Since WLAs are expressed as annual loads (lbs/yr), permits should require permittees to calculate and report rolling 12-month sums of total monthly loads for TP. Total monthly loads should be calculated by multiplying the monthly average discharge concentration (mg/L) by the total flow for the month (MG/month) and by the conversion factor of 8.34. Sum the total monthly loads from the most recent twelve months. Rolling 12-month sums may be compared directly to the annual WLA.

During the permit reissuance process subsequent to the effective date of the TMDL-derived permit limit, limits calculators should evaluate whether or not the annual WLA is being achieved. For example, review the rolling 12-month sums reported by the permittee. If the annual WLA is not being met, the limits calculator should consider recalculating permit limits. Calculating a CV from effluent data collected following the effective date of the TMDL-derived permit limit, increasing the monitoring frequency, or using a probability basis of 95 percent should be considered.

The above guidance for expressing TL/LM TMDL WLAs as permit limits is based on USEPA's statistical method for deriving water quality-based effluent limits as presented in 5.4 and 5.5 of the *Technical Support Document for Water Quality-based Toxics Control* (EPA/505/2-90-001). Other methods may be used, if deemed appropriate by the Department. Staff should contact the Point Source TMDL Implementation Coordinator (Kari Fleming: kari.fleming@wisconsin.gov) when discussing other approaches. Decisions that are made contrary to the guidance suggested here should also be clearly documented in WQBEL memos and/or permit fact sheets so others can tell why decisions were made.

4.6.5 Non-continuous Discharges

Non-continuous discharges are discharges which do not meet the definition of a continuous discharge expressed above on page 18. Methods for converting TMDL WLAs to permit effluent limits for non-continuous discharges should be determined on a case-by-case basis. In practice the most common types of non-continuous discharges that will be encountered fall into these basic categories:

1. Discharges from stabilization ponds and cannery operations which routinely discharge during a limited period of the year.
2. Discharges from industries where interrupted production on weekends results routinely in no discharge for one or two days per week.
3. Discharges from municipal lagoon systems where effluent is held for short periods of time (usually 1-2 months) to avoid non-compliance with BOD_5 or NH_3 limitations.
4. Discharges where market forces dictate whether production occurs (e.g. dairies may choose to landspread whey rather than processing it further).

In all cases the most practical manner of expressing TMDL based limits would be in terms of total mass per reporting period which is consistent with 40 CFR 122.45 (e). For those TMDLs where the WLAs are given on a monthly basis, those would be directly translated into the permit as monthly total mass limits.

For those TMDLs where the WLAs are given on an annual basis, there should be flexibility in determining whether it is practical to have monthly limits in addition to annual limits. For example, facilities where discharge does not occur on weekends but occurs routinely throughout the year, the statistical methods outlined earlier for continuous discharges could be used to translate the annual WLA into a monthly limit. This method could also be considered for seasonal discharges such as can cooling waters where once seasonal production starts, effluent flow rates are continuous until shutdown.

For controlled discharges and other discharges where there is no valid statistical basis for transforming annual WLAs into shorter term limits, limits should be expressed as total annual discharge. Using shorter term limits would have the effect of unduly limiting operational flexibility, and since TMDLs are required to be protective of critical conditions, an annual discharge limit would be consistent with the TMDL and protective of water quality. In the case of phosphorus, if there are local conditions that are not adequately addressed with the WLA-based limit, more stringent limitations based on the procedures in NR 217.13 should be included in the permit.

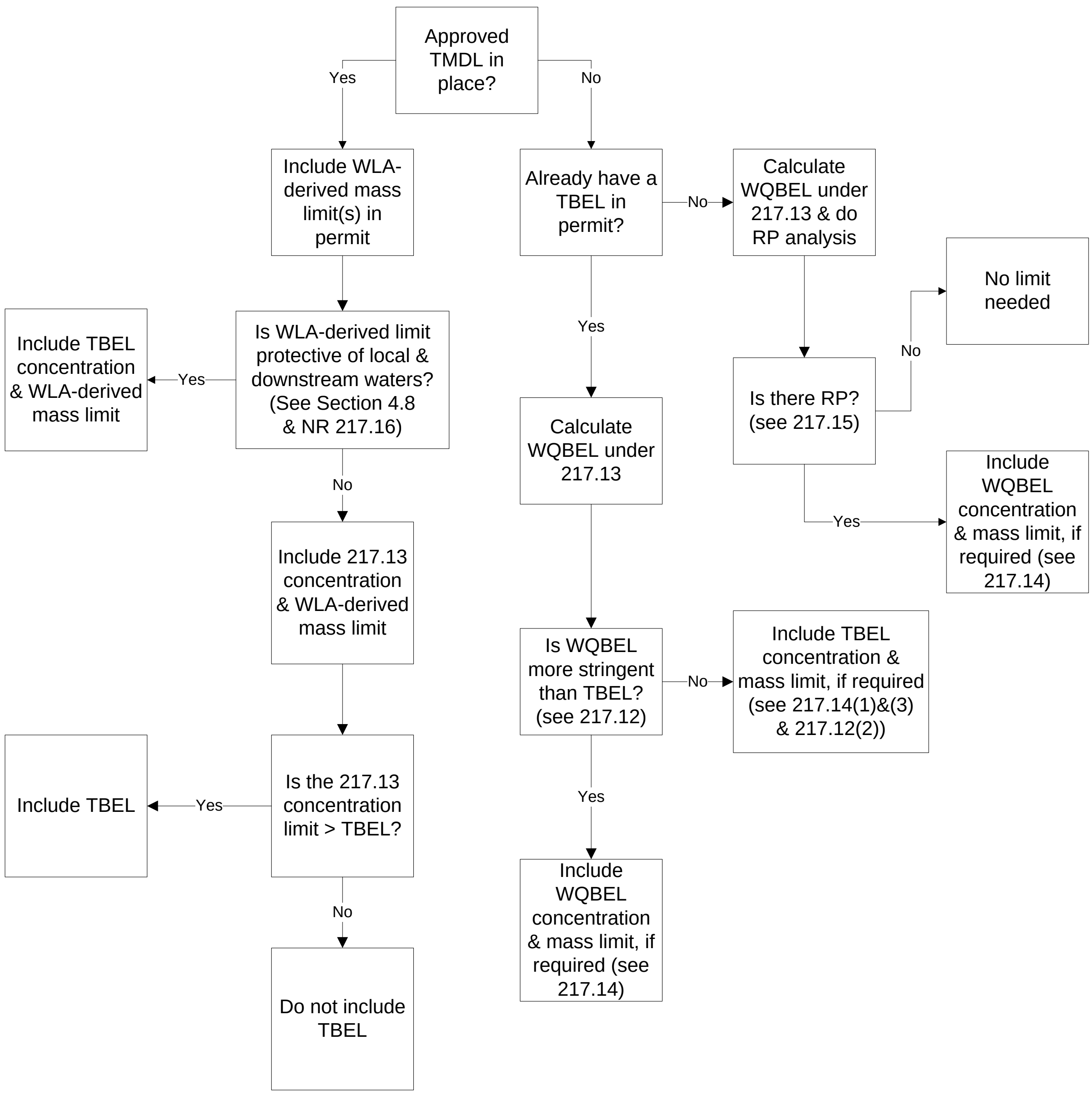
4.7 Relationship of TMDL-derived Limits, other WQBELs, and Technology-based Effluent Limits

Total maximum daily load (TMDL)-derived effluent limits, usually expressed as a mass, must be included in a WPDES permit whenever a facility is given a wasteload allocation in a USEPA approved TMDL, in order to be consistent with the goals of that TMDL. In addition to TMDL-derived mass limits, other WQBELs and/or technology-based limits (TBELs), usually expressed as a concentration, may also need to be included in WPDES permits to ensure protection of local and downstream water quality, and to conform to regulatory requirements for specific pollutants.

If the same parameter is regulated by a TMDL-derived limit and a TBEL, both limits should be included in the permit. When a TMDL-derived limit is given, the permittee must continue to comply with applicable TBELs even if the permittee acquires additional load or wasteload allocation through trades. Conversely, the permittee must also continue to comply with applicable TMDL-derived limits should the TBEL increase due to increased production or expansion of the facility (see ch. NR 217.12 for language that pertains to phosphorus effluent limits expressed as concentrations).

A TMDL-derived limit may replace another WQBEL in a permit. A TMDL-derived limit replaces the non-TMDL WQBEL in the permit if the same parameter is regulated by both limits and the TMDL-derived limit is more restrictive than the non-TMDL WQBEL. If the TMDL-derived WQBEL is less restrictive than the non-TMDL WQBEL already in effect, the less restrictive TMDL-derived limit may replace the non-TMDL WQBEL if the TMDL-derived WQBEL is for the immediate receiving water and then only after antidegradation requirements are met. Specific administrative rule provisions must also be in place to allow this replacement. For example, s. NR 217.16, Wis. Adm. Code, allows the WLA-derived limit to replace the non-TMDL WQBEL under certain circumstances, as shown in Figure 1 below and explained in the next section.

Figure 1. Determining Which Phosphorus Limits Are Needed



4.8 Phosphorus: Comparing NR 217.13 limits to TMDL-based phosphorus limits

There are three types of phosphorus limits that can be included in WPDES permits: phosphorus TBELs (NR 217 Subchapter II, Wis. Adm. Code), phosphorus WQBELs (s. NR 217.13, Wis. Adm. Code), and TMDL-derived phosphorus WQBELs. Some or all of these phosphorus limits may need to be included in WPDES permits upon reissuance. The purpose of this guidance is to help staff determine which phosphorus limits, if any, need to be included in WPDES permits.

Including a TBEL in addition to the TMDL-derived WQBEL
A phosphorus TBEL must be included in a WPDES permit when a TBEL is triggered pursuant to s. NR 217.04(a)(1-6), Wis. Adm. Code, unless a more restrictive s. NR 217.13 WQBEL, which is expressed as a concentration, has taken effect in the permit. An exception may occur when the permittee enters into a water quality trading agreement to demonstrate compliance with a more restrictive s. NR 217.13 WQBEL, however. See applicable water quality trading guidance to determine whether the TBEL remains in the permit in those situations.

A TBEL, which is expressed as a concentration, is not replaced by TMDL-derived WQBELs, which are expressed as a mass. Both the TBEL and the TMDL-derived WQBELs should be included in the permit unless the TBEL is displaced by a more restrictive s. NR 217.13 WQBEL.

Including a TMDL-derived WQBEL
TMDL-derived phosphorus WQBELS *must* be included in WPDES permits whenever a facility is given a phosphorus WLA in a USEPA approved TMDL (s. NR 217.16, Wis. Adm. Code). These TMDL-derived limits are mass limits and are expressed consistently with the TMDL (see Section 4.1 for details).

Including a NR 217.13 WQBEL in addition to the TMDL-derived WQBEL
Section NR 217.16, Wis. Adm. Code, states that the Department may include a TMDL-derived WQBEL for phosphorus in addition to, or in lieu of, a s. NR 217.13 WQBEL in a WPDES permit. If the direct receiving water is the impaired segment covered under a USEPA approved TMDL, or if the TMDL was derived so that local and downstream water quality criteria would be met through TMDL implementation, the WLA-based limit can be included in the WPDES permit absent the s. NR 217.13 WQBEL. This limit should be expressed in a manner consistent with the wasteload allocation and assumptions of the TMDL (see Section 4.1).

Under certain TMDL scenarios facilities may be given WLAs to protect a downstream impaired water, but these WLAs may not be sufficient to protect water quality in the immediate receiving water body segment. In these situations Department staff should use professional judgment to determine whether a s. NR 217.13 WQBEL is necessary. In order to be environmentally protective, it is recommended that both the TMDL-derived limit and s. NR 217.13 WQBEL be included in the permit unless sufficient evidence can justify dropping the latter limit. When deciding whether to use a WLA-based WQBEL as a substitute for the WQBEL calculated under s. NR 217.13, the Department shall consider the following factors (s. NR 217.16(1)(a-c), Wis. Adm. Code):

1. **The degree to which nonpoint sources contribute phosphorus to the impaired water**.

   If the watershed is nonpoint source-dominated, it is likely that TMDL implementation will result in water quality improvement in the direct receiving water because nonpoint sources will be controlled in addition to point sources to meet the water quality goals downstream. If it can be demonstrated that these reductions are sufficient to meet both the local water quality goals and the downstream TMDL targets, a s. NR 217.13 WQBEL may not be necessary in the first two permit terms. This demonstration can be made by the WPDES permit holder or the Department in a TMDL implementation plan. If, on the other hand, the watershed is balanced or point source-dominated, or there is limited dilution, a s. NR 217.13 WQBEL should be included in the permit.

   To determine if the impaired water in question is point or nonpoint source dominated, review the TMDL report or consider running the PRESTO model at the start of the impaired segment. Contact dnrwaterqualitymodeling@wisconsin.gov if you are interested in attaining PRESTO results for a site not currently specified in the PRESTO report- http://dnr.wi.gov/topic/surfacewater/presto.html.

If the Department determines that s. NR 217.13 limits are not necessary, the Department will re-evaluate this decision after every permit term. If after two permit terms, the Department determines the nonpoint source load allocation has not been substantially reduced, the Department may include the s. NR 217.13 WQBEL unless these reductions are likely to occur. A s. NR 217.13 WQBEL will be included in the permit after the third permit term if significant reductions have not been made (s. NR 217.16(2)).

2. Whether waters upstream of the impaired waters are meeting the phosphorus criteria.

If the local phosphorus water quality criterion is attained and/or local water quality goals are met, it may also be feasible to include the TMDL-derived limit absent the s. NR 217.13 limit. In this scenario a TMDL-derived limit will likely be sufficiently protective of both local and downstream water quality because local water quality goals are already being met in the direct receiving water and further water quality improvements will be observed through point and nonpoint source reductions during TMDL implementation. The TMDL-derived limit may be the sole limit included in the WPDES permit regardless if this limit is more or less stringent than the s. NR 217.13 limit.

3. Whether waters downstream of the impaired waters are meeting the phosphorus criteria.

If a TMDL is not protective of downstream water quality, TMDL-derived limits and NR 217.13 limits may be necessary to ensure adequate protection is given to local and downstream water quality. For example, if a TMDL is developed for a river flowing into Lake Michigan and the WLA is protective of the river but not sufficiently protective of the Lake, both TMDL-derived and s. NR 217.13 limits are likely necessary for inclusion in the WPDES permit.

When making this evaluation, thought should be given to whether the applicable criterion in the downstream water is more or less stringent than the criterion of the upstream WLA-approved waterbody. If the TMDL is based on meeting a water quality criterion which is equal to, or more stringent than, the applicable criterion for the downstream water, the s. NR 217.13 WQBEL may not be necessary to protect the downstream water. For example, if an impaired stream flows into a large river, a s. NR 217.13 WQBEL may not be necessary to ensure the protection of the downstream water. If , on the other hand, the TMDL is based on meeting a water quality criterion which is less stringent than the applicable criterion for the downstream water, then inclusion of both the s. NR 217.13 and TMDL-derived WQBELs would be appropriate, particularly if point source loadings are significant. In these cases the Department may also wish to revise the TMDL to adequately protect the downstream water.

4. How far the point source is from the impairment.

If the impaired segment is a significant distance away from the point source in question, that TMDL-derived limit is less likely to be protective of local water quality. Additionally, the likelihood of marginal impairments between the discharge and the impaired segment increases. Therefore, both TMDL-derived WQBELs and s. NR 217.13 limits are recommended in these cases.

The above discussion pertains to facilities that do not use the receiving water body segment as their source of water. If a facility is given a WLA to protect a downstream receiving water and the facility utilizes the receiving water as its water source, it may be necessary to include a s. NR 217.13 WQBEL, expressed as a concentration and mass, in the permit to protect the immediate receiving water.

4.9 Demonstrating Compliance with TMDL-derived Effluent Limits

The following definitions should be used when evaluating compliance with TMDL-derived effluent limits.

Daily discharge means the discharge of a pollutant measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. For pollutants with limits expressed in units of mass, the daily discharge is calculated as the total mass of the pollutant discharged over the day. For pollutants with limits expressed in other units of measurement, the daily discharge is calculated as the average measurement of the pollutant over the day.

Daily maximum effluent limit means the highest allowable daily discharge.

6-Month average effluent limit means the highest allowable average of daily discharges over a specified 6-month period, calculated as the sum of all daily discharges measured during the 6-month period divided by the number of daily discharges measured during that 6-month period. For total phosphorus, 6-month periods are specified as May through October and November through April.

Monthly average effluent limit means the highest allowable average of daily discharges over a calendar month, calculated as the sum of all daily discharges measured during a calendar month divided by the number of daily discharges measured during that month.

Weekly average effluent limit means the highest allowable average of daily discharges over a specified 7-day period, calculated as the sum of all daily discharges measured during the 7-day period divided by the number of daily discharges measured during that 7-day period. For total suspended solid effluent limits derived from TMDL WLAs, the 7-day periods are specified as the first of the month through the seventh, the eighth of the month through the fourteenth, and so on.

The following examples show how compliance with TMDL-derived effluent limits may be demonstrated. In an earlier example (page 19), effluent limits of 52.8 lbs/day 6-month average and 158 lbs/day monthly average were derived from total phosphorus (TP) WLAs for the Green Bay Metropolitan, Green Bay Facility. From Table 6 on page 37 it can be seen that had the effluent limits been in effect during 2011, the Green Bay Facility would have been in compliance with the monthly average effluent limit every month depicted except July. Note that the average mass discharge of TP for a calendar month is compared to the monthly average effluent limit of 158 lbs/day. Since the average of all 184 daily discharge values collected during the 6-month period equals 90 lbs/day, the Green Bay Facility would have been out of compliance with the 6-month average effluent limit of 52.8 lbs/day.

Continuing with this example, effluent limits of 1,196 lbs/day monthly average and 1,478 lbs/day weekly average for TSS were derived from TSS WLAs. From Table 7 on page 38 it can be seen that had TSS effluent limits been in effect during 2011, the Green Bay Facility would have been in compliance with the monthly average limit for the month of September, but not April. Similarly, the Green Bay Facility would have been in compliance with the weekly average limit for the four weekly averaging periods during September, but out of compliance for the four weekly averaging periods during April.

An additional example compares Neenah-Menasha Wastewater Treatment Facility effluent data to TP effluent limits of 19.4 lbs/day 6-month average and 58.2 lbs/day monthly average. From Table 8 on page 39 it can be seen that had the phosphorus limits been in effect during 2011, Neenah-Menasha WWTF would have complied with the monthly average effluent limit every month depicted except May. Since the average of all 120 daily discharge values collected during the 6-month period equals 39 lbs/day, the Green Bay Facility would have been out of compliance with the 6-month average effluent limit.

Table 6. Green Bay Metropolitan, Green Bay Facility 2011 Discharge of Total Phosphorus

Date	May (lbs/day)	June (lbs/day)	July (lbs/day)	August (lbs/day)	September (lbs/day)	October (lbs/day)
1	25	69	44	75	63	60
2	37	61	56	277	189	43
3	66	59	58	120	213	56
4	38	41	37	115	174	45
5	40	26	151	280	111	44
6	39	31	279	173	254	46
7	34	36	139	63	79	38
8	29	29	180	52	79	29
9	50	31	247	52	115	27
10	70	38	237	47	147	29
11	67	64	258	85	157	39
12	72	37	139	40	226	46
13	52	26	107	39	100	47
14	99	38	117	30	65	48
15	38	67	315	32	76	44
16	29	55	140	38	66	50
17	45	30	167	41	62	41
18	32	25	393	40	51	53
19	38	31	303	92	84	168
20	41	30	167	90	85	249
21	52	32	99	51	43	185
22	39	236	71	54	37	159
23	33	187	54	59	43	160
24	46	100	61	51	44	230
25	55	46	167	50	50	124
26	38	43	161	112	48	79
27	56	42	184	190	46	51
28	37	151	215	183	44	49
29	33	52	424	155	41	41
30	27	41	159	69	49	43
31	74	-	66	69	-	132
Monthly Average	46	59	168	91	95	79

Table 7. Green Bay Metropolitan, Green Bay Facility 2011 Discharge of Total Suspended Solids

	April		September	
Date	Daily Discharge (lbs/day)	Weekly Average Discharge (lbs/day)	Daily Discharge (lbs/day)	Weekly Average Discharge (lbs/day)
1	2005		2005	
2	1980		1980	
3	2733		2733	
4	2256		2256	
5	2143		2143	
6	2055		2055	
7	1486	2094	1486	939
8	1671		1671	
9	1548		1548	
10	2593		2593	
11	3471		3471	
12	4883		4883	
13	1678		1678	
14	1255	2443	1255	782
15	1392		1392	
16	3310		3310	
17	2886		2886	
18	2412		2412	
19	2191		2191	
20	1814		1814	
21	4080	2583	4080	767
22	2942		2942	
23	2265		2265	
24	2006		2006	
25	1747		1747	
26	7512		7512	
27	4628		4628	
28	3247	3478	3247	689
29	2138		2138	
30	1905		1905	
Monthly Average	2608		797	

Table 8. Neenah-Menasha Wastewater Treatment Facility 2011 Discharge of Total Phosphorus

Date	May (lbs/day)	June (lbs/day)	July (lbs/day)	August (lbs/day)	September (lbs/day)	October (lbs/day)
1	48	25	29	41	31	35
2	49	25	23	48	39	31
3	37	18	27	40	43	32
4	27	15	31	48	35	25
5	26	14	31	-	42	29
6	-	-	-	-	-	-
7	-	-	-	-	-	-
8	46	12	22	66	36	31
9	122	11	24	59	15	39
10	158	15	39	50	25	46
11	202	11	36	45	42	67
12	213	7	31	72	54	62
13	-	-	-	78	-	-
14	-	-	-	-	-	-
15	26	14	21	58	47	31
16	27	13	20	49	34	27
17	28	11	26	45	21	24
18	24	13	38	53	22	21
19	31	17	34	47	23	51
20	-	-	-	-	-	-
21	-	-	-	-	-	-
22	16	28	24	73	36	21
23	20	97	32	61	41	27
24	23	31	37	42	32	27
25	45	34	25	35	53	27
26	25	25	21	30	92	25
27	-	-	-	-	-	-
28	-	-	-	-	-	-
29	-	-	-	-	-	-
30	-	-	-	-	-	-
31	-	-	-	-	-	-
Monthly Average	60	22	29	52	38	34

4.10 Compliance Schedules

When incorporated into a WPDES discharge permit, a limit that is consistent with the requirements and assumptions of a TMDL WLA becomes a WQBEL, as discussed above in Section 4.6, starting on page 17. At the time of permit reissuance, the Department will evaluate the potential for a discharge to exceed this TMDL-derived WQBEL to determine the need for a compliance schedule. If the WQBEL has the potential to be exceeded, a compliance schedule may be granted for existing facilities to comply with these limits when justifiable (s. 283.13(5), Wis. Stats.).

A compliance schedule may not be included in the permit for a new discharge. Chapters NR 106, NR 207, and NR 217, Wis. Adm. Code, have different definitions of "new discharges" making it necessary to complete a new discharge determination on a case-by-case basis, depending on the pollutant(s) covered under the TMDL. If a date certain is not available in rule for a given pollutant, a new discharge can be defined as a discharge that is issued a WPDES permit on or after the effective date of the TMDL and was not given a WLA under that TMDL.

Procedures for granting and administering a compliance schedule may be specific to the point source type (e.g., wastewater treatment plant, municipal storm water) or specific to the pollutant (e.g., phosphorus in s. NR 217.17, Wis. Adm. Code). Prior to issuing a compliance schedule, the Department must use available information to determine if the schedule of compliance 1) will lead to compliance with the WQBEL as soon as possible, 2) is appropriate and necessary because the permittee cannot immediately achieve compliance with the WQBEL based on existing operation of its treatment facility, and 3) is consistent with a TMDL implementation plan in the AWQMP, if appropriate. The following is a brief summary of compliance schedule requirements:

- The duration of a compliance schedule should be as short as reasonably possible;
- Compliance schedules must include interim steps and may not allow more than one year between compliance dates; and
- If justified, compliance schedules may extend past the expiration date of the permit only when the permit includes both an interim limit effective upon the permit's expiration date and the final effluent limitation, which is advisory in that it does not become effective within the permit's term.

There are many factors the Department can consider when determining the appropriate length of a compliance schedule. These can include the stringency of the limit, the length of time the facility has already had to consider compliance options, and the complexity/cost of the compliance options, among others. For TMDLs that cover multiple pollutants, Department staff will need to evaluate the need for, and appropriate duration of a compliance schedule for each pollutant separately from one another. In these instances, however, the Department may consider the similarities and differences in compliance options for these pollutants. If similar compliance options will likely be used for both pollutants, the Department may wish to coordinate the timing between the compliance schedules.

Example 1: A TMDL is developed to control TP and TSS pollution. A facility needs to install treatment technology to comply with both phosphorus and TSS limits. To avoid the need for separate facility plans and overlapping construction projects, it makes sense to synchronize the compliance dates for TSS and phosphorus in the permit.

Example 2: A TMDL is developed to control TP and TSS pollution. A facility needs to install treatment technology to comply with phosphorus limits, but can optimize treatment to meet the TSS limit. In this case, the compliance schedules should not be synchronized as the TSS limit can be achieved far sooner than the phosphorus limit.

4.11 Reassigning Wasteload Allocations (WLAs)

TMDLs are developed to establish maximum allowable loads for an impaired water body to assure water quality standards will be met. The wasteload allocation (WLA) is the portion of the maximum allowable load allocated to point sources that discharge into that waterbody. For holders of specific WPDES permits, the TMDL will usually enumerate individual WLAs. The individual WLA is used as the basis for effluent limits in the point source's WPDES permit.

According to USEPA guidance, individual WLAs may be adjusted during the WPDES process, so long as the total WLA expressed in the TMDL remains the same or decreases and there is no reallocation between the total WLA and the total load allocation. In other words, individual WLAs may increase or decrease so long as the total WLA expressed in the TMDL (or TMDL reach) is not exceeded. It may be appropriate to adjust/reassign individual WLA to correct allocation errors in the TMDL, to allow discharges and communities to regionalize, or to reassign WLA that becomes available when a facility closes or an outfall is terminated.

Note: for specific BOD allocations established in ch. NR 212, Wis. Adm. Code, the procedures in that chapter must be followed for reallocations or temporary transfers of those WLAs. This guidance is intended to address other reallocations of available WLA not covered by NR 212, Wis. Adm. Code.

The process of reassigning available WLA to municipal and industrial WPDES permit holders with individual WLAs should not be confused with water quality trading or allocating a portion of the reserve capacity. The differences between these approaches are highlighted later on in this Guidance in the paragraphs entitled 'Available WLA vs. Reserve Capacity' and 'Available WLA vs. Trading WLAs', located at the end of this section (see page 46).

Reassigning WLAs to Correct for Allocation Errors
In some cases, the Department may need to reassign WLAs to account for an existing point source that was 'missed' or under-allocated during TMDL development. These sorts of corrections should be made before any available WLA is set aside in reserve capacity or reassigned to other permittees. As mentioned, this WLA adjustment process does not require establishment of a new TMDL, but affected permittees and other interested parties will be notified when these decisions are made. Public notification includes written notification to the affected facilities as well as posting these decisions on the public notice website (http://dnr.wi.gov/topic/wastewater/publicnotices.html) for 30 days.

Reassigning Available WLA to Account for Regionalization
Rather than discharging their effluent directly, some point sources may choose to send their effluent to another point source for further treatment. For example, an industry that previously treated and discharged its own wastewater may decide to connect to a municipal treatment plant for wastewater treatment. Or a smaller municipality may connect to a larger municipality rather than continue to treat its own wastewater. In these cases it is recommended that the available WLA be added to the WLA of the point source that is accepting the additional effluent. This may require permit reissuance of the facility accepting the waste and permit termination of the other. Adjustments to the available WLA may be necessary to accommodate the change in location of the discharge. It should be noted that a reallocation may in some circumstances be considered an increased discharge subject to antidegradation demonstrations, as required by ch. NR 207, Wis. Adm. Code.

Reassigning Available WLA When a Facility Closes or an Outfall is Terminated

Upon closure of a facility and termination of a permit containing TMDL-derived effluent limits, or the reissuance or modification of a permit to remove a surface water outfall, the WLA may be sold by the permittee or reassigned by the Department, when appropriate. The discussion below describes the recommended process for handling available WLA from closed facilities and terminated outfalls. A flow chart is also provided at the end of this section (see page 45), to further illustrate how this process might work.

Note: this section and the supporting flowchart are intended solely as guidance. The process described is intended to apply in most situations, but the Department recognizes that steps may occur in another order or may not be necessary in some situations. For example, a seller (facility terminating discharge) may have already reached an agreement with a potential buyer (another existing or new discharger in the TMDL area) before announcing to the Department that it intends to close its facility. Or, Department staff may decide in some cases that it is more appropriate to terminate the seller's permit at the same time that the buyer's permit is reissued, revoked and reissued, or modified with the adjusted WLA. In any event, all proposed reallocations should be public noticed so that others can be aware of proposed decisions and agreements that have been made. The written notice should, in all cases, describe the status of the facility closure and all proposed reallocations, if agreements have already been reached.

<u>Wasteload Allocation (WLA) Becomes Available</u> (see Steps 1 & 2 in the flowchart)

A WLA may become available in a number of different ways. Most often, the WLA will have been incorporated in a WPDES permit. Before final reassignment of a WLA can occur, the WPDES permit incorporating the WLA must be terminated or modified to eliminate the subject outfall. Termination of the seller's permit or outfall can occur prior to reissuance, revocation and reissuance, or modification of the buyer's permit(s) or these permit actions can occur simultaneously. If the WPDES permit holder wishes to sell their WLA to another facility, the permittee (seller) should notify the Department of this intent. If the permittee fails to notify the Department of the intent to sell the WLA before or with the request for termination, or during the public notice of a permit termination, the available WLA should be rolled into the reserve capacity of the TMDL upon termination of the permit, in order to allow for future growth within the TMDL reach (see 'Contracts Between Buyer(s) and Seller' below).

<u>Public Notification of WLA Availability</u> (see Step 3 in the flowchart)

Upon receiving notification that a closed facility has an available WLA that the company wishes to sell, the Department will notify the availability of WLA in writing to the municipal and industrial WPDES permit holders with individual WLAs in the TMDL, and will also publish this availability on the public notice website (http://dnr.wi.gov/topic/wastewater/publicnotices.html) for at least 120 days. This written notification should include general information about the closed facility and factors that may impact the eligibility of potential buyers. For example, available WLA sales are only permissible if the sale does not create localized exceedances of water quality and does not result in the exceedance of WQBELs for toxicity derived pursuant to ch. NR 106, Wis. Adm. Code, including limits for whole effluent toxicity and limits based on criteria for temperature. Pursuant to 40 CFR 122.41(g) and s. NR 205.07(1)(c), Wis. Adm. Code, a WPDES permit does not convey any property rights of any sort nor any exclusive privilege. While a facility with an assigned WLA may propose to the Department how that WLA should be reallocated based upon an agreement with one or more other facilities within the TMDL, all proposed WLA reallocations within a TMDL are subject to Department review and approval and must be consistent with applicable regulations.

Note: If the seller notifies the Department that it has already reached an agreement with a buyer(s) and does not wish to solicit other interested buyers, and if the Department tentatively approves the need demonstration of the *buyer(s) and proposed reallocation based on the existing agreement(s), the Department will publish notice of the proposed reallocation decision and allow a 30 day comment period before the buyer's permit is modified, revoked and reissued, or reissued to incorporate any reallocation. This 30 day comment period is in addition to (and should not occur simultaneously with) that normally required when the permit is modified, revoked and reissued, or reissued.*

<u>Dischargers Interested in Available WLA</u> (see Step 4 in the flowchart)
Interested dischargers should submit a written notice of interest along with a demonstration of need (see 'Demonstrating Need' below) to the seller and the Department before the public notice period closes. If no eligible WPDES permit holder expresses interest in the available WLA within the 120 day public notice period, the available WLA should be put into the reserve capacity of the TMDL (see 'Contracts Between Buyer(s) and Seller' below).

<u>Demonstrating Need</u> (see Step 5 in the flowchart)
Interested dischargers should not be given available WLA unless they can demonstrate a need for the WLA. Since need must be demonstrated, the Department is anticipating that only current or new WPDES permit holders will be eligible to purchase or receive available WLA. Examples of point sources in need of available WLA include the following:

1. The point source(s) is in need of, or has, a s. 283.15, Wis. Stats, statutory variance for the TMDL-derived limits;
2. The point source(s) is a new discharge or is expanding their current discharge;
3. The point source(s) is unable to meet current WLAs despite optimal operation and maintenance of their treatment facility.
4. The available WLA will be permanently retired or otherwise utilized in an adaptive management plan to work toward compliance pursuant to s. NR 217.18, Wis. Adm. Code;
5. The available WLA will be used in lieu of, or in addition to, water quality trading to achieve compliance with TMDL-derived limits;

The Department should notify those dischargers that indicated interest whether they have made an acceptable demonstration of need. It should be noted that a reallocation may in some circumstances be considered an increased discharge that is subject to antidegradation demonstrations, as required by ch. NR 207, Wis. Adm. Code.

<u>Determining Appropriate Amount of WLA Available</u> (see Step 6 in the flowchart)
Although the full WLA is available for one or multiple WPDES permit holders to acquire, adjustments may need to be made in some cases when applying the additional WLA to permit limits, in order to protect water quality and to conform to the requirements of the TMDL. If adjustments are not necessary, the entire WLA amount may be applied when deriving WLA-based permit limits for that facility. Adjustments may be necessary if:

- The buyer is upstream of the seller;
- The buyer and seller are not in the same TMDL reach;
- The buyer and seller are not discharging the same form of the pollutant;
- The buyer and seller are not discharging at the same time; or
- Other factors, as necessary to ensure protection of local and downstream water quality.

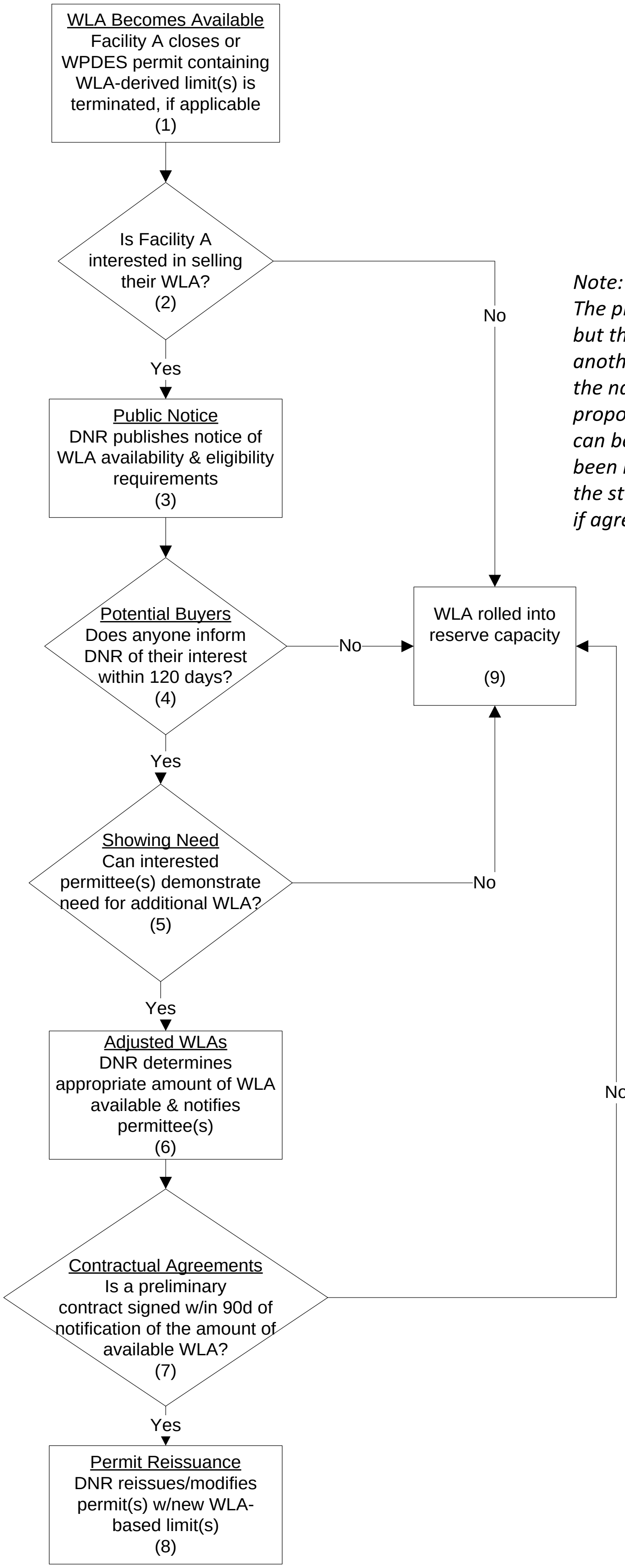
These factors are similar to components addressed when calculating a site-specific trade ratio, and it is therefore recommended to consult the trade ratio guidance in "*Guidance for Implementing Water Quality Trading in WPDES Permits*" when making these decisions (http://dnr.wi.gov/topic/SurfaceWater/waterqualitytrading.html). If one or more permittees (potential buyers) have notified the Department and the seller (owner of the closed facility or terminated outfall) of their interest in the available WLA during the 120 day notice period, and the Department concurs the potential buyer(s) have demonstrated need for the available WLA, the Department will calculate the applicable adjustment factors for each potential buyer and notify the seller of the WLA and potential buyer(s) of these calculations.

Contracts Between Buyer(s) and Seller (see Step 7 in the flowchart)
The seller of the WLA can enter into contractual agreements with the interested buyer(s) to allocate some or all of the available WLA as they deem appropriate. The Department will reallocate the available WLA to the interested party or parties that gave notice in accordance with the contractual agreements made between these parties, provided that the Department has determined that need was demonstrated and any necessary adjustments were incorporated into the reallocation.

If the seller does not enter into any contractual agreements with interested permittees within 90 days of being notified of the maximum WLA available to the potential buyers (see 'Determining Appropriate Amount of WLA Available' above), the Department may make a final determination on where the available WLA goes. It may be that the WLA gets equally or proportionally distributed among all interested parties, or part or all of the WLA could go into the reserve capacity of the TMDL. Sellers and buyers should know that any adjusted limit that incorporates a reallocation is subject to the public participation procedures of a modification , revocation and reissuance, or reissuance under chapter 283, Stats. The seller will need to submit written confirmation or certification of an agreement with a buyer before the Department will initiate a modification, revocation and reissuance, or reissuance of the buyer's permit to reflect the reallocation.

NOTE: if the closed facility and the facility chosen to receive the available WLA (i.e., the "seller" and "buyer") are owned by the same entity, then a contractual agreement may not be necessary. However, these facilities will still need to notify the Department of their arrangement in writing within 90 days of being notified of the maximum WLA available. The Department will still need to publish notice of the proposed reallocation decision and allow a 30 day comment period before the buyer's permit is changed to incorporate any reallocation. This 30 day comment period is in addition to that normally required when the permit is modified, revoked and reissued, or reissued.

Permit Reissuance and Public Noticing (see Step 8 in the flowchart)
The Department will use the information provided in the steps above to modify , revoke and reissue, or reissue the WPDES permit of the buyer(s), and, if applicable, the WPDES permit of the seller (e.g. removing an outfall). Reallocation decisions and other related permit determinations are subject to public notice and participation procedures as well as opportunities for challenge at the time of permit modification, revocation and reissuance, or reissuance under chapter 283, Stats. The affected WPDES permits will be public noticed at http://dnr.wi.gov/topic/wastewater/publicnotices.html and in the legal notices section of a local newspaper in the vicinity of the facility for the standard 30 days, and the other eligible dischargers in the watershed will be notified of the final decision in writing.



Note: this section & flowchart are intended solely as guidance. The process described is intended to apply in most situations, but the Department recognizes that steps may occur in another order or may not be necessary in some situations. See the narrative in this section for examples. In any event, all proposed reallocations should be public noticed so that others can be aware of proposed decisions and agreements that have been made. The written notice should, in all cases, describe the status of the facility closure and all proposed reallocations, if agreements have already been reached.

Available WLA vs. Reserve Capacity

The concept of available WLAs can be confused with 'reserve capacity', but they are different. In some TMDLs, a portion of the total loading capacity is set aside as a 'reserve' to allow for future increases in pollutant loading or for other reasons. For example, if there is a proposed new or expanding discharger, this 'reserve capacity' might be used to allow the new or increased discharge. Reserve capacity is different from available WLAs in that reserve capacities are built into the TMDL. On the other hand, available WLAs are created after the TMDL has been approved, when a point source no longer needs the WLA that was set aside for them in the TMDL. However, available WLAs can be placed in reserve capacity after the TMDL is approved and then used for future increases in pollutant loading or for other reasons.

Available WLA vs. Trading WLAs
Once a TMDL-derived limit is specified in a WPDES permit, it is no longer an 'available WLA'. However, some facilities may not need their full WLA to comply with their limit in the short term. For example, the facility could add treatment to go above and beyond the TMDL-derived limit. In these cases, the unused portion could be traded to other point sources to help meet their limits. For more guidance regarding water quality trading visit http://dnr.wi.gov/topic/surfacewater/documents/wqt-framework-final.pdf.

4.12 Removing TMDL-derived Limits From Permits

While a surface water may be removed from the s. 303(d) list due to improved water quality, the potential for existing sources to exceed the assimilative capacity of the surface water may remain. Consequently, WQBELs included in permits to implement WLAs should remain in the permits until it is determined that the potential for exceeding the assimilative capacity has been eliminated. The means for making such a determination is a revision of the TMDL. Until the TMDL is revised, WQBELs established to implement the TMDL should remain in permits.

Limit calculators and permit drafters should be aware that removing a surface water from the s. 303(d) list does not automatically eliminate the TMDL. Until the TMDL is revised or eliminated through the continued planning process, WLAs from the TMDL must be included in permits as WQBELs.

4.13 Variances

Since a WLA from an approved TMDL is expressed as a WQBEL in the WPDES permit, the permittee may seek a variance from the limit pursuant to s. 283.15, Wis. Stats. The need for a variance would have to be based on naturally occurring pollutants or other limiting factors that prevent attainment of the standard; human caused conditions or sources of pollution that prevent attainment of the standard and cannot be remedied; hydrologic modifications that preclude the attainment of the standard and cannot be restored; physical conditions related to the natural features of the water body that preclude attainment of aquatic life uses; or that the standard would cause substantial and widespread adverse social and economic impacts. (See s. 283.15(4)(a)1.a-f, Wis. Stats., for more detail.)

A TMDL does not have to be revised if multiple permittees receive a variance pursuant to s. 283.15, Wis. Stats. Variances are intended to be temporary and the recipient of the variance is expected to eventually achieve their WLA. Therefore, the TMDL does not have to be redone.

4.14 Antidegradation

If the new TMDL-derived limit results in an increase in an effective existing limit in a permit, then an antidegradation evaluation is needed. These limitations are no different than other water quality-based effluent limitations with respect to antidegradation. For example, the initial imposition of a water quality-based effluent limit, which include TMDL-derived limits, does not require an antidegradation evaluation as long as the pollutant of concern was previously present in the discharge and the permittee isn't proposing an increased load to the receiving water . Possible exceptions include the initial imposition of a TMDL-derived limit for a discharge to Exceptional and Outstanding Resource Waters, for a bioaccumulative chemical of concern such as mercury when an increased discharge is proposed, and when a change in discharge location is proposed.

With a few exceptions, ch. NR 207 requires an antidegradation evaluation when a new or increased discharge is proposed. Therefore, an antidegradation evaluation is necessary before a TMDL-derived limit, which has been incorporated into a WPDES permit and has become effective, is increased or the TMDL-derived limit replaces a less restrictive effective effluent limit.

Note that in most cases, complying with Wisconsin antidegradation requirements also satisfies federal anti-backsliding requirements.

4.15 Managing Expiration Dates to Facilitate Implementation

Permit drafters should consult the TMDL report, amended AWQMP and TMDL implementation plan to see whether a scheme for permit expiration dates is proposed. To prevent workload issues, WPDES program staff should participate in the development of the TMDL, amended AWQMP and implementation plan.

4.16 Monitoring TMDL Performance

If a permittee agrees to perform surface water monitoring, or is required to perform this monitoring as part of an adaptive management project, surface water monitoring requirements may be placed in the permit. While the Department can require effluent monitoring to assess compliance with WQBELs based on TMDL WLAs, permits should not include surface water monitoring to verify compliance with a TMDL, unless this is required as part of an adaptive management project as specified in s. NR 217.18, Wis. Adm. Code. Note: Due to limited resources, the Department may want to think of incentives for the regulated community or a third party to perform instream monitoring.

4.17 Monitoring of Pollutants Causing Impairments

If there is cause to believe that the discharge of a pollutant may be contributing to impairment of the surface water (i.e. exceeding the water quality standard), then limit calculators should recommend that facilities monitor their effluents for the pollutant of concern prior to or during TMDL development (s. 283.55 (1), Wis. Stats.). Effluent monitoring data could be important when determining accurate loading rates from point sources for the TMDL. The frequency of monitoring necessary may depend on pollutant type, water quality standards, or site-specific factors. Permits staff should consult with TMDL development staff when developing a sample collection frequency.

4.18 WQBEL Calculator Responsibilities

Once a TMDL is approved, limit calculators should include TMDL-derived WQBELs in recommendation memos for modified or reissued permits. When preparing WQBELs recommendations, identify the TMDL report as the source of TMDL-derived effluent limits. The TMDL report or the implementation plan should identify the WLAs that were used to derive WQBEL effluent limits. Not all of the TMDL's WLAs need to be included in the permit, however. If it is not clear what effluent limits should be included in the permit, here are a few suggestions:

- If TMDL-derived limits are not identified in the TMDL or implementation plan, you must select from the TMDL which WLAs to use as permit limits. The WLA may have to be translated into a workable permit limit, however. Refer to the sections above for detailed guidance related to how to determine which limits are appropriate and how to express WLAs as permit limits.

- Just because every TMDL provides a WLA representing a total maximum daily load, a daily maximum limit does not have to be included in permits. This is especially true when the total maximum daily load equals the monthly total or annual total load divided by 30 or 365, respectively.

Recommendation memos for WQBELs should also indicate whether the TMDL-derived effluent limit replaces other WQBELs for the same parameter and address antidegradation considerations when doing so. Recommendations for monitoring discharges of pollutants of concern to impaired waters without an approved TMDL should also be included in WQBELs recommendation memos.

4.19 Permit Drafter Responsibilities

The WQBEL recommendation memo should specify which WQBELs (including TMDL-derived effluent limits, when appropriate) should be included in WPDES discharge permits. Here are a couple of examples on how to include TMDL-derived effluent limits in permits. If you are drafting a permit with more complex TMDL-derived effluent limits, contact the Permits Section for assistance.

Example #1:

If a permit with a technology-based phosphorus effluent limit of 1 mg/L from ch. NR 217, Subchapter II, Wis. Adm. Code, is being reissued with a TMDL-derived effluent limit for phosphorus or 6.7 lbs/day monthly average, the following steps should be taken:

- Include in the draft permit the parameter “Phosphorus, Total” and continue the 1 mg/L phosphorus limit, sample frequency and sample type from the previous permit;

- Include in the draft permit the parameter “Phosphorus Total” with units of lbs/day, a monthly average limit of 6.7 lbs/day, a sample frequency from the previous permit, and a calculated sample type; and

- Code the monthly average limit in SWAMP for all twelve months of the year, beginning in the year that the limit becomes effective.

Example #2:

If a permit with monthly average and daily maximum technology-based concentration limits for TSS is being reissued with TMDL-derived effluent limits for TSS of 3,000 lbs/day monthly average and 6,000 lbs/day daily maximum, for example, the following steps should be taken:

- Include in the draft permit the parameter "Suspended Solids, Total" and continue the TBELs, sample frequency and sample type from the previous permit;

- Include in the draft permit the parameter "WLA Suspended Solids, Total" with units of lbs/day, a monthly average limit of 3,000 lbs/day, a daily maximum effluent limit of 6,000 lbs/day, a sample frequency equal to that from the current permit, and a calculated sample type;

- Code the monthly average and daily maximum limits in SWAMP for all twelve months of the year, beginning in the year that the limit becomes effective

Example #3:

If a WQBEL is derived from an annual WLA (lbs/yr), the permit should require the permittee to report 12-month rolling sums for the parameter addressed by the TMDL-derived WQBEL.

Note that the method for calculating the 12-month rolling sum is included in the standard requirements provided by SWAMP. Therefore, a special footnote to explain how the value is calculated is not necessary in the main portion of the permit.

Note that guidance for including TMDL-derived effluent limits in permits is likely to change frequently until we gain experience with implementing TMDLs by way of WPDES discharge permits and modify SWAMP to more efficiently support the implementation effort. While new guidance will be circulated to permitting staff, you may want to contact the Permits Section before including a TMDL-derived effluent limit in a draft permit.

If the permittee requires time to comply with a TMDL-derived effluent limit, see the previous guidance for compliance schedules in this document.

5 Appendix A. How to Access TMDL/WLA Information

TMDL/WLA information may be accessed in four ways:

A. Via DNR Web Site: Staff can find TMDL reports on the DNR web site.

Information about draft and final approved TMDLs can be found here: http://dnr.wi.gov/topic/tmdls/.

B. Via WATERS (Water Assessment, Tracking & Electronic Reporting System): It is possible to determine whether or not a TMDL is being or has been prepared for a particular waterbody by reviewing an "Impaired Waters Report" in WATERS. Here's how to do it:

Start by connecting to WATERS link under "DNR Tasks" on the DNR Intranet home page or at: http://prodoasjava.dnr.wi.gov/wadrs/.

1. Log on to WATERS using your Oracle ID and password.
2. Click on the "Reports" tab.
3. Select "Impaired Water Reports."
4. Click on the drop-down box in the "Impaired Water Status" field and select either "TMDL Development" or "TMDL Approved."
5. Finally, click "Create Report."

Where applicable, TMDL reports (and the associated WLAs) are available to download from the "Waterbody Documents" section for a particular waterbody in WATERS.

C. Via WT Webviewer (Intranet Surface Water Data Viewer): It is possible to determine whether or not a TMDL is being or has been prepared for a particular waterbody by viewing and/or creating a map in the Surface Water Data Viewer. Start by connecting to the "WT Webviewer" link under "DNR Tasks" on the DNR Intranet home page or at:
http://dnrintranetmaps.enterprise.wistate.us/imf/imf.jsp?site=watershed

1. Click the "Find Location" tab.
2. To specify what you would like to find, select "Waterbody Name and County."
3. Enter the applicable waterbody and county information, click "Go!" A map showing the waterbody will appear. Zoom in and out as necessary.
4. Click the "Layers" tab.
5. Under "Watershed Management Layers," click on the "Standards, Monitoring, & Assessment Data" subfolder.
6. Under the "Impaired Waters" subfolder, select the "TMDL status" layer.
7. Finally, click on the "Legend" tab to determine the TMDL status for the waterbody in question.
8. If desired, click on the "Print" tab to print a PDF version of the map.

D. Via USEPA's Assessment TMDL Tracking and Implementation System (ATTAINS): It is possible to determine whether or not a TMDL has been prepared for a particular waterbody by viewing USEPA's ATTAINS web site at: http://www.epa.gov/waters/ir/. Users need to click on the state of Wisconsin on the map and then follow the link to the most current "Impaired Waters Report." From that report, users can conduct a "TMDL Document Search" by clicking on the link with that title.

6 Appendix B. How to Access Impaired Waters Information

Impaired waters information may be accessed in three ways:

A. Via DNR Web Site: DNR staff can find impaired water information, including the s. 303(d) List of Impaired Waters, on the DNR web site at: http://dnr.wi.gov/topic/impairedwaters/.

B. Via WATERS (Water Assessment, Tracking & Electronic Reporting System): It is possible to determine whether or not a waterbody is impaired by reviewing an "Impaired Waters Report" in WATERS. Here's how to do it:

Start by connecting to WATERS link under "DNR Tasks" on the DNR Intranet home page or at: http://prodoasjava.dnr.wi.gov/wadrs/.

1. Log on to WATERS using Oracle ID and password.
2. Click on the "Reports" tab.
3. Select "Impaired Water Reports."
4. Click on the drop-down box in the "Impaired Water Status" field and select "303d Listed."
5. Finally, click "Create Report."

C. Via WT Webviewer (Intranet Surface Water Data Viewer): It is possible to determine whether or not a waterbody is impaired by viewing and/or creating a map in the Surface Water Data Viewer. Here's how to do it:

Start by connecting to the "WT Webviewer" link under "DNR Tasks" on the DNR Intranet home page or at: http://dnrintranetmaps.enterprise.wistate.us/imf/imf.jsp?site=watershed.

1. Click the "Find Location" tab.
2. To specify what you would like to find, select "Waterbody Name and County."
3. Enter the applicable waterbody and county information, click "Go!" A map showing the waterbody will appear. Zoom in and out as necessary.
4. Click the "Layers" tab.
5. Under "Watershed Management Layers," click on the "Standards, Monitoring, & Assessment Data" subfolder.
6. Under the "Impaired Waters" subfolder, select the "Impaired Waters (303d)" layer.
7. Finally, click on the "Legend" tab to determine the impaired waters status for the waterbody in question.
8. If desired, click on the "Print" tab to print a PDF version of the map.

7 Appendix C. Statutes and Administrative Rules Relevant to TMDLs

Chapter 227.52, Wis. Stats., ADMINISTRATIVE PROCEDURE AND REVIEW
(Go to: http://nxt.legis.state.wi.us/nxt/gateway.dll?f=templates&fn=default.htm&d=stats&jd=Ch.%20227)

Chapter 283, Wis. Stats., POLLUTION DISCHARGE ELIMINATION
s. 283.13 (5) SUBCHAPTER III STANDARDS; EFFLUENT LIMITATIONS
(Go to: http://nxt.legis.state.wi.us/nxt/gateway.dll?f=templates&fn=default.htm&d=stats&jd=Ch.%20283)
s. 283.31 SUBCHAPTER IV, PERMITS
(Go to: http://nxt.legis.state.wi.us/nxt/gateway.dll?f=templates&fn=default.htm&d=stats&jd=Ch.%20283)
s. 283.35 (3) WITHDRAWAL.
(Go to: http://nxt.legis.state.wi.us/nxt/gateway.dll?f=templates&fn=default.htm&d=stats&jd=Ch.%20283)
s. 283.83 SUBCHAPTER V, GENERAL PROVISIONS: ENFORCEMENT
s. 283.83 Continuing planning process.
(Go to: http://nxt.legis.state.wi.us/nxt/gateway.dll?f=templates&fn=default.htm&d=stats&jd=Ch.%20283)
s. 283.84 Trading of water pollution credits.
(Go to: http://nxt.legis.state.wi.us/nxt/gateway.dll?f=templates&fn=default.htm&d=stats&jd=Ch.%20283)

Chapter NR 102, Wis. Adm. Code, WATER QUALITY STANDARDS FOR WIS SURFACE WATERS
102.06 Phosphorus.
(Go to: http://nxt.legis.state.wi.us/nxt/gateway.dll?f=templates&fn=default.htm&d=code&jd=top)

Chapter NR 121, Wis. Adm. Code, AREAWIDE WATER QUALITY MANAGEMENT PLANS
(Go to: http://nxt.legis.state.wi.us/nxt/gateway.dll?f=templates&fn=default.htm&d=code&jd=top)

Chapter NR 151, Wis. Adm. Code, RUNOFF MANAGEMENT
NR 151.004 Performance standards for TMDLs.
NR 151.07 Nutrient management.
NR 151.24 Post–construction performance standard.
(Go to: http://nxt.legis.state.wi.us/nxt/gateway.dll?f=templates&fn=default.htm&d=code&jd=top)

Chapter NR 200, Wis. Adm. Code, VARIANCES
(Go to: http://nxt.legis.state.wi.us/nxt/gateway.dll?f=templates&fn=default.htm&d=code&jd=top)

Chapter NR 212, Wis. Adm. Code, WASTE LOAD ALLOCATED WQ RELATED LIMITATIONS
(Go to: http://nxt.legis.state.wi.us/nxt/gateway.dll?f=templates&fn=default.htm&d=code&jd=top)

Chapter NR 216, Wis. Adm. Code, STORM WATER DISCHARGE PERMITS.
NR 216.002 Definitions.
NR 216.023 Urbanized area exemption.
NR 216.025 Designation criteria.
(Go to: http://nxt.legis.state.wi.us/nxt/gateway.dll?f=templates&fn=default.htm&d=code&jd=top)

Chapter NR 217, Wis. Adm. Code, PHOSPHORUS EFFLUENT STANDARDS AND LIMITATIONS
(Go to: http://nxt.legis.state.wi.us/nxt/gateway.dll?f=templates&fn=default.htm&d=code&jd=top)

FEDERAL LAW/REGULATIONS

Overview: Go to: http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/index.cfm
Section 303(d) of the 1972 Clean Water Act
40 CFR Part 130 (1985, amended 1992)

BUREAU OF WATERSHED MANAGEMANT
PROGRAM GUIDANCE

Storm Water Management Program

TMDL Guidance for MS4 Permits: Planning, Implementation, and Modeling Guidance

Effective: October 20, 2014
Guidance #: 3800-2014-04

Notice: This document is intended solely as guidance, and does not contain any mandatory requirements except where requirements found in statute or administrative rule are referenced. This guidance does not establish or affect legal rights or obligations, and is not finally determinative of any of the issues addressed. This guidance does not create any rights enforceable by any party in litigation with the State of Wisconsin or the Department of Natural Resources. Any regulatory decisions made by the Department of Natural Resources in any matter addressed by this guidance will be made by applying the governing statutes and administrative rules to the relevant facts.

APPROVED:

Pam Biersach, Director
Bureau of Watershed Management

10/28/14
Date

A. Statement of Problem

The U.S. Environmental Protection Agency (EPA) requires the wasteload allocations (WLAs) developed as part of a Total Maximum Daily Load (TMDL) be reflected and implemented through permits. In Wisconsin, storm water discharge permits are issued pursuant to ch. NR 216, Wis. Adm. Code. As part of the TMDL process, permitted Municipal Separate Storm Sewer Systems (MS4s) are assigned individual TMDL WLAs. The placement of the WLA in a storm water permit can create numerous challenges including defining the municipal area encompassed by the WLA and modeling conditions to which the storm water WLA is to be applied. Department staff, municipal officials and storm water management plan developers need guidance to clarify how assessment of permit compliance with a WLA is to be demonstrated.

B. Background

A TMDL quantifies the amount of pollution that a waterbody can assimilate and still meet water quality standards. EPA requires that waters listed as impaired on Wisconsin's 303-d list have TMDLs developed. At a minimum, TMDLs must allocate the assimilative capacity between the load allocation, the WLA, and a margin of safety. The WLA is the portion of the assimilative capacity that is allocated to point sources. Nonpoint sources receive load allocations (LAs). WLAs are established for continuous point source discharges and also intermittent pollutant releases such as permitted storm water discharges.

Establishing WLAs for storm water sources requires an understanding of under what flow conditions impairments occur, and how storm water discharges are contributing to the identified impairments. Establishing WLAs for storm water sources also requires an understanding of exactly where the discharges are occurring. In many cases, municipal separate storm sewer systems (MS4s) have multiple discharge points that can be located in more than one reachshed[1]. In a TMDL, WLAs are assigned for each pollutant of concern and by reach. In a TMDL a MS4 can have multiple and different pollutant reduction goals within its municipal jurisdiction.

C. Discussion

Once EPA has approved a TMDL that contains permitted MS4s, the next permit issued must contain an expression of the WLAs consistent with the assumptions and requirements contained in the TMDL. As part of the TMDL process EPA approves the WLAs and generally these WLAs are mirrored directly in the permit. While this seems like a relatively straight forward permit process, the direct application of the WLA can present certain challenges in implementation due to assumptions required during the development of the TMDL. These assumptions revolve around aerial extent of the MS4 and its boundary, incorporation of new areas and expansion of the municipal boundary, and modeling differences between the tools used to create the TMDL versus the compliance tools used by the MS4. In addition, permitted MS4s have already performed municipal wide analysis to comply with requirements stipulated in ch. NR 151.13, Wis. Adm. Code. These requirements expressed reduction goals as a percent reduction from a defined no controls scenario with defined climate records.

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[1] Reachsheds are also referred to as subwatersheds or segment sheds in TMDL development. A reach is a stream segment or individual lake or reservoir that is artificially assigned a compliance point or "pour point" where the applicable in-stream water quality standards must be met. Breaks for stream reaches are made at changes in stream listing (each individually named 303(d) water must have their own set of TMDLs), changes in water quality criteria, and at pour points or compliance points just upstream of significant changes in flow/assimilative capacity.

To build on established methodologies contained in s. NR 151.13, DNR's preferred option for implementing TMDLs is using a percent reduction methodology similar to s. NR 151.13. The use of a percent reduction strategy will utilize reduction goals consistent with the TMDL and allow implementation to continue to build on the same percent reduction strategy employed in s. NR 151.13 using the same models and tools that MS4s have already been utilizing. Since EPA only approves the WLA and not the corresponding percent reduction it is important that the TMDL reports and permit fact sheets, as appropriate, highlight that the percent reductions being used for implementation are consistent with the approved WLAs in the TMDL.

The usage of a percent reduction framework for implementation allows both the MS4 and DNR the ability to implement the reductions without having to reallocate and track WLAs across reachsheds, MS4s, and other land uses. This will minimize the need to continually update the TMDL as municipal boundaries evolve and ease reporting requirements. In some rare cases allocations may need to be adjusted. This is discussed in Attachment A.

D. Guidance

This document divides DNR's guidance for implementing TMDL WLAs for permitted MS4s into three parts:

- **Part 1** – Expressing WLAs and Reduction Targets
- **Part 2** – Implementation and Compliance Benchmarks
- **Part 3** – Modeling

PART 1 – Expressing WLAs and Reduction Targets

An MS4 will have a WLA for each pollutant of concern addressed by the TMDL. Generally the pollutant of concern for TMDLs in Wisconsin include total suspended solids (TSS) and total phosphorus (TP); however, allocations for other pollutants such as bacteria or chlorides are possible depending on what pollutants are causing impairments to surface waters.

Unlike the requirements contained in s. NR 151.13, individual MS4s may be divided in multiple reachsheds. As such, MS4s may have multiple WLAs and percent reductions instead of the uniform municipal wide percent reduction employed in s. NR 151.13. Multiple WLAs and percent reductions are the result of needing to meet water quality requirements for all water bodies and account for changes in water body type, changes in water quality criteria or targets, changes in flow, changes in designated use, and other similar factors. Compliance with TMDL requirements will need to be achieved on a reach by reach basis.

Due to the complexity of natural systems, the WLAs identified in the TMDL are the best estimate for meeting water quality standards and are modeled or simulated predictions. Initial implementation of the TMDL will be in most cases by design using SLAMM, P-8, or equivalent methodologies to estimate and track pollutant reductions. The MS4 is typically not required to perform ambient monitoring to assess if water quality standards are being met, but MS4s do need to track implementation activities and reductions achieved, and report on TMDL implementation in MS4 annual reports. Once an adequate level of implementation has been achieved, ambient monitoring can be used to judge progress and monitoring will ultimately be needed to de-list impaired waters and show compliance with the TMDL.

During the first term of an MS4 permit, after EPA approval of a TMDL, DNR will request that each permitted MS4 report its actual MS4 area served within each reachshed. Existing MS4 permittees should already have sewershed mapping completed to satisfy previous MS4 permit conditions and this should be used to verify the current MS4 area served within each reachshed. The Department will provide the GIS data sets used for the TMDL reachshed boundaries through its website. The main reasons for reporting this information are to determine if the MS4 area served by each permittee corresponds to each other and does not overlap or omit MS4 service areas and to provide a detailed accounting of MS4 areas and responsible parties.

In most TMDLs, non-traditional MS4s such as permitted universities and state and county highway facilities were not given unique WLAs and these areas will need to be identified. In addition, most TMDLs are not able to account for modifications in drainage due to manmade conveyance systems such as storm sewers. These modifications may require modification of reachshed boundaries. To account for this, the MS4 permit (MS4 General Permit see section 1.5.4.3) will require that permittees submit information to the DNR to verify appropriate boundaries and areas. To accomplish this DNR will require the following information:

- Updated storm sewer system map that identifies:
  - The current municipal boundary/permitted area. For city and village MS4s, identify the current municipal boundary. For MS4s that are not a city or village, identify its permitted area. The permitted area for towns, counties and non-traditional MS4s pertains to the area within the Urbanized Area of the 2010 Decennial Census.
  - The TMDL reachshed boundaries within the municipal boundary, and the area in acres of each TMDL reachshed within the municipal boundary.
  - The MS4 drainage area boundary associated with each TMDL reachshed, and the area in acres of the MS4 drainage area associated with each TMDL reachshed.
- Identification of areas on a map and the acreage of those areas within the municipal boundary that the permittee believes should be excluded from its analysis to show compliance with its WLA (see "WLA Analysis Area" in Part 3 of this document"). In addition, the permittee shall provide an explanation of why each area identified should not be its responsibility.
  Note: This information is to be acquired by the DNR through an MS4 annual report.

DNR will evaluate this information and consider whether modifications to the TMDL are warranted. It is common for TMDL derived MS4 areas and reachsheds to deviate from the actual MS4 drainage areas. Such deviations can have an impact on the TMDL; however in most cases, these deviations will not have a significant effect on the calculated percent reduction needed to meet the TMDL allocations.

To assist in understanding allocations the TMDLs developed in Wisconsin have in many cases expressed reduction goals in both a WLA format (a load expressed as a mass) and a percent reduction format. The percent reduction is calculated from the baseline condition used in the TMDL to quantify what is needed to meet water quality standards. During the development of the TMDLs, the percent reduction is calculated using the following equation:

$$\text{Percent Reduction (from baseline)} = 100 * (1 - (\text{WLA Loading Condition} / \text{Baseline Loading Condition}))$$

The baseline loading condition should be described in the TMDL. While there is some variation across TMDLs in Wisconsin, the baseline loading condition should reflect the regulatory conditions stipulated in s. NR 151.13 and utilize either the 20% TSS control requirement or the 40% TSS control requirement as the starting point for TMDL allocations. This is because TMDLs are required, at a minimum, to meet existing regulatory requirements.

In 2011, the Wisconsin Legislature approved Act 32 which prohibited the Department from enforcing the 40% TSS reduction contained in s. NR 151.13, Wis. Adm. Code. As such, TMDLs under development and approved by EPA prior to January 1, 2012 used the 40% reduction as the baseline loading condition. For TMDLs approved by EPA after January 1, 2012, the 20% reduction serves as the baseline loading condition. The 20% reduction required under s. NR 151.13, Wis. Adm. Code, was to have been achieved by 2008.

For consistency with existing s. NR 151.13 guidance and requirements, the permittee's MS4 permit (MS4 General Permit - see section 1.5.4.4.1) will be requiring that the no-controls modeling condition be used such that the TMDL percent reduction goals will be measured from the no controls modeling condition. Since TMDL development uses the 20% or 40% TSS reduction baseline loading condition, implementation planning will necessitate converting the TMDL stipulated percent reduction back to a no-controls percent reduction for pollutants of concern such as TSS and Total Phosphorus (TP). As identified in the approved Rock River TMDL, a 40% TSS reduction corresponds with a 27% Total Phosphorus (TP) reduction. Based on loading data from the WinSLAMM model, a 20% TSS reduction for MS4s from the no-controls condition corresponds with a 15% TP reduction. This can be done using a mathematical conversion:

For a TMDL that uses 20% TSS reduction as the baseline loading condition (TMDLs approved after January 1, 2012) the conversion to the no-controls modeling condition is:

TSS Percent Reduction (no-controls) = 20 + (0.80 * % control from baseline in TMDL)
TP Percent Reduction (no-controls) = 15 + (0.85 * % control from baseline in TMDL)

For a TMDL that uses 40% reduction as the baseline loading condition (TMDLs approved prior to January 1, 2012) the conversion to the no-controls modeling condition is:

TSS Percent Reduction (no-controls) = 40 + (0.60 * % control from baseline in TMDL)
TP Percent Reduction (no-controls) = 27 + (0.73 * % control from baseline in TMDL)

The above calculated reductions correspond to the percent reduction measured from no-controls as required by the permittee's MS4 permit (MS4 General Permit - see section 1.5.4.4.1). These percent reductions can be compared to the reduction already achieved with existing management practices as required under the permittee's MS4 permit (MS4 General Permit - see section 1.5.4.4.4). This comparison, needed for each reachshed, will determine if additional reductions are needed to meet the TMDL requirements. The MS4 percent reductions from the no-controls condition for the Rock River TMDL and Lower Fox River TMDL are given in Attachments C and D.

For the MS4 area contained in each reachshed, the no controls load is calculated using SLAMM, P-8, or equivalent. The MS4 area includes the entire acreage that the MS4 is responsible for excluding areas not under the jurisdiction of the permittee. As new MS4 area is added or subtracted, the TMDL percent reduction applied to these areas remains the same. The percent reduction from no controls to meet the TMDL is applied to the MS4's modeled no-controls load to obtain the necessary load reduction to meet the TMDL. This load reduction may be different from that needed to meet the stipulated TMDL WLA; however, MS4 implementation of the TMDL is driven by the percent reduction and its corresponding load reduction.

For permittees that elect to use water quality trading or where adaptive management may lead to water quality trading, the load reduction calculated from the no-controls percent reduction should be used when evaluating the necessary mass.

TMDLs do not negate requirements stipulated in s. NR 151.13, Wis. Adm. Code. Therefore, both TMDL percent reductions and s. NR 151.13 requirements must be met. Once an MS4 meets the s. NR 151.13 requirement of 20% TSS control, an MS4 does not need to continue to update their s. NR 151.13 development urban area modeling. This is because s. 281.16 (2)(am)3., Wis. Stats., requires a municipality to maintain storm water treatment practices that are already in place prior to July 1, 2011.

TMDL reports may include both an average annual WLA and a percent reduction for MS4s. For implementation, MS4s should use the percent reduction. The average annual allocations represent the sum of allocations over the year and do not account for the monthly variations in the loading capacity of the receiving water. The percent reductions provided in the TMDL are based on monthly reductions and better reflect the reductions required to meet the water quality standards.

> Example: Appendix V in the Rock River TMDL lists annual mass allocations for Reach 81. The City of Beloit has a baseline loading for TSS of 181.75 tons and a WLA of 259.62 tons (a net increase). However, Appendix I identifies that Beloit needs a 7% reduction in TSS for Reach 81 from the 40% TSS baseline condition. This is because on an overall annual basis Beloit meets its allocation but in certain individual months it does not. The percent reduction is calculated based on the average of the monthly allocations used to determine compliance with the water quality standards.

PART 2 – Implementation and Compliance Benchmarks

Storm Water Management Planning (SWMP)

As described in the permittee's MS4 permit (MS4 General Permit - see sections 1.5.4.4 and 1.5.4.5), DNR will be requiring a TMDL implementation analysis and plan be completed by MS4 permittees subject to TMDL WLAs. This analysis and plan should be incorporated in the SWMP as required by the permittee's MS4 permit (MS4 General Permit - see section 1.5.4). Each MS4 permittee should evaluate all potentially cost-effective alternatives to reduce its discharge of pollutants of concern so that its discharge is comparable to the percent reductions stipulated in the TMDL. MS4 permittees may work together with other MS4s that reside in the same reachshed.

A focus of the SWMP should be on improving storm water treatment for areas of existing development during times of redevelopment. Older, urban development patterns typically did not include the same level of stormwater management controls that new development does. Reductions achieved through redevelopment can be counted towards compliance with WLAs. Each municipality should estimate the pollutant reductions that are expected to be achieved over time through redevelopment of both public and private facilities, including roadway reconstruction. The rate of redevelopment should be estimated in order to provide a gauge as to how long it would take to improve storm water management in areas of redevelopment.

When developing components of a TMDL implementation plan, municipalities should, at a minimum, consider the following implementation methods:

- **Ordinance Review and Updates** – A municipality may elect to revise its current post-construction storm water management ordinance to require greater levels of pollutant control for redevelopment and highway reconstruction that are above the minimum performance standards of ch. NR 151, Wis. Adm. Code and are consistent with the reduction requirements contained in the TMDL.

  Current ch. NR 151 post-construction performance standards for areas of new development include an 80% TSS control level and maintaining 60 - 90% of predevelopment infiltration (with certain exemptions and exclusions). Areas that have stormwater management practices designed and maintained to meet these performance standards should already be controlling TSS and total phosphorus to levels comparable to TMDL water quality targets.

In addition, core provisions in the municipality's SWMP could be strengthened. For example, if bacteria are a pollutant of concern the MS4 may want to place greater emphasis on detecting and eliminating cross-connections between wastewater pipes and storm sewers or stronger pet waste programs.

- **Quantifiable Management Practices** – These practices include, but are not limited to, structural controls such as wet detention ponds, infiltration basin, bioretention, sump cleaning, low impact development (LID), street cleaning and vegetated swales where reductions can be quantified through water quality modeling such as WinSLAMM and P-8.

- **Non-Quantifiable Management Practices –** Quantifiable pollutant reductions may be difficult to determine for some practices such as residential leaf and yard debris management programs, lawn fertilizer bans and information and education outreach activities. This could also include strengthened provisions of the core SWMP. For example, if bacteria is a pollutant of concern the MS4 may place greater emphasis on detecting and eliminating cross connections, stronger pet waste programs and greater focus on elimination of leaching from dumpsters. As data becomes available to quantify reductions the appropriate credit will be given toward meeting the TMDL reduction requirements. In the interim, DNR and the permittee should be able to come to an agreement as to whether the measure is beneficial. In cases where quantifiable reductions are not possible, the use of a non-quantifiable but beneficial practice shall be deemed as making progress toward compliance with the TMDL reductions. The DNR, in consultation with stakeholders, will evaluate these practices as new science and data becomes available.

- **Stabilization of MS4** – Stabilization of eroding streambanks are eligible for a 50% cost share match through DNR's Runoff Management Grant Program. DNR considers streambank stabilization activities an important step in reducing the discharge of sediment. However, TMDL baseline modeling already assumes that drainage systems are stable; therefore, it is not appropriate to take credit against the WLA or percent reduction in the TMDL for stabilization of a drainage ditch or channel of the MS4. However stabilization projects should be identified in the TMDL implementation plan and can serve as a compliance benchmark toward meeting overall TMDL goals.

- **Streambank Stabilization Outside of the Permitted MS4** – Permitted MS4s may take credit through pollutant trading for stabilization of channels and streambanks which are outside of the area served by their MS4. Applicable credit thresholds and trade ratios would apply.

- **Water Quality Trading and Adaptive Management -** If economically beneficial, a MS4 may wish to participate in one of these programs. MS4s are eligible to participate in water quality trading to help meet WLAs. MS4 permittees with areas in the same reachshed can share load reduction credits for practices within those reachsheds using a 1:1 trade ratio. Also a MS4 may be invited by a Waste Water Treatment Facility (WWTF) to participate in an adaptive management program pursuant to s. NR 217.18, Wis. Adm. Code, to reduce phosphorus. Water quality trading and adaptive management guidance are covered under separate DNR guidance documents available on the DNR website.

- **Constructed Wetland Treatment –** Wetlands constructed for the purpose of providing storm water treatment are eligible for treatment credit provided that a long-term maintenance plan is implemented. Wetlands that receive runoff pollutants are expected to, at some point, reach a certain equilibrium point where they would provide minimal pollutant removal or even act as a pollutant source unless they are maintained by harvesting vegetation and/or have accumulated sediment removed from them. Additionally, constructed wetlands installed need to be maintained as stormwater treatment areas in order to maintain their "non-waters-of-the-state" status. Per federal regulations, wetlands constructed as part of wetland mitigation cannot be used for treatment credit.

- **Storm Water Practices and Existing Wetlands -** Wetlands are waters of the state and wetland water quality standards under ch. NR 103, Wis. Adm. Code apply. Additionally, the U.S. Army Corps of Engineers has authority to protect wetlands as well. As such, existing wetlands cannot be used for treatment, however, in limited circumstances storm water practices can be installed in a wetland provided all applicable state and federal wetland permits are obtained. It is often difficult to obtain state and federal permits to construct a storm water treatment facility in a wetland. Contact the local DNR water management specialist to discuss whether this project might be permissible and the associated written justification needed to support a wetland permit application.

As discussed, SWMPs for municipalities with approved TMDLs should identify what pollutant reduction measures will be employed and over what time frame reductions will occur (i.e. 20 tons/yr TSS for redevelopment sites over the next 20 years).

Compliance Schedule and Benchmarks

Once a TMDL is approved, affected MS4 permittees will receive a TMDL implementation planning requirement within their next (or potentially initial) permit term. TMDL implementation planning will include determining storm water management treatment and other measures needed and their associated implementation costs and timelines to achieve TMDL reductions consistent with the TMDL WLAs. It is expected that the following MS4 permit term will include a compliance schedule to implement pollutant reduction measures in accordance with a storm water management plan to meet applicable TMDL reductions.

The compliance schedule will require that the permittee be able to show continual progress by meeting 'benchmarks' of performance within each permit term. In this case, a 'benchmark' means a progress increment – a level of pollutant reduction or an application of a pollutant reduction measure, which is part of a larger TMDL implementation plan designed to bring the overall MS4 discharge of pollutants of concern down to a level which is comparable to the MS4's TMDL WLA. It is possible that certain benchmarks will not be easily quantifiable but there needs to be evidence that such benchmarks will provide a legitimate step toward reducing the discharge of pollutants of concern.

DNR may elect to place specific benchmarks in an MS4 permit. However, it is expected that MS4 permittees will have the primary role in establishing their own benchmarks for each 5-year permit term. Benchmarks should be reevaluated at least once every 5 years and are interim steps/goals of compliance. Where substantial reductions are required multiple benchmarks of compliance will be needed and likely implemented over more than one permit cycle. However, the schedule should lead to meeting the TMDL WLA as quickly as is feasible.

Redevelopment ordinances designed to implement stormwater management controls to achieve compliance with the TMDL requirements are an excellent tool to show progress in meeting the WLA with smart growth and development patterns. Management practices should be installed as infrastructure is replaced. For example, it may be most cost-effective for municipalities to install storm water treatment and infiltration practices as other street or sewer projects are scheduled.

Under a TMDL, EPA does not acknowledge the concept of maximum extent practicable as defined in s. NR 151.006, Wis. Adm. Code, but rather compliance schedules can be structured in SWMPs and permits to allow MS4s the flexibility needed to meet TMDL goals. Any storm water control measures employed by the MS4 permittee to reduce its pollutant discharge to comply with the TMDL reductions will need to be maintained or replaced with comparable stormwater control measures to ensure that load reductions will be maintained into the future.

Runoff Treatment Outside of the MS4's Jurisdiction
In order for an MS4 to take credit for the control of pollutants by another municipality or private property owner (i.e. industry or riparian property owner), the MS4 must have an agreement with the entity with control over such treatment measure. This agreement must specify how the pollutant reduction credit will be shared or otherwise granted to an MS4. Responsibilities for maintenance of the BMPs and preservation of the BMPs over time should also be addressed in any such agreement.

Tracking
The permittee will need to track and show progress in reducing discharges of pollutants of concern. This tracking should assist in showing that MS4 permit compliance benchmarks have been achieved in accordance with an overall storm water management plan to achieve compliance with the TMDL percent reduction targets.

A tabular TMDL compliance summary of pollutant loading per reach will be required to be submitted to DNR with the MS4 report at least once every MS4 permit term. The summary should identify the following: reach name and number (consistent with the name and number in the TMDL report), the MS4 outfall numbers, named/labeled drainage areas, the applicable TMDL percent reduction target(s), pollutant reduction benchmarks, storm water management control measures implemented, and pollutant reduction achieved as compared to no controls. Attachment B is an example of a tabular TMDL MS4 compliance summary.

PART 3 – Modeling

<u>Discussion</u>

The following discussion highlights the main compatibility challenges between TMDL development and MS4 implementation and how they will be addressed.

TMDL waste load allocations are by definition expressed as daily loads. There is flexibility, however, to implement the loads using monthly, seasonal, or annual load allocations. Due to the variability of storm water events and associated pollutant loadings, MS4's have historically used modeling to estimate flows and pollutant loadings using a percent reduction format for the purpose of s. NR151.13 compliance. As part of TMDL implementation, average percent reductions have been developed for MS4s for each reach. These percent reductions generally reflect an average of monthly reductions needed to meet allocations because waters are evaluated against the phosphorus criteria based on monthly sampling protocols. This will allow MS4s to continue using water quality models such as WinSLAMM and P-8 for demonstrating compliance with TMDL allocations. As with s. NR 151.13, TMDL compliance for MS4s will be by design.

Since the modeling tools used to demonstrate compliance with s. NR151.13 pollutant loadings are the same tools used to demonstrate compliance with TMDL pollutant load allocations, much of the existing mapping, water quality modeling, and planning methodologies used for s. NR151.13 compliance can be used or adjusted for TMDL compliance planning.

Generally, the modeling completed as part of TMDL development is at a less detailed scale than the modeling completed by individual MS4s. Due to the scale at which the respective models are completed, it is not unusual to have differences in the drainage areas and the pollutant mass loadings associated with them. Because of the scale at which they are developed, allocations from a TMDL have generally been applied across the entire urban area that is served by the permitted MS4. It is important to note that while many components of existing planning efforts and modeling results can be used for TMDL implementation, adjustments will likely be necessary to account for a TMDL focus on compliance by reachshed.

There may be inconsistencies between the TMDL modeled drainage areas to the actual MS4 drainage areas. Actual MS4 drainage areas may not follow the surface drainage areas and MS4 drainage areas commonly expand due to urban development. For example, the modeled versus actual MS4 drainage areas commonly deviated by 30% and by as much as 60% in the Rock River TMDL. Although these deviations may have a significant effect on a mass wasteload allocation, its affects are greatly moderated on a percent reduction basis across the reachshed. Area deviations commonly affect the MS4 percent reductions by only a few percent. Given the modeling assumptions that have gone into TMDL modeling, deviations by even 10% are within the expected error range of TMDL modeling. Modeling is not an exact science and the TMDL MS4 percent reductions are still considered valid implementation targets to work toward achieving in-stream water quality.

As noted above, MS4s subject to a TMDL should perform analyses and planning to identify cost-effective approaches for reducing discharges of pollutants of concern. To cost-effectively achieve pollutant reductions, MS4s should look for opportunities such as site redevelopment and road reconstruction projects, implementation of streambank stabilization and wetland restoration projects, implementation of traditional BMPs, and possibly water quality trading and adaptive management[2]. Each of these elements can be considered for implementation to meet the requirements of a TMDL. It is likely that existing MS4 water quality modeling and mapping can be used and adjusted as necessary for SWM planning needs for TMDL implementation.

Guidance

TMDL-established WLAs and LAs are 'targets' of treatment performance and/or pollutant control for point and non-point sources. The WLAs and LAs are TMDL modeled estimates of the level of pollutants that can be discharged and still meet in-stream standards. The ultimate goal of a TMDL is for continual reduction of pollutants discharged so that both the listed impaired waters and other waters meet in-stream water quality standards, which would then allow for removal of waters from the 303-d impaired waters list. Municipalities should consider the drainage area served by their MS4 and look for the most cost-effective means to reduce discharges of pollutants of concern until their discharge is comparable with its TMDL requirements.

TMDL Analysis Area

An MS4 is to include all areas within its corporate boundary unless it is listed as optional. Although the MS4 permit focuses on current areas served by an MS4, it may be appropriate to include future land use planning areas.

Incorporation of rural areas: A city or village may have incorporated the entire township or a large portion of the rural township in which it resides. In this situation, the city or village needs to include all areas within the most

2 The Department has prepared separate guidance documents on water quality trading and adaptive management. MS4s are considered non-point sources for the purposes of adaptive management. This does not preclude them from participating in an adaptive management program if approached by a traditional point source such as a municipal or industrial wastewater treatment facility. The "Adaptive Management Technical Handbook" is available for download at http://dnr.wi.gov/topic/surfacewater/adaptivemanagement.html

recent urbanized area, adjacent developed and developing areas whose runoff is connected or will connect to their MS4.

Highways: A permitted MS4 owner/operator of a highway needs to account for the pollutants generated within the Right-Of-Way (ROW). An exception would be a roadway crossing over a highway where the owner of the roadway crossing structure is responsible for the pollutants associated with their bridge and approach structure within the lower highway's ROW. WisDOT is responsible for state highways that are not connected highways. A county is responsible for county highways that it maintains. Cities and villages need to include connecting highways as identified and listed in the Official Highway State Truck Highway System Maps at: http://www.dot.wisconsin.gov/localgov/highways/connecting.htm

Optional: The pollutant loads associated with the following areas are optional for an MS4 to include:

1. Area that never passes through a permittee's MS4 such as a riparian area.
2. Land zoned for agricultural use and operating as such.
3. Manufacturing, outside storage and vehicle maintenance areas of industrial facilities permitted under subch. II of ch. NR 216, Wis. Adm. Code, are optional to include. This does not include any industrial facilities that have certified a condition of "no exposure" pursuant to s. NR 216.21(3), Wis. Adm. Code. *Note: DNR recommends that municipalities include all industrial facility areas within their WLA analysis area instead of creating 'holes' within its area of analysis.*
4. Any area that discharges to an adjacent municipality's MS4 (Municipality B) without passing through the jurisdictional municipality's MS4 (Municipality A). Municipality B that receives the discharge into their MS4 may choose to be responsible for this area from Municipality A. If Municipality B has a stormwater treatment practice that serves a portion of A as well as a portion of B, then the practice must be modeled as receiving loads from both areas, independent of who carries the responsibility for the area. However, if runoff from an area within Municipality A's jurisdiction drains into Municipality B's MS4 but then drains back into Municipality A's MS4 farther downgradient, then Municipality B does not have the option of including the load from Municipality A in their analysis and the load from that area is Municipality A's responsibility.
5. For county and towns, the area outside of the most recent urbanized area as defined by the US Census Bureau. This area is classified as non-permitted urban and part of the non-point source load allocation (NPS LA).

MS4 Water Quality Models and Related Information

To model pollutants such as TSS and total phosphorus in the area served by the MS4, the municipality must select a model such as SLAMM, P8 or an equivalent method deemed acceptable by the Department. For the analysis to show compliance, SLAMM version 9.2 or P8 version 3.4 or a subsequent version of these models may be used.

All roadway right-of-ways within the urbanized area that are part of a county or town's MS4 are the responsibility of the county or town. Model the road based on the urban land use that will most typify the traffic, even if agricultural land use is on one or both sides of the road (for example commercial or residential) and include that area in the corresponding standard land use file.

A municipality is not required to use the standard land use files if it has surveyed the land uses in its developed urban area and has "real" source area data on which to base the input files. The percent connected imperviousness beyond the standard land use files must be verified in the field. Disconnection may be assumed for residential rooftops where runoff has a flow path of 20 feet or greater over a pervious area in good condition. Disconnection for impervious surfaces other than residential rooftops may be assumed provided all of the following are met:

- The source area flow length does not exceed 75 feet,

- The pervious area is covered with a self-sustaining vegetation in “good” condition and at a slope not exceeding 8%,
- The pervious area flow length is at least as long as the contributing impervious area and there can be no additional runoff flowing into the pervious area other than that from the source area.
- The pervious area must receive runoff in a sheet flow manner across an impervious area with a pervious width at least as wide as the contributing impervious source area.

Water quality modeling is a means to determine a storm water management control practice’s treatment efficiency. If the model cannot predict efficiencies for certain storm water management control measures that a municipality identifies as a water quality management practice, then a literature review should be conducted to estimate the reduction value. Proprietary stormwater management control measures that utilize settling as their means of TSS reduction should be modeled in accordance with DNR Technical Standard 1006 (Method for Predicting the Efficiency of Proprietary Storm Water Sedimentation Devices).

When designing storm water management practices, runoff draining to a management practice from off-site must be taken into account in determining the treatment efficiency of the measure. Any impact on the efficiency must be compensated for by increasing the size of the measure accordingly.

Storm water management practices on private property that drain to an MS4 can be given treatment credit, provided the municipality enters into an agreement or has an equivalent enforceable mechanism with the facility/land owner that will ensure the management practice is properly maintained. The municipality will need a tracking system that includes maintenance of treatment practices. An operation and maintenance plan, including a maintenance schedule, must be developed for the stormwater management practice in accordance with relevant DNR technical standards. The agreement or equivalent mechanism between the municipality and the private owner should include the following:

- A description of the stormwater management practice including dimensions and location.
- Identify the owner of the property on which the stormwater management practice is located.
- Identify who is responsible for implementing the operation and maintenance plan.
- Outline a means of terminating the agreement that includes notifying DNR.

The efficiency of a storm water management practice on both public and private property must be modeled using the best information the municipality can obtain on the design of the practice. For example, permanent pool area is not sufficient information to know the pollutant reduction efficiency of a wet detention basin even if it matches the area requirements identified in Technical Standard 1001 Wet Detention Basin for an 80% reduction. Information on the depth of the wet pool and the outlet design are critical features that determine the level of control a detention pond is providing.

Modeling Clarifications

- A TMDL might remove certain internally drained areas from its analysis. If an internally drained area is removed from the TMDL analysis, the MS4 permittee shall not include such area in its MS4 analysis to show compliance with its TMDL requirements. Under this scenario if stormwater is pumped from inside the internally drained area to an external drainage area, then this additional pollutant discharge needs to be accounted for in the MS4 analysis to show compliance with its TMDL requirements.
- Where an internally drained area is included in the TMDL analysis, an MS4 permittee has the option of including this area in its TMDL analysis to show compliance with its TMDL requirements. However, credit for pollutant removal in internally drained areas may only be taken provided the April 6, 2009 DNR Internally Drained Area guidance memo is met with respect to taking pollutant reduction credit within internally drained areas.

- When water is pumped rather than gravity drained from an internally drained area of many acres in area, the MS4 will be expected to use monitoring data to determine the annual average mass of pollutants discharged to the surface water to which the TMDL applies. This does not apply to dewatering covered under a DNR storm water construction site general permit.
- If a portion of a municipality's MS4 drains to a stormwater treatment facility in an adjacent municipality, the municipality generating the load will not receive any treatment credit due to the downstream municipality's treatment facility unless there is an inter-municipal agreement where the downstream municipality agrees to allow the upstream municipality to take credit for such treatment. DNR anticipates that such an agreement would have the upstream municipality assist with the construction and/or maintenance of the treatment facility. This contract must be in writing with signatures from both municipalities specifying how the treatment credit will be shared.
- For reporting purposes, the pollutant reductions must be summarized by TMDL reachshed. Additionally, pollutant loads for grouped drainage areas as modeled shall also be reported. Drainage areas may be grouped at the discretion of the modeler for such reasons as to emphasize higher priority areas, balance model development with targeting or for cost-effectiveness.
- The additional runoff volume from areas that are outside of the analysis area needs to be accounted for when it drains into treatment devices. The pollutant load can be "turned off" but the runoff hydrology needs to be accounted for to properly calculate the treatment efficiency of the device.
- Due to concerns of sediment resuspension, basins with an outlet on the bottom are generally not eligible for pollutant removal based solely on settling. However, credit may be taken for treatment due to infiltration or filtration. Filtration might occur through engineered soil or proprietary filters. Features to prevent scour should always be included for any practice where appropriate.
- Credit should not be taken for street cleaning unless a curb or equivalent barrier is present which leads to sediment buildup on the street.
- To model a combination of mechanical broom and vacuum assisted street cleaning, it may require an analysis of several model runs depending on the timing of the mechanical and vacuum cleaning. If mechanical broom and vacuum cleaning occur at generally the same time (e.g. within two weeks of each other) then only the removal efficiency of the vacuum cleaning should be taken. If the municipality performs broom sweeping in the spring or fall and vacuum clean the remained of the year, calculate the combined cleaning efficiency using the following method:
  (A) Model the entire street cleaning program as if entire period is done by a mechanical broom cleaner.
  (B) Model just the period of time for vacuum cleaning (do not include the mechanical broom cleaning).
  (C) Model the same period as B) but with a mechanical broom.
  (D) The overall combined efficiency would be A + B – C.

WinSLAMM clarification

- WinSLAMM 9.4 and earlier versions of WinSLAMM result in double counting of pollutant removal for most treatment practices modeled in series. WinSLAMM 9.2 and subsequent versions contain warnings to help alert modelers of this issue. The modeler will need to make adjustments to ensure that the results do not include double credit for removal of the same particle size. PV & Associates has created a document titled 'Modeling Practices in Series Using WinSLAMM' which helps to guide a user as to whether and or how certain practices can be modeled in series and this document is available at: http://winslamm.com/Select_documentation.html
- In WinSLAMM 9.4 and earlier versions, when street cleaning is applied across a larger modeled area with devices that serve only a certain area within the larger modeled area, it is acceptable to first take credit for street cleaning across the entire larger area but then the treatment efficiency for other devices must be reduced by the efficiency of the street cleaning to prevent double counting.

P8 clarifications

- P8 does not account for scour and sediment resuspension. DNR requires that a wet basin with less than a 3-foot permanent pool have its treatment efficiency reduced. A basin with zero permanent pool depth should be considered to get zero credit for pollutant removal due to settling and a basin with 3 or more feet of permanent pool depth can be given the full pollutant removal efficiency credited by settling. The pollutant removal efficiency may be given straight-line depreciation such that a basin with a 1.5 foot-deep permanent pool would be eligible for 1/2 the pollutant removal efficiency that would be credited due to settling.
- A device that DNR gives no credit for pollutant removal may still be modeled if it is in series with other practices because of its benefit on runoff storage capacity that may enhance the treatment efficiency of downgradient treatment devices. To do so, turn the treatment efficiency off in P-8.
- P8 should be started an extra year or at least several months before the "keep dates", in order to allow the model to build up representative pollutant concentrations in wet basins.

CREATED:

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On behalf of the Storm Water Liaison Team

Date

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APPROVED:

Mary Anne Lowndes — 10/21/14

Mary Anne Lowndes, Chief
Runoff Management Section

Date

Runoff Management Policy Management Team approved on 9/30/14 (date).

Attachment A: Technical Notes

Establishing relationships between multiple point and nonpoint pollutant sources and their influences on stream flow and water quality is complex. This process is often further complicated by the spatial scale under which TMDLs are developed. In order to help make TMDL development manageable, TMDLs are often developed using large scale modeling approaches that can be difficult to translate to the smaller scale often needed for implementation. For instance, loadings from “non-traditional” permitted MS4s (WDOT and county highways and UW campus systems) are often aggregated with the loadings of traditional MS4s (cities, villages and towns). This loss in resolution can result in inconsistencies in the WLA assignment necessitating a more thorough examination and possible reallocation of a portion of the WLA to non-traditional MS4 permittees.

In many cases where there is an existing TMDL that aggregated WLAs, the Wisconsin Department of Natural Resources (DNR) will need to review, and may need to reallocate WLAs to MS4 permittees. MS4 permittees will then need to conduct storm water management planning to evaluate their current pollutant loads relative to the TMDL reduction goals and create and implement a plan to meet the TMDL reductions.

Whether or not a municipality changes in size or land use, the allowable pollutant load that the receiving water can handle does not change. In the TMDL, the total allowable permitted MS4 load was determined by reach and typically was distributed uniformly across permitted MS4s on a unit area load basis. Since the permitted MS4 allowable unit area load is the same across a reachshed, MS4 WLAs can be reallocated between each other based on area. However, this reallocation must occur at the same time step that was used in the TMDL development process.

> Example: the Rock River TMDL generated allocations on a monthly basis so any reallocation of the WLA between sources must also proceed on a monthly basis. Simply adding the monthly allocations into an annual load and reallocating using an average annual unit load approach will result in a misrepresentation of the TMDL allocations. Analysis must be conducted on a monthly basis.

It is expected that the extent area that will need to be modeled for the MS4 WLA will be larger than that modeled under the s. NR 151.13 (developed urbanized area modeling analysis). This is because the s. NR 151.13 modeling area has many optional and excluded areas, whereas, the TMDL WLA analysis generally lumps all of these areas into the WLA. Also, s. NR 151.13 modeling was based on year 2004 developed area condition versus a TMDL which generally considers most recent development information.

In municipalities that have recently experienced significant growth, there may be a significant increase in urban area. In addition, in some instances the total actual permitted MS4 area within a reachshed is different than that used in the TMDL development process. Initially DNR believed that it would be easy to reallocate a portion of the non-point source LA to the permitted MS4s based on a unit load approach; however, the task can be more difficult than it initially appears. As explained above, the reallocation needs to be conducted using the same time step used in the development of the TMDL and at the same critical flow period used to develop the TMDL. In many cases, this critical flow period used in the development of the TMDL may not correspond with an average annual unit load.

<u>Reallocation Option</u>: In some cases, where TMDL analysis was conducted on an average annual basis it may be appropriate to adjust WLAs based on the acreage associated with each MS4 by reachshed. If reallocating WLAs and LAs within the same reach will still not be adequate to address significant area differences between actual and TMDL modeled reachsheds, DNR will consider on a case-by-case basis as to whether a reallocation between reaches is warranted. For example, an MS4 may collect runoff from a substantial amount of area from one reachshed and discharge it directly into another reachshed.

DNR would include reallocated WLAs in the next reissued permit of affected MS4s. MS4s would have the opportunity to comment and/or adjudicate reallocated WLAs when the permit is public noticed.

Attachment B: TMDL Compliance Summary

TMDL Reach Number & Name: 64 (Yahara River, Lake Mendota & Lake Monona)
MS4 TMDL Percent Reductions needed (no controls): 73% (TSS) & 68% (TP)*
MS4 Existing Controls Percent Reduction (year 2014): 32% (TSS) & 24% (TP)
Modeled MS4 Annual Average Pollutant Load (no controls): 433 tons/yr (TSS) & 124 lb/yr
Modeled MS4 Annual Average Pollutant Load (existing controls): 294 tons/yr (TSS) & 94 lb/yr

Benchmark (BM)	Description of BM Measure	Outfalls Affected by BM control	Affected Drainage Areas (as modeled)	Implementation Date	Measure Treatment Performance	BM % Reduction toward TMDL Reduction	MS4 Cumulative % Control (from no controls)
N/A	Existing control measures	All	All	Ongoing	TSS: 32% TP: 24%	TSS: 32% TP: 24%	TSS: 32% TP: 24%
1	Increased SWM control for Roadway Reconstruction	All	All	1/1/2020	TSS: 60% TP: 40% to MEP	TSS: 0.6% (annually) TP: 0.4% (annually) (30% TSS reduction over 50 years)	TSS: 35% TP: 26% (Accounts for 5 years of reduction)
2	Implement Enhanced Street Cleaning Program	001 003 004 008	1A - 1D 3A – 3K 4C – 4F 8D	1/1/2020	TSS: 12% TP: 8% (no redundant controls)	TSS: 9% TP: 6% (eff. reduced for redundant measures)	TSS: 44% TP: 32%
3	Implement Enhanced Yard Waste Collection Program	All	All	1/1/2021	TSS: 2% TP: 6% (no redundant controls)	TSS: 1.6% TP: 5% (eff. reduced for redundant measures)	TSS: 46% TP: 37%
4	Ordinance Revised – Higher Redevelopment Standard	All	All	1/1/2022	TSS: 60% TP: 40% to MEP	TSS: 0.6% (annually) TP: 0.4% (annually) (30% of TSS reduction over 50 years)	TSS: 49% TP: 39% (Accounts for 5 years of reduction)
5	Retrofit 2nd St. Basin into wet basin	002	B4	1/1/2023	TSS: 60% TP: 40%	TSS: 2% TP: 1% (only serves part of MS4)	TSS: 51% TP: 40%
6	New Wet Basin B15	005	5B - 5H	1/1/2023	TSS: 60% TP: 40% to MEP	TSS: 3% TP: 2% (only serves part of MS4)	TSS: 54% TP: 42%
7	Stabilize MS4 Drainage Ways between X and Y streets	003	3D and 3E	1/1/2024	20 tons/year sediment reduction	N/A Streambank & MS4 stabilization does not count against TMDL reduction requirement	TSS: 54% TP: 42%

* The TSS and TP percent reductions were taken from the Rock River Report's Appendix H and I. All other mass and percent reductions listed are fictitious and shown for example purposes only.

Attachment C: Rock River TMDL MS4 Annual Average Percent Reductions

Reach	Appendix H TP reduction from baseline of 27%	Appendix I TSS reduction from baseline of 40%	Calculated TP reduction from no-controls	Calculated TSS reduction from no-controls
2	29%	1%	48%	41%
3	82%	26%	87%	56%
20	14%	0%	37%	40%
21	10%	0%	34%	40%
23	12%	11%	36%	47%
24	11%	12%	35%	47%
25	64%	32%	74%	59%
26	35%	29%	53%	57%
27	0%	0%	27%	40%
28	1%	0%	28%	40%
29	51%	7%	64%	44%
30	0%	0%	27%	40%
33	29%	9%	48%	45%
34	81%	31%	86%	59%
37	66%	54%	75%	72%
39	0%	0%	27%	40%
45	13%	8%	36%	45%
51	14%	0%	37%	40%
54	61%	6%	72%	44%
55	68%	43%	77%	66%
56	19%	0%	41%	40%
59	54%	15%	66%	49%
60	29%	1%	48%	41%
61	6%	2%	31%	41%
62	70%	70%	78%	82%
63	14%	11%	37%	47%
64	47%	55%	61%	73%
65	49%	46%	63%	68%
66	37%	37%	54%	62%
67	0%	0%	27%	40%
68	52%	18%	65%	51%
69	72%	21%	80%	53%
70	1%	1%	28%	41%
71	29%	31%	48%	59%
72	0%	0%	27%	40%
73	51%	49%	64%	69%
74	17%	20%	39%	52%
75	15%	19%	38%	51%
76	75%	29%	82%	57%
78	4%	0%	30%	40%
79	54%	37%	66%	62%
81	20%	7%	42%	44%
83	37%	25%	54%	55%

Baseline reductions of TP = 27% & TSS = 40% were identified in the RR TMDL report on pages 25 & 27.
% TP reduction from no-controls = 27 + [0.73 x (% TP control in Appendix H)]
% TSS reduction from no-controls = 40 + [0.60 x (% TSS control in Appendix I)]
Reaches that are not listed above did not have a permitted MS4 within the reach.

Table developed by: Eric Rortvedt, DNR Stormwater Engineer
Dated: 9/16/2014

Attachment D: Lower Fox River Basin TMDL MS4 Annual Average Percent Reductions

Sub-Basin	TMDL Report TP reduction from baseline of 15%	TMDL Report TSS reduction from baseline of 20%	Calculated TP reduction from no-controls	Calculated TSS reduction from no-controls
East River	30.0%	40.0%	41%	52%
Baird Creek	30.0%	40.0%	41%	52%
Bower Creek	30.0%	40.0%	41%	52%
Apple Creek	30.0%	40.0%	41%	52%
Ashwaubenon Creek	30.0%	40.0%	41%	52%
Dutchman Creek	30.0%	40.0%	41%	52%
Plum Creek	30.0%	40.0%	41%	52%
Kankapot Creek	30.0%	40.0%	41%	52%
Garners Creek	63.1%	49.9%	69%	60%
Mud Creek	39.0%	28.5%	48%	43%
Duck Creek	30.0%	40.0%	41%	52%
Trout Creek	30.0%	40.0%	41%	52%
Neenah Slough	30.0%	40.0%	41%	52%
Lower Fox River Main Stem	30.0%	65.2%	41%	72%
Lower Green Bay	30.0%	40.0%	41%	52%

Baseline reductions of TP = 15% & TSS = 20%.
% TP reduction from no-controls = 15 + [0.85 x (% TP control in Lower Fox TMDL Report)]
% TSS reduction from no-controls = 20 + [0.80 x (% TSS control Lower Fox TMDL Report)]

Table checked by : Eric Rortvedt and Amy Minser, DNR Stormwater Engineers
Dated: 9/16/2014

CORRESPONDENCE/MEMORANDUM

State of Wisconsin

DATE: November 24, 2010

TO: Regional Water Leaders, Basin Leaders and Experts
Storm Water Permit Staff (via email)

FROM: Russ Rasmussen, Director, Bureau of Watershed Management
DNR Storm Water Permit Engineers

SUBJECT: Process to Assess and Model Grass Swales for ss. NR 151.13(2) and NR 216.07(6), Wis. Adm. Code - Total Suspended Solids Reduction

This document is intended solely as guidance, and does not contain any mandatory requirements except where requirements found in statute or administrative rule are referenced. This guidance does not establish or affect legal rights or obligations, and is not finally determinative of any of the issues addressed. This guidance does not create any rights enforceable by any party in litigation with the State of Wisconsin or the Department of Natural Resources. Any regulatory decisions made by the Department of Natural Resources in any matter addressed by this guidance will be made by applying the governing statutes and administrative rules to the relevant facts. ***This guidance document supersedes the guidance document on Dated April 24, 2008 and subsequent erratas dated August, 2008 and April, 2009.***

Issue

Under s. NR 151.13(2), Wis. Adm. Code, a municipality subject to the municipal storm water permit requirements of s. NR 216.07(6), Wis. Adm. Code, must implement a 20% reduction in total suspended solids (TSS), by March 10, 2008 or 24 months from coverage under the Municipal Separate Storm Sewer System (MS4) general permit, and a 40% TSS reduction by March 10, 2013. This memorandum provides DNR staff with guidance to advise affected municipalities and their consultants on how to evaluate grassed swales in the developed urban area for water quality credit. (This guidance does not address design of grassed swales to serve new development. The Vegetated Infiltration Swale, Interim Technical Standard, No. 1005 provides information on construction of new grassed swales.)

Discussion

To meet the requirements of the MS4 permit and the TSS reduction goal of s. NR 151.13(2), Wis. Adm. Code, a municipality must assess existing best management practices (BMPs) for TSS control and propose additional BMPs if the performance standard cannot be met with existing practices. One BMP available to many permitted municipalities is the grassed swale. This guidance provides a basis for assessing and modeling swales for TSS reduction to foster consistent application of this practice in all permitted municipalities. The goals of this guidance are to:

- Determine which water quality swales in the MS4 are eligible to receive TSS reduction credit, and
- Identify a typical swale geometry that can be considered representative. (It may be appropriate to develop more than one typical swale geometry if the swale characteristics in the MS4 are highly variable.)

DNR Guidance

Step 1. Identify which swales in the municipality can be considered water quality swales for the purpose of meeting the 20% and 40% TSS reduction goal.

The following apply to all swales in the developed urban area if they are to be considered water quality swales:

A. Swales are not required to have pretreatment swales or equivalent pretreatment.
B. The longitudinal slope must be less than 4% unless slope interruption devices are installed in the swales to ensure low flow velocities. Slope interruption devices must be consistent with Ditch Check Technical

Standard, No. 1062. Swales with slope interruption devices will be evaluated using a modified longitudinal slope of 1%.

C. The Department is concerned about channel scouring and re-suspension of previously settled particles in swales that are being used for MS4 pollutant removal credit. To address this concern, all swales should be inspected for visual evidence of scour. Swales with visual evidence of scour, such as channel cuts in the bottom or areas of bare soil, can not be included.

There are two ways of identifying water quality swales within an MS4:

A. If swale survey data is available, determine the locations of water quality swales and arrive at typical swale geometry based on statistical methods.

B. In the absence of survey data, a desktop and field survey would be appropriate. The desktop and field procedure is as follows:

1. Identify potential water quality swale areas by using available topographic, land use and soil information.

2. Based on results of the desktop evaluation, select a representative number of typical swale locations in the MS4 by conducting a field survey. A minimum of five locations should be selected. At each location:

   - Measure the width of the swale bottom using a tape measure.
   - For side slopes, measure the vertical drop over the level length using a carpenter's level and tape measure.
   - Select at least three cross-sections of the swale and average the results to determine the bottom width and side slopes.
   - Determine longitudinal slope using 2-ft contour mapping or other available topographic information.

3. Use the typical swale geometry that best represents each drainage area.

Step 2. Model the swales identified in **Step 1.** using a model such as SLAMM or P8.

When modeling swales in SLAMM or P8 the following must be considered:

How should drainage basins with a mix of swale and storm sewer conveyance systems be evaluated?

Drainage basins with a combination of swales and storm sewer should be subdivided by conveyance system type and the subdivisions modeled separately. In SLAMM, swales need to be modeled separately because drainage system type (e.g., swale vs. storm sewer) cannot be assigned to individual source areas.

Where swale density varies within a modeled area, the swale density should be an area weighted average across the model area. For example, if a 100 acre modeled area has 90 acres of residential land use with an average swale density of 359 ft/acre and 10 acres of strip commercial with an average swale density of 412 ft/acre then the area weighted average across modeled area is [(90 x 359) + (10 x 412)] / 100 = 364 ft/acre.

Table 1 identifies the average swale density used in the standard land use files from SLAMM version 9.2. It is recommended that rather than using these averages, the municipality should identify the actual swale density for each of the representative areas.

TABLE 1

Land use	Swale Density (ft/acre)
Low density residential	238
Medium density residential	359
High density residential	385
Strip commercial	412
Shopping centers	92
Industrial	265
Freeway (Shoulder only)	1309
Freeway (Shoulder and Center)	1964

Note: These average swale density figures are from the SLAMM version 9.2 Standard Land Use files available on the USGS website at: http://wi.water.usgs.gov/slamm/

Should swales be modeled using the "wetted perimeter" or "typical swale geometry" option?

The typical swale geometry option must be used. Both SLAMM and P8 calculate wetted perimeter from the geometry for each storm event, which is more accurate than a user selected defined wetted perimeter.

What Manning's "n" should be used for the typical swale geometry[1]?

A Manning's "n" value of 0.30 or less is recommended, based on type of vegetation, mowing height and depth of flow. Supporting documentation should be provided if Manning's "n" values greater than 0.30 are used

How should the infiltration rate be determined?

The guidance provided in the Site Evaluation for Stormwater Infiltration Technical Standard, No. 1002 should be followed. The swale infiltration rate should be determined based on the representative soil texture identified in the NRCS soil survey or other soil data if available. When the representative soil texture has been determined, the appropriate design infiltration rate should be selected from Table 2 of the Technical Standard, No. 1002. If the infiltration rate is measured in the field using a scientifically credible field test method, the measured value can be used for the static infiltration rate without using the correction factors in Table 3 of Technical Standard, No. 1002. **Prior to entering an infiltration rate in the model, the design infiltration rate from Table 2, or the measured infiltration rate must be reduced by 50%.** The SLAMM default "infiltration rate by soil type" values should not be used.

Existing language in Technical Standard 1002 V. Step C. 4.b indicates that a measured infiltration rate using a double-ring infiltrometer test must follow the requirements of ASTM D3385. While this may be appropriate for designing new swales, is there any flexibility for measuring an existing swale using a double-ring infiltrometer test?

To determine the static infiltration rate of existing swales using a double-ring infiltrometer the following modifications to procedures in ASTM D3385 are allowed:

While the dimension and materials used for the double-ring should be based on the requirements of ASTM D3385, the infiltration rate can be measured in a time frame of a minimum of 2 hours instead of 24 hours and the water level in both rings does not have to stay constant during the test. The following procedure is a more cost-effective

[1] SLAMM version 9.3 will adjust Manning's "n" based on flow, swale geometry and vegetative retardance classifications

approach to obtaining a reasonable estimate of the infiltration rate of existing grass swales. For most soil types the infiltration rate measured by the procedure should represent the soils under more saturated conditions. Sandier soil types might not be represented by saturated conditions, but the higher infiltration rate will probably represent reality for the duration of most storm events. The lowest infiltration rate observed is the one to be used for estimating the TSS reduction for the swales and is considered a static infiltration rate. The static rate should be cut in half to represent the dynamic infiltration rate in the model.

Field Test Procedure for Double-Ring Infiltrometer

1. Select a relatively flat test area so that the double-ring infiltrometer will not be placed at an angle.
2. Cut the grass to a height of between two to four inches.
3. Gently drive the infiltrometer into the ground.
4. Inspect the soil seal around each ring to make sure that it is even and smooth.
5. Pour clean water into the inner chamber and allow it to overflow and fill up the outer ring. Maintain a level in the outer ring approximately equal to the level in the inner ring.
6. Add more water to both rings when the level in the inner ring has dropped a measurable amount. For most soil types this should be less than an inch.
7. Repeat this step until the rate the water level drops begins to decline.
8. When the rate of decline begins to slow, bring the water level up to the top and start timing the decrease in water level.
9. Record the start time.
10. Stop timing when the water level in the inner ring has gone down a measureable level (the ASTM standard requires keeping the water level constant). Timing the rate of decline should probably be started almost immediately for more clayey soils, since it might be difficult to observe when the rate change has slowed.
11. Record the time, elapsed time, and change in water level.
12. Refill both rings and restart the timing.
13. Record the time, elapsed time, change in water level, and the elapsed time since the beginning of the first measurement.
14. Repeat the timing steps until the infiltration rate has become relatively constant or the test has been conducted for a minimum of two hours. (The ASTM standard requires 24 hours).
15. The measured rate of infiltration is considered a static infiltration rate. The dynamic infiltration rate is ½ the static rate. Be aware some models, such as WinSLAMM, call for the dynamic rate for swales.

I have taken a number of measurements along a swale length and have several infiltration rates to average. How do I average the results of my in-field tests?

The geometric mean(s) of infiltration testing results should be used. However, equally important is to consider whether the measured infiltration rates should be 'grouped' in order to apply separate geometric means to different areas in order to provide representative TSS results across a municipality. Grouping of results might be done based on soil type, spatial reasons or simply done as a method to help provide representative results. For instance, if there are several relatively low infiltration rates measured and the geometric mean of the entire data set is quite high, it may be prudent to group the relatively low rates together and assign them to a representative area.

Note: In order to calculate a geometric mean, the data set of values must be greater than zero. Where the infiltration rate is too low to measure, a rate of 0.03 in/hr may be used to calculate a geometric mean of the data set.

Are velocity calculations required?

The swales that were not eliminated by visual inspection should be evaluated for scour and re-suspension using the results of velocity or shear stress calculations conducted at the representative swale locations from **Step 1**. Velocity or shear stress calculations should be conducted based on the peak discharge rate for a 2-yr, 24-hr design event (or a reasonably equivalent event from the SLAMM or P8 rainfall file for the area) to verify that scour and re-suspension will not be a problem.

Do water quality swales need to meet the slope parameters identified in Vegetated Infiltration Swale, Interim Technical Standard, No. 1005?

If functioning as vegetated conveyance systems, swales with longitudinal slope less than 1% can be used. However, there is concern that swales with slopes less than 1% can clog. Where visual evidence indicates that the infiltration rate has been reduced (e.g., significant duration of ponded water or evidence of wetland vegetation), infiltration rates appropriate for clay soils should be used.

How do I model road runoff that sheet flows off the road and is dispersed with no apparent concentrated flow path?

For roads where runoff sheet flows off to the side of the road and is dispersed into adjacent pervious areas with no concentrated flow path in the vicinity, the roadway would be considered a disconnected impervious surface. Currently, SLAMM does not have the option of disconnecting a roadway, whereas rooftops and driveways can be disconnected. Therefore, an alternative method is needed to give treatment credit for such a system. If there is no concentrated flow path near the roadway and the runoff is dispersed as sheet flow across healthy vegetated areas, model this as a very broad, flat swale unless there is an option to model it as a vegetated filter strip.

Approved By:

Gordon Stevenson, Chief
Runoff Management Section

CORRESPONDENCE/MEMORANDUM

State of Wisconsin

DATE: November 24, 2010

TO: Regional Water Leaders, Basin Leader & Experts
Stormwater Permit Staff (via Email)

FROM: Russ Rasmussen, Director
Bureau of Watershed Management

SUBJECT: Developed Urban Areas and the 20% and 40% TSS Reductions
Sections NR 151.13(2) and NR 216.07(6), Wis. Adm. Code

This document is intended solely as guidance, and does not contain any mandatory requirements except where requirements found in statute or administrative rule are referenced. This guidance does not establish or affect legal rights or obligations, and is not finally determinative of any of the issues addressed. This guidance does not create any rights enforceable by any party in litigation with the State of Wisconsin or the Department of Natural Resources. Any regulatory decisions made by the Department of Natural Resources in any matter addressed by this guidance will be made by applying the governing statutes and administrative rules to the relevant facts. ***This document supersedes the guidance memo dated June 6, 2005, subsequent errata dated 8/15/05 and April, 2009 and the guidance memo dated May 14, 2010.***

Issue

Under s. NR 151.13 (2), Wis. Adm. Code, a municipality subject to the municipal stormwater permit requirements of subch. I of ch. NR 216, Wis. Adm. Code, must, to the maximum extent practicable, implement a 20% and a 40% reduction in total suspended solids in runoff that enters waters of the state as compared to no controls, by March 10, 2008 and March 10, 2013, respectively. Staff who work with affected municipalities need guidance on what areas under the municipalities' jurisdictions will be included in this requirement. They also need to know what is meant by "no controls" and "with controls", and what methods are acceptable for making these calculations.

Discussion

Chapter NR 216, Wis. Adm. Code, is the implementation code for the developed urban area performance standard. Applicability for permit coverage purposes is dictated by s. NR 216.02, Wis. Adm. Code. Under this provision, owners or operators of the following municipal separate storm sewer systems (MS4s) are required to obtain coverage under a WPDES municipal stormwater permit:

- MS4s serving populations of 100,000 or more.
- Previously notified owners or operators of municipal separate storm sewer systems.
- MS4s within urbanized areas as identified by EPA.
- MS4s serving populations over 10,000 unless exempted by DNR.

"MS4" is defined under s. NR 216.002 (17), Wis. Adm. Code, as a conveyance or system of conveyances, including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, constructed channels or storm drains, which meets all the following criteria:

- Owned or operated by a municipality.
- Designed or used for collecting or conveying stormwater.
- Not a combined sewer conveying both sanitary and stormwater.

- Not part of a publicly owned wastewater treatment works that provides secondary or more stringent treatment.

"Waters of the state" is defined under s. 283.01 (20), Stats., and it includes surface water, wetlands and groundwater. Waters of the state may overlap with the definition of MS4. For this purpose, if a waterway meets the definition of an MS4, it will be regulated as an MS4. The significant language in that definition is whether or not the municipality owns or operates the drainage way (i.e., maintains, has easement access for work, dredges, etc.). For example, when a "stream" is designed or used for collecting or conveying stormwater such as flowing through a municipally owned or operated culvert or bridge restriction, that "stream" is part of the MS4.

Under s. NR 216.07 (6)(a), Wis. Adm. Code, a municipality must develop a stormwater management program to achieve compliance with the developed urban area performance standard (s. NR 151.13 (2), Wis. Adm. Code). Developed areas are generally those that were not subject to the post-construction performance standards (s. NR 151.12 or NR 151.24, Wis. Adm. Code). The total suspended solids control requirements of s. NR 151.13 (2)(b)1.b. and 2., Wis. Adm. Code, may be achieved on an individual municipal basis. Control does not have to apply uniformly across the municipality. The control may also be applied on a watershed or regional basis by involving several municipalities. However, note that the Department is proposing to revise s. NR 151.12, Wis. Adm. Code, to limit the geographic extent of the watershed or regional area that municipalities may collectively meet the developed urban area standard.

A municipality is required under s. NR 216.07 (6)(b), Wis. Adm. Code, to provide an assessment of the actions taken to comply with the performance standards. This assessment may take the form of an annual progress report. The initial assessment must include a pollutant-loading analysis using a model such as SLAMM, P8 or equivalent methodology that is approved by the department. At a minimum, a pollutant-loading analysis must be conducted for total suspended solids and phosphorus. A model would not be run again after the initial assessment unless significant management changes occurred that should be accounted for, or the progress report indicates a re-run is necessary.

DNR Guidance

To comply with the code, the developed urban area must be modeled under a "no control" condition and a "with controls" condition. The 20% and 40% TSS reductions are assessed against the "no control" condition for the entire area served by the MS4 as defined below. They are not applied uniformly across the municipality, nor are they applied drainage area by drainage area within the municipal boundary. In most cases however, a calculation drainage basin by drainage basin will be used to determine the total loading and the achieved reductions.

Areas Required to be Included in the Calculations

A municipality must include the following areas when calculating compliance with the developed urban area standard (s. NR 151.13, Wis. Adm. Code):

1. Any developed area that was not subject to the post-construction performance standards of s. NR 151.12 or 151.24, Wis. Adm. Code, for new development only, that drains to the MS4 owned or operated by the municipality. The baseline developed urban area does not change due to future redevelopment of existing urban areas.
2. Any area covered by an NOI submitted prior to October 1, 2004 where development is still underway. The pollutant load shall be based on full build out. If it is known that the future development of some parcels may require compliance with s. NR 151.12 or NR 151.24, Wis. Adm. Code, then these areas may be excluded from the calculation.
3. Any undeveloped (in-fill) areas under 5 acres. These areas must be modeled as fully developed, with a land use similar to the properties around them.
4. For municipalities with large areas of agricultural lands separating areas of development, only the developed areas within the urbanized area as defined by the U.S. Census Bureau.

5. Non-manufacturing areas of industrial facilities such as customer or employee parking lots. (The manufacturing, outside storage and vehicle maintenance areas of these industrial facilities are covered under subch. II of ch. NR 216, Wis. Adm. Code, industrial permit.)
6. Any industry that has certified a condition of "no exposure" in accordance with s. NR 216.21(3), Wis. Adm. Code.
7. Any connecting highways as identified and listed in the Official Highway State Truck Highway System Maps at: http://www.dot.wisconsin.gov/localgov/highways/connecting.htm

Areas Prohibited from Inclusion in the Calculations
Areas and loadings that shall not be included:
1. Lands zoned for agricultural use and operating as such.
2. Pollutant loadings from an upstream MS4 (independent of whether it is regulated under a ch. NR 216, Wis. Adm. Code, permit) unless the municipality has an agreement to share the pollutant control credit with the upstream municipality.
3. Undeveloped land parcels over 5 acres within the municipality. These areas will be subject to the new development post-construction performance standards of s. NR 151.12 or 151.24, Wis. Adm. Code, when developed.
4. Any internally drained area with <u>natural</u> infiltration. (This does not include engineered or constructed infiltration areas.) However, a separate guidance memo dated April 6, 2009 (Subject: Developed Urban Areas and the 20% and 40% Reductions - Internally Drained Areas) provides conditions under which an internally drained area may be included in the calculation.
5. Any active or inactive mining site unless it has been reclaimed into another land use. The pollutant load associated with a mining site is not included in the calculation. However, runoff which drains into a mining site would be eligible for treatment credit in accordance with the April 6, 2009 guidance memo.
6. Areas subject to the new development performance standards of s. NR 151.12, Wis. Adm. Code.

Optional Areas to Include in the Calculations
Areas a municipality may, but is not required to, include in the developed urban area load calculation:
1. Property that drains to *waters of the state* without passing through the permittee's MS4.
2. Any area that discharges to an adjacent municipality's MS4 (Municipality B) without passing through the jurisdictional municipality's MS4 (Municipality A). Municipality B that receives the discharge into their MS4 may choose to be responsible for this area from Municipality A. If Municipality B has a stormwater treatment practice that serves a portion of A as well as a portion of B, then the practice must be modeled as receiving loads from both areas, independent of who carries the responsibility for the area. However, if runoff from an area within Municipality A's jurisdiction drains into Municipality B's MS4 but then drains back into Municipality A's MS4 farther downgradient, then Municipality B does not have the option of including the load from Municipality A in their analysis and the load from that area is Municipality A's responsibility.
3. Industrial facilities subject to a permit under subch. II of ch. NR 216, Wis. Adm. Code, except the pollutant load associated with an active or inactive mining site. This exclusion covers the facilities that are required to have permit coverage. Contact the regional stormwater specialist or central office to get a list of permitted facilities within a municipality.
    - The industrial NR 216 permit covers areas with industrial materials and activities, specifically areas with manufacturing, vehicle maintenance, storage of materials, etc.

A municipality may include any of the areas identified above in their developed urban area as part of their load calculation provided the areas are not prohibited from inclusion in the calculation. If they choose to include an area, it must be included in both the "no controls" and "with controls" condition. Inclusion of areas they choose to be responsible for will allow them to take credit for any of those areas that may have controls in place. For example, if an industrial park would have been excluded because all the industries in the industrial park have an NR 216 industrial permit, but the municipality chooses to keep this area in their "no controls" area, then any best management practices existing or built to serve the industrial park can be included in the "with controls" scenario.

Model Inputs

Model Version:
To model the TSS load in the area served by the MS4, the municipality must select a model such as SLAMM, P8 or an equivalent method deemed acceptable by the Department. For the analysis to show compliance with the 40% developed urban area performance standard, SLAMM version 9.2 or P8 version 3.4 or a subsequent version of these models may be used. As part of the reporting process, the municipality must identify which model version is being used. The analysis must use the same version for both the "no controls" scenario and the "with controls" scenario unless it is verified that the "no controls" pollutant discharge load does not change between the model versions. If there is a change in the no controls pollutant discharge load then the new pollutant discharge load corresponding with the version of the model selected for the analysis needs to be utilized. An entire city-wide municipal "no controls" scenario does not need to be remodeled, only those areas being updated with the new version of the model.

"No control"
In SLAMM, the "no controls" condition generally will be based on the standard land use files for different land uses. This assumes certain default parameter files, an assumed level of disconnection and an assumed distribution of road smoothness. The "no controls" condition for each land use is based on this assumed percent of disconnected imperviousness. All land uses as modeled must be equal to the connected imperviousness values in the standard land use files unless site specific data is available. However under the "with controls" condition, land use that has a greater level of disconnection than the values in the standard land use files may take credit for volume and pollutant reduction. In P8, the help menu provides standard land use values that can be used for the percent directly connected versus indirectly connected impervious surfaces.

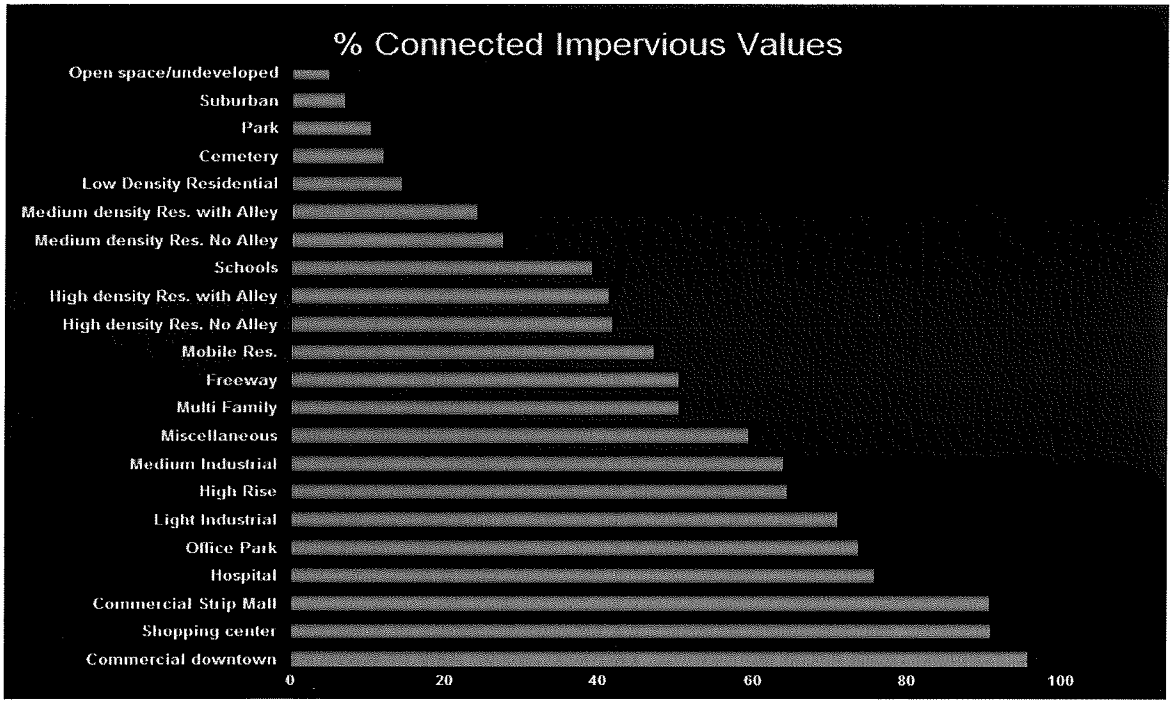
All roads within the urbanized area that are part of a county or town's MS4 are the responsibility of the county or town. To generate a load under "no controls", model the road based on the nearest urban land use, even if agricultural land use is on one or both sides of the road. Select the urban land use that will most likely typify the traffic that will be on that road (for example commercial or residential) and include that area in the corresponding standard land use file.

For the drainage system, the default will be curb and gutter (even if the drainage system is currently swale drainage), in fair condition. For "no controls" there will be no recognition of street sweeping, catch basin cleaning, swale drainage, or the existence of any engineered best management practices. These practices and facilities will be accounted for under the "with controls" condition.

A municipality is not required to use the standard land use files if it has surveyed the land uses in its developed urban area and has "real" source area data on which to base the input files. The percent connected imperviousness must be verified in the field. Disconnection may be assumed for residential rooftops where runoff has a flow path of 20 feet or greater over a pervious area in good condition. Disconnection for impervious surfaces other than residential rooftops may be assumed provided all of the following are met:

- The source area flow length does not exceed 75 feet,
- The pervious area is covered with a self-sustaining vegetation in "good" condition and at a slope not exceeding 8%,
- The pervious area flow length is at least as long as the contributing impervious area and there can be no additional runoff flowing into the pervious area other than that from the source area.
- The pervious area must receive runoff in a sheet flow manner across an impervious area with a pervious width at least as wide as the contributing impervious source area.

The table below shows the overall percent connected imperviousness that is associated with SLAMM standard land use files. The overall percent disconnection shown in this table is not input into SLAMM as the percent disconnection, rather the individual road, roof top, sidewalk, etc. areas have their own individual connectedness included in the standard land use files.



<u>"With controls"</u>
The "with controls" condition is applied to the developed urban area with the inclusion of the practices and facilities (existing and proposed). Modeling is a means to confirm a practice's efficiency for the conditions found in Wisconsin. If the model cannot predict efficiencies for certain practices that the municipality identifies as water quality practices, then a literature review must be conducted to estimate the reduction value. Proprietary stormwater practices that utilize settling as their means of solids reduction should be modeled in accordance with DNR Technical Standard 1006 (Method for Predicting the Efficiency of Proprietary Storm Water Sedimentation Devices).

When designing treatment practices, runoff draining to the practice from off-site must be taken into account in determining the treatment efficiency of the practice. Any impact on the efficiency must be compensated for by increasing the size of the practice accordingly.

Practices on private property that drain to an MS4 can be included in the "with controls" scenario for a municipality, provided the municipality enters into an agreement or equivalent enforceable mechanism with the stormwater treatment facility owner that will ensure the practice is properly maintained. An operation and maintenance plan, including a maintenance schedule, must be developed for the stormwater treatment facility in accordance with relevant DNR technical standards. The agreement or equivalent mechanism between the municipality and the private owner should include the following:

- A description of the stormwater treatment facility including dimensions and location.
- Identify the owner of the property on which the stormwater treatment facility is located.
- Identify who is responsible for implementing the operation and maintenance plan.
- Outline a means of terminating the agreement that includes notifying DNR.

The efficiency of the practice on private property must be modeled using the best information the municipality can obtain on the design of the practice. For example, permanent pool area is not sufficient information to know the pollutant reduction efficiency of a wet detention basin even if it matches the area requirements identified in Technical Standard 1001 Wet Detention Basin for an 80% reduction. Information on the depth of the wet pool and the outlet design are critical features that determine whether a detention pond is providing 80% TSS reduction.

Further clarifications

- If a portion of a municipality's MS4 drains to a stormwater treatment facility in an adjacent municipality, the municipality generating the load will not receive any treatment credit due to the downstream municipality's treatment facility unless there is an inter-municipal agreement where the downstream municipality agrees to allow the upstream municipality to take credit for such treatment. DNR anticipates that such an agreement would have the upstream municipality assist with the construction and/or maintenance of the treatment facility. This contract must be in writing with signatures from both municipalities specifying how the treatment credit will be shared.

- The model results will be the basis for determining compliance with the permit for "no controls" and "with controls" TSS load.
- For reporting purposes, the pollutant load must be summarized as the cumulative total for the developed urban area served by the MS4. Additionally pollutant loads for grouped drainage areas as modeled shall also be reported. Drainage areas may be grouped at the discretion of the modeler for such reasons as to emphasize higher priority areas, balance model development with targeting or for cost-effectiveness.
- No credit should be taken for sweeping of non-curbed streets.
- The additional runoff volume from areas that are exempt or outside of the developed urban area to which the TSS standard applies needs to be accounted for when it drains into the treatment device. The pollutant load can be "turned off" but the runoff hydrology needs to be accounted for to properly calculate the treatment efficiency of the device.
- Due to concerns of sediment resuspension, basins with an outlet on the bottom are generally not eligible for pollutant removal based solely on settling. However, credit may be taken for treatment due to infiltration or filtration. Features to prevent scour should always be included for any practice where appropriate.
- When street cleaning is applied across a watershed with devices that serve only certain areas within the watershed, it is acceptable to first take credit for street cleaning across the entire watershed but then the treatment efficiency for devices must be reduced by the efficiency of the street cleaning to prevent double counting.
- To model a combination of mechanical broom and vacuum assisted street cleaning, it may require an analysis of several model runs depending on the timing of the mechanical and vacuum cleaning. If mechanical broom and vacuum cleaning occur at generally the same time (e.g. within two weeks of each other) then only the removal efficiency of the vacuum cleaning should be taken. If the municipality performs broom sweeping in the spring or fall and vacuum clean the remained of the year, calculate the combined cleaning efficiency using the following method:
  (A) Model the entire street cleaning program as if entire period is done by a mechanical broom cleaner.
  (B) Model just the period of time for vacuum cleaning (do not include the mechanical broom cleaning).
  (C) Model the same period as B) but with a mechanical broom.
  (D) The overall combined efficiency would be A + B – C.

WinSLAMM clarification:

- WinSLAMM 9.3.4 and earlier versions of WinSLAMM result in double counting of pollutant removal for most treatment practices modeled in series. WinSLAMM 9.2 and subsequent versions contain warnings to help alert modelers of this issue. The modeler will need to make adjustments to ensure that the results do not include double credit for removal of the same particle size. PV & Associates has created a document titled 'Modeling Practices in Series Using WinSLAMM' which helps to guide a user as to whether and or how certain practices can be modeled in series and this document is available at: http://winslamm.com/Select_documentation.html

P8 clarifications

- P8 does not account for scour and sediment resuspension. DNR requires that a wet basin with less than a 3-foot permanent pool have its treatment efficiency reduced. A basin with zero permanent pool depth should be considered to get zero credit for pollutant removal due to settling and a basin with 3 or more feet of permanent pool depth can be given the full pollutant removal efficiency credited by settling. The pollutant removal efficiency may be given straight-line depreciation such that a basin with a 1.5 foot-deep permanent pool would be eligible for 1/2 the pollutant removal efficiency that would be credited due to settling.
- A device that DNR gives no credit for pollutant removal may still be modeled if it is in series with other practices because of its benefit on runoff storage capacity that may enhance the treatment efficiency of downgradient treatment devices. To do so, turn the treatment efficiency off in P-8.

- P8 starts its model runs with no water in the basins. P8 should be started an extra year before the "keep dates", in order to allow the model to fill up ponds to the lowest outlet elevation.

Approved By:

Gordon Stevenson

Gordon Stevenson, Chief
Runoff Management Section

CORRESPONDENCE/MEMORANDUM

State of Wisconsin

DATE: April 6, 2009

TO: Regional Water Leaders, Basin Leader
Storm Water Permit Staff (via Email)

FROM: Russ Rasmussen, Director
Bureau of Watershed Management

SUBJECT: Developed Urban Areas and the 20% and 40% TSS Reductions
Internally Drained Areas

This document is intended solely as guidance, and does not contain any mandatory requirements except where requirements found in statute or administrative rule are referenced. This guidance does not establish or affect legal rights or obligations, and is not finally determinative of any of the issues addressed. This guidance does not create any rights enforceable by any party in litigation with the State of Wisconsin or the Department of Natural Resources. Any regulatory decisions made by the Department of Natural Resources in any matter addressed by this guidance will be made by applying the governing statutes and administrative rules to the relevant facts.

Issue

The Department of Natural Resources June 6, 2005 guidance memo, *Developed Urban Areas and the 20% and 40% TSS Reductions*, addresses areas prohibited from inclusion in the municipal modeling calculations including the following on page 3 of the guidance:

3. "Any internally drained area with natural infiltration. (This does not include engineered or constructed infiltration areas). However, an internally drained area that discharges to a karst feature is not likely to be receiving adequate treatment prior to contact with the groundwater. The municipality is encouraged to look at this area for possible treatment options."

Some municipal separate storm sewer systems (MS4s) contain areas that are internally drained, but drain to a constructed pond or quarry with no outlet under observed runoff event conditions. There are questions on how these areas could be included in the municipal analysis to demonstrate compliance with the developed urban area total suspended solids (TSS) performance standard of s. NR 151.13(2), Wis. Adm. Code.

Discussion

An internally drained area is an area where runoff from the MS4 does not enter a surface water of the state including wetlands. Determining if an area is internally drained may be made from aerial photos or historic data. If runoff from storm events up to a 10-year, 24-hour event does not leave the depression area, then this area is considered internally drained and shall not be included in the developed urban area analysis (i.e. not included in the base condition or any subsequent scenarios). If runoff leaves the depression area during lesser storm events, then this area is not internally drained and the drainage area to the depression area must be included in the developed urban area analysis.

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DNR Guidance

Notwithstanding the discussion above, there are situations where an internally drained area may be included in the analysis. For this to happen, all of the following conditions must be met:

1. Consistent with s. NR 151.12(5)(c)8., Wis. Adm. Code, the discharge of runoff from the MS4 into an internally drained area must to the extent technically and economically feasible minimize the level of pollutants infiltrating to groundwater and shall maintain compliance with the preventive action limit at a point of standards application in accordance with ch. NR 140, Wis. Adm. Code. However, if site specific information indicates that compliance with a preventive action limit is not achievable, the infiltration practice may not be installed or shall be modified to prevent infiltration to the maximum extent practicable. The municipality must assess the usual or potential presence of any toxic pollutant, the degradability of the pollutant and the capacity of the soil to remove the pollutant. A discharge to groundwater must remain below the enforcement standard at the point of standards application.

Note: Also consistent with s. NR 151.12(5)(c)5.i., Wis. Adm. Code, the following characteristics are believed to be protective of groundwater for the treatment of storm water: The soils between the bottom of an infiltration practice and the seasonal high groundwater or top of bedrock have at least a 3−foot soil layer with 20% fines or greater; or at least a 5−foot soil layer with 10% fines or greater or where the soil medium within the infiltration system provides an equivalent level of protection. "Percent fines" means the percentage of a given sample of soil, which passes through a # 200 sieve.

2. Any runoff from parking lots or roads in commercial, institutional or industrial areas directed into an internally drained area shall be pretreated to help prevent clogging of the internally drained area.

3. If the area is not owned by the municipality, then the municipality must have a long-term maintenance agreement in place with the property owner to ensure that the internally drained area will be maintained. If the municipality owns the area, then the municipality must include maintenance of the area in its storm water management program.

Where conditions 1-3 are met, internally drained areas can be included in the developed urban area analysis. Additional runoff may be directed to an internally drained area meeting conditions 1-3. One hundred percent credit for TSS removal may be taken for the runoff that stays within the internally drained area.

Department staff will assist in evaluating these determinations prior to allowing credit for TSS reduction from internally drained areas on a case by case basis. There may also need to be a determination regarding natural water features in the depression area prior to the Department's concurrence that these areas can be used toward the TSS removal credit.

Approved By:

Gordon Stevenson, Chief
Runoff Management Section

Mary Anne Lowndes
Storm Water Engineer

City of Oshkosh Specific WDNR Correspondence

Comments on modeling are shown below. Comments have been categorized as follows:

A. Issues that have the potential to address the overall modeling results significantly. Please address before finalizing modeling.
B. Issues likely to have a minor impact on overall modeling results on an individual basis, but may cumulatively impact the overall results. Please address as many of these as possible before finalizing modeling.
C. Informational comments—No action is required at this time.

Comment No.	Comment Category	Comment applies to analysis for the following purposes	Comment	Response
1.	B	NR 216 and TMDL	Approximately 70 acres near the intersection of W Ripple Ave and S. Washburn St. appears to be campground but it is coded as agricultural and therefore excluded from the analysis. This area does not appear on aerial photos to be utilized for agricultural purposes and therefore should be assigned a land use that more closely fits its use. It should be included in the analysis for both NR 216 and TMDL.	NR -216 – The situation was reviewed. Since this land use was agriculture in 2004, it will remain coded as agricultural for the MS4 analysis. TMDL – The situation was reviewed and the identified areas are now modified to reflect the appropriate land use.

<table>
<tr><th>Comment No.</th><th>Comment Category</th><th>Comment applies to analysis for the following purposes</th><th>Comment</th><th>Response</th></tr>
<tr><td>2.</td><td>B</td><td>NR 216 and TMDL</td><td>The Pollutant Loading analysis should include all areas that the City has maintenance jurisdiction over. For State Highways, overpasses where the City has maintenance jurisdiction should be included in the City's analysis. Examples are:
1. County Road N over US 41
2. W. 20th Ave over US 41
3. W. 9th Ave over US 41
4. Witzel Ave over US 41
5. W. Snell Rd. over US 41

The above overpasses represent a relatively small area overall but are noted for future reference.</td><td>The City has sent a MOU to the County in 2009 to confirm who has jurisdiction over the various State Highways. This formal status of "maintenance jurisdiction" is pending with the County for resolution. The draft MOU can be found in Attachment 1. Current anticipated responsibilities are noted in the comments section.

The City will continue to work with respective agencies and will incorporate loadings and reductions accordingly. This will not be accomplished in this SWMP update cycle. These modifications will not have a significant impact on the results of implementation plan of the study.</td></tr>
</table>

Comment No.	Comment Category	Comment applies to analysis for the following purposes	Comment	Response
3.	B	NR 216 and TMDL	Generally given BMP, particularly a wet pond, serves only area from a single watershed. Area from the following watersheds have all been assigned to the Winnebago County Mental Health BMP and TSS and TP removals of 0.73 and 0.47 respectively: • East Snell Road (379.74 acres) • Fernau Ave (0.32 acres) • Green Valley Road (13.17 acres) • Neenah Slough (0.12 acres) • Sherman Road South (20.67 acres) Looking at the WinSLAMM for Winnebago Cty Mental Health v2, it has two ponds (not in series) as follows: • Main Park Pond (500.977 acres)-71% TSS reduction, 47% TP reduction • Coughlin Center Pond (23.26 acres)-92% TSS reduction, 65% TP reduction It appears that the Main Park Pond discharges within the East Snell Road watershed and the Coughlin Center Pond discharges to the Sherman Road South watershed MS4 system. If the source areas do drain to these ponds, then the source areas should be assigned to the watershed they drain to and have pollutant removals consistent with the pond they drain to. This is also an issue for the following BMP's: • 400 E. Main Parking Lot • Deerfield Village • Winnebago Cty Sheriffs Dept.	• The situation was reviewed and the identified areas are now modified to reflect the appropriate watershed name. • The model for the Winnebago Cty Mental Health area does have the BMPs in series. They are in the same model, but in parallel systems. The overall weighted reduction was applied to both of the sites rather than modeling each site individually which results in the same reduction overall from the site. • The situation was reviewed and the identified areas are now modified to reflect the appropriate watershed name.

Comment No.	Comment Category	Comment applies to analysis for the following purposes	Comment	Response
4.	A	NR 216 and TMDL	The Pollutant Loading analysis includes all County roadway Right-of-way and several large County-owned parcels. Please provide documentation of maintenance agreements with Winnebago County clarifying which areas are under the maintenance jurisdiction of the City. Please provide the Department with any existing agreements to take credit from pollutant removal from areas under County maintenance jurisdiction and large parcels owned by the county. Any areas for which an agreement is not currently in place may be modeled but must be quantified separately and the City may not take credit for pollutant loading and removal until the necessary agreements are in place.	County ROW areas that were identified by the County as their MS4 responsibility are excluded from the analysis (see excluded areas map of the Oshkosh SWMP report and attached figure of County ROW used to establish excluded areas) As noted previously, an MOU with the County has been initiated. The City will continue to work with respective agencies and will incorporate loadings and reductions accordingly. This will not be accomplished in this SWMP update cycle. While future modifications to these ROW areas would change final loading results, we feel that it would not have an significant impact on the results overall nor impact the City's meeting of the current MS4 reduction requirements or change the implementation plan of this study. Larger parcels, such as, the airport swales, are subject to the stormwater utility credit which required maintenance and reporting. See the Airport Stormwater Management Report example in Attachment 2. Section 4.7 explains the maintenance agreement. The larger parcels are included and identified in the report and can be tracked individually.

Comment No.	Comment Category	Comment applies to analysis for the following purposes	Comment	Response
5.	A	NR 216 and TMDL	The Pollutant Loading analysis includes the entire UW Oshkosh campus. Please provide the Department with any existing agreements to take credit from pollutant removal from the UW Oshkosh MS4 area. Any areas for which an agreement is not currently in place may be modeled but must be quantified separately and the City may not take credit for pollutant loading and removal until the necessary agreements are in place.	The City was working with UWO on a MOU to define roles and responsibilities. This is pending with UWO for resolution, since April 26, 2012 (See attached draft MOU in Attachment 5). The City will continue to work with UWO. Since, UWO is anticipated to become City responsibilities it is included and quantified separately in report.

Comment No.	Comment Category	Comment applies to analysis for the following purposes	Comment	Response
6.	B	NR 216 and TMDL	A comparison of select Base Load WinSLAMM runs to the Street Cleaning WinSLAMM runs were made to determine if the No-controls source areas matched the with controls conditions. It was found that for Rail-Clay Soils, the base load source areas did not match the source areas modeled for the with controls condition (for example, the acres of roof and parking area was not the same). A subsequent comparison of the 'NC Particulate Solids Yield (lbs)' column in the Base Loads.xls file (for clay soils only) used to calculate no-controls and with controls loadings demonstrated that the following land uses are likely overestimating or underestimating pollution loadings due to differences in the source areas: • Airport • Light Industrial • Multi-family Residential With Alleys • Medium Industrial • Railroad	The situation was reviewed and the identified source areas are now modified.

<table>
<tr><th>Comment No.</th><th>Comment Category</th><th>Comment applies to analysis for the following purposes</th><th>Comment</th><th>Response</th></tr>
<tr><td>7.</td><td>B</td><td>NR 216 and TMDL</td><td>Land Use assignments between Base condition and Existing condition should be consistent. The following variations were noted:
<table>
<tr><td>3rd Ave</td><td>LI</td><td>UWO</td><td>1.33</td></tr>
<tr><td>Campbell Creek</td><td>SCOM</td><td>UWO</td><td>4.34</td></tr>
<tr><td>Dawes St</td><td>LI</td><td>MFRNA</td><td>0</td></tr>
<tr><td>Division St</td><td>LI</td><td>MFRNA</td><td>0.29</td></tr>
<tr><td>Division St</td><td>LI</td><td>MI</td><td>1.68</td></tr>
<tr><td>Division St</td><td>LI</td><td>SCOM</td><td>8.37</td></tr>
<tr><td>N/A</td><td>LI</td><td>MI</td><td>0.09</td></tr>
<tr><td>N/A</td><td>LI</td><td>UWO</td><td>0.04</td></tr>
<tr><td>Nebraska St</td><td>LI</td><td>MFRNA</td><td>0.99</td></tr>
<tr><td>Osceola St</td><td>LI</td><td>UWO</td><td>0.47</td></tr>
<tr><td>Osceola St</td><td>SCH</td><td>UWO</td><td>2.81</td></tr>
<tr><td>Sawyer Creek</td><td>OSUD</td><td>LDR</td><td>0</td></tr>
<tr><td>South Main St</td><td>LI</td><td>MFRNA</td><td>0.33</td></tr>
<tr><td>Total</td><td></td><td></td><td>20.74</td></tr>
</table></td><td>This comment was discussed with the WDNR during the review process and the identified sites will remain as is. Since, the land use on the parcels changed, it is appropriate for the analysis that they are assigned different land uses between base and existing conditions.</td></tr>
</table>

Comment No.	Comment Category	Comment applies to analysis for the following purposes	Comment	Response
8.	C	NR 216 and TMDL	Michel's Materials Oshkosh Quarry (111 acres) is identified in mapping as isolated but per DNR records this site is externally drained with pit dewatering. Therefore it cannot be excluded as 'internally drained' but could be excluded as a production area of a permitted industrial site.	This comment was discussed with the WNDR during the review process and the coding of this site was revised to "Quarry -Permitted Industrial" instead and will still be excluded from the analysis.
9.	A	NR 216 and TMDL	No field verification documentation has been provided for grass swales. Grass swale conditions and geometry should be reviewed per DNR Guidance "Process to Assess and Model Grass Swales" at http://dnr.wi.gov/topic/stormwater/documents/GrassSwales080424.pdf Swales that were not eliminated by visual inspection should be evaluated for scour and re-suspension using the results of velocity or shear stress calculations as identified in the guidance. This is a particular concern for swales that receive water from piped systems and/or drain large areas.	A summary of the swale field verification was provided to WDNR (Sue Larson and Gus Glaser) on 2-7-2013 via email. Concurrence with approach was reached with WDNR on April 4, 2013. See Attachment 3 for the documentation of the correspondence with WNDR.

Comment No.	Comment Category	Comment applies to analysis for the following purposes	Comment	Response
10.	A	NR 216 and TMDL	Given the variability of the swale infiltration rates measured during 2-hour double ring infiltrometer tests, these values should not be used individually. The values should be grouped and then a geometric mean established for each group. The Department suggests grouping the values on a macro-watershed basis (for example, grouping the test values for swales draining into Lake Butte des Morts and grouping the test results for swales draining into Lake Winnebago). A practical maximum infiltration rate should also be discussed if modeled swale discharges do not correlate with observed discharges during rain events. This also applies to the 'airport swales' modeling.	Methods for approaching and using the site specific infiltration information were discussed with WDNR in the past. The method currently applied was approved as noted in the email exchange with WDNR (Sue Larson and Gus Glaser) between 2/7 and 4/4 2013. See Attachment 3 for the documentation of the correspondence with WNDR. This comment was again discussed with the WDNR during the review process for these comments. The City will leave the modeling as is for this SWMP report since it was conducted based on the best know representation of the areas in question and approved by WDNR. The City would be open to modifying the approach taken in the future should WDNR guidance on this subject change.

Comment No.	Comment Category	Comment applies to analysis for the following purposes	Comment	Response
11.	A	NR 216 and TMDL	For SW04, the Department has the following comments: a. Please provide a map showing the assumed drainage area and the conveyance types for each area. b. Credit for street cleaning can only be taken for curbed streets c. There appears to be a mixture of areas served directly by swale conveyance systems and areas with piped systems that may outlet to swale systems. These areas should be subdivided to correctly apply the swale treatment to the applicable areas. d. Please address infiltration rates and provide field verification documentation and velocity calculations as requested in the comments above. e. Please exclude any length of swale that shows visual evidence of significant duration of ponded water.	The report includes a map showing the swale drainage areas. See Attachment 3 for the documentation of the correspondence with WNDR. This comment was discussed with the WDNR during the review process. We believe that the modeling for swale and C&G areas with street cleaning are applied properly.

Comment No.	Comment Category	Comment applies to analysis for the following purposes	Comment	Response
12.	A	216 and TMDL	Street cleaning appears to have been modeled using a mix of mechanical and vacuum assisted street cleaning equipment. The 2008 City of Oshkosh storm water management plan assumed all vacuum assisted street cleaners. Please provide a summary of what type of equipment and what the frequency of sweeping is under current conditions. Modeling using a combination of mechanical broom street sweepers and vacuum assisted street cleaners should be completed per page 6 of the MS4 Modeling - NR 151.13 (20/40% TSS Standard) guidance (http://dnr.wi.gov/topic/stormwater/documents/Guidance_TSS.pdf)	The mechanical broom street cleaner is used more heavily in spring time and in areas with heavier debris (such as construction sites), often prior to a HE cleaner pass. Otherwise HE cleaning is applied city-wide year round. We feel that the approach and blend of street cleaners used in appropriate WinSLAMM files by prorating the street cleaning types over the source areas and is a reasonable representation of this mix of street cleaning. If anything, the method employed for modeling street cleaning may be slightly conservative.
13.	A	216 and TMDL	The 9th and Washburn Regional pond is not an 'existing BMP' as it has not been constructed yet (permit applications have been submitted to the Department and are pending). Therefore it should be listed as a proposed BMP in the storm water management plan. The WRAPP submittal includes modeling with a 356 acre drainage area but the database only includes 275 acres as draining to the BMP. Please verify the drainage area served by this BMP and make updates as needed.	The 9th and Washburn Detention Basin is now listed as a proposed BMP.

Comment No.	Comment Category	Comment applies to analysis for the following purposes	Comment	Response
14.	A	216 and TMDL	Please provide location information for regional ponds at 9th & Washburn Westhaven, South Park Ave, and Westhaven Club House. If these ponds have not yet been installed, then they may not be included as existing BMP's but should be listed as proposed.	The report includes a figure identifying all BMPs.
15.	B	216 and TMDL	The BMP at 1200 Koeller St does not appear to be holding water on the current Google Maps aerial photo. If this BMP is not being maintained such that there is permanent pool then credit cannot be taken for this feature. Please either remove from the modeling or provide documentation that the pond has been repaired such that it can function as designed.	The Google map photo at 1200 S. Koeller St. was taken during construction, see photo below. This BMP has since been completed and now holds water. 

Comment No.	Comment Category	Comment applies to analysis for the following purposes	Comment	Response
16.	B	216 and TMDL	Please provide additional information for Department review on the Morton Biofilters. Specifically, please provide information on the composition of the engineered soil and indicate if there is a maintenance agreement in place for this practice. In addition, the Department was not able to replicate the 40% TSS removal and 32% TP removal values listed in the database by running the WinSLAMM input files provided on 8/24/14. Please either revise the values in the database or provide documentation supporting the values in the database.	Additional information on the Morton Biofilters is included in Attachment 4.
17.	C	TMDL	Modeling for TMDL purposes should be summarized per impaired reachshed. Draft information on the Upper Fox/Wolf TMDL is available at http://dnr.wi.gov/topic/tmdls/foxwolf/	This report was completed when the TMDL was not implemented. This report was not specifically for TMDL purposes and the scope of the project did not involve this level of detail. The geodatabase is set up to be easily modified to align with TMDL reachsheds in the future.

Comments on report are shown below. Comments have been categorized as follows:

A. High priority comments. Please address before finalizing report.
B. Lower priority comments. Please address as many of these as possible before finalizing report.
C. Informational comments—No action is required at this time.

Comment No.	Comment Category	Comment	Response
1.	A	On p. ES-2, "When TMDLs are calculated for the Upper Fox River watershed, new reduction targets will be established that will supersede the current NR 151 requirements." Please revise this statement. TMDL's do not supersede current NR 151 requirements. TMDL's are in addition to the NR 151 requirements.	The statement was revised.
2.	A	In the Executive Summary, please break out the pollutant removal associated with the County and UW Oshkosh areas in the table and include a note identifying that the City cannot take credit for these removals until agreements are finalized with the County and UW. The City should be reporting pollutant removal results without including county and UW areas until such time as the agreements are signed by both parties.	The summary of MS4 area percent removal by MS4 owning agency from added to the Executive Summary.
3.	B	Table 4-6 lists Sioux Prop. Man. Inc as a non-regional Wet Detention Basin with 100% TSS removal. Review of the WinSLAMM Modeling for this site shows that the site was modeled not with the wet pond that is present on site but with swale BMP's. This appears to be inappropriate as the only swales visible on aerial photos are on WisDOT ROW and not part of the City's MS4. Please either remove the facility from the list (if it drains directly to the WisDOT ROW without passing through the City's MS4 then it is an optional area) or revise the modeling to reflect the BMP on the property.	The site drains to the wet detention basin through swales on the property then to a wet detention pond. It does not utilize DOT swales. We understand your concern regarding the high infiltration rates associated with some swales. We are utilizing the best available information and applying local data to the degree possible. We will further evaluate our approach to using site specific swale data in the future.

Comment No.	Comment Category	Comment	Response
4.	C	In section 1.3.3 grass swales are identified as an existing BMP with rather high infiltration rates given the prevalence of clay soils within the City. Please be advised that the Department plans on re-assessing its technical guidance on grass swale modeling and this may result in less credit being given to grass swales in the future.	The City would consider modifying the approach taken in the future should WDNR guidance on this subject change.
5.	B	In Section 5.1.1.3, please review the verb tenses so that it is clear that the sizing and pollution removals are estimates. For example, on p. 5-3 the text states that "The 9 proposed sites would achieve an approximate annual TSS reduction of 216 tons and a TP reduction of 948 pounds, which is 12 percent and 9 percent respectively of the City's base load." It would be clearer to state that the sites are projected to provide pollution removal because detailed design and modeling have not been completed for these sites.	The statement was revised to "The 9 proposed sites are projected to achieve an…"
6.	C	Engineered swales are identified as a proposed BMP in section 5.1.1.5. There is not enough information in this section for the Department to evaluate the reasonableness of the assumed TSS and TP reductions.	A statement was added to the report that the engineered swales were evaluated using WinSLAMM.
7.	B	Biofilters are identified in Section 5.1.1.6 as BMP's that may be utilized in industrial areas. Some industrial areas may not be suitable for biofilter installation or treatment due to the presence of soil and ground water contamination. In addition, there are prohibitions on infiltration practices from certain industrial source areas. Has this been considered in the evaluation of potential treatment areas?	The biofilters are considered for placement in parking lot areas primarily. Site specific analysis will be required before implementation.
8.	C	Most of the proposed ponds are located in areas with wetland indicator soils. Wetland delineations are likely to be required for storm water permitting and the presence of wetlands may impact eligibility for urban non-point source grants.	The City is aware of this base on prior implementation efforts.

Comment No.	Comment Category	Comment	Response
9.	C	All regional ponds are subject to wetlands and waterway permitting requirements. Figure 5-2 and Appendix D have been forwarded to Sarah Adkins, Water Management Specialist. The ponds in Figures D-1, D-4, D-9, and D-11 appear to warrant further coordination with DNR Waterways and Wetlands program staff to discuss BMP location and potential permitting concerns prior to proceeding with design development.	The City will consider this before implementation.
10.	B	There are so many 'Major Watersheds' mapped for the City that it would be helpful to group the watersheds listed in Appendix B by major receiving body (i.e. Lake Butte des Morts, Fox River, and Lake Winnebago).	This report was not specifically for TMDL purposes and the scope of the project did not involve this level of detail. The City would be open to grouping the watersheds listed in the future.

Attachment 1

County MOU

MEMORANDUM OF UNDERSTANDING
Between
The City of Oshkosh Department of Public Works
and
The Winnebago County Highway Department

I. PURPOSE

The purpose of this Memorandum of Understanding (Memo) is to define the working relationship between the City of Oshkosh Department of Public Works and the Winnebago County Highway Department with respect to stormwater management. Specifically, this Memo will clarify the collaborative roles and responsibilities of the two agencies as it relates to the Wisconsin Department of Natural Resources (WDNR) Municipal Separate Storm Sewer System (MS4) General Permit [herein after referred to as MS4 Permit] activities.

II. BACKGROUND

1. The WDNR has issued separate MS4 Permits to both the City of Oshkosh and to Winnebago County [under the Wisconsin Pollutant Discharge Elimination System (WPDES) requirements in accordance with ch.283, WI Stats. and subch. I of ch. NR216, Wis. Adm. Code] for stormwater management.
2. A requirement of the MS4 Permit is to develop a pollutant loading analysis for the municipalities' MS4 utilizing a stormwater computer model.
3. The MS4 Permit also requires communities to achieve 20% and 40% total suspended solids (TSS) reduction from the municipalities' MS4 stormwater discharge by roughly 2008 and 2013, respectively.
4. Winnebago County, currently, owns six (6) county road right-of-ways (ROW) located within the City of Oshkosh (County Roads A, E, K, Y, I, and Waukau Avenue). [ROW includes county road surfaces, shoulder, swales, and additional area within the ROW.]
5. Currently, four (4) of the six (6) county roadways within the City of Oshkosh (see attached Table 1.) were designed and constructed to drain stormwater directly into the City of Oshkosh storm sewer, which underlies the county road ROW. As such, stormwater generated within the county road ROW (and potentially any additional associated drainage areas) are directed to curb inlets that are connected to City of Oshkosh storm sewer. The City of Oshkosh owns the storm sewer system underlying the Winnebago County ROW at these locations.
6. Based on the MS4 Permit, stormwater runoff generated within the county road ROW would be required to achieve the 20%/40% TSS reductions prior to the stormwater entering the City of Oshkosh storm sewer. However, the WDNR indicates that if the stormwater from the county road ROW would receive the required 20% and 40% TSS removals at another location (in this case, other than the curb inlets) prior to discharging to waters of the state, this would meet the MS4 Permit requirements.

III. AGREEMENT

1. CITY of OSHKOSH RESPONSIBILITIES

The City of Oshkosh agrees to:

a. Perform operation and maintenance on the City of Oshkosh owned stormwater systems [ie. storm sewer (and any other City owned utility/structures)] underlying the County ROW and/or serving to drain stormwater runoff from the county road ROW. [Illicit connections to City-owned stormwater systems would be the responsibility of the City of Oshkosh.]

b. Develop a pollutant loading analysis for the county road ROWs listed in Table 1. using a stormwater computer model in accordance with all WDNR requirements;

c. Accept and address (attenuate) stormwater runoff from the Winnebago County ROWs listed in Table 1. to meet all current (20%/40% TSS reductions) and any future stormwater requirements (further TSS reductions and/or other parameters/pollutants) dictated or enacted by the United States Environmental Protection Agency (EPA) and/or the state of Wisconsin;

d. Provide Winnebago County with any and all necessary records, reports, results, data, or any documentation regarding stormwater management/MS4 permitting for the county road ROWs listed within this Memo;

e. The City of Oshkosh will not impose any fees and/or request monies from Winnebago County for any of these or other associated activities.

2. WINNEBAGO COUNTY RESPONSIBILITIES

Winnebago County agrees to:

a.) Perform operation and maintenance on the county owned ROW as long as the ROWs are owned by Winnebago County; maintenance includes the following:

  i. Repair and maintenance of roadways including road surfaces and/or road base,

  ii. Snow and ice removal from the roadways,

  iii. Street sweeping of road surfaces and appropriate disposal of sweepings,

  iv. Repair and maintenance of road shoulders, swales and county owned ROW;

b.) Prepare, monitor, and implement illicit discharge procedures for the county road ROW listed herein;

c.) Prepare, maintain, and implement a pollution prevention plan and procedures for the county road ROW listed herein;

d.) Provide information and education activities to Winnebago County Highway personnel regarding these roadways;

e.) Provide the City of Oshkosh with any and all necessary records, reports, results, data, or any documentation regarding stormwater management/MS4 permitting of the road segments listed within this Memo.

IV. PROVISIONS

1. The provisions of this Memo are effective upon both parties signatures and shall continue in effect indefinitely.
2. This Memo covers all future or expanded MS4 Permit boundaries (Urbanized Area) and/or all future county road ROW constructed to route stormwater to City of Oshkosh stormwater systems.
3. This Memo and any supplements contained within may be amended at any time by mutual consent of the parties.
4. Either party may terminate this Memo by giving thirty (30) days prior notice in writing to the other party.

V. ADOPTION

The foregoing memorandum of understanding has been adopted by each of the parties thereto, duly recorded in the official proceedings of each, and as attested by the signatures affixed below.

For the City of Oshkosh Department of Public Works:

____

David Patek, City of Oshkosh, Department of Public Works Date

For the Winnebago County Highway Department:

____

John Haese, Winnebago County Highway Commissioner Date

Table 1. Winnebago County Road ROW within the City of Oshkosh*, MS4 Modeling and Stormwater Treatment Responsibilities, Memorandum of Understanding Between the City of Oshkosh and Winnebago County.

OSHKOSH RESPONSIBILITES

County Road A (North Shore Dr., Harrison St.)

from County Road Y to Libbey Ave. (approx. 2.6 miles)

County Road E (Witzel Ave.)

from Barton Rd. to Koeller St. (approx. 1.0 miles)

County Road K (20th Ave.)

from Clairville Rd. to South Park Ave. (approx. 2.4 miles)

County Road I (Oregon St.)

from 24th Ave. to Waukau Ave. (approx. 0.8 miles)

TOTAL approx. 6.8 miles

* The road segments/areas may expand or be revised in the future.

03/05/09 km nr216/osh mou

Attachment 2

Airport SWM Report

Stormwater Management Report

For

Wittman Regional Airport Perimeter Road

City of Oshkosh
Winnebago County, Wisconsin

OMNNI ASSOCIATES
One Systems Drive
Appleton, WI 54914

WISCONSIN BRIAN C. OLESEN 37303-006 MADISON WI 6/27/12 PROFESSIONAL ENGINEER

March 2, 2012
Revised May 1, 2012
Revised June 27, 2012

APPROVED
7-19-12 JRL/JG/LG

OMNNI Project No. E1974A10

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APPENDICES

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    a. Plate A – County Map
    b. Plate B – Soils Map
    c. Plate C – USGS Map
    d. Plate D – Perimeter Road Location Map
2. Drainage Plans
3. TR-55 Time of Concentration
4. HydroCAD Input/Output
5. WinSLAMM Input/Output
6. Stormwater Management Systems – Maintenance Inspection Form

1.0 General Project Information

1.1 Project Description

Wittman Regional Airport (OSH)

The project site is located at Wittman Regional Airport (OSH) on the airport grounds. More specifically, it is located in the Sections 34 & 35 of T18N, R16E, and in Sections 2, 3, and 11 of T17N, R16E. The site resides in the City of Oshkosh and the Town of Nekimi. A general location map is provided in Appendix 1.

This project involves the construction of 5.1 miles of new asphalt and gravel road at OSH, the relocation of an additional 1.1 miles of asphalt road, and the construction of a regional stormwater detention pond. The regional detention pond will consist of three bays with interconnected pipes. See Appendix 1 for a layout of the proposed perimeter roads.

1.2 Methodology

The addition of paved roads on site will create a large amount of additional stormwater runoff. However, due to airport safety restrictions, a wet pond is not allowed on site. In addition, existing topography does not provide any opportunities to construct biofilters near the new roadways. A dry detention pond will be constructed in the northeast corner of the project site, away from any of the new roads, to offset the additional stormwater runoff. No stormwater discharge from the new roads will actually drain to the proposed pond as the proposed pond had to be located away from runways, taxiways, and restricted areas due to safety concerns.

The proposed pond will collect water from currently developed airplane hangar areas as shown on map in Appendix 2. The area around the proposed pond has current flooding issues and the pond will alleviate some of these problems. The size of the pond has been maximized, per site restrictions, and will control stormwater discharge from the existing hangar areas, proposed new roads, and future hangar developments.

Grassed ditches will be constructed along all of the new paved roadways. These ditches will provide TSS removal for the project.

The dry detention pond is designed to store stormwater runoff for the 1, 2, 10, and 100-year storm events. As previously mentioned, the pond has been oversized to accommodate existing developed areas, future developed areas, and alleviate current flooding issues. The pond flows are calculated to meet the City of Oshkosh requirement of reducing the post development 100-year event to the pre-development 10-year event.

1.3 Regulatory Requirements

The City of Oshkosh requires that the peak runoff from the post development 10-year and 100- year storm events shall not exceed the pre-development 10-year storm event within a 24-hour duration. Given that the site is redevelopment, a total suspended solid (TSS) reduction of 40% must be achieved for all roads and parking lots in accordance to Wisconsin

Department of Natural Resources' performance standards. Since the site will disturb more than one acre, a Notice of Intent will be filed with the Wisconsin Department of Natural Resources.

1.4 Evaluation of Potential Infiltration

The site is exempt from infiltration requirements based on the Wisconsin DNR's infiltration exclusions under Chapter NR 151.12(5)(c)6.c, redevelopment.

2.0 Hydrologic Analysis

The U.S. Department of Agriculture, Technical Release 55 Urban Hydrology for Small Watersheds, June 1986 was used to calculate the time of concentration and curve numbers for the site. Peak flow rates and pond routing calculations were performed by HydroCAD version 10.00.

2.1 Rainfall

Rainfall information was obtained from the U.S. Department of Commerce Technical Paper 40, *Rainfall Frequency Atlas of the United States,* for the 1-year and 2-year storm events. For the 10-year and 100-year storm events, rainfall information was obtained from the *Frequency Atlas of the Midwest (Bulletin 71*). The 24-hour rainfall depths for Winnebago County are summarized in Table 2-1. The SCS 24-hour, Type II rainfall distribution was used in this study.

RAINFALL EVENT	DEPTH (in.)
1 – year	1.96
2 – year	2.40
10- year	3.56
100 – year	6.35

Table 2-1 - 24 Hour Rainfall Depth

2.2 Drainage Area

The drainage areas were established from contours based on actual survey data obtained by OMNNI Associates and Winnebago County 2' contour data.

2.3 Soils

This site is located within eight soil mapping units, as indicated by the United States Department of Agriculture – Soil Conservation Service (USDA-SCS) soil survey for Winnebago County, Wisconsin. The mapping units are as follows:

(KnB) Kewaunee Silt Loam

(LzB) Lorenzo Variant Loam

(MaA) Manawa Silty Clay Loam

(MtA)	Mosel Silt Loam
(OmB)	Omro Clay Loam
(HrB)	Hortonville Silt Loam
(Pu)	Poygan Silty Clay Loam
(HmB)	Hochheim Loam

According to the SCS soil survey, Kewaunee series consists of well drained, moderately well drained soils that are moderately slowly or slowly permeable. These soils formed in a thin mantle of silty or sandy material and in the underlying loamy or clayey glacial till. These soils are on ground, end and recessional moraines. Slopes are 2 to 12 percent. Kewaunee Silt loam is in the Type C hydrologic soil group.

Loreno Varient Loam consists of moderately well drained soils on till plains. Permeability is moderate in the upper part of the subsoil, rapid or very rapid in the gravelly material, and slow or moderately slow in the substratum. Slopes are 2 to 8 percent. Lorenzo Variant Loam is in the Type C hydrologic soil group.

Manawa Silty Clay Loam consists of somewhat poorly drained soil in drainageways and depressions. Permeability is slow and available water capacity is moderate. Slopes are 0 to 3 percent. Manawa Silty Clay Loam is in the Type C hydrologic soil group.

Mosel Silt Loam consists of somewhat poorly drained soil on valley terraces and in drainageways and swales in the uplands. Permeability is moderate in the subsoil and moderately slow or slow in the substratum and available water capacity is high. Slopes are 0 to 3 percent. Mosel Silt Loam is in the Type C hydrologic soil group.

Omro series consists of well drained soils that are slowly or moderately slowly permeable in the upper part and moderately permeable in the lower part. Omro clay loam is in the Type C hydrologic soil group.

Hortonville series consists of well drained, moderately or moderately slowly permeable soils formed in a thin mantle of silty or sandy material in the underlying loamy glacial till. Hortonville silt loam is in the Type C hydrologic soil group.

Poygan Silty Clay Loam consists of poorly drained soil in drainageways and depressions. Permeability is slow and available water capacity is moderate. Poygan Silty Clay Loam is in the Type D hydrologic soil group.

Hochheim series consists of well drained, moderately or moderately slowly permeable soils formed in loamy glacial till. Hochheim loam is in the Type B hydrologic soil group.

Maps displaying the soil types on the site can be seen in Appendix 1.

2.4 Runoff Curve Number

Pre- and post-development runoff curve numbers were computed for the site using TR-55 methodology. It is required that meadow curve numbers be used for the pre-development conditions. Therefore, a CN of 71 will be used for all pre-development conditions. The post-development curve numbers were calculated based on the actual imperviousness for the drainage area. Summarized results are displayed below in Table 2-2. Please see Appendix 2 for pond drainage areas and Appendix 3 for runoff curve number calculations.

Runoff Curve Number		
	Pre-Development	Post Development
Area 1 – Pond	71	85
Area 2 – Pond	71	86
Area 3 – Pond	71	80
Proposed Roads	71	98

Table 2-2 Pre & Post-Development Runoff Curve Numbers

2.5 Time of Concentration

The time of concentration is the time required for a drop of water to travel from the most hydrological remote point in the drainage area to the point of collection. Summarized results for pre- and post development are displayed below in Table 2-3. See Appendix 3 for time of concentration calculations and Appendix 2 for a map showing time of concentration flow paths. Since the dry pond is being constructed in an already developed area, time of concentrations for pre-development and post development are the same.

Time of Concentration (minutes)		
	Pre-Development	Post Development
Area 1 – Pond	18.5	18.5
Area 2 – Pond	12.2	12.2
Area 3 – Pond	42.5	42.5
Proposed Roads	5.0	5.0

Table 2-3 - Time of Concentration

2.6 Hydrologic Results

Peak flow calculations and pond routing calculations were performed by HydroCAD version 10.00. Peak flow and discharge results are displayed in Tables 2-4 and 2-5. See Appendix 4 for HydroCAD Input data and Output graphs.

	1-Year Storm Event		2- Year Storm Event		10- Year Storm Event		100- Year Storm Event	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Proposed Roads	3.79	29.81	7.86	36.82	21.50	55.18	65.23	99.07

Table 2-4 – Pre & Post Development Peak Flows for Proposed Roads

To take credit for the new roads in this pond, we will need to reduce the 100 year post (99.07 cfs) to the 10-year predevelopment (21.50 cfs) rate. This will require a reduction of 77.57 cfs, which is easily accounted for in the proposed pond.

	1-year Storm Event		2- Year Storm Event		10- Year Storm Event		100- Year Storm Event	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
West Subarea	3.00	14.37	6.70	20.94	19.87	39.65	60.94	86.92
Middle Subarea	0.81	3.93	1.77	5.60	5.12	10.29	15.34	21.97
East Subarea	8.27	26.07	18.07	42.33	55.42	91.71	174.28	225.84

Table 2-5 – Pre & Post Development Peak Flows for Hangar Areas near Dry Pond

Table 2-6 below summarizes the peak inflow rates and the water elevations in the East Dry Pond (the last pond in the series) for the 1, 2, 10, and 100-year, 24-hr storm events. Table 2-7 summarizes the post development discharge rates from the East Dry Pond.

Storm Event	Peak Inflow Rates to the East Dry Pond (cfs)	Peak Water Elevation in the East Dry Pond (ft)	Peak Water Elevation in the West Dry Pond (ft)	Peak Water Elevation in the Mid Dry Pond (ft)
1-Year	33.95	762.39	767.31	765.69
2-Year	52.71	762.80	767.61	765.94
10-Year	106.49	763.70	768.31	766.59
100-Year	245.86	765.24	769.83	767.94

Table 2-6 – East Dry Pond Peak Inflow Rates and Water Elevations

Storm Event	Peak Discharge Rates from the East Dry Pond (cfs)
1-Year	16.74
2-Year	22.14
10-Year	30.42
100-Year	54.27

Table 2-7 –Post Development Peak Discharge Rates

With the proposed pond design, peak inflow for the 100-year storm event is 245.86 cfs and peak discharge is 54.27. The pond therefore provides a total flow reduction of 191.59 cfs.

Table 2-8 below summarizes the peak flow rates for future hangar development near the proposed ponds.

	10- Year Storm Event		100- Year Storm Event	
	Pre	Post	Pre	Post
Proposed Roads	2.33	5.99	6.78	10.75

Table 2-8 – Pre & Post Development Peak Flows for Future Hangars

The pond design also currently includes 1.15 acres of impervious surfaces for future hangars on site. The separate 100 year post rate for the future hangars is 10.75 cfs which will be reduced to the 10 year predevelopment rate of 2.33 cfs, for a total reduction of 8.42 cfs.

With the proposed roads and future hangars accounting for a total necessary reduction of 85.99 cfs (77.57 + 8.42), the proposed pond has an additional reduction credit of 105.60 cfs (191.59 – 85.99). This credit of **105.60 cfs** can be applied to other development on the airport in the Glatz Creek Watershed.

As previously mentioned, the dry pond is being constructed in open space around existing hangars. The size of the pond is maximized to account for stormwater runoff from the proposed perimeter roads, the existing hangars, and future hangar development. The three bays of the pond are modeled separately to account for individual drainage areas.

2.7 Outlet Design

The primary outlet for the east dry detention pond is an existing 42"x29" elliptical RCCP pipe with an upstream elevation of 760.50 and discharging into an existing grassed swale at an elevation of 760.30. The primary outlets for the west and middle ponds are two 24" culvert pipes and two 18" culvert pipes, respectively. The secondary outlets (emergency overflow) for all three dry detention ponds are the existing perimeter road. The onsite perimeter roadway adjacent to the pond currently floods and although the proposed pond alleviates some of this flooding, the 100-year elevation for the east pond will still crest the low point of the road. All flooded roadways are on airport property.

3.0 Water Quality Analysis

3.1 Methodology

WinSLAMM version 9.4 was used to calculate the source loading from the tributary areas and particulate control of the proposed stormwater controls. The analysis includes land use data, proposed controls data, and calibration data files. The land use for the tributary area was obtained from CAD files. All of the input files used in WinSLAMM are displayed in Table 3-1. "Commercial" was used as the Land Use type. All the Land Use and other input values are displayed in Appendix 5.

File	File Name
Rainfall File (03/29/69 – 11/25/69)	Green Bay WI 1969.RAN
Pollutant Probability File	WI_GEO01.ppd
Runoff Coefficient File	WI_SL06 Dec06.rsv
Particulate Solids Concentration	WI_AG01.psc
Particulate Residue Delivery File	WI_DLV01.prr
Street Delivery File	WI_Com Inst Indust Dec06.std
Particle Size Distribution	NURP.cpz

Table 3-1 – WinSLAMM Input Files

Because the site is redevelopment, the required reduction of total suspended solids (TSS) is 40%. In order to determine an amount of TSS that must be removed to meet requirements, two models (one for sloped roads and one for crowned roads) will be used to compute the amount of TSS produced by the proposed impervious areas. Table 3-2 summarizes the totals for all of the WinSLAMM models.

	lbs TSS
Total TSS Created by New Impervious	32,985
Total TSS Needed to be Removed to Meet 40% Required Removal	13,194

Table 3-2 – Total TSS Created and Required Removal

3.2 Control Practices

Due to airport safety restrictions and on site topography, the only BMP available to achieve the required 40% reduction in TSS is grassed roadside ditches. Of the 6.2 miles of new or relocated roads, 4.3 miles are crowned and 1.9 miles are sloped to one side. TSS removal from the ditches has been adjusted to account for ditches on one side, or both sides of the new roads.

3.2.1. Grassed road ditches

The drainage area to the grassed ditches is 13.9 acres of asphalt and gravel road (4.2 acres from the crowned roads and 9.7 acres from the sloped roads). The WinSLAMM calculations include 3.3 acres of perimeter road that was relocated as part of this project. Since those sections were not new impervious, then were not included in the HydroCAD models.

The lengths of the grassed ditches were determined based on the lengths of new or relocated road for the project. The swale density was calculated using the drainage area in acres divided by the length of the grassed ditches in feet.

A map showing the proposed roads can be seen in Appendix 1. The ditches have a base width of 0.1 ft, side slopes are at 25%, and the longitudinal slope averages 0.9%. Summarized results for the ditches can be seen below in Table 3-3.

	Lbs TSS
Total TSS Before Treatment	32,985
Total TSS After Treatment	11,635
Total TSS Removed	21,350

Table 3-3 –TSS Removal via roadside ditches

3.3 Infiltration Rate

The infiltration rate of the grassed ditch soils was determined by using a weighted average of each soil type present in the road areas. Using GIS, the area of each soil type was calculated and the percentage of each soil type for the road areas determined. That percentage was then multiplied by the appropriate infiltration rate for each soil based on WDNR Tech Standard 1002. See Table 3-4 below for calculations.

Soil Type	Area (sf)	Percent of Total (%)	Infiltration Rate (in / hr)	Average Weighted Total
Silt Loams	663,142	47.1	0.13	0.0613
Loams	403,654	28.7	0.24	0.0688
Silty Clay Loams	321,897	22.9	0.04	0.0092
Clay Loams	18,589	1.3	0.03	0.0004
Total	**1,407,282**	**100**	-	**0.1396**

Table 3-4 –Weighted Average of Soil Infiltration Rates

Based on the calculations, the weighted average for the soil infiltration rate is 0.14 inches per hour. For the WinSLAMM model, a rate of ½ that total (0.07 inches/hour) will be used.

3.4 Water Quality Results

The total amount of TSS removed by all of the control practices described above is 21,350 pounds as seen in Table 3-3. Based on the net total of TSS created by the project of 32,985 lbs, 64.7% of the TSS is removed, which meets the requirements for TSS removal.

All WinSLAMM data can be found in Appendix 5.

4.0 Erosion Control and Storm Water Management

4.1 Permitting Requirements

The City of Oshkosh requires approval of the stormwater management plan prior to construction. The Wisconsin Department of Natural Resources requires a Notice of Intent Permit. WDNR and City approval will be obtained before any construction begins.

4.2 Remarks

A copy of this report shall be kept onsite and with the owner at all times during construction.

4.3 Planned Erosion Control and Storm Water Management Practices

1. Construction Entrance/Exit

Gravel-tracking pads will be constructed at all entry drives to the site. The pad shall consist of 3-6 inch clear stone placed a minimum of 12 inches in depth. Refer to the construction plans for details and locations.

2. Stockpiles

Topsoil and excavated clay/clay borrow will be stockpiled at the location indicated on the plans. Silt fence will be installed around the stockpiled soils. Stockpiles shall be seeded and mulched or anionic polyacrylimide shall be applied if left in place more than 7 days. If polyacrylimide is used, it should be placed in accordance with DNR code 1050.

3. **Land Grading**

   Land grading will be the minimum necessary for construction. There will be areas of cut and fill. Topsoil will be stripped from areas that are to be filled prior to fill placement. Any disturbed ground left inactive for 7 or more days shall be properly stabilized.

4. **Silt Fence**

   Silt fence will be installed at a 5 foot offset to the grading limits down-slope of disturbed areas, as shown on the plans.

5. **Storm Drain Inlet Protection for Construction Site**

   All fabrics used as part of an inlet protection device must be selected from the list of approved fabrics certified for inlet protection, Geotextile Fabric, Type FF in the current addition of the WisDOT Product Acceptability List (PAL)

6. **Seeding**

   Vegetation will be established as soon as practical following grading operations.

7. **Fertilizer**

   Fertilizer shall conform to Section 629.2.1.3 of the WisDOT Standard Specifications for Highway and Structure Construction. Type B fertilizer shall be applied at a rate of 7 pounds per 1000 square feet of area to establish vegetation.

4.4 Anticipated Construction Schedule

- Obtain plan approval and applicable permits
- Install silt fence as shown on plans
- Construct stabilized construction entrance and tracking pad
- Remove asphalt, gravel, fencing, and utilities as shown in the demolition plan as needed for construction
- Strip Topsoil from areas being used for stormwater detention and conveyance systems.
- Grade stormwater detention area and construct utilities
- Topsoil, seed and mulch all disturbed areas
- Strip topsoil from site

- Begin pavement construction
- Finish pavement construction
- Finish Grading
- Seed and mulch all disturbed area
- Stabilize entire construction site
- File Notice of Termination Upon Project Completion

4.5 Maintenance Plan

1) All erosion and sediment control items will be checked for stability and operation every seven days and within twenty-four hours of a storm producing at least 0.5 inch of rainfall. Any needed repairs will be made as soon as practical to maintain all erosion items as designed.

2) Remove sediment from behind any silt fence when it has accumulated to a depth of twelve inches or more. Repair the fence as necessary to provide an effective barrier. Offsite areas shall be inspected every workday and any substantial sediment transported offsite shall be removed at the end of each workday.

3) All seeded areas, including ditches, will be reseeded and mulched as necessary to maintain sufficient vegetative cover.

4) Remove silt fence and temporary structures after final stabilization and vegetative cover is established.

4.6 Provisions for Inspection and Maintenance

The contractor shall complete erosion control installation and maintenance. The inspections shall occur at least once every seven days and within 24 hours after precipitation events of 0.5 inches and greater. Weekly written reports of all inspections must be maintained. These reports must include:

- Date, time and exact place of inspection
- Name of individual performing inspection
- A description of any erosion and sediment control implementation and maintenance performed, and
- A description of the site's present phase of construction.

The contractor shall be responsible for the installation and regular maintenance of the erosion control measures shown on the plan. The contractor shall maintain the erosion control measures as required to prevent sediment from leaving the construction site. At a minimum the erosion control measures shall be maintained weekly and within 24 hours of a 0.5 inch rainfall or greater. Additional erosion control measures may be required by the inspector or as needed to prevent sediment from leaving this construction site.

Corrective action shall be required to clean up any unauthorized release of sediment to waters of the state. The contractor shall shut down all construction operations until erosion control measures are installed to prevent future sedimentation and until the released sediment is cleaned up.

The engineering plan sheets including erosion control plan and stormwater management plan shall be kept on site at all times during construction. All permits shall be kept on site at all times. The contractor shall obtain any technical standards available on the DNR website (http://dnr.wi.gov/org/water/wm/nps/stormwater/techstds.htm#Construction) and keep it onsite at all times.

4.7 Post Construction Maintenance Plan

4.7.1 Routine Maintenance

Inspections - Inspection Checklist can be found in the Appendix 6.

1. Inspect pond areas and grass swales at least twice annually, once in the Spring, once in the Fall and after a rainfall event determined to be greater than or equal to the 10-year recurrence interval. Conduct inspections during wet weather conditions to determine if the drainage devices are functioning properly.

2. Inspection priorities include visual observation and documentation of:

   The embankments for subsidence, erosion, cracking and woody plant material growth.

   Accumulation of sediment and debris in the barrels of the outlet structure.

   The adequacy of upstream and downstream channel erosion protection measures.

   Confirm any modification to the contributory watershed and document any modifications.

   The pond and channel side slope integrity.

3. Use as-built plans for reference during the inspection procedures.

4. Documentation of all inspection shall be provided to the City of Oshkosh and shall be kept on record.

Erosion Control

1. If the pond side slopes, emergency spillway and embankment suffer from slumping and/or erosion, corrective measures such as re-grading, riprap replacement and re-vegetation will be required. Complete the appropriate corrective measure(s) to repair the problem(s) in a timely manner. (Notify City Engineer of schedule and tasks.)

Mowing

1. Mow the pond area, side slopes, and embankments on an annual basis to prevent the growth of woody plants and control weed growth. The grasses around the ponds will be native prairie or wet prairie grasses and will not be typically mowed.

2. The swales shall be mowed once a year by a contractor. The grass shall be mowed to a height of not less than 6 inches.

Debris and Litter Removal

1. Remove debris and litter from the area.

2. Remove debris and litter from the primary and emergency outlet structures including grass swales to prevent clogging.

3. All garbage and debris shall be removed. Disposal of yard waste into the pond shall be prohibited.

4. No tracking mud on porous asphalt or adjacent asphalt.

3. No stockpiling any material including soil, mulch or aggregates on or near the porous asphalt at any time.

4.7.2 Non-Routine Maintenance

Structural Repairs and Replacement

1. Conduct routine inspection and maintenance of primary outlet structure for the pond to insure their longevity.

2. A plan to correct any failures shall be presented to the City within 30 days of a failed inspection.

Sediment Removal

1. For pond areas:

   a) Check dry detention basin for trash/litter and debris.

   b) Inspect dry pond at least twice annually.

   c) Sediment that is deposited in dry pond shall be removed.

   d) Grass clipping shall not be mowed into the dry detention pond.

4.7.4 Documentation of maintenance

A. Maintain a record onsite on a semi-annual basis, at a minimum.

B. The landowners shall maintain stormwater management practices in accordance with the storm water practice maintenance provisions contained in the approved storm water management plan submitted.

Responsible Parties

Design Engineer:	Compliance Enforcement:
Mr. Brian C. Olesen P.E. OMNNI Associates, Inc. One Systems Drive Appleton, WI 54914	James Rabe City of Oshkosh 215 Church Avenue P.O. Box 1130 Oshkosh, WI 54903-1130
Responsible Party:	
Mr. Peter Moll Airport Director Wittman Regional Airport 525 W. 20th Avenue Oshkosh, WI 54902-6871	Wisconsin DNR Susan Larson 625 E County Road Y, Suite 700 Oshkosh, WI 54901

Attachment 3

Infiltation Documents -
See Appendix C

Attachment 4

Morton Biofilters

AECOM
558 North Main Street
Oshkosh, Wisconsin 54901

920.235.0270 tel
920.235.0231 fax

Biofilter Operation and Maintenance Plan
90 Riverway Drive
135 and 155 Jackson Street, Oshkosh, Wisconsin

August 15, 2011

The Operation and Maintenance Plan (O&M Plan) for these sites biofilters involves inspection, operation and maintenance of the physical facilities and of the vegetation within the biofilters. Implementation of the O&M Plan will enhance biofilter performance and longevity.

Overview

The purpose of a biofilter is to capture runoff from a small watershed and to remove suspended solids and associated pollutants from the runoff. Biofilters include grass filter strips on the perimeter, runoff ponding area, mulch and filter bed (engineered soil) to filter and absorb pollutants under drains and overflow. The ability of the biofilters to function as designed is dependent on proper operation and maintenance of a biofilter as well as maintenance operations within the watershed draining to the biofilter. Watershed maintenance activities include periodic sweeping of paved areas and removal of debris and litter. Biofilters are not to be used for stock piling snow.

Mulch Considerations

The use of mulch in the biofilter can lead to mulch floating or being washed away, particularly if the incorrect type of mulch is used. Mulch should be shredded hardwood aged at least one year. Other types of mulch are less dense than hardwood mulch and have a significant tendency to float or be washed away. Overall, shredded hardwood mulch tends not to float or be washed away. Experience indicates that some hardwood mulch may float, particularly when first installed, but this potential problem occurs less frequently over time. However, there are examples where there have been only small quantities of loss of hardwood mulch even in drainage ditch locations where flowing water occurs frequently.

The mulch layer should be approximately three inches thick. A thinner layer does not provide the filtration desired for the mulch. A thicker layer blocks desirable gas transfer between the atmosphere and the filter bed.

Operation and Maintenance Procedures

1. Inspections

The biofilters should be inspected periodically according to the following schedule:

a. In the spring immediately after snow melt has ended
b. Immediately after rains having a depth of 0.5 inches or greater
c. At a minimum of every month during the snow free period.

Inspections should note the presence of accumulated sediment, debris or litter, condition of the mulch, the presence of eroded soil, condition of the grass filter strip around the biofilters, and condition of the overflow and condition of the vegetation. Problems or issues identified by the inspection should be corrected according to the guidelines in Table 1. The site owner will be responsible for completing the inspections.

2. Operation

Operation of the biofilters involves periodic observations of the length of ponding within a biofilter and removing blockage from the overflow if this occurs after a large rain storm. If ponding lasts longer than 24 hours after a storm, this observation should be recorded. If ponding longer than 24 hours continues over time (one growing season), or the ponding time gets even longer, the mulch and filter bed likely require replacement unless the under drain is blocked.

3. Maintenance

Biofilter maintenance activities and frequency are described in Table 1.

Table 1	
Typical Biofilter Maintenance Activities	
Activity	Frequency
Remove accumulate sediment	As needed, but typically is an annual activity that occurs in Spring after snow melt. Sweeping of paved areas reduces this need, particularly sweeping in early spring to remove accumulated road grit.
Add additional mulch	Once per year in spring based on spring inspection. Re-mulch void areas after storms as needed. Generally, the above schedule allows total replacement of the mulch every three to five years. Mulch should be added to provide a layer three inches thick. Mulch should be shredded hardwood mulch aged at least one year.
Inspect surface and repair eroded areas	Minimum every month, repair as needed.
Inspect filter strip grass and repair as needed	Minimum every month, repair as needed.
Inspect energy dissipater rock or grass inlet areas	Minimum every month and after major storms, repair as needed.
Inspect overflow structures	Minimum every month, remove blockage as needed.
Replace filter bed	Typically every ten years, dependent on ponding duration, condition of the filter bed and how often the mulch has been replaced. Determine the condition of the filter bed by digging a small soil test pit and soil pH testing every 5 years. In the test pit look for

	evidence of the accumulation of fines on the surface or within the filter bed. Values for soil pH should range between 5 and 7. If poor drainage appears to be caused by surface clogging then replace only the top foot of the filter bed. If the duration of ponding is consistently less than 24 hours, the accumulation fines is minimal, pH readings are within the correct range and the mulch has been consistently maintained then filter bed replacement times can exceed 10 years.
Inspect perforated pipe under drain	Inspect if ponding in biofilter exceeds 24 hours, remove blockage if necessary.
Remove litter and debris	Monthly
Water plants	Monthly during first two years after plant installation when inadequate rain occurs.
Replace dying plants	Inspect monthly/replace as necessary
Vegetation replacement	Necessary when replace the filter bed. It may be possible to save some plants.

The site owner will be responsible for completing the maintenance activities.

Reporting

The site owner shall report storm water operation and maintenance activities annually in the fall of the year to the City of Oshkosh Engineering Department. The report will contain a summary of stormwater operation and maintenance activities including what the activity was, who completed the work, the date of the activity, and cost.

Attachments

Operation and Maintenance Form

Biofilter Location Diagram

Biofilter Operation and Maintenance Plan
90 Riverway Drive
135 and 155 Jackson Street
Oshkosh, Wisconsin

Operations and Maintenance Record Form

Year ___________ Biofilter Number___________

Activity	Frequency	O&M Completion Record (check off)								
		Mar	Apr	May	June	July	Aug	Sep	Oct	Nov
Remove Sediment	Annual (Spring)									
Add Mulch	Annual (Spring)									
Repair Eroded Surface	Inspect monthly, repair as needed									
Repair Rip-rap Filter Strip	Inspect monthly, repair as needed									
Repair Inlet Area	Inspect monthly, repair as needed									
Clean Overflow Structure	Inspect monthly, remove blockage as needed									
Remove Litter and Debris	Monthly									
Water Plants	if inadequate rain									
Inspect Plants	Monthly, replace dead plants									
Inspect Under drain, Clean	When Ponding Exceeds 24 Hours									
Replace Filter Bed	Typically Every 10 years (O&M Plan)									

"THE INFORMATION SHOWN ON THIS DRAWING CONCERNING TYPE AND LOCATION OF UNDERGROUND UTILITIES IS NOT GUARANTEED TO BE ACCURATE OR ALL INCLUSIVE. THE CONTRACTOR IS RESPONSIBLE FOR MAKING HIS OWN DETERMINATIONS AS TO THE TYPE AND LOCATION OF UNDERGROUND UTILITIES AS MAY BE NECESSARY TO AVOID DAMAGE THERETO."

N

0 30

1" = 30'

TO OBTAIN LOCATIONS OF PARTICIPANTS UNDERGROUND FACILITIES BEFORE YOU DIG IN WISCONSIN

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1-800-242-8511
TOLL FREE

WIS STATUTE 182.0175(1974)

LEGEND

PL	PROPERTY LINE
750	5' CONTOUR
752	1' CONTOUR
GAS	U.G. NATURAL GAS LINE
OH	OVERHEAD ELECTRIC LINE
ELEC	U.G. ELECTRIC LINE
PHON	U.G. TELEPHONE LINE
FIB	U.G. FIBER OPTIC LINE
	PAVEMENT CENTERLINE
SAN	U.G. SANITARY SEWER MAIN
ST	U.G. STORM MAIN
W	U.G. WATERMAIN
	EASEMENT LINE
X	FENCE
	MANHOLE SANITARY
	MANHOLE STORM
	CATCH BASIN
	INLET
	U.G. WATER VALVE
	ELECTRICAL PEDESTAL
	MANHOLE ELECTRIC
	MANHOLE UNKNOWN
	UNDERGROUD GAS VALVE
	FIRE HYDRANT
	LIGHT POLE
	POWER POLE
	MONITORING WELL - EXISTING
	SIGN POST
	TELEPHONE PEDESTAL
	MANHOLE WATER
	MANHOLE TELEPHONE
	GUARD POST/BOLLARD
	GUY ANCHOR
+750.7	SPOT ELEVATION
	CONCRETE PAVEMENT

PROPOSED LEGEND

751.5	HALF-FOOT CONTOUR
752	1' CONTOUR
750	5' CONTOUR
SF	SILT FENCE (SEE DETAIL SHEET C5.0)
1	LAND DIVISION LINE
	HIGH-SIDE CURB
	STORM MANHOLE
	ROUND CATCH BASIN
	CURB INLET
	SANITARY MANHOLE
	INLET PROTECTION (SEE DETAIL SHEET C5.0)
	HEAVY DUTY ASPHALT PAVEMENT (SEE DETAIL SHEET C6.0)
	CONCRETE PAVEMENT (SEE DETAIL SHEET C6.0)
	EROSION SLOPE MATTING (SEE DETAIL SHEET C5.0)
	STONE TRACKING PAD (SEE DETAIL SHEET C5.0)
+766.29	PROPOSED SPOT GRADE

CONSTRUCTION NOTES

CONTRACTOR TO OBTAIN A RIGHT-OF-WAY PERMIT FOR ALL WORK PERFORMED WITHIN THE CITY OF OSHKOSH RIGHT-OF-WAY.

ALL WORK PERFORMED WITHIN THE RIGHT-OF-WAY SHALL CONFORM TO CITY OF OSHKOSH SPECIFICATIONS.

CONTRACTOR TO INSTALL EROSION CONTROL EMATT FOR SEEDING OF ALL TERRACE AREAS, TRENCH IN MATTING PER CITY OF OSHKOSH REQUIREMENTS.

CONTRACTOR SHALL MAINTAIN ONE LANE OF TRAFFIC IN EACH DIRECTION ON PEARL AVENUE AT ALL TIMES DURING CONSTRUCTION.

2 CURB HEAD FOR ALL PROPOSED DRIVEWAYS SHALL TAPER TO ZERO HEIGHT AT THE RIGHT OF WAY OR BACK OF WALK. SEE DETAIL M, SHEET C6.0.

SURVEY NOTES

SITE SURVEYED BY AECOM ON 6-15-09 AND 6-19-09.

HORIZONTAL COORDINATES ARE REFERENCED TO THE WISCONSIN STATE PLANE COORDINATE SYSTEM, SOUTH ZONE.

ELEVATIONS ARE REFERENCED TO THE CITY OF OSHKOSH DATUM (NGVD29).

UNDERGROUND UTILITIES WERE SURVEYED AS MARKED BY DIGGERS HOTLINE PER TICKET NUMBER 20092411283.

THE CONTRACTOR/OWNER IS RESPONSIBLE FOR MAKING HIS/HER OWN DETERMINATION AS TO THE TYPE AND LOCATION OF UNDERGROUND UTILITIES THAT MAY BE NECESSARY TO AVOID DAMAGE THERETO. CONTRACTOR/OWNER SHALL BE RESPONSIBLE TO CONTACT DIGGER'S HOTLINE PRIOR TO START OF ANY CONSTRUCTION.

PROPERTY AND EASEMENT LINES SHOWN ARE PER WINNEBAGO COUNTY CERTIFIED SURVEY MAP NUMBER 5840.

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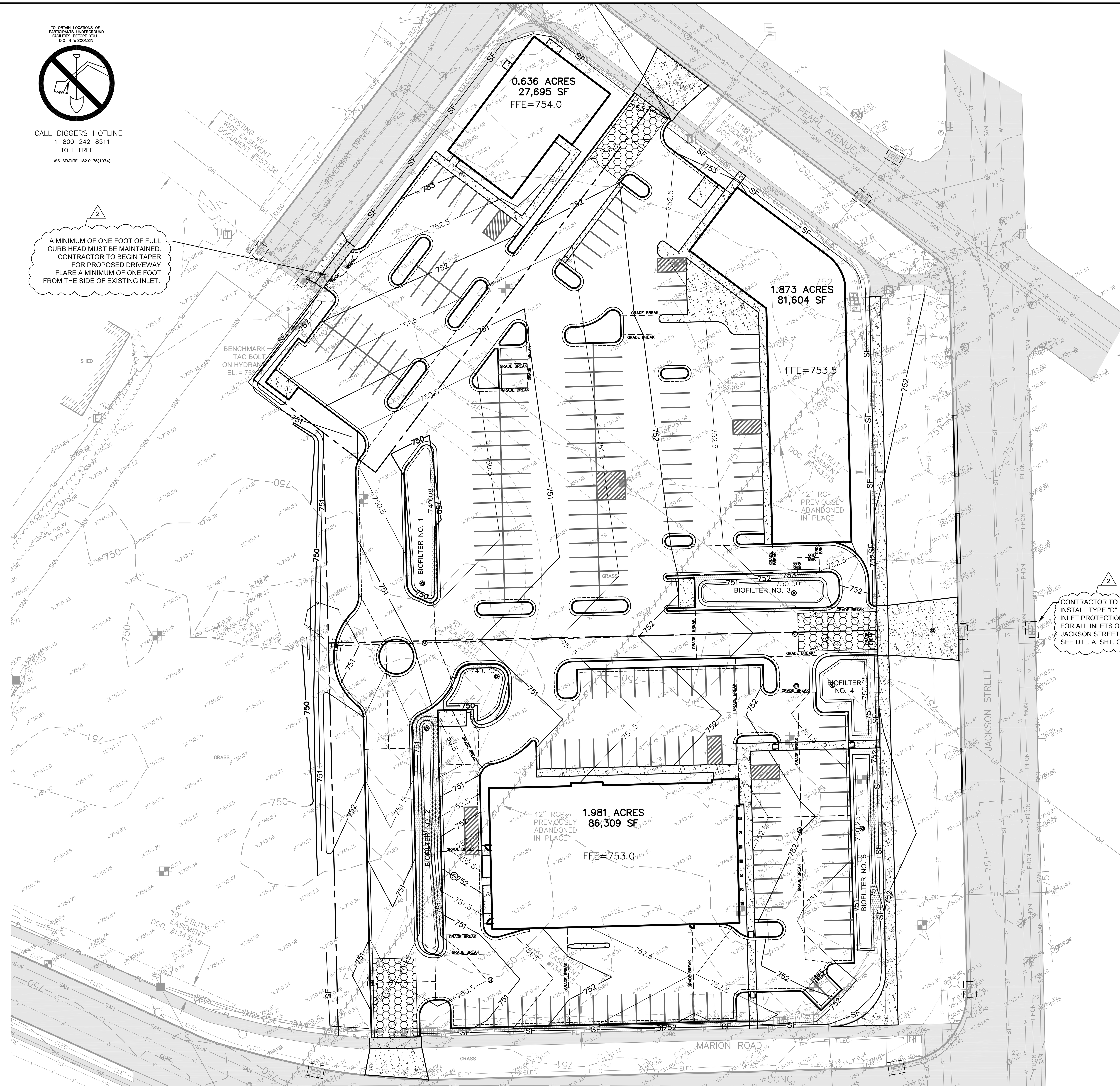

AECOM

558 North Main Street
Oshkosh, WI 54901

920.235.0270

www.aecom.com

MASTER GRADING AND EROSION CONTROL PLAN
MARION/PEARL PHASE II SITE DEVELOPMENT
INTERSECTION OF MARION ROAD AND JACKSON STREET
OSHKOSH, WISCONSIN

Issued

Rev Date Description

2 11/19/2009 City Comments
1 9/24/2009 Issued for Construction

Designed: REO 9/10/2009
Drawn: MCW 9/10/2009
Checked: CXM 9/10/2009
Approved:

PROJECT NUMBER
60101542

SHEET REFERENCE NUMBER
C3.0

AECOM

Storm Water Management and Erosion Control Plan
September 21, 2009

Marion/Pearl Phase II Site Development

AECOM Project No. 60101542

Prepared by:
Matthew C. Woodrow, P.E.
Project Engineer
AECOM
920-236-6719

AECOM

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558 North Main Street
Oshkosh, WI 54901
T (920) 235-0270 F (920) 235-0321

September 21, 2009

Mr. James Rabe
Engineering Department
215 Church Avenue
P.O. Box 1130
Oshkosh, Wisconsin 54903-1130

RE: Storm Water Management and Erosion Control Plan, Marion/Pearl Phase II Site Development, Oshkosh, Wisconsin -- AECOM Project No. 60101542

Dear Mr. Rabe:

AECOM has completed this Storm Water Management and Erosion Control Plan for the Marion/Pearl Phase II Site Development located between the intersections of Marion Road and Pearl Avenue with Jackson Street, Oshkosh, Wisconsin. This plan was prepared to meet the requirements of the City's Municipal Code Chapter 24, Article II, and pertinent sections of Wisconsin Department of Natural Resources NR 151 and NR 216.

This plan describes the erosion control features that will be implemented during the reconstruction, and the long-term management of storm water generated at the site. Analyses were performed to compare the storm water discharge from the site for post-development conditions to the pre-development conditions. The evaluation documents that the proposed biofilters and catch basins with sumps incorporated into the site design meet the City of Oshkosh and WDNR storm water management criteria for a redevelopment site.

Please feel free to contact Matt Woodrow (920-236-6719) or Christopher Murawski (920-236-6714) with any questions or comments regarding the attached report.

Respectfully,

Matthew C. Woodrow, P.E.
Project Engineer

Christopher L. Murawski, P.E.
Senior Project Engineer

Table of Contents

Figures

Attachments

Appendices

1.0 Introduction

AECOM has prepared this Storm Water Management and Erosion Control Plan (SWM/EC) for the Marion/Pearl Phase II Site Development, located between the intersections of Marion Road and Pearl Avenue with Jackson Street, Oshkosh, Wisconsin (Figure 1). The purpose of this Plan is to describe the development and the methods that will be implemented to manage peak storm water discharge rates, improve storm water quality, and control erosion. The Plan includes analyses of pre-development and post-development flow conditions as required by the City of Oshkosh. This Plan also meets the substantive requirements for managing water quality by implementing the Wisconsin Department of Natural Resources (WDNR) regulations. These requirements include:

- Substantive requirements of Wisconsin Construction Site Storm Water Discharge Permits (NR 216 Subchapter III and NR 151.12)

- City of Oshkosh Municipal Code Chapter 24 Article II: Storm Drainage Regulations

- Wisconsin Storm Water Management Technical Standards for Construction Site Erosion & Sediment Control: 1056 (Silt Fence), 1057 (Stone Tracking Pad), 1058 (Mulching for Construction Sites), 1059 (Seeding for construction site erosion control), 1060 (Storm Drain Inlet Protection), and 1068 (Dust Control),

2.0 Site Description

This narrative and the supporting documents describe the proposed reconstruction of the Marion/Pearl Phase II Site Development. The site location map is provided on Figure 1 on a portion of the United States Geological Survey (USGS) 7.5-minute topographic map.

The development extends from Pearl Avenue on the north to Marion Road to the south. The site is bordered on the east by Jackson Street and to the west is a green space area that will be utilized for future commercial development.

The site is approximately 4.5 acres that was historically industrial and is currently a brownfield redevelopment site. The use of the site will change to commercial after the redevelopment is completed. The redevelopment will include a pharmacy, multi-use building, restaurant, parking lot, utilities, and construction of five biofilters to provide water quality benefits.

3.0 Relevant Regulatory Requirements

The development plans were prepared to comply with City of Oshkosh Municipal Code Chapter 24, Article II, and pertinent sections of WDNR NR 151, and NR 216.

3.1 Peak Discharge Rate Control

The Marion/Pearl Phase II Site Development is considered a redevelopment occurring in a designated redevelopment district, and the proposed site improvements do not result in an increase in the percentage of impervious surfaces from the predevelopment condition. Therefore, the provisions of Municipal Code Chapter 24, Article II shall be applied on a district-wide basis and peak discharge rate control will not be required. The site is also exempt from peak discharge requirements of NR 151.12 (5)(b) because the site is considered a redevelopment post-construction site. Per the request of the City of Oshkosh, AECOM has provided pre- and post-construction peak discharge rates for comparison purposes only.

3.2 Storm Water Quality Improvement

Storm water quality improvement requirements of NR 151.12 (5)(a)(2) requires reduction, to the maximum extent practicable, the total suspended solids (TSS) load by 40% for redevelopment projects, based on an average annual rainfall, as compared to no runoff management controls. To satisfy this requirement, the majority of the developed site is designed to direct runoff to biofilters.

3.3 Storm Water Infiltration

Infiltration of collected storm water is exempt per NR 151.12 (5)(c)(6)(c) – redevelopment of post-construction sites. Storm water that falls on vegetated portions of the developed site will infiltrate these naturally pervious areas.

3.4 Biofilter Design Criteria

To satisfy storm water quality requirements, site planning has included five biofilters with controlling overflow structures. The biofilters have been designed according to the WDNR Storm Water Management Technical Standard 1004 (Bioretention for Infiltration) to the extent practicable. Section 5.0 describes these criteria in more detail.

4.0 Peak Discharge Rates

This section discusses the approach, details, and results for the hydrologic/hydraulic analysis used to develop the peak discharge rates from the site.

4.1 Approach

The proposed project watershed is estimated to be 4.53 acres in the “Pre-development Condition”. This 4.53 acres is also the approximate area of disturbance. The newly designed storm sewer will include flow from proposed building rooftops; however, runoff generated from the rooftop areas will not be directed to the biofilters because the roof is considered “clean” with respect to Total Suspended Solids (TSS). AECOM used the HydroCAD software package to model the storm water runoff from this watershed. This model is based on the Soil Conservation Service (SCS), Urban Hydrology for Small Watersheds Manual (TR-55). A runoff curve number and time of concentration was estimated for each tributary area. The runoff from the drainage areas is represented by a hydrograph to obtain the peak discharge from the site. The peak discharge rates were estimated to the point at which storm water runoff enters the onsite storm sewer which is ultimately tributary to the City of Oshkosh storm sewer.

4.2 Storm Events

For the hydrologic analysis, an SCS Type II, 24-hour rainfall distribution was used. Table 1 lists the rainfall depths and corresponding storm frequencies used for the City of Oshkosh.

Table 1 - Storm Frequencies/Rainfall Depths

Storm Frequency	24-Hour Rainfall Depth (inches)
2-year	2.40
10-year	3.56
100-year	6.35

Although there is no peak discharge control requirement, AECOM has modeled the 2, 10- and 100-year, 24-hour storm events to compare the pre- to the post-development site peak discharge rates. The goal is to limit flooding of the parking lot while attaining the required 40% reduction of TSS.

4.3 Analysis of Pre-development Conditions

AECOM has modeled the 2-, 10- and 100-year, 24-hour storm events for comparison to the post-development site discharge rates.

4.3.1 Drainage Areas

The pre-development watershed was assumed to be one drainage area in it original meadow condition. The site was historically used for industrial purposes with the majority of the site being impervious. The site has since been cleared leaving it once again in a meadow state. The site was not modeled in its current state, because there are several low-lying areas that would allow water to pond, and no site discharge would be realized until larger storm events. Exhibit 1, "Hydrology Study – Pre-development Condition" in the Attachments section, illustrates the drainage area, along with time of concentrations (Tc), and runoff curve number (RCN) information.

Drainage Areas 1E is 4.53 acres in size. Storm water runoff from this area is directed to the public storm sewer system within the right-of-way, adjacent to the site. The storm water is then conveyed to the Fox River by the use of a 54-inch diameter pipe in Jackson Street.

4.3.2 Soil Types and RCN

To help estimate the RCN for the drainage areas, soil types were obtained from the Web Soil Survey (WSS), operated by the U.S. Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS), for Winnebago County, Wisconsin. A copy of the soil map for this area is included as Figure 2.

4.3.3 Results

Table 2 summarizes modeling input information and resulting peak discharge estimates for each drainage area and the total routed site discharge rate, for each respective storm event. Computer output is attached in Appendix A, which details the input information and resulting runoff/discharge rates.

Table 2 – Pre-development Condition
(2, 10, and 100-Year, 24-Hour Storm Frequencies)

Area No.	Area (acres)	Tc (min)	RCN	2-Year Peak Runoff (cfs)	10-Year Peak Runoff (cfs)	100-Year Peak Runoff (cfs)
1E	4.53	17.5	71	1.91	5.65	17.24
Total	**4.53**			**1.91**	**5.65**	**17.24**

The above pre-development condition total site discharge rates will be compared to post-development total site discharge rates, in the following section.

4.4 Analysis of Post-development Condition

AECOM has modeled the 2-, 10- and 100-year, 24-hour storm events for comparison to the pre-development site discharge rates.

4.4.1 Drainage Areas

The proposed site has been subdivided into six drainage areas. Exhibit 2, “Hydrology Study - Post-development Condition” in the Attachments section, illustrates these drainage areas, along with time of concentrations (Tc), and runoff curve number (RCN) information. A minimum Tc of 5 minutes was assumed for drainage areas 2P to 6P because of the impervious nature of the site and the short flow path length. Drainage Area 1P has a Tc flowpath long enough to measure it using sheet and shallow concentrated flow. Routing of storm water was done as described in the Pre-development analysis.

Drainage Areas 1P through 5P are 3.29 acres of parking lot pavements, sidewalks, and grassed areas that are tributary to the five biofilters. The biofilters provide detention and water quality aspects before discharging to the proposed storm sewer system. The storm sewer system is tributary to the public storm sewer in Jackson Street and ultimately the Fox River.

Drainage Area 6P is the remaining 1.24 acres that is not tributary to the biofilters. These areas are made up of the three proposed buildings, and pavements and grassed areas that are either collected by the public storm sewer or the onsite storm sewer. The areas were modeled as one subcatchment in HydroCAD since none of them had a Tc longer than the minimum of 5 minutes. The two on-site catch basins included in this area have 18-inch sumps to provide a reduction in TSS.

4.4.2 Biofilters

Discharge from the biofilters will be controlled by a combination of the engineered soil, perforated underdrain pipe and the overflow structure. The biofilter was designed following the WDNR’s Post-Construction Storm Water Management Technical Standard 1004 – *Bioretention* is provided to the extent possible. An in-depth description of the biofilters is provided in Section 5, and details and specifications are provided in Attachment 3.

4.4.3 Results

Table 3 summarizes modeling input information and resulting peak discharge estimates for each drainage area, and the total routed site discharge rate, for each respective storm event. Computer output is attached in Appendix B, which details the input information and resulting runoff/discharge rates. The stage-storage-discharge tables for the biofilters are presented in Appendix C.

Table 3 – Post-development Condition

(2, 10, and 100-Year, 24-Hour Storm Frequencies)

Area No.	Area (acres)	Tc (min)	Runoff Curve Number	2-Year Peak Runoff (cfs)	10-Year Peak Runoff (cfs)	100-Year Peak Runoff (cfs)
1P*	1.76	5.5	96	5.71	8.75	15.97
Biofilter 1**				5.52	7.57	8.10
2P*	0.86	5.0	94	2.66	4.21	7.85
Biofilter 2**				2.50	2.79	3.14
3P*	0.13	5.0	90	0.34	0.58	1.14
Biofilter 3**				0.04	0.04	0.26
4P*	0.21	5.0	93	0.62	0.99	1.87
Biofilter 4**				0.12	0.89	1.83
5P*	0.33	5.0	91	0.92	1.52	2.96
Biofilter 5**				0.48	1.45	2.77
6P**	1.24	5.0	90	3.25	5.48	10.81
Total		---	---	**11.27**	**17.88**	**26.32**

* Runoff that is conveyed to the biofilters

** Hydrographs combined to calculate the total site discharge

The Hydro-CAD model also calculated the following peak biofilter elevations:

Table 4

Biofilter Peak Water Surface Elevation

Biofilter	2-Year (ft)	10-Year (ft)	100-Year (ft)
Biofilter 1	749.87	750.11	750.65
Biofilter 2	749.92	750.06	750.42
Biofilter 3	750.63	750.77	751.04
Biofilter 4	750.82	750.89	750.97
Biofilter 5	750.82	750.89	751.00

These results indicate that the overflow structure will control flow from the biofilter. The model also indicates that even during the 100-year storm event, the peak water surface elevation does not exceed the limits of Biofilters 3, 4, and 5. The model indicates some inundation of the parking lot in the areas of Biofilters 1 and 2 during the 100-year event; however, the 10-year storm event should be mostly contained within the biofilter. Storage volume within the biofilters was only modeled from the surface and up. Some storage volume is available below the biofilter surface, but a conservative approach was taken and this volume was not included in the model. This would indicate that the actual peak water surface elevations within the biofilters are most likely lower than indicated in the above table. For larger storm events, overland relief is provided to pass storm water runoff into the Jackson Street and Marion Road right-of-ways and ultimately to the public storm sewer in the streets.

4.5 Comparison of Pre-development to Post-development Discharge Rates

Table 5 presents a comparison of the peak discharge rates for both the pre-development conditions and the post-development conditions.

Table 5

Comparison of Pre-development Discharge and Post-development Discharge Rates

Condition	2-Year Discharge (cfs)	10-Year Discharge (cfs)	100-Year Discharge (cfs)
Pre-development	1.91	5.65	17.24
Post-development	11.27	17.88	26.32

Control of peak flow rates is not required due to the classification of the site as redevelopment. The above table is for comparison purposes only. Please note that the Pre-development Condition was assumed to be meadow prior to any historic site development. The proposed biofilters provide a degree of attenuation; therefore, the above "Post-development" discharge rates are most likely less than the peak rates that were discharged from the historic industrial site.

5.0 Water Quality Improvement

This section discusses the approach, details, and results of the analysis for removal of Total Suspended Solids (TSS), as a means of storm water quality improvement.

5.1 Approach

Removal of TSS will be accomplished using catch basin sumps and biofilters. The biofilters been designed to comply with the WDNR Storm Water Management Technical Standard 1004 (Bioretention for Infiltration) design criteria to the fullest extent feasible. These criteria include:

- Biofilter geometry
- Flow regulation
- Planting Bed

5.1.1 Biofilter Geometry

The following guidelines were followed in the design of the biofilters:

- The maximum ponding depth does not exceed 12 inches
- The side slope are 2H:1V or flatter
- The surface area of the planting bed was maximized based on site constraints
- The surface slope of the biofilter does not exceed 1%
- The depth of engineered soil was maximized based on site constraints

The ponding depths for the biofilters are approximately 6 inches or less controlled by the overflow structures. The side slope of the biofilters are 2H:1V in order to maximize the surface area of the engineered soil planting beds. The depths of the engineered soil planting beds are less than the recommended minimum depth of 3 feet; however, the depths were limited by the need to discharge collected storm water to the existing storm sewer in Jackson Street.

The bottom of the biofilters shall be pitched to direct collected storm water to the perforated underdrain pipe. Storm water will be prevented from infiltrating into the native soil by a geosythetic liner. The geosynthetic liner will prevent infiltration into the subsurface of the parking lot, and also prevent the possibility of seasonal high ground water from entering the biofilter. See Attachment 3 for biofilter cross-sections, details, and specifications.

5.1.2 Flow Regulation

Please note that the intended use of the biofilter is for TSS reduction and not for retention or infiltration into the surrounding native soils. Flow from the biofilter, however, is regulated by the overflow structure. The underdrain pipe shall be protected from clogging by use of filter fabric or a filter sock, and a 6-inch clean-out shall be provided for maintenance purposes. A geosynthetic composite liner will line the sides and the bottom of the biofilter to prevent infiltration into the subsurfaces of the parking lot, and also to prevent the possibility of seasonal high ground water from entering the biofilter. See Attachment 3 for design details on the overflow structures and underdrains.

5.1.3 Planting Bed

The planting bed will have an engineered soil consisting of 50% mineral (SiO_2) sand and 50% compost. Above the engineered soil will be 2 inches of hardwood mulch. Below the engineered soil there will be a varying depth of pea gravel in order to pitch the bottom of the biofilter towards the perforated underdrain. See Attachment 3 for layering and material specifications.

5.2 WinSLAMM Analysis

The WinSLAMM software was used to model the effectiveness of the biofilters designed for the site. The biofilters were designed using criteria from the WDNR Technical Standard 1004 (Bioretention for Infiltration) to the extent practicable. Site constraints limited the depth and area of the biofilter, but the design parameters entered into WinSLAMM indicated that the overall site removal of suspended solids exceeds the 40% reduction as required for a redevelopment site.

5.2.1 Methdology

WinSLAMM version 9.3.2 was used to calculate the source loading from each drainage area and particulate control provided by the appropriate storm water best management practice. The analysis includes land use data, controls data, and calibration files. The overall reduction in TSS was determined by running seven separate WinSLAMM analyses, and then summing the resulting TSS loads before and after application of Best Management Practices (BMPs). These summed TSS loads were then used to determine an overall site reduction. The seven models were necessary to separately model the areas contributing storm water runoff to the five biofilters, two catch basins with sumps, and the area that directed storm water runoff off-site without any BMP. See Appendix D for WinSLAMM input, output, and an overall TSS reduction calculation spreadsheet.

5.2.2 Results

WinSLAMM computes the total TSS for the site “without controls” and then computes the total TSS for the site “after outfall controls”. Based on a comparison of these two totals, the proposed design will result in a TSS removal of 40.2%. This removal rate complies with the 40% removal rate required by both the City and WDNR for a redevelopment site. Input and output data and an overall TSS reduction calculation spreadsheet are included in Appendix D.

6.0 Erosion Sediment Control

This section discusses practices and sequencing of construction to control erosion and minimize sediment movement from the site.

6.1 Erosion Control Practices

Best Management Practices (BMP's) will be implemented to control erosion for both the planned construction and continuing site operations. These BMP's follow the WDNR Construction Site Erosion & Sediment Control Technical Standards and include:

- Non-channel Erosion Mat (1052)
- Silt Fence (1056)
- Stone Tracking Pad (1057)
- Mulching for Construction Sites (1058)
- Seeding for Construction Site Erosion Control (1059)
- Storm Drain Inlet Protection (1060)
- Dust Control (1068)

Plan sheets in Attachments 4 and 5 show the locations, details and specifications for erosion control proposed for the site.

The redevelopment of the Marion/Pearl Phase II site will include construction of parking lots, utilities, and three buildings. This redevelopment will include five biofilters with overflow structures, and two catch basins with sumps to improve storm water quality prior to discharge to the City storm sewer.

6.2 Description of Construction Methods

Construction will be implemented in five basic steps: preparation, site grading, building and utility construction, paving, and restoration. A general description of each of these steps and the associated erosion control measures are provided in the following sections. The erosion control measures will be followed as necessary depending on construction activity.

6.2.1 Preparation

These activities consist of installation and maintenance of perimeter erosion control measures. Silt fence will be placed around the north, east, and south sides of the site and inlet protection shall be placed in the curb inlets in Pearl Avenue, Jackson Street, and Marion Road as indicated on Plan Sheets in the Attachment 4. A stone-tracking pad will be provided at appropriate locations on the site to prevent tracking of sediment associated with construction from the site onto public roadways. After the perimeter erosion controls are in place, the site clearing, grubbing, demolition and utility abandonment shall commence. Topsoil and granular material that will be reused shall be stripped and maintained on-site.

6.2.2 Site Grading

This activity consists of movement and placement of granular fill materials to reach the design grades indicated on Plan Sheets C3.0, C3.1, and C3.2 in the Attachments section. Grading will be completed by bulldozers, skid steers, and backhoes. Compaction of fill will likely be completed using mechanical compaction equipment, either hand-operated (plate compactor) or self-propelled, depending on the size and nature of the area being compacted.

During grading activities, on-site dust control will be performed in accordance with WDNR Technical Standard 1068. Erosion control features installed during the Preparation step will be maintained. Construction of the biofilters will not take place until after the parking lot construction has been completed to prevent clogging of the engineered soil planting beds from sediment generated during the construction phase.

6.2.3 Building and Utility Construction

This activity consists of construction of the three proposed building foundations and constructing the water, storm and sanitary sewer located on site. Utility trenching and placement will be completed by a backhoe. Specific erosion control measures during pipe installation will include: (1) the placement of excavated materials on the high side of the trench; (2) backfilling, compacting, and stabilizing the trench immediately after pipe construction; and (3) not discharging trench water before passing through filtering or settling tanks. Following installation, storm inlets will be protected using geotextile fabric as shown on Plan Sheets C3.1 and C3.2 in the Attachments.

6.2.4 Paving

This activity includes placement and compaction of dense graded gravel base course and installation of asphalt and concrete paving for parking areas and sidewalks. Equipment will include a dump truck to haul the material, a grader to finish grade the base course, machine pavers, and a roller for compaction. Erosion control installed in prior steps will be maintained during this process.

6.2.5 Restoration

These activities include final grading, topsoil replacement, and re-vegetation of disturbed areas. Landscaping and removal of erosion control measures are also included in the restoration process.

Topsoil, where required on site, will be placed to a depth of 6 inches commencing immediately after the completion of final grading. Soils will be stabilized by seeding within seven days of establishing final grade (refer to WDNR

Technical Standard 1059 – Seeding for Construction Site Erosion Control). Additional landscaping materials (such as fertilizer and mulch) will be used, as necessary, to ensure seeding and planting success and soil stabilization (refer to WDNR Technical Standard 1058 – Mulching for Construction Sites).
The following seed mixture will be utilized:

- Kentucky Blue Grass: 35%
- Improved Hard Fescue: 20%
- Improved Turf Type Hard Fescue: 25%
- Improved Fine Perennial Rye: 20%

The seed mixture may be applied as a slurry with a hydraulic seeder at a rate of 3 lbs per 1,000 square feet evenly in two intersecting directions. Do not seed area in excess of that which can be mulched on the same day.

After construction is completed, the biofilters will be installed (see the biofilter details and specifications in Attachment 3). The side slopes of the biofilters shall have non-channel erosion mat down to the top of the planting bed.

6.3 Construction Site Sequencing

Construction is to begin in October of 2009. The construction site sequence for the development is identified below:

1. Install temporary tracking pads and maintain perimeter erosion controls,
2. Install erosion control silt fence and hay bales downstream of designated stockpile locations,
3. Strip topsoil and stockpile only amount necessary for reuse on-site,
4. Site demolition,
5. Perform preliminary site grading,
6. Construct building foundations,
7. Install water, storm sewer, and sanitary sewer,
8. Work subgrade material to desired subgrade elevation in areas of site improvements,
9. Complete final grading, installation of granular subgrade and placement of curbs, pavements, walkways, and other surface hardscape,
10. Place topsoil, establish vegetative cover, and install landscape features,
11. Construct biofilters

12. Remove erosion controls.

6.4 Erosion Control Inspection and Maintenance

Inspection: All erosion control measures will be inspected: (1) within 24 hours of the end of each rainfall event that produces 0.5 inches or more during a 24-hour period, (2) daily during periods of prolonged rainfall, and (3) weekly during periods without rainfall. Construction Site Inspection Report forms will be used to document these inspections.

Maintenance: All erosion control measures will be constructed and maintained in accordance with the Wisconsin Department of Natural Resources (WDNR) Technical Standards for Construction Site Erosion and Sediment Control. All damaged, failed, or inadequate erosion control measures will be immediately repaired or replaced. Maintenance of all erosion control measures will be routine to ensure proper function of erosion controls at all times. Erosion control measures are to be in working order at the end of each workday.

7.0 Long Term Maintenance

The following post-development maintenance for the biofilters will be performed by the Owner.

7.1 Inspections and Maintenance

Document and keep these inspection and maintenance activities, on record. Utilize design plans for reference during inspections.

On a monthly basis:

- Inspect the biofilter for sediment build-up and clogging.
- Inspect biofilter's planting bed for plant health.
- Inspect the biofilter's inlets and overflow structure for collected debris
- Inspect the biofilter for collected debris within the planting bed. Observe the condition and integrity of the side-slope soils, and the establishment and cover related to erosion protection.
- Inspect landscaped areas to provide the maximum benefit of vegetative cover.

On an annual basis:

- Add additional mulch to the planting bed of the biofilter
- Test pH of the biofilter's planting bed soil to maintain the optimum growing conditions

As needed:

- Water biofilter plants as necessary during the first growing season, and as needed after the first growing season during dry periods.
- Inspect the condition of the biofilters, and erosion controls after a storm event involving >0.5 inches of precipitation over a 24-hour period.

7.2 Corrective Action

As required:

- Sediment shall be removed and/or the engineered soil planting bed shall be excavated and replaced when the biofilter exhibits signs that infiltration is no longer taking place. Sediment shall be disposed of at an approved location.
- Re-mulch void areas of the planting bed.
- Treat/replace diseased vegetation to maintain a healthy planting bed.
- Remove litter and debris to ensure proper operation.

Note: In order to prevent compaction of the biofilters, snow shall not be dumped directly onto the conditioned planting beds.

The Owner shall provide access to perform the above operation and maintenance activities.

8.0 Conclusion

This SWM/EC plan summarizes the planned development activities at the Marion/Pearl Phase II Site, and the methods of storm water management and erosion control that will be employed during and following construction.

Development plans include the parking lot design, storm water collection and conveyance systems, sanitary sewer, water main, commercial buildings and biofilters and catch basins with sumps for storm water quality improvement. This SWM/EC plan includes analyses that show:

- The biofilters are adequately designed and sized to meet the requirements of the City of Oshkosh storm water criteria for a redevelopment site. Pre-development and post-development condition peak discharge rates were compared for the 2-year, 10-year, and 100-year, 24-hour storm events.

- The developed site will comply with the City of Oshkosh and WDNR Chapter NR 151 and NR 216 storm water quality improvement criteria for removal of 40% of the Total Suspended Solids load on an average annual basis.

This SWM/EC plan also includes provisions for erosion control practices during construction and on a long-term basis to minimize the potential for erosion and sediment movement. Criteria are established for long-term maintenance activities intended to inspect and maintain storm water management features.

Figures

Attachments

Attachment 1	Hydrology Study - Pre-development Condition
Attachment 2	Hydrology Study - Post-development Condition
Attachment 3	Biofilter Details and Specifications (Plan Sheets C8.0 through C8.4)
Attachment 4	Grading, Paving, & Erosion Control Plan (Plan Sheets C3.0, C3.1, C3.2)
Attachment 5	Erosion Control Details (Plan Sheet C5.0)
Attachment 6	Department of Commerce Notice of Intent (NOI)

Appendices

Appendix A

Pre-development Condition: 2-Year, 10-Year, and 100-Year, 24-hour Storm Events

Appendix B

Post-development Condition: 2-Year, 10-Year, and 100-Year, 24-hour Storm Events

Appendix C

Biofilter Stage-Storage-Discharge Reports

Appendix D

WinSLAMM Results and Input and Output Data

Attachment 5

UWO MOU

INTERGOVERNMENTAL COOPERATION AGREEMENT

**CITY OF OSHKOSH AND STATE OF WISCONSIN,
UNIVERSITY OF WISCONSIN – OSHKOSH**

WHEREAS, the City of Oshkosh ("City") operates a storm sewer disposal system and has been designated by the State Department of Natural Resources as an MS4 (Municipal Separate Storm Sewer System) provider of services; and

WHEREAS, the University of Wisconsin – Oshkosh ("University") is treated under the law as a municipal provider of storm water disposal services with respect to stormwater generated on and dispersed from the campus of the University and is similarly designated; and

WHEREAS, the City and University storm water disposal systems are interconnected; and

WHEREAS, the City has the ability to fulfill the responsibilities of managing both its systems and that of the University in a manner consistent with laws and regulation applicable thereto and the University desires to avail itself of said services from the City.

NOW, THEREFORE, THIS AGREEMENT.

1. Authority

This agreement is entered into by the parties hereto pursuant to the authority vested in each of them under §66.0301, Wis. Stats., pursuant to which any city in conjunction with the state and any department thereof may jointly perform or one on behalf of the other may perform and the other may receive services or jointly exercise any powers or duties authorized by law. Each of the parties hereto is authorized to engage in stormwater disposal services pursuant to approval by the State Department of Natural Resources ("DNR") and each currently owns and operates a stormwater disposal system, subject to the oversight of and approval by the DNR.

2. Functions to be Performed by the City on behalf of the University

Through this agreement, the City agrees to provide Stormwater Utility service to the University in a manner consistent with the service it provides to other ratepayers. Furthermore, the City agrees to perform the following stormwater related services on behalf of the University:

a. Public Education Website

The City will maintain its website providing education about stormwater effects and conservation efforts. The University may link to the City page to provide educational information to University website users as well. The City shall not, under this agreement, be obligated to provide additional information on its website at the request of the University.

b. Erosion Control Inspections

The City will provide erosion control inspections of all University active building sites and report inspection results to the Director of Facilities Management at UW-Oshkosh for follow up. The City shall not be responsible for any follow up action. Inspection schedule shall be worked out on a project by project basis.

c. Outfall Inspections

The City will perform annual inspections of the major storm sewer system outfalls on the Fox River adjacent to UW Oshkosh, and to which UW Oshkosh is a major contributor. A University employee will accompany the City employee if available. All inspection reports and follow up work required will be submitted to the University. The University shall be responsible for the follow up work that is required.

d. Storm Sewer Inspections

The City will do a comprehensive inspection of the main storm sewer system components as shown in Exhibit A. Inspections shall occur at a minimum of once every 5 years. Any repairs that are needed will be performed by the University. The University will continue to do its own visual inspections of the system semi-annually as required by their NOI (notice of intent).

e. Pond Inspections

The City will inspect all University owned and operated ponding facilities within the same rotation as all other City ponds. Currently the ponds are on a 5 year inspection rotation. All design information needed to perform adequate inspections shall be provided by the University to the City. Without such information, the inspections may not cover all required components. Any uncovered items shall be the responsibility of the University. The ponds to be inspected by the City are also highlighted in Exhibit A.

f. Storm Sewer System Map

The City will create and maintain a digital map of the University storm sewer system. The University shall provide to the City any information it obtains about its storm sewer system. Any corrections and/or updates shall be submitted to the City. The City will prepare a map submittal for the DNR on an annual basis. The City will update the map as appropriate based on storm system inspection results. The City will only be responsible for the completeness of the map to the extent of the information provided by the University.

3. Functions to be performed as a joint effort between the City and University

a. Public Educational Efforts

The City shall provide the University with any informational brochures already produced. The University has a stormwater logo contest planned; the City will assist this effort. The end result will be a logo that can be used by the City and University in stormwater efforts. The City and University will work together in locating and promoting generic public service announcements regarding stormwater management. These public service announcements will be aired on the City cable station, Channel 16 as well as the University cable station, Channel 19.

b. Community Outreach

c. Annual Public Meeting

The University will organize and hold its own annual public meeting. The City will provide a representative at that meeting to answer any questions that may arise.

4. Obligation of the University to the City

The University agrees to purchase Storm Water Utility services from the City throughout the term of this agreement. The University's fee to purchase this service shall be in accordance with established rules, rates and ordinances of the City. The stormwater utility fee is a runoff based fee, which has been adjusted for the University based on the actual land uses of the University. Monthly rates to the university are established based on estimates of runoff produced and the current fee per runoff unit, consistent with all other ratepayers receiving service from the Storm Water Utility.

In exchange for the willingness of the City to perform the functions identified in 2., above, the University agrees that it shall transfer to the City, during the term of this Agreement, all pollution control credits needed to help meet the 20% and 40% total suspended solids removal requirement. The City acknowledges that this is adequate consideration in exchange for the duties which it is willing to perform under this Agreement. In addition, the University will continue to pay stormwater utility fees to the City at the current contribution rate.

5. Separate Maintenance and Operation to be Continued

This Agreement shall not be interpreted as an understanding between the parties hereto that the City will assume the responsibility for the ownership and operation of the University's stormwater disposal system. Each party hereto shall separately administer and operate its system, despite interconnections, subject only to the City's willingness to provide services in relationship thereto on behalf of the University. To this extent, the University acknowledges that it shall remain solely responsible to maintain roof drains, catch basins, and proprietary devices located on its campus, which direct stormwater into its disposal system. In addition, the University will organize its own street sweeping, fleet maintenance, and snow and ice removal program. The University will also conduct semi-annual visual inspections of their storm water system in addition to the more in depth inspection the City will perform every 5 years. The City and University will each produce their own annual reports for the DNR. For items the City has performed for the University, the City will provide the University documentation needed to complete the annual report.

6. Term of Agreement

This Agreement shall continue for a term of ten years from and after the 1st day of the month next following the date of execution hereof by the parties hereto. Said term shall be shortened only in the even that the DNR determines that it is in volition of state law or regulations or by mutual agreement of both parties affected by this Agreement.

7. Miscellaneous Terms

a. The laws of the State of Wisconsin shall govern this Agreement.

b. Notices under this Agreement shall be provided, personally or by US Mail to the following representatives of the parties hereto:

City of Oshkosh	Mr. David Patek, P.E. Public Works Director 215 Church Ave P.O. Box 1130 Oshkosh, WI 54903-1130 (920) 236-5065
University	Mr. Richard Wells Chancellor 800 Algoma Blvd Oshkosh, WI 54901 (920) 424-0200

c. The City is not, by assuming the duties imposed upon it under this Agreement, taking on or absorbing any fiscal responsibility of the University to operate its stormwater disposal system. Each party shall remain responsible for its own costs of operation, maintenance and repair. However, to the extent that portions of the University stormwater disposal system are drained into the City system and to the extent that portions of the City stormwater disposal system drain into the University system, each agrees to make such accommodations to the other in terms of operations and cost as may be deemed equitable under the circumstances.

Dated this ____ day of ________________, 2010.

CITY OF OSHKOSH **UNIVERSITY OF WISCONSIN-OSHKOSH**

By:________________________ By:_______________________________

Appendix B

Pollution Loads by Watershed

Appendix B
City of Oshkosh
Pollutant Loads by Watershed

Watershed	MS4							TMDL						
	Area	Base Load		Existing Load		Percent Reduction		Area	Base Load		Existing Load		Percent Reduction	
		TSS	TP	TSS	TP	TSS	TP		TSS	TP	TSS	TP	TSS	TP
		(lbs/ac/yr)	(lbs/ac/yr)	(lbs/ac/yr)	(lbs/ac/yr)	(lbs/ac/yr)	(lbs/ac/yr)		(lbs/ac/yr)	(lbs/ac/yr)	(lbs/ac/yr)	(lbs/ac/yr)	(lbs/ac/yr)	(lbs/ac/yr)
10th Ave	35.0	331.4	0.8	291.4	0.7	12%	9%	35.0	331.4	0.8	291.4	0.7	12%	9%
14th Ave	129.6	247.0	0.9	197.1	0.8	20%	13%	129.6	247.0	0.9	197.1	0.8	20%	13%
15th Ave	14.9	291.8	0.9	209.4	0.7	28%	19%	14.9	291.8	0.9	209.4	0.7	28%	19%
16th Ave	34.3	303.4	0.9	240.9	0.8	21%	13%	34.3	303.4	0.9	240.9	0.8	21%	13%
17th Ave	140.6	247.9	0.9	204.4	0.8	18%	11%	140.6	247.9	0.9	204.4	0.8	18%	11%
18th Ave	20.5	220.0	0.8	177.7	0.7	19%	12%	20.5	220.0	0.8	177.7	0.7	19%	12%
19th Ave	107.7	235.3	0.9	190.6	0.7	19%	13%	107.7	235.3	0.9	190.6	0.7	19%	13%
21/41 Interchange	36.9	324.4	0.8	281.1	0.8	13%	9%	36.9	324.4	0.8	281.1	0.8	13%	9%
24th Ave	102.8	304.2	0.8	244.0	0.7	20%	14%	102.8	304.2	0.8	244.0	0.7	20%	14%
3rd Ave	49.1	403.7	0.9	329.5	0.8	18%	12%	49.1	398.9	0.9	329.5	0.8	17%	12%
4th Ave	12.0	476.4	0.9	476.4	0.9	0%	0%	12.0	476.4	0.9	476.4	0.9	0%	0%
6th Ave	8.8	435.3	1.0	435.3	1.0	0%	0%	8.8	435.3	1.0	435.3	1.0	0%	0%
Alpine Ct	9.2	224.5	0.8	179.2	0.7	20%	12%	9.2	224.5	0.8	179.2	0.7	20%	12%
Anchorage Ct	467.3	337.3	0.9	236.3	0.7	30%	22%	476.2	331.8	0.9	232.5	0.7	30%	22%
Asylum Point	61.0	390.5	0.9	390.5	0.9	0%	0%	89.6	281.2	0.7	281.2	0.7	0%	0%
Babbitz Ave	4.8	239.5	0.9	174.5	0.7	27%	18%	4.8	239.5	0.9	174.5	0.7	27%	18%
Baldwin Ave	124.2	256.4	0.9	190.1	0.7	26%	17%	124.2	256.4	0.9	190.1	0.7	26%	17%
Bavarian Ct	8.5	207.2	0.8	180.6	0.7	13%	8%	8.5	207.2	0.8	180.6	0.7	13%	8%
Bay St	37.7	313.4	1.0	249.4	0.8	20%	15%	37.7	313.4	1.0	249.4	0.8	20%	15%
Blackhawk St	46.5	343.9	1.0	302.5	0.9	12%	6%	46.5	343.0	1.0	302.5	0.9	12%	6%
Bowen St	79.3	265.3	0.9	211.4	0.8	20%	13%	79.3	265.3	0.9	211.4	0.8	20%	13%
Broad St	35.1	366.0	1.0	313.4	0.9	14%	9%	35.1	366.0	1.0	313.4	0.9	14%	9%
Campbell Creek	1128.5	350.5	0.9	168.0	0.6	52%	35%	1167.1	342.7	0.9	163.2	0.6	52%	36%
Ceape Ave	32.4	247.7	0.9	197.0	0.8	20%	13%	32.4	247.7	0.9	197.0	0.8	20%	13%
Chestnut St	41.3	177.6	0.7	146.8	0.6	17%	10%	41.3	177.6	0.7	146.8	0.6	17%	10%
Cliffview Ct Island	10.0	209.7	0.8	188.8	0.8	10%	6%	10.0	209.7	0.8	188.8	0.8	10%	6%
Court St	23.8	389.7	1.0	302.3	0.9	22%	14%	23.8	389.7	1.0	302.3	0.9	22%	14%
Dawes St	44.4	398.1	1.0	315.3	0.8	21%	14%	44.4	392.7	1.0	315.3	0.8	20%	14%
Division St	211.7	351.6	1.0	251.3	0.8	29%	20%	211.7	346.8	1.0	251.3	0.8	28%	20%
Doemel St	31.8	217.2	0.8	169.8	0.7	22%	14%	31.8	217.2	0.8	169.8	0.7	22%	14%
Dove St	1.6	419.8	1.0	336.1	0.9	20%	14%	1.6	419.8	1.0	336.1	0.9	20%	14%
East Murdock Ave	26.7	211.9	0.8	169.9	0.7	20%	12%	26.7	211.9	0.8	169.9	0.7	20%	12%
East New York Ave	51.7	237.3	0.9	191.9	0.8	19%	12%	51.7	237.3	0.9	191.9	0.8	19%	12%

Appendix B
City of Oshkosh
Pollutant Loads by Watershed

Watershed	MS4							TMDL						
	Area	Base Load		Existing Load		Percent Reduction		Area	Base Load		Existing Load		Percent Reduction	
		TSS	TP	TSS	TP	TSS	TP		TSS	TP	TSS	TP	TSS	TP
		(lbs/ac/yr)	(lbs/ac/yr)	(lbs/ac/yr)	(lbs/ac/yr)	(lbs/ac/yr)	(lbs/ac/yr)		(lbs/ac/yr)	(lbs/ac/yr)	(lbs/ac/yr)	(lbs/ac/yr)	(lbs/ac/yr)	(lbs/ac/yr)
East Snell Rd	502.6	181.8	0.7	61.4	0.4	66%	42%	530.1	174.9	0.7	59.2	0.4	66%	42%
Edgewood Lane	78.4	237.2	0.8	115.5	0.5	51%	36%	120.1	190.9	0.7	103.3	0.5	46%	32%
Eveline St	19.8	207.4	0.8	187.3	0.8	10%	6%	19.8	207.4	0.8	187.3	0.8	10%	6%
Fairview St	16.4	212.0	0.8	181.6	0.7	14%	9%	16.4	212.0	0.8	181.6	0.7	14%	9%
Fernau Ave	477.6	416.5	0.9	325.1	0.7	22%	22%	544.6	393.9	0.9	298.4	0.7	24%	22%
Frankfort St	21.6	201.9	0.8	166.5	0.7	18%	11%	21.6	201.9	0.8	166.5	0.7	18%	11%
Gallups/Merritts Creek	475.5	384.4	0.8	265.2	0.6	31%	27%	544.1	342.0	0.8	233.9	0.5	32%	28%
Glatz Creek	1342.6	178.2	0.6	109.2	0.3	39%	42%	1440.4	174.8	0.6	107.4	0.3	39%	42%
Green Valley Rd	518.1	341.2	0.9	247.4	0.7	27%	21%	1038.7	197.0	0.6	147.2	0.5	25%	18%
Greenwood Ct	4.7	249.3	0.9	213.3	0.8	14%	10%	4.7	249.3	0.9	213.3	0.8	14%	10%
Hickory Lane	34.1	196.1	0.8	134.7	0.6	31%	27%	40.5	172.8	0.7	120.9	0.5	30%	25%
Honey Creek	0.0	390.5	0.9	390.5	0.9	0%	0%	0.0	390.5	0.9	390.5	0.9	0%	0%
Irving Ave	86.0	229.9	0.8	173.6	0.7	24%	16%	86.0	229.9	0.8	173.6	0.7	24%	16%
Johnson Ave	187.9	276.9	0.8	222.3	0.6	20%	21%	187.9	276.9	0.8	222.3	0.6	20%	21%
Kewaunee St	3.3	331.4	0.9	233.4	0.7	30%	23%	3.3	331.4	0.9	233.4	0.7	30%	23%
Lake Shore Golf Course	123.9	146.3	0.6	145.1	0.6	1%	0%	123.9	146.3	0.6	145.1	0.6	1%	0%
Lake St	7.8	211.0	0.8	180.7	0.7	14%	9%	7.8	211.0	0.8	180.7	0.7	14%	9%
Lakeview Cemetary	46.3	134.3	0.6	132.3	0.6	2%	1%	46.3	134.3	0.6	132.3	0.6	2%	1%
Lawndale St	8.9	185.3	0.7	148.5	0.6	20%	12%	8.9	185.3	0.7	148.5	0.6	20%	12%
Leeward Ct	17.5	387.2	0.9	336.1	0.8	13%	8%	17.5	387.2	0.9	336.1	0.8	13%	8%
Legion Place	1.3	219.5	0.8	199.5	0.8	9%	6%	1.3	219.5	0.8	199.5	0.8	9%	6%
Libbey Ave	410.0	303.5	0.9	231.3	0.7	24%	19%	417.6	298.9	0.9	227.7	0.7	24%	19%
Lincoln Ave	18.9	246.9	0.9	200.7	0.8	19%	12%	18.9	246.9	0.9	200.7	0.8	19%	12%
Linde St	14.9	123.7	0.6	111.9	0.5	10%	5%	14.9	123.7	0.6	111.9	0.5	10%	5%
Melvin Ave	110.8	248.9	0.9	174.2	0.7	30%	21%	110.8	248.9	0.9	174.2	0.7	30%	21%
Menominee Park Central	12.8	125.5	0.6	113.2	0.5	10%	5%	12.8	125.5	0.6	113.2	0.5	10%	5%
Menominee Park South	7.8	115.3	0.5	108.0	0.5	6%	3%	7.8	115.3	0.5	108.0	0.5	6%	3%
Merritt Ave	63.9	292.7	0.9	234.3	0.7	20%	13%	63.9	292.7	0.9	234.3	0.7	20%	13%
Mill St	10.2	324.8	1.0	265.0	0.9	18%	12%	10.2	324.8	1.0	265.0	0.9	18%	12%

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Watershed	MS4							TMDL						
	Area	Base Load		Existing Load		Percent Reduction		Area	Base Load		Existing Load		Percent Reduction	
		TSS	TP	TSS	TP	TSS	TP		TSS	TP	TSS	TP	TSS	TP
		(lbs/ac/yr)	(lbs/ac/yr)	(lbs/ac/yr)	(lbs/ac/yr)	(lbs/ac/yr)	(lbs/ac/yr)		(lbs/ac/yr)	(lbs/ac/yr)	(lbs/ac/yr)	(lbs/ac/yr)	(lbs/ac/yr)	(lbs/ac/yr)
Minnesota St	13.3	510.8	0.9	469.2	0.9	8%	5%	13.3	510.8	0.9	469.2	0.9	8%	5%
N/A	94.2	315.0	0.8	306.5	0.8	3%	2%	96.9	307.4	0.8	299.2	0.8	3%	2%
Nebraska St	56.3	337.5	1.0	272.1	0.8	19%	12%	56.3	333.2	1.0	272.1	0.8	18%	12%
Neenah Slough	35.1	124.7	0.6	124.7	0.6	0%	0%	35.1	124.7	0.6	124.7	0.6	0%	0%
Nevada Ave	94.7	231.9	0.8	171.6	0.7	26%	17%	94.7	231.9	0.8	171.6	0.7	26%	17%
Nicolet Ave	189.6	417.4	0.9	341.0	0.8	18%	13%	199.8	398.6	0.8	325.3	0.7	18%	13%
North Main St	45.7	390.0	1.0	280.4	0.8	28%	19%	45.7	390.0	1.0	280.4	0.8	28%	19%
North Sawyer St	141.5	293.0	0.9	258.9	0.8	12%	8%	141.5	293.0	0.9	258.9	0.8	12%	8%
Oak St	21.4	249.7	0.8	213.4	0.8	15%	9%	21.4	249.7	0.8	213.4	0.8	15%	9%
Ohio St	74.1	301.9	0.9	233.8	0.8	23%	15%	74.1	301.9	0.9	233.8	0.8	23%	15%
Omro Rd	117.1	437.7	1.0	174.2	0.5	60%	49%	137.6	426.9	1.0	167.8	0.5	61%	49%
Osceola St	139.2	296.1	1.0	228.7	0.8	23%	15%	139.2	294.5	1.0	228.7	0.8	22%	15%
Otter Ave	9.1	231.6	0.9	160.6	0.7	31%	21%	9.1	231.6	0.9	160.6	0.7	31%	21%
Packer Ave	126.8	211.6	0.8	187.7	0.7	11%	7%	126.8	211.6	0.8	187.7	0.7	11%	7%
Parkway	121.7	257.7	0.9	196.8	0.8	24%	15%	121.7	257.7	0.9	196.8	0.8	24%	15%
Pioneer Dr	25.7	342.2	0.8	301.1	0.7	12%	9%	25.7	342.2	0.8	301.1	0.7	12%	9%
Rahr Ave	5.8	196.3	0.8	158.5	0.7	19%	11%	5.8	196.3	0.8	158.5	0.7	19%	11%
Rainbow Park	41.6	214.9	0.8	199.2	0.7	7%	4%	41.6	214.9	0.8	199.2	0.7	7%	4%
Red Arrow Park	36.5	298.9	0.9	260.9	0.9	13%	7%	36.5	298.9	0.9	260.9	0.9	13%	7%
River Mill Rd	29.0	227.3	0.8	188.7	0.7	17%	11%	29.0	227.3	0.8	188.7	0.7	17%	11%
Riverside Cemetary	17.0	183.0	0.7	183.0	0.7	0%	0%	17.0	183.0	0.7	183.0	0.7	0%	0%
Sawyer Creek	2075.4	270.9	0.8	190.0	0.7	30%	21%	2298.3	275.3	0.8	203.1	0.7	26%	19%
Shangri La Point Rd	0.7	127.2	0.6	112.3	0.5	12%	12%	0.7	127.2	0.6	112.3	0.5	12%	12%
Sherman Rd South	134.9	265.4	0.7	79.7	0.3	70%	58%	141.5	255.1	0.7	77.8	0.3	70%	57%
Shorewood Dr Penninsula	24.7	207.1	0.8	191.1	0.8	8%	5%	24.7	207.1	0.8	191.1	0.8	8%	5%
Siewert Trail	15.5	204.8	0.8	176.9	0.7	14%	8%	15.5	204.8	0.8	176.9	0.7	14%	8%
South Main St	19.1	367.4	0.9	306.7	0.8	17%	11%	19.1	363.1	0.9	306.7	0.8	16%	11%
Starboard Ct	16.9	281.1	0.9	240.9	0.8	14%	9%	16.9	281.1	0.9	240.9	0.8	14%	9%
Stillman Dr	102.1	445.4	0.8	372.5	0.7	16%	13%	147.5	327.7	0.7	272.2	0.6	17%	13%
Stringham Creek	802.5	334.5	0.9	258.1	0.7	23%	16%	809.6	332.0	0.9	256.1	0.7	23%	16%
Sunnyview Rd	96.5	295.9	0.9	249.7	0.7	16%	19%	125.7	240.2	0.7	201.9	0.6	16%	18%
Vine Ave	57.3	327.5	0.9	269.6	0.8	18%	14%	57.3	327.5	0.9	269.6	0.8	18%	14%

Appendix B
City of Oshkosh
Pollutant Loads by Watershed

Watershed	MS4							TMDL						
	Area	Base Load		Existing Load		Percent Reduction		Area	Base Load		Existing Load		Percent Reduction	
		TSS	TP	TSS	TP	TSS	TP		TSS	TP	TSS	TP	TSS	TP
		(lbs/ac/yr)	(lbs/ac/yr)	(lbs/ac/yr)	(lbs/ac/yr)	(lbs/ac/yr)	(lbs/ac/yr)		(lbs/ac/yr)	(lbs/ac/yr)	(lbs/ac/yr)	(lbs/ac/yr)	(lbs/ac/yr)	(lbs/ac/yr)
Warren St	12.9	358.2	1.0	322.7	0.9	10%	5%	12.9	358.2	1.0	322.7	0.9	10%	5%
Washington Ave	27.7	248.3	0.8	200.8	0.7	19%	12%	27.7	248.3	0.8	200.8	0.7	19%	12%
Waugoo Ave	27.5	243.1	0.9	199.3	0.8	18%	11%	27.5	243.1	0.9	199.3	0.8	18%	11%
Welle Dr	3.2	274.3	0.9	214.1	0.7	22%	22%	3.2	274.3	0.9	214.1	0.7	22%	22%
West Algoma Park	3.4	274.0	1.0	220.7	0.8	19%	13%	3.4	274.0	1.0	220.7	0.8	19%	13%
West Murdock Ave	289.8	255.2	0.9	218.9	0.8	14%	9%	289.8	255.2	0.9	218.9	0.8	14%	9%
West New York Ave	72.4	272.5	0.9	218.4	0.8	20%	13%	72.4	272.5	0.9	218.4	0.8	20%	13%
West Snell Rd	44.6	334.6	0.9	70.2	0.2	79%	76%	223.4	128.1	0.5	68.2	0.3	47%	34%
White Swan Dr	10.8	207.8	0.8	177.1	0.7	15%	9%	10.8	207.8	0.8	177.1	0.7	15%	9%
Wilson Ave	64.2	199.0	0.8	179.2	0.7	10%	6%	64.2	199.0	0.8	179.2	0.7	10%	6%
Windward Ct Island	6.1	211.9	0.8	190.0	0.8	10%	6%	6.1	211.9	0.8	190.0	0.8	10%	6%
Winnebago Ave	25.0	251.0	0.9	206.7	0.8	18%	11%	25.0	251.0	0.9	206.7	0.8	18%	11%
Woodland Ave	51.0	376.4	0.9	333.5	0.8	11%	9%	51.0	376.4	0.9	333.5	0.8	11%	9%

Appendix C

Grass Swale Infiltration Testing

Bartlein, Ashley

From: Glaser, Gus G - DNR <Gus.Glaser@Wisconsin.gov>
Sent: Thursday, April 04, 2013 8:28 AM
To: Burger, Caroline J.
Cc: Larson, Susan M - DNR; Bachhuber, Jim; Rabe, James E.
Subject: RE: City of Oshkosh Grass Swale Infiltration Testing Results

Caroline:
I agree with you, that would be the most accurate for predicting runoff and stay-on.
Gus

From: Burger, Caroline J. [mailto:Caroline.Burger@aecom.com]
Sent: Tuesday, April 02, 2013 3:10 PM
To: Glaser, Gus G - DNR
Cc: Larson, Susan M - DNR; Bachhuber, Jim; Rabe, James E.
Subject: RE: City of Oshkosh Grass Swale Infiltration Testing Results

Hi Gus,

I looked into what you suggested and I don't know how much sense that makes. With that option, we'd use 0.29 in/hr for three of the areas and 7.64 in/hr for the other seven areas.

Because the results are so variable, I'd like to propose we use an individual rate for each of the ten areas. The model files are already set up using the specific swale geometry (side slope, bottom width, etc) for each test site, so adding an individual infiltration rate to each would not be too much additional effort.

What do you think of that proposal?

Thanks,
Caroline Burger, P.E.
Water Resources Engineer
AECOM Water
D 608.828.8146
M 608.957.9430
caroline.burger@aecom.com

AECOM
1350 Deming Way, Suite 100
Middleton, WI 53562
T 608.836.9800 F 608.836.9767
www.aecom.com

From: Glaser, Gus G - DNR [mailto:Gus.Glaser@Wisconsin.gov]
Sent: Tuesday, April 02, 2013 12:03 PM
To: Burger, Caroline J.
Cc: Larson, Susan M - DNR
Subject: FW: City of Oshkosh Grass Swale Infiltration Testing Results

Caroline:

Group the City of Oshkosh infiltration test results into two Groups, Group (1) Areas with less than 1 in/hr and Group (2) Areas with greater than 1/in/hr, calculate a geometric mean rate for each group, assign rates to appropriate areas of the City. You will essentially have two rates for the City a high and a low.

Given that there are some areas with less than 1 in/hr of infiltration, I believe that in reality there will be some areas where most runoff entering swales will reach waters of the state. Grouping into 2 rates for separate areas will result in a more representative level of runoff being generated in the model.

Sincerely,
Gus Glaser

Gus Glaser, P.E.

Storm Water Engineer
Northeast Region
2984 Shawano Ave
Green Bay, WI 54313-6727
Wisconsin Department of Natural Resources
(☎) phone: (920) 662-5461
(☎) fax: (920) 662-5498
(✉) e-mail: gus.glaser@wisconsin.gov

Find us at: http://dnr.wi.gov/topic/stormwater/ or http://www.facebook.com/WIDNR

From: Burger, Caroline J. [mailto:Caroline.Burger@aecom.com]
Sent: Thursday, February 07, 2013 2:36 PM
To: Larson, Susan M - DNR; Glaser, Gus G - DNR
Cc: Rabe, James E.; Bachhuber, Jim; Bartlein, Ashley
Subject: City of Oshkosh Grass Swale Infiltration Testing Results

Hello Sue and Gus,

Attached are the results for the infiltration testing of roadside swales we conducted in the City of Oshkosh on October 3rd, and 4th, 2012. Also attached is a map showing the test locations in the City. The data for each test site was tabulated and graphed based on the field measurements. We used a "best fit line" for each graph and pulled the value for the static infiltration rate at 2 hours for each site. The summary page shows both the static and dynamic infiltration rates for each test location, as well as an average value for the City using the geometric mean calculation. We would like to use the geometric mean value of **2.86 in/hr** (dynamic rate) for the WinSLAMM modeling of all roadside swales within the City of Oshkosh.

Gus – as you are well aware, some of the swales have very high infiltration rates. Some of the rates were so high that they could not be measured. Where they could not be measured, we used the highest, measurable rate from the testing. Is this an acceptable approach?

Please feel free to contact me with any questions or comments. Additionally, if you would like to have a conference call to discuss these results please let me know and I will set one up.

Thank you,

Caroline Burger, P.E.
Water Resources Engineer
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caroline.burger@aecom.com

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Bartlein, Ashley

From:	Burger, Caroline J.
Sent:	Thursday, February 07, 2013 2:34 PM
To:	'susan.larson@wisconsin.gov'; 'Glaser, Gus G - DNR'
Cc:	'Rabe, James E.'; Bachhuber, Jim; Bartlein, Ashley
Subject:	City of Oshkosh Grass Swale Infiltration Testing Results
Attachments:	Oshkosh Infiltration Rate Testing Results.pdf; Oshkosh Infiltation Testing Locations 34x44.pdf

Hello Sue and Gus,

Attached are the results for the infiltration testing of roadside swales we conducted in the City of Oshkosh on October 3rd, and 4th, 2012. Also attached is a map showing the test locations in the City. The data for each test site was tabulated and graphed based on the field measurements. We used a "best fit line" for each graph and pulled the value for the static infiltration rate at 2 hours for each site. The summary page shows both the static and dynamic infiltration rates for each test location, as well as an average value for the City using the geometric mean calculation. We would like to use the geometric mean value of **2.86 in/hr** (dynamic rate) for the WinSLAMM modeling of all roadside swales within the City of Oshkosh.

Gus – as you are well aware, some of the swales have very high infiltration rates. Some of the rates were so high that they could not be measured. Where they could not be measured, we used the highest, measurable rate from the testing. Is this an acceptable approach?

Please feel free to contact me with any questions or comments. Additionally, if you would like to have a conference call to discuss these results please let me know and I will set one up.

Thank you,

Caroline Burger, P.E.
Water Resources Engineer
AECOM Water
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City of Oshkosh Infiltration Testing: Summary

Project No. 60268145

Location	Test #	Static Infiltration Rate* (in/hr)	Dynamic Infiltration Rate (in/hr)	City Average** Dynamic Rate (in/hr)
Edgewood Lane	#1***	34.30	17.15	2.86
STH 41 (north of STH 45)	#2	0.76	0.38	
Olson Ave	#3	4.53	2.27	
Sherman Rd	#4	3.95	1.98	
Hwy 41 and Witzel Ave	#5	0.24	0.12	
9th Ave	#6	34.30	17.15	
S. Washburn St	#7	1.05	0.53	
Poberezny Rd	#8	12.50	6.25	
W. 28th Ave	#9***	34.30	17.15	
STH 45	#10	21.60	10.80	

*Value from best fit curve at 2 hours

**Geometric Mean

***Infiltration rates at test locations #1 and #9 were too high to measure with available equipment. The infiltration rate at these locations was set to that of test location #6, which had a high, but measurable, infiltration rate.

Double-Ring Infiltration Rate Test Field Sheet

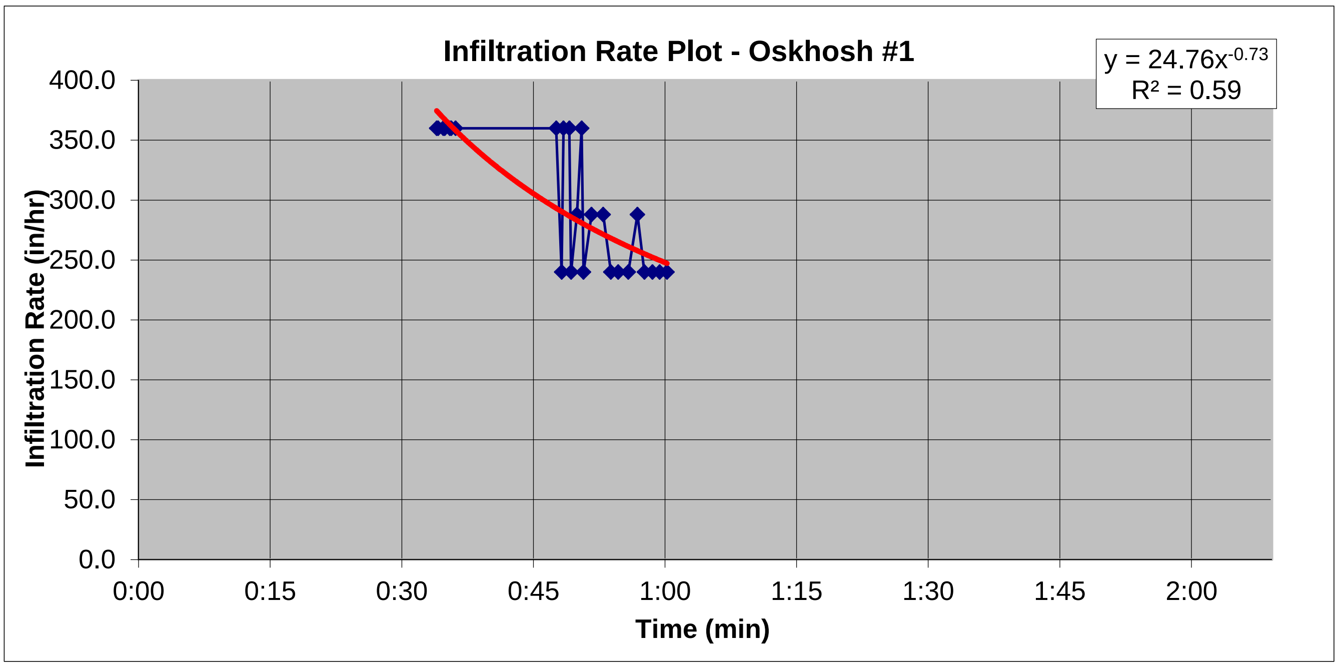
Site: City of Oshkosh #1
Date: 10/4/2012
Time: 8:00 AM
Conditions: Sunny; 45 deg
Field Staff: T. Jacobson, D. Joachim
Amount / Date of Last Rain:
Equipment Used: 12" / 24" PVC Rings
Amount of Water Used: 200 gal.

Water Level (in)	Time (hh:mm:ss)	Change in Time (mm:ss)	Water Level Change (in)	Time Interval Midpoint (mm:ss)	Cumulative Time to Midpoint (hh:mm:ss)	Infiltration Rate (in/hr)
4.00	0:34:00					
3.00	0:34:10	00:10	1.00	00:05	0:34:05	360.00
2.00	0:34:20	00:10	1.00	00:05	0:34:15	360.00
4.00	0:34:45					
3.00	0:34:55	00:10	1.00	00:05	0:34:50	360.00
2.00	0:35:05	00:10	1.00	00:05	0:35:00	360.00
4.00	0:35:30					
3.00	0:35:40	00:10	1.00	00:05	0:35:35	360.00
2.00	0:35:50	00:10	1.00	00:05	0:35:45	360.00
4.00	0:36:05					
2.00	0:36:25	00:20	2.00	00:10	0:36:15	360.00
4.00	0:47:35					
2.00	0:47:55	00:20	2.00	00:10	0:47:45	360.00
4.00	0:48:15					
3.00	0:48:30	00:15	1.00	00:07	0:48:22	240.00
2.00	0:48:40	00:10	1.00	00:05	0:48:35	360.00
4.00	0:49:10					
3.00	0:49:20	00:10	1.00	00:05	0:49:15	360.00
2.00	0:49:35	00:15	1.00	00:07	0:49:28	240.00
4.00	0:49:55					
2.00	0:50:20	00:25	2.00	00:13	0:50:08	288.00
4.00	0:50:35					
3.00	0:50:45	00:10	1.00	00:05	0:50:40	360.00
2.00	0:51:00	00:15	1.00	00:07	0:50:52	240.00
4.00	0:51:35					
2.00	0:52:00	00:25	2.00	00:13	0:51:48	288.00
4.00	0:52:55					
2.00	0:53:20	00:25	2.00	00:13	0:53:08	288.00

Water Level (in)	Time (hh:mm:ss)	Change in Time (mm:ss)	Water Level Change (in)	Time Interval Midpoint (mm:ss)	Cumulative Time to Midpoint (hh:mm:ss)	Infiltration Rate (in/hr)
4.00	0:53:45					
2.00	0:54:15	00:30	2.00	00:15	0:54:00	240.00
4.00	0:54:35					
2.00	0:55:05	00:30	2.00	00:15	0:54:50	240.00
4.00	0:55:45					
2.00	0:56:15	00:30	2.00	00:15	0:56:00	240.00
4.00	0:56:50					
2.00	0:57:15	00:25	2.00	00:13	0:57:03	288.00
4.00	0:57:35					
2.00	0:58:05	00:30	2.00	00:15	0:57:50	240.00
4.00	0:58:30					
2.00	0:59:00	00:30	2.00	00:15	0:58:45	240.00
4.00	0:59:20					
2.00	0:59:50	00:30	2.00	00:15	0:59:35	240.00
4.00	1:00:10					
2.00	1:00:40	00:30	2.00	00:15	1:00:25	240.00

shaded cells in table are formulas

At 2 hours, Infiltration Rate = VERY HIGH (in/hr)



AECOM

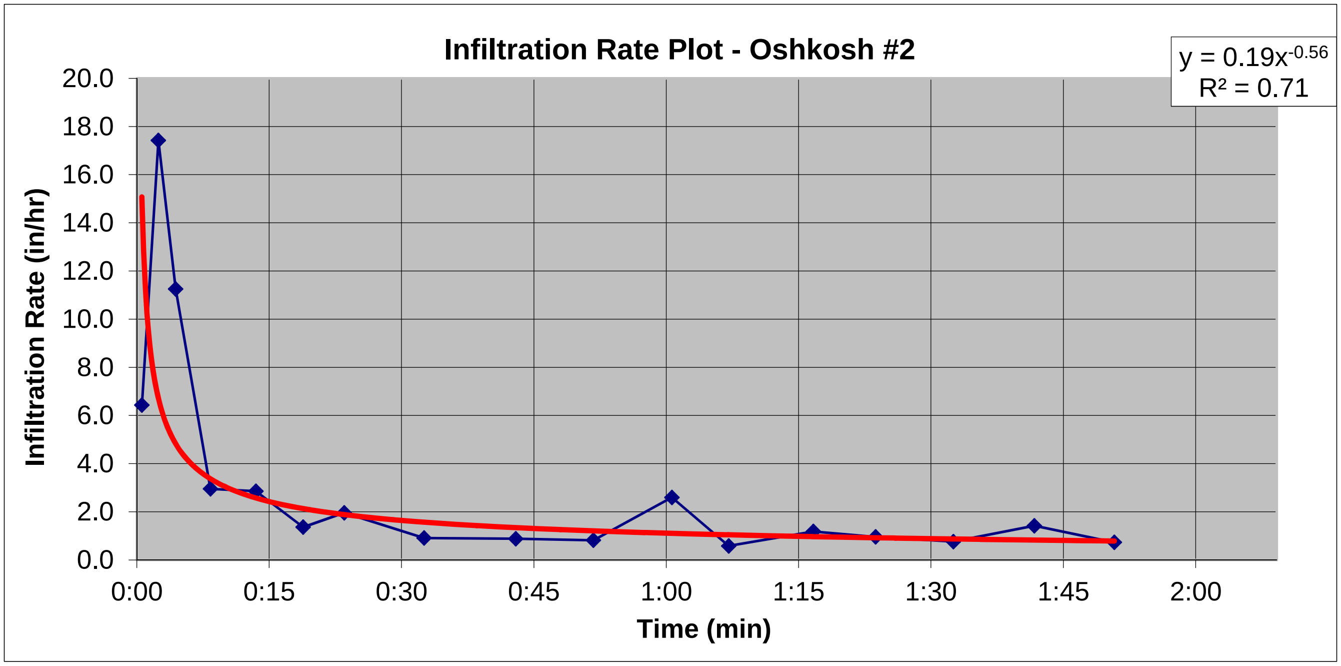
Double-Ring Infiltration Rate Test Field Sheet

Site: City of Oshkosh #2
Date: 10/4/2012
Time: 2:00 PM
Conditions: Sunny; 70s
Field Staff: T. Jacobson, D. Joachim
Amount / Date of Last Rain:
Equipment Used: 12" / 24" PVC Rings
Amount of Water Used: 20 gal.

Water Level (in)	Time (hh:mm:ss)	Change in Time (mm:ss)	Water Level Change (in)	Time Interval Midpoint (mm:ss)	Cumulative Time to Midpoint (hh:mm:ss)	Infiltration Rate (in/hr)
3.13	0:00:00					
3.00	0:01:10	01:10	0.13	00:35	0:00:35	6.43
2.25	0:03:45	02:35	0.75	01:18	0:02:27	17.42
2.00	0:05:05	01:20	0.25	00:40	0:04:25	11.25
3.00	0:05:50					
2.75	0:10:55	05:05	0.25	02:32	0:08:22	2.95
2.50	0:16:10	05:15	0.25	02:38	0:13:33	2.86
2.38	0:21:40	05:30	0.13	02:45	0:18:55	1.36
2.25	0:25:30	03:50	0.13	01:55	0:23:35	1.96
3.06	0:26:30					
2.88	0:38:50	12:20	0.19	06:10	0:32:40	0.91
2.75	0:47:20	08:30	0.13	04:15	0:43:05	0.88
2.63	0:56:30	09:10	0.13	04:35	0:51:55	0.82
2.25	1:05:10	08:40	0.38	04:20	1:00:50	2.60
3.00	0:00:00					
2.88	0:12:55	12:55	0.13	06:28	0:06:28	0.58
2.75	0:19:15	06:20	0.13	03:10	0:16:05	1.18
2.63	0:27:05	07:50	0.13	03:55	0:23:10	0.96
2.50	0:36:55	09:50	0.13	04:55	0:32:00	0.76
3.06	0:37:15					
2.88	0:45:10	07:55	0.19	03:58	0:41:13	1.42
2.75	0:55:25	10:15	0.13	05:07	0:50:18	0.73

shaded cells in table are formulas

At 2 hours, Infiltration Rate = 0.60 (in/hr)


Infiltration Rate Plot - Oshkosh #2
y = 0.19x^-0.56
R² = 0.71
Infiltration Rate (in/hr)
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
0:00
0:15
0:30
0:45
1:00
1:15
1:30
1:45
2:00
Time (min)

Double-Ring Infiltration Rate Test Field Sheet

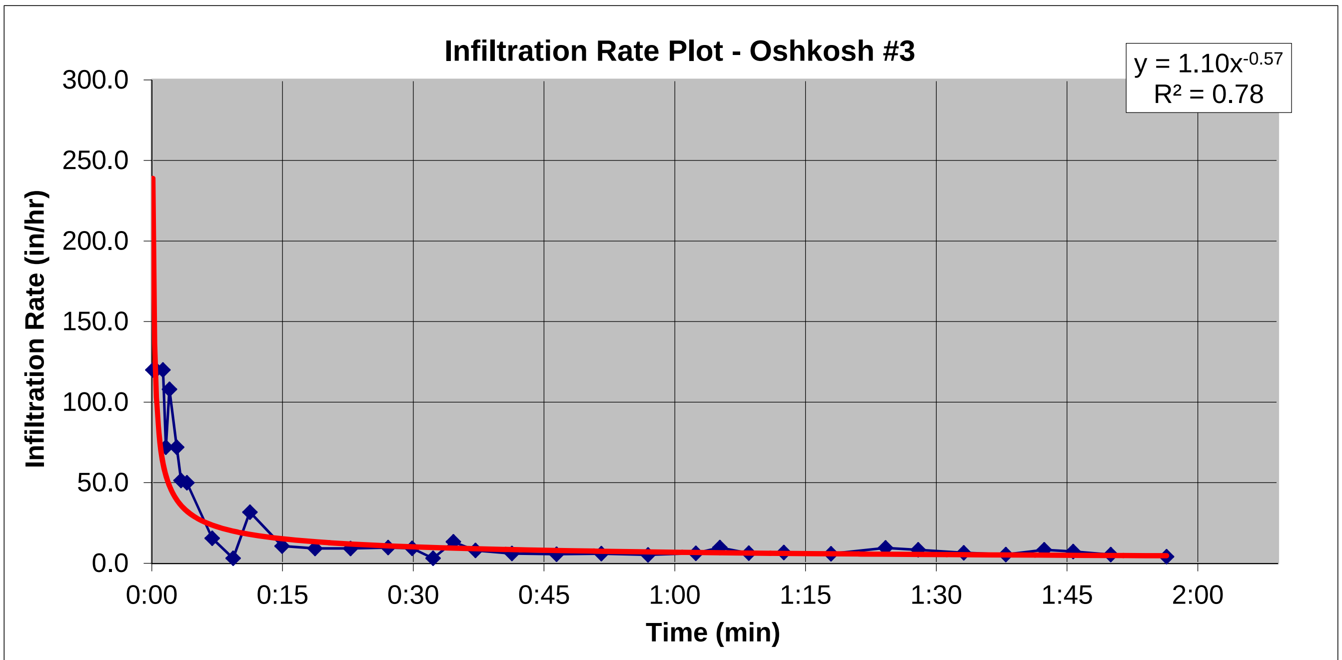
Site: City of Oshkosh #3
Date: 10/4/2012
Time: 10:35 AM
Conditions: Sunny; 60s
Field Staff: T. Jacobson, D. Joachim
Amount / Date of Last Rain:
Equipment Used: 12" / 24" PVC Rings
Amount of Water Used:

Water Level (in)	Time (hh:mm:ss)	Change in Time (mm:ss)	Water Level Change (in)	Time Interval Midpoint (mm:ss)	Cumulative Time to Midpoint (hh:mm:ss)	Infiltration Rate (in/hr)
3.50	0:00:00					
3.00	0:00:15	00:15	0.50	00:08	0:00:08	120.00
2.00	0:00:45	00:30	1.00	00:15	0:00:30	120.00
3.50	0:01:10					
3.00	0:01:25	00:15	0.50	00:08	0:01:18	120.00
2.50	0:01:50	00:25	0.50	00:12	0:01:38	72.00
1.75	0:02:15	00:25	0.75	00:12	0:02:02	108.00
3.50	0:02:40					
3.00	0:03:05	00:25	0.50	00:13	0:02:53	72.00
2.50	0:03:40	00:35	0.50	00:17	0:03:23	51.43
1.88	0:04:25	00:45	0.63	00:23	0:04:03	50.00
3.50	0:05:45					
2.88	0:08:10	02:25	0.63	01:12	0:06:57	15.52
2.75	0:10:35	02:25	0.13	01:13	0:09:22	3.10
2.00	0:12:00	01:25	0.75	00:42	0:11:18	31.76
3.88	0:13:15					
3.25	0:16:45	03:30	0.63	01:45	0:15:00	10.71
2.63	0:20:50	04:05	0.63	02:02	0:18:48	9.18
2.00	0:24:55	04:05	0.63	02:02	0:22:52	9.18
3.88	0:25:40					
3.38	0:28:45	03:05	0.50	01:33	0:27:12	9.73
3.00	0:31:10	02:25	0.38	01:12	0:29:58	9.31
2.88	0:33:35	02:25	0.13	01:12	0:32:23	3.10
2.38	0:35:50	02:15	0.50	01:07	0:34:43	13.33
2.00	0:38:40	02:50	0.38	01:25	0:37:15	7.94
4.00	0:39:00					
3.50	0:43:55	04:55	0.50	02:27	0:41:28	6.10
3.00	0:49:15	05:20	0.50	02:40	0:46:35	5.63
2.50	0:54:15	05:00	0.50	02:30	0:51:45	6.00
2.00	1:00:00	05:45	0.50	02:53	0:57:08	5.22

Water Level (in)	Time (hh:mm:ss)	Change in Time (mm:ss)	Water Level Change (in)	Time Interval Midpoint (mm:ss)	Cumulative Time to Midpoint (hh:mm:ss)	Infiltration Rate (in/hr)
4.13	1:01:25					
3.88	1:03:50	02:25	0.25	01:13	1:02:37	6.21
3.38	1:06:55	03:05	0.50	01:33	1:05:23	9.73
3.00	1:10:30	03:35	0.38	01:47	1:08:43	6.28
2.50	1:15:00	04:30	0.50	02:15	1:12:45	6.67
1.88	1:21:20	06:20	0.63	03:10	1:18:10	5.92
4.13	1:22:30					
3.50	1:26:25	03:55	0.63	01:57	1:24:28	9.57
3.00	1:30:00	03:35	0.50	01:48	1:28:13	8.37
2.25	1:36:55	06:55	0.75	03:27	1:33:27	6.51
2.00	1:39:40	02:45	0.25	01:23	1:38:17	5.45
3.88	1:40:55					
3.38	1:44:30	03:35	0.50	01:48	1:42:42	8.37
3.00	1:47:35	03:05	0.38	01:32	1:46:03	7.30
2.50	1:53:10	05:35	0.50	02:47	1:50:22	5.37
2.00	2:00:25	07:15	0.50	03:38	1:56:47	4.14

shaded cells in table are formulas

At 2 hours, Infiltration Rate = 4.53 (in/hr)



AECOM

Double-Ring Infiltration Rate Test Field Sheet

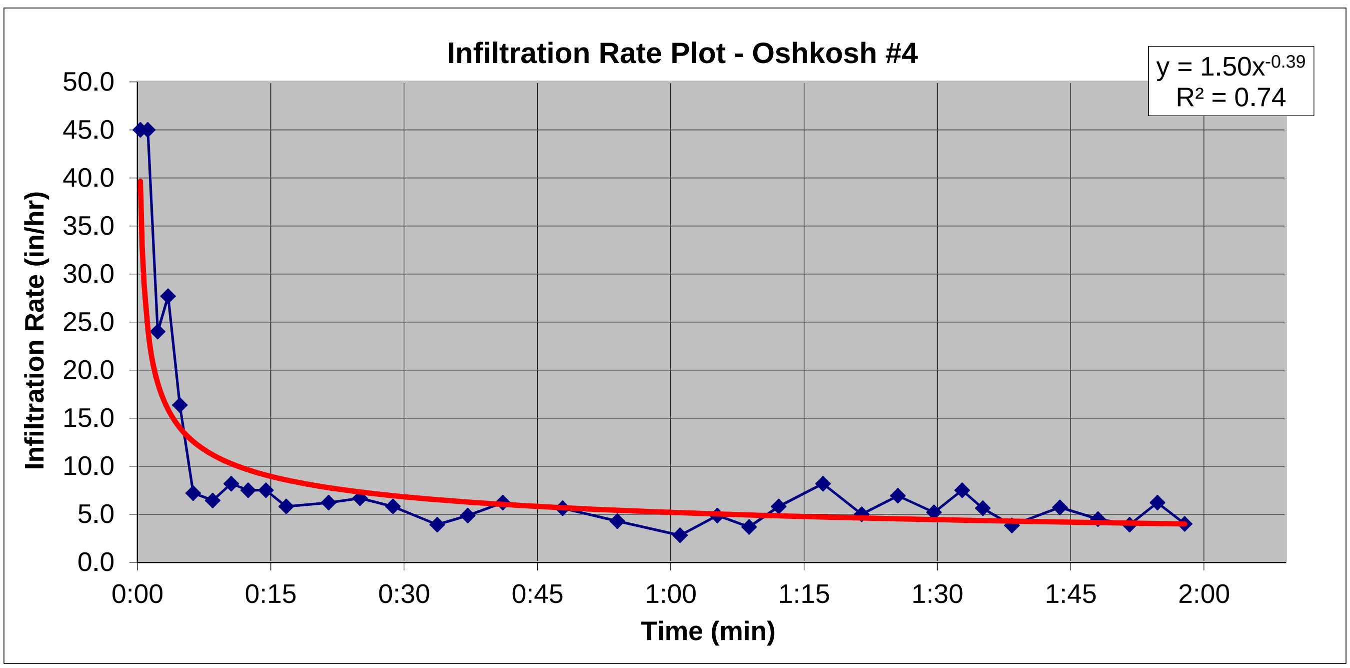
Site: City of Oshkosh #4
Date: 10/4/2012
Time: 12:00 AM
Conditions: Sunny; 60s
Field Staff: T. Jacobson, D. Joachim
Amount / Date of Last Rain:
Equipment Used: 12" / 24" PVC Rings
Amount of Water Used: 50 gal. over 18 minutes; 15 gal. during later 2 hour period

Water Level (in)	Time (hh:mm:ss)	Change in Time (mm:ss)	Water Level Change (in)	Time Interval Midpoint (mm:ss)	Cumulative Time to Midpoint (hh:mm:ss)	Infiltration Rate (in/hr)
4.25	0:00:00					
3.75	0:00:40	00:40	0.50	00:20	0:00:20	45.00
3.00	0:01:40	01:00	0.75	00:30	0:01:10	45.00
2.50	0:02:55	01:15	0.50	00:38	0:02:17	24.00
2.00	0:04:00	01:05	0.50	00:33	0:03:28	27.69
4.75	0:04:20					
4.50	0:05:15	00:55	0.25	00:28	0:04:47	16.36
4.25	0:07:20	02:05	0.25	01:02	0:06:17	7.20
4.00	0:09:40	02:20	0.25	01:10	0:08:30	6.43
3.75	0:11:30	01:50	0.25	00:55	0:10:35	8.18
3.50	0:13:30	02:00	0.25	01:00	0:12:30	7.50
3.25	0:15:30	02:00	0.25	01:00	0:14:30	7.50
3.00	0:18:05	02:35	0.25	01:17	0:16:48	5.81
4.00	0:19:10					
3.50	0:24:00	04:50	0.50	02:25	0:21:35	6.21
3.25	0:26:15	02:15	0.25	01:08	0:25:07	6.67
2.75	0:31:25	05:10	0.50	02:35	0:28:50	5.81
4.00	0:31:55					
3.75	0:35:45	03:50	0.25	01:55	0:33:50	3.91
3.50	0:38:50	03:05	0.25	01:33	0:37:18	4.86
3.00	0:43:40	04:50	0.50	02:25	0:41:15	6.21
4.00	0:45:20					
3.50	0:50:40	05:20	0.50	02:40	0:48:00	5.63
3.00	0:57:40	07:00	0.50	03:30	0:54:10	4.29
4.00	0:58:35					
3.75	1:03:55	05:20	0.25	02:40	1:01:15	2.81
3.50	1:07:00	03:05	0.25	01:33	1:05:28	4.86
3.25	1:11:05	04:05	0.25	02:03	1:09:03	3.67
3.00	1:13:40	02:35	0.25	01:17	1:12:23	5.81

Water Level (in)	Time (hh:mm:ss)	Change in Time (mm:ss)	Water Level Change (in)	Time Interval Midpoint (mm:ss)	Cumulative Time to Midpoint (hh:mm:ss)	Infiltration Rate (in/hr)
4.13	1:16:00					
3.75	1:18:45	02:45	0.38	01:23	1:17:23	8.18
3.25	1:24:45	06:00	0.50	03:00	1:21:45	5.00
3.00	1:26:55	02:10	0.25	01:05	1:25:50	6.92
4.13	1:27:45					
3.75	1:32:05	04:20	0.38	02:10	1:29:55	5.19
3.50	1:34:05	02:00	0.25	01:00	1:33:05	7.50
3.25	1:36:45	02:40	0.25	01:20	1:35:25	5.62
3.00	1:40:40	03:55	0.25	01:57	1:38:42	3.83
4.50	1:41:30					
4.00	1:46:45	05:15	0.50	02:38	1:44:07	5.71
3.75	1:50:05	03:20	0.25	01:40	1:48:25	4.50
3.50	1:53:55	03:50	0.25	01:55	1:52:00	3.91
3.25	1:56:20	02:25	0.25	01:13	1:55:07	6.21
3.00	2:00:05	03:45	0.25	01:53	1:58:13	4.00

shaded cells in table are formulas

At 2 hours, Infiltration Rate = 3.95 (in/hr)



Double-Ring Infiltration Rate Test Field Sheet

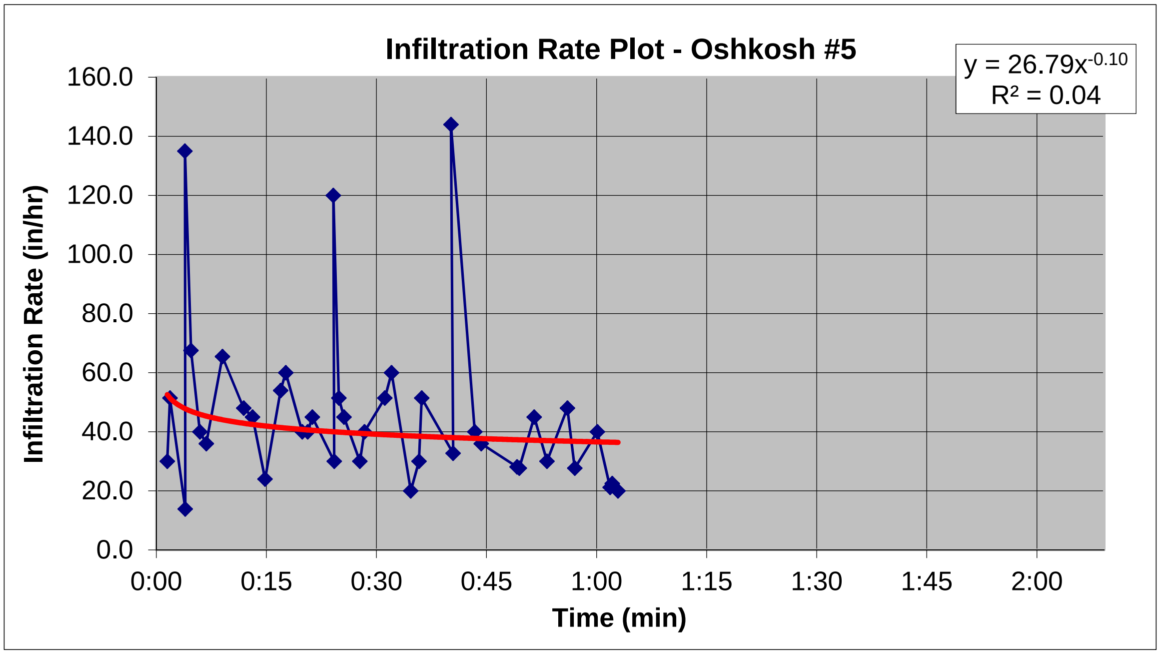
Site: City of Oshkosh #5
Date: 10/3/2012
Time: 11:00 AM
Conditions: Sunny; 70s
Field Staff: T. Jacobson, D. Joachim
Amount / Date of Last Rain:
Equipment Used: 12" / 24" PVC Rings
Amount of Water Used: 195 gal.

Water Level (in)	Time (hh:mm:ss)	Change in Time (mm:ss)	Water Level Change (in)	Time Interval Midpoint (mm:ss)	Cumulative Time to Midpoint (hh:mm:ss)	Infiltration Rate (in/hr)
3.0	0:00:00					
2.5	0:01:00	01:00	0.50	00:30	0:01:30	30.00
2.0	0:01:35	00:35	0.50	00:18	0:01:53	51.43
3.0	0:02:20					
2.8	0:03:25	01:05	0.25	00:33	0:03:58	13.85
2.0	0:03:45	00:20	0.75	00:10	0:03:55	135.00
1.3	0:04:25	00:40	0.75	00:20	0:04:45	67.50
3.0	0:04:50					
2.5	0:05:35	00:45	0.50	00:23	0:05:57	40.00
2.0	0:06:25	00:50	0.50	00:25	0:06:50	36.00
3.0	0:07:40					
2.0	0:08:35	00:55	1.00	00:28	0:09:03	65.45
3.0	0:10:05					
2.0	0:11:20	01:15	1.00	00:38	0:11:58	48.00
3.3	0:12:40					
3.0	0:13:00	00:20	0.25	00:10	0:13:10	45.00
2.5	0:14:15	01:15	0.50	00:37	0:14:52	24.00
3.5	0:15:45					
2.8	0:16:35	00:50	0.75	00:25	0:17:00	54.00
2.0	0:17:20	00:45	0.75	00:23	0:17:42	60.00
3.5	0:18:50					
3.0	0:19:35	00:45	0.50	00:23	0:19:58	40.00
2.5	0:20:20	00:45	0.50	00:22	0:20:42	40.00
2.0	0:21:00	00:40	0.50	00:20	0:21:20	45.00
4.0	0:22:50					
3.5	0:23:50	01:00	0.50	00:30	0:24:20	30.00
3.0	0:24:05	00:15	0.50	00:07	0:24:12	120.00
2.5	0:24:40	00:35	0.50	00:18	0:24:58	51.43
2.0	0:25:20	00:40	0.50	00:20	0:25:40	45.00

Water Level (in)	Time (hh:mm:ss)	Change in Time (mm:ss)	Water Level Change (in)	Time Interval Midpoint (mm:ss)	Cumulative Time to Midpoint (hh:mm:ss)	Infiltration Rate (in/hr)
3.0	0:26:20					
2.5	0:27:20	01:00	0.50	00:30	0:27:50	30.00
2.0	0:28:05	00:45	0.50	00:23	0:28:28	40.00
4.0	0:29:30					
3.0	0:30:40	01:10	1.00	00:35	0:31:15	51.43
2.0	0:31:40	01:00	1.00	00:30	0:32:10	60.00
3.3	0:33:40					
3.0	0:34:25	00:45	0.25	00:22	0:34:47	20.00
2.5	0:35:25	01:00	0.50	00:30	0:35:55	30.00
2.0	0:36:00	00:35	0.50	00:17	0:36:17	51.43
3.5	0:37:50					
2.5	0:39:40	01:50	1.00	00:55	0:40:35	32.73
1.5	0:40:05	00:25	1.00	00:13	0:40:18	144.00
3.0	0:42:25					
2.5	0:43:10	00:45	0.50	00:23	0:43:32	40.00
2.0	0:44:00	00:50	0.50	00:25	0:44:25	36.00
3.8	0:45:20					
2.5	0:48:00	02:40	1.25	01:20	0:49:20	28.13
2.0	0:49:05	01:05	0.50	00:33	0:49:38	27.69
3.8	0:50:10					
3.0	0:51:10	01:00	0.75	00:30	0:51:40	45.00
2.3	0:52:40	01:30	0.75	00:45	0:53:25	30.00
4.0	0:54:20					
3.0	0:55:35	01:15	1.00	00:37	0:56:13	48.00
2.5	0:56:40	01:05	0.50	00:33	0:57:13	27.69
2.0	0:57:30	00:50	0.50	00:25	0:57:55	36.00
4.0	0:59:10					
3.5	0:59:55	00:45	0.50	00:23	1:00:18	40.00
3.0	1:01:20	01:25	0.50	00:42	1:02:03	21.18
2.8	1:02:00	00:40	0.25	00:20	1:02:20	22.50
2.5	1:02:45	00:45	0.25	00:22	1:03:08	20.00

shaded cells in table are formulas

At 2 hours, Infiltration Rate = 34.3 (in/hr)


Infiltration Rate Plot - Oshkosh #5
y = 26.79x^-0.10
R² = 0.04
Infiltration Rate (in/hr)
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
0:00
0:15
0:30
0:45
1:00
1:15
1:30
1:45
2:00
Time (min)

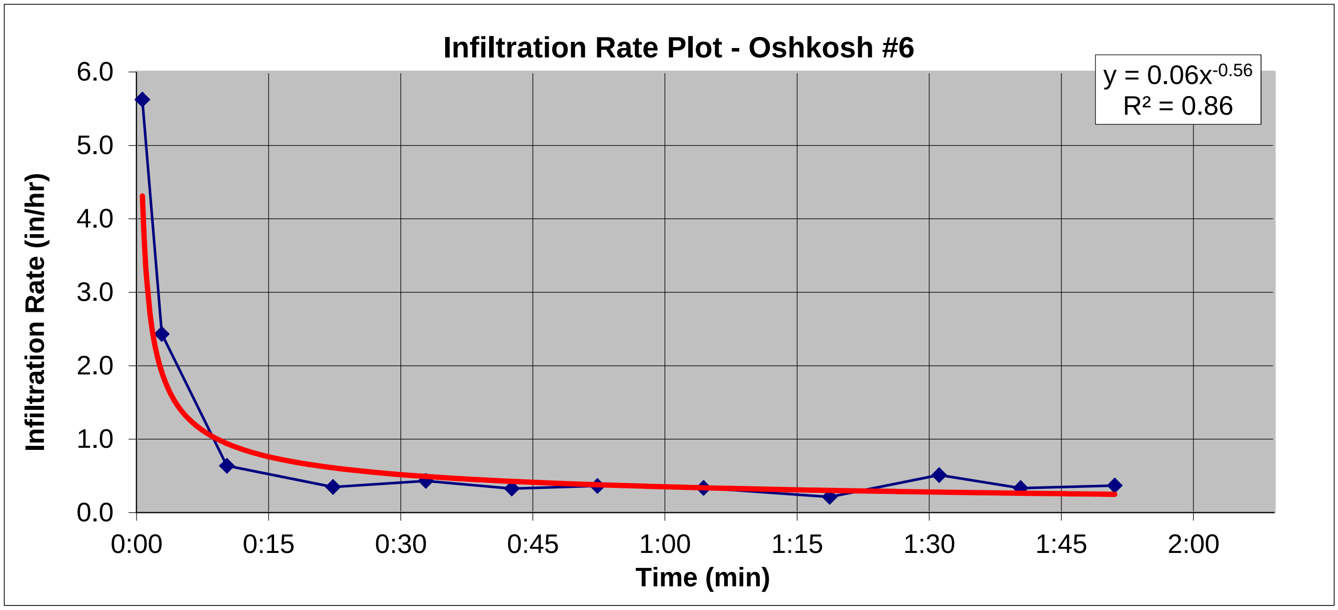
Double-Ring Infiltration Rate Test Field Sheet

Site: City of Oshkosh #6
Date: 10/3/2012
Time: 9:00 AM
Conditions: Cloudy; 50s
Field Staff: T. Jacobson, D. Joachim
Amount / Date of Last Rain:
Equipment Used: 12" / 24" PVC Rings
Amount of Water Used: 10 gal.

Water Level (in)	Time (hh:mm:ss)	Change in Time (mm:ss)	Water Level Change (in)	Time Interval Midpoint (mm:ss)	Cumulative Time to Midpoint (hh:mm:ss)	Infiltration Rate (in/hr)
4.00	0:00:00					
3.88	0:01:20	01:20	0.13	00:40	0:00:40	5.63
3.75	0:04:25	03:05	0.13	01:33	0:02:53	2.43
3.63	0:16:10	11:45	0.13	05:53	0:10:18	0.64
4.06	0:17:00					
4.00	0:27:45	10:45	0.06	05:23	0:22:23	0.35
3.93	0:38:10	10:25	0.08	05:12	0:32:57	0.43
3.88	0:47:20	09:10	0.05	04:35	0:42:45	0.33
3.81	0:57:40	10:20	0.06	05:10	0:52:30	0.36
4.06	0:59:00					
4.00	1:10:10	11:10	0.06	05:35	1:04:35	0.34
3.94	1:27:45	17:35	0.06	08:47	1:18:58	0.21
3.88	1:35:05	07:20	0.06	03:40	1:31:25	0.51
3.81	1:46:20	11:15	0.06	05:37	1:40:42	0.33
3.75	1:56:30	10:10	0.06	05:05	1:51:25	0.37

shaded cells in table are formulas

At 2 hours, Infiltration Rate = 0.24 (in/hr)


Infiltration Rate Plot - Oshkosh #6
y = 0.06x-0.56
R² = 0.86
Infiltration Rate (in/hr)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0:00
0:15
0:30
0:45
1:00
1:15
1:30
1:45
2:00
Time (min)

Double-Ring Infiltration Rate Test Field Sheet

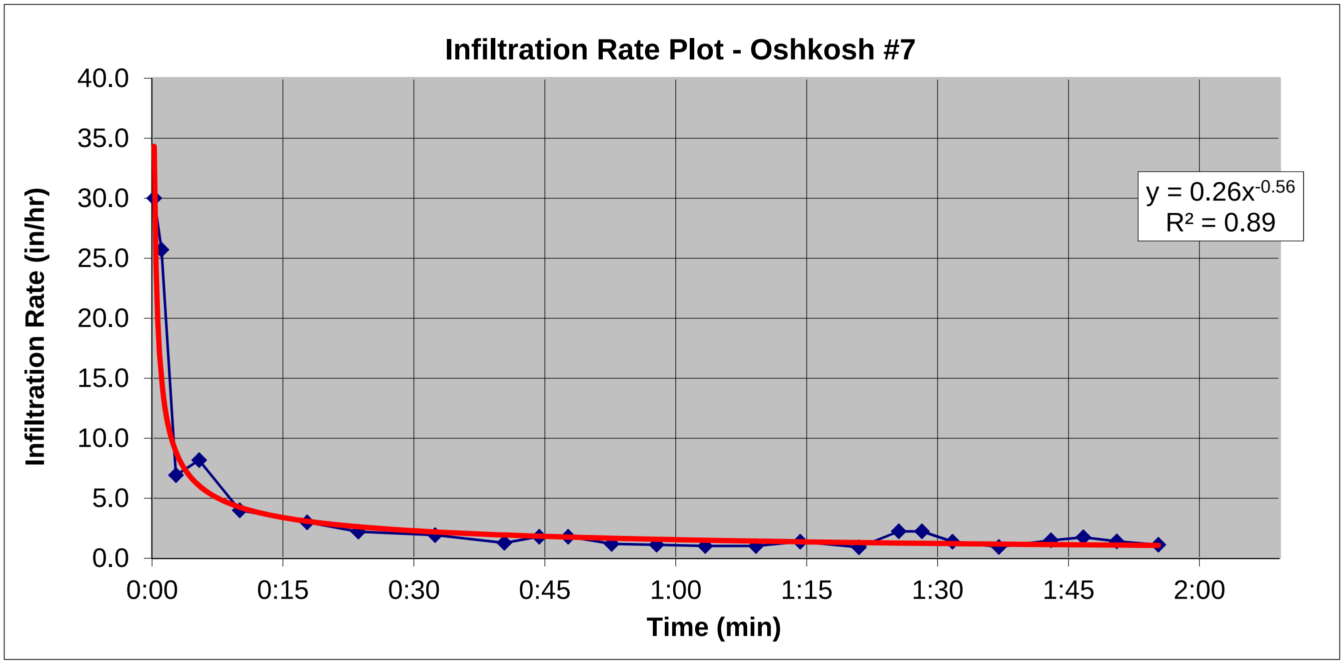
Site: City of Oshkosh #7
Date: 10/3/2012
Time: 8:20 PM
Conditions: Foggy; 40s
Field Staff: T. Jacobson, D. Joachim
Amount / Date of Last Rain:
Equipment Used: 12" / 24" PVC Rings
Amount of Water Used:

Water Level (in)	Time (hh:mm:ss)	Change in Time (mm:ss)	Water Level Change (in)	Time Interval Midpoint (mm:ss)	Cumulative Time to Midpoint (hh:mm:ss)	Infiltration Rate (in/hr)
4.75	0:00:00					
4.50	0:00:30	00:30	0.25	00:15	0:00:15	30.00
4.00	0:01:40	01:10	0.50	00:35	0:01:05	25.71
3.75	0:03:50	02:10	0.25	01:05	0:02:45	6.92
4.75	0:04:30					
4.50	0:06:20	01:50	0.25	00:55	0:05:25	8.18
4.00	0:13:50	07:30	0.50	03:45	0:10:05	4.00
4.75	0:15:20					
4.50	0:20:20	05:00	0.25	02:30	0:17:50	3.00
4.25	0:27:05	06:45	0.25	03:23	0:23:42	2.22
4.75	0:28:40					
4.50	0:36:25	07:45	0.25	03:52	0:32:32	1.94
6.30	0:38:10					
6.40	0:42:50	04:40	-0.10	02:20	0:40:30	1.29
6.50	0:46:10	03:20	-0.10	01:40	0:44:30	1.80
6.60	0:49:30	03:20	-0.10	01:40	0:47:50	1.80
6.00	0:50:20					
6.10	0:55:20	05:00	-0.10	02:30	0:52:50	1.20
6.20	1:00:40	05:20	-0.10	02:40	0:58:00	1.13
6.30	1:06:30	05:50	-0.10	02:55	1:03:35	1.03
6.40	1:12:20	05:50	-0.10	02:55	1:09:25	1.03
6.50	1:16:40	04:20	-0.10	02:10	1:14:30	1.38
5.90	1:18:00					
6.00	1:24:30	06:30	-0.10	03:15	1:21:15	0.92
6.10	1:27:10	02:40	-0.10	01:20	1:25:50	2.25
6.20	1:29:50	02:40	-0.10	01:20	1:28:30	2.25
6.30	1:34:10	04:20	-0.10	02:10	1:32:00	1.38
6.40	1:40:30	06:20	-0.10	03:10	1:37:20	0.95

Water Level (in)	Time (hh:mm:ss)	Change in Time (mm:ss)	Water Level Change (in)	Time Interval Midpoint (mm:ss)	Cumulative Time to Midpoint (hh:mm:ss)	Infiltration Rate (in/hr)
6.00	1:41:20					
6.10	1:45:20	04:00	-0.10	02:00	1:43:20	1.50
6.20	1:48:45	03:25	-0.10	01:43	1:47:02	1.76
6.30	1:53:00	04:15	-0.10	02:08	1:50:52	1.41
6.40	1:58:20	05:20	-0.10	02:40	1:55:40	1.13

shaded cells in table are formulas

At 2 hours, Infiltration Rate = 1.05 (in/hr)



Double-Ring Infiltration Rate Test Field Sheet

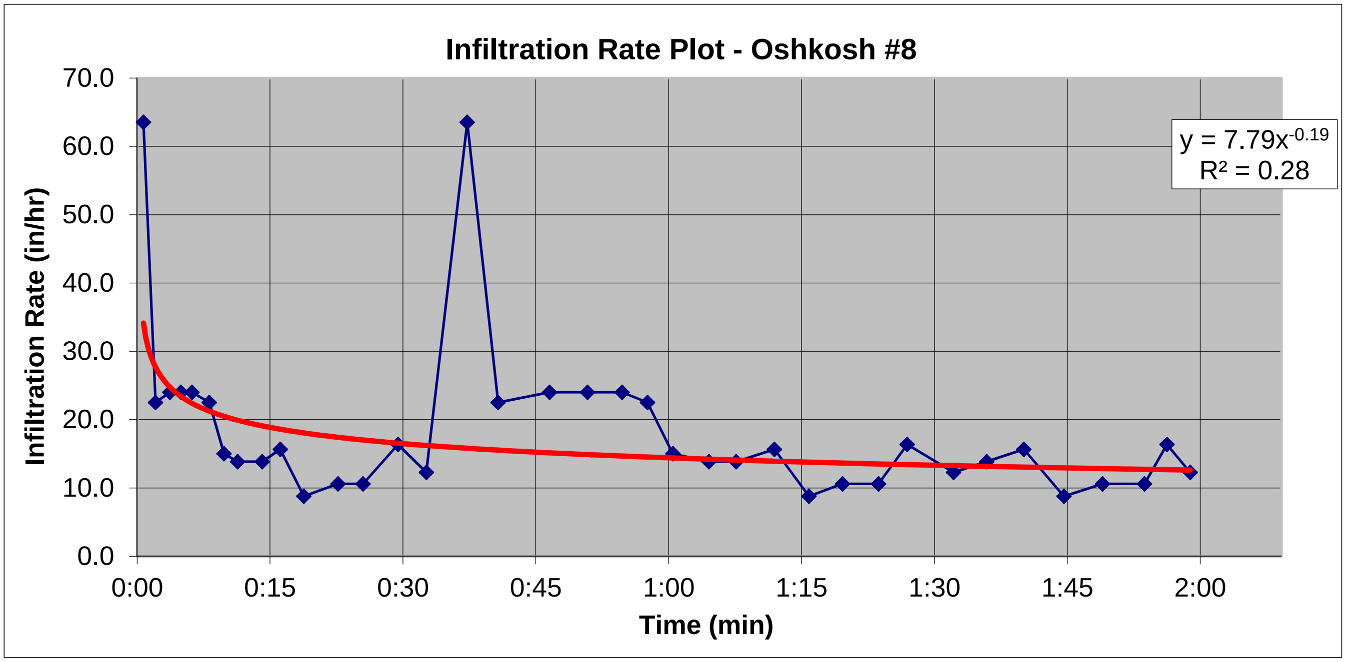
Site: City of Oshkosh #8
Date: 10/3/2012
Time: 2:00 PM
Conditions: Sunny; 70s
Field Staff: T. Jacobson, D. Joachim
Amount / Date of Last Rain:
Equipment Used: 12" / 24" PVC Rings
Amount of Water Used:

Water Level (in)	Time (hh:mm:ss)	Change in Time (mm:ss)	Water Level Change (in)	Time Interval Midpoint (mm:ss)	Cumulative Time to Midpoint (hh:mm:ss)	Infiltration Rate (in/hr)
3.50	0:00:00					
2.00	0:01:25	01:25	1.50	00:43	0:00:43	63.53
1.50	0:02:45	01:20	0.50	00:40	0:02:05	22.50
3.50	0:03:05					
3.00	0:04:20	01:15	0.50	00:37	0:03:42	24.00
2.50	0:05:35	01:15	0.50	00:38	0:04:57	24.00
2.00	0:06:50	01:15	0.50	00:38	0:06:12	24.00
3.50	0:07:30					
3.00	0:08:50	01:20	0.50	00:40	0:08:10	22.50
2.50	0:10:50	02:00	0.50	01:00	0:09:50	15.00
2.25	0:11:55	01:05	0.25	00:32	0:11:22	13.85
3.50	0:13:05					
3.00	0:15:15	02:10	0.50	01:05	0:14:10	13.85
2.50	0:17:10	01:55	0.50	00:58	0:16:12	15.65
2.00	0:20:35	03:25	0.50	01:42	0:18:52	8.78
3.50	0:21:20					
3.00	0:24:10	02:50	0.50	01:25	0:22:45	10.59
2.50	0:27:00	02:50	0.50	01:25	0:25:35	10.59
3.50	0:28:10					
2.75	0:30:55	02:45	0.75	01:23	0:29:32	16.36
2.00	0:34:35	03:40	0.75	01:50	0:32:45	12.27
3.50	0:35:40					
2.75	0:39:05	03:25	0.75	01:43	0:37:22	13.17
2.25	0:42:40	03:35	0.50	01:47	0:40:52	8.37
3.00	0:44:05					
2.50	0:49:20	05:15	0.50	02:37	0:46:43	5.71
2.00	0:52:40	03:20	0.50	01:40	0:51:00	9.00

Water Level (in)	Time (hh:mm:ss)	Change in Time (mm:ss)	Water Level Change (in)	Time Interval Midpoint (mm:ss)	Cumulative Time to Midpoint (hh:mm:ss)	Infiltration Rate (in/hr)
3.00	0:56:20	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
2.50	0:59:15	02:55	0.50	01:28	0:57:48	10.29
2.25	1:02:05	02:50	0.25	01:25	1:00:40	5.29
3.50	1:02:50					
2.75	1:06:40	03:50	0.75	01:55	1:04:45	11.74
2.25	1:09:00	02:20	0.50	01:10	1:07:50	12.86
3.50	1:10:15					
3.00	1:14:05	03:50	0.50	01:55	1:12:10	7.83
2.50	1:18:05	04:00	0.50	02:00	1:16:05	7.50
2.00	1:21:40	03:35	0.50	01:48	1:19:53	8.37
3.50	1:22:30					
3.00	1:25:25	02:55	0.50	01:28	1:23:58	10.29
2.50	1:29:00	03:35	0.50	01:48	1:27:13	8.37
3.50	1:30:30					
3.00	1:34:25	03:55	0.50	01:57	1:32:27	7.66
2.50	1:38:00	03:35	0.50	01:47	1:36:12	8.37
2.25	1:42:50	04:50	0.25	02:25	1:40:25	3.10
3.50	1:43:15					
3.00	1:46:40	03:25	0.50	01:43	1:44:57	8.78
2.25	1:52:00	05:20	0.75	02:40	1:49:20	8.44
3.50	1:53:00					
3.00	1:55:10	02:10	0.50	01:05	1:54:05	13.85
2.50	1:58:05	02:55	0.50	01:28	1:56:37	10.29
2.25	2:00:25	02:20	0.25	01:10	1:59:15	6.43

shaded cells in table are formulas

At 2 hours, Infiltration Rate = 12.49 (in/hr)



Infiltration Rate Plot - Oshkosh #8
y = 7.79x-0.19
R² = 0.28
Infiltration Rate (in/hr)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0:00
0:15
0:30
0:45
1:00
1:15
1:30
1:45
2:00
Time (min)

Double-Ring Infiltration Rate Test Field Sheet

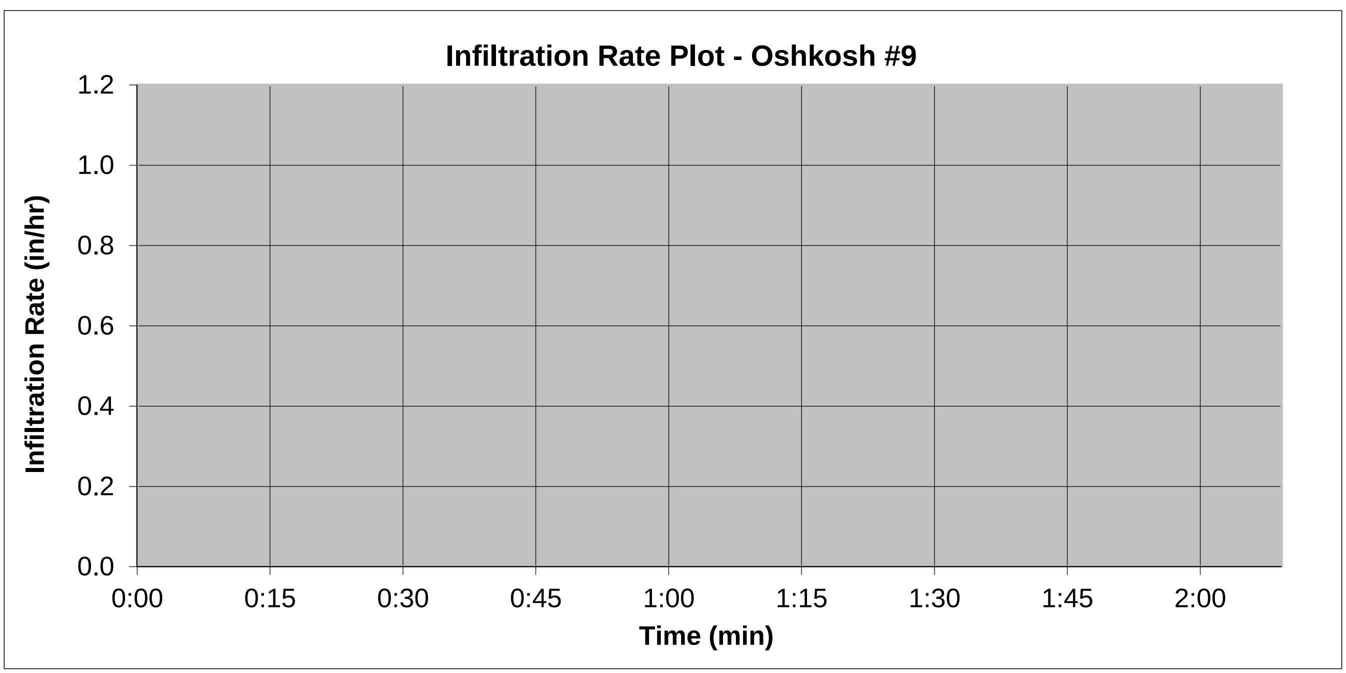
Site: City of Oshkosh #9
Date: 10/3/2012
Time: 2:30 PM
Conditions: Sunny; 70s
Field Staff: T. Jacobson, D. Joachim
Amount / Date of Last Rain:
Equipment Used: 12" / 24" PVC Rings
Amount of Water Used: 180 gal.

Water Level (in)	Time (hh:mm:ss)	Change in Time (mm:ss)	Water Level Change (in)	Time Interval Midpoint (mm:ss)	Cumulative Time to Midpoint (hh:mm:ss)	Infiltration Rate (in/hr)

The infiltration rate at site #9 was too high to be measured. On four separate occasions within 2.5 hours, 45 gallons were added to the infiltrometer (with approximately 20 minutes betwen each filling used to fill up water tanks and return to the site) . The time to infiltrate the 45 gallons was 3:10, 5:00, 13:10, and 16:10, respectively. No steady-state measurements could be taken due to the high infiltration rates.

shaded cells in table are formulas

At 2 hours, Infiltration Rate = VERY HIGH (in/hr)



Double-Ring Infiltration Rate Test Field Sheet

Site: City of Oshkosh #10
Date: 10/3/2012
Time: 5:00 PM
Conditions: Sunny; 60s
Field Staff: T. Jacobson, D. Joachim
Amount / Date of Last Rain:
Equipment Used: 12" / 24" PVC Rings
Amount of Water Used:

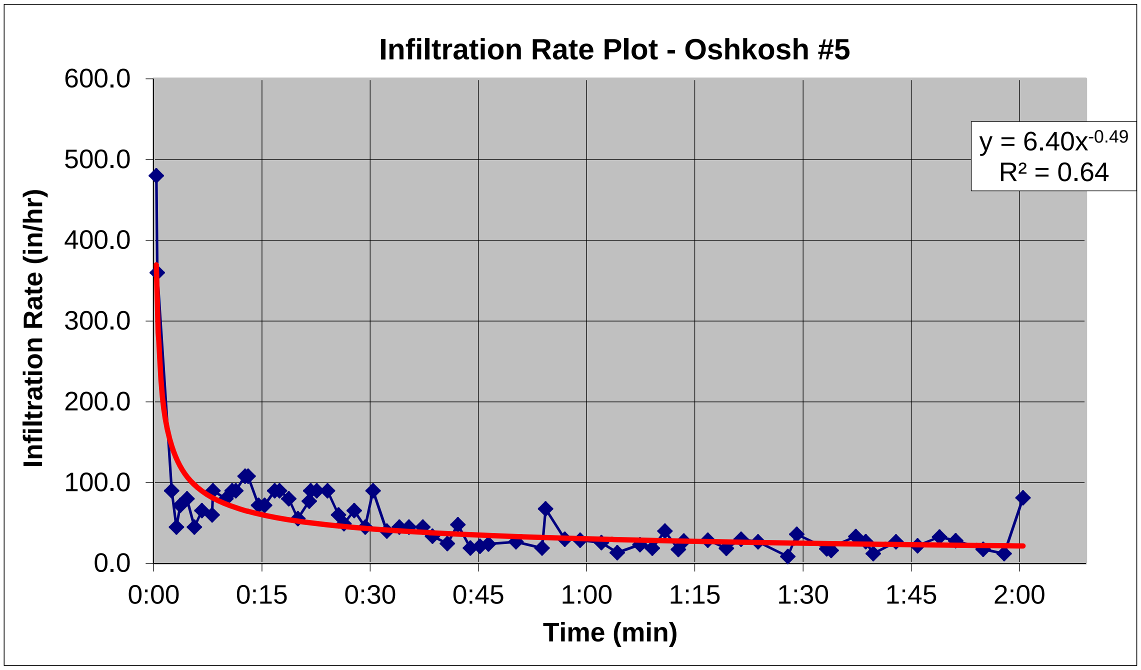
Water Level (in)	Time (hh:mm:ss)	Change in Time (mm:ss)	Water Level Change (in)	Time Interval Midpoint (mm:ss)	Cumulative Time to Midpoint (hh:mm:ss)	Infiltration Rate (in/hr)
4.0	0:00:00					
2.0	0:00:15	00:15	2.00	00:08	0:00:23	480.00
1.0	0:00:25	00:10	1.00	00:05	0:00:30	360.00
4.0	0:01:30					
3.0	0:02:10	00:40	1.00	00:20	0:02:30	90.00
2.5	0:02:50	00:40	0.50	00:20	0:03:10	45.00
3.5	0:03:05					
3.0	0:03:30	00:25	0.50	00:12	0:03:42	72.00
2.0	0:04:15	00:45	1.00	00:23	0:04:37	80.00
3.5	0:04:40					
3.0	0:05:20	00:40	0.50	00:20	0:05:40	45.00
2.0	0:06:15	00:55	1.00	00:28	0:06:43	65.45
3.8	0:07:00					
3.0	0:07:45	00:45	0.75	00:23	0:08:08	60.00
2.5	0:08:05	00:20	0.50	00:10	0:08:15	90.00
3.5	0:08:55					
2.5	0:09:40	00:45	1.00	00:22	0:10:02	80.00
3.5	0:10:10					
2.8	0:10:40	00:30	0.75	00:15	0:10:55	90.00
2.0	0:11:10	00:30	0.75	00:15	0:11:25	90.00
3.5	0:12:05					
2.8	0:12:30	00:25	0.75	00:12	0:12:43	108.00
2.0	0:12:55	00:25	0.75	00:12	0:13:07	108.00
4.0	0:13:20					
3.0	0:14:10	00:50	1.00	00:25	0:14:35	72.00
2.0	0:15:00	00:50	1.00	00:25	0:15:25	72.00

Water Level (in)	Time (hh:mm:ss)	Change in Time (mm:ss)	Water Level Change (in)	Time Interval Midpoint (mm:ss)	Cumulative Time to Midpoint (hh:mm:ss)	Infiltration Rate (in/hr)
4.0	0:15:50					
3.0	0:16:30	00:40	1.00	00:20	0:16:50	90.00
2.0	0:17:10	00:40	1.00	00:20	0:17:30	90.00
4.0	0:17:40					
3.0	0:18:25	00:45	1.00	00:23	0:18:48	80.00
2.0	0:19:30	01:05	1.00	00:33	0:20:03	55.38
4.3	0:20:45					
3.5	0:21:20	00:35	0.75	00:17	0:21:37	77.14
3.0	0:21:40	00:20	0.50	00:10	0:21:50	90.00
2.0	0:22:20	00:40	1.00	00:20	0:22:40	90.00
4.5	0:23:10					
3.5	0:23:50	00:40	1.00	00:20	0:24:10	90.00
2.3	0:25:05	01:15	1.25	00:38	0:25:42	60.00
1.5	0:26:00	00:55	0.75	00:28	0:26:28	49.09
4.0	0:26:30					
3.0	0:27:25	00:55	1.00	00:28	0:27:53	65.45
2.0	0:28:45	01:20	1.00	00:40	0:29:25	45.00
4.5	0:29:30					
3.5	0:30:10	00:40	1.00	00:20	0:30:30	90.00
2.5	0:31:40	01:30	1.00	00:45	0:32:25	40.00
4.5	0:32:10					
3.5	0:33:30	01:20	1.00	00:40	0:34:10	45.00
2.5	0:34:50	01:20	1.00	00:40	0:35:30	45.00
4.5	0:35:25					
3.5	0:36:45	01:20	1.00	00:40	0:37:25	45.00
2.8	0:38:05	01:20	0.75	00:40	0:38:45	33.75
2.0	0:39:55	01:50	0.75	00:55	0:40:50	24.55
4.5	0:40:25					
3.5	0:41:40	01:15	1.00	00:38	0:42:18	48.00
3.0	0:43:15	01:35	0.50	00:48	0:44:02	18.95
2.5	0:44:40	01:25	0.50	00:42	0:45:22	21.18
2.0	0:45:55	01:15	0.50	00:38	0:46:33	24.00
4.0	0:47:00					
3.0	0:49:15	02:15	1.00	01:07	0:50:22	26.67
2.0	0:52:25	03:10	1.00	01:35	0:54:00	18.95
4.8	0:53:30					
4.0	0:54:10	00:40	0.75	00:20	0:54:30	67.50
3.0	0:56:10	02:00	1.00	01:00	0:57:10	30.00
2.0	0:58:15	02:05	1.00	01:02	0:59:18	28.80

Water Level (in)	Time (hh:mm:ss)	Change in Time (mm:ss)	Water Level Change (in)	Time Interval Midpoint (mm:ss)	Cumulative Time to Midpoint (hh:mm:ss)	Infiltration Rate (in/hr)
4.0	0:58:45					
3.0	1:01:05	02:20	1.00	01:10	1:02:15	25.71
2.5	1:03:20	02:15	0.50	01:08	1:04:28	13.33
4.0	1:03:45					
3.0	1:06:20	02:35	1.00	01:17	1:07:38	23.23
2.4	1:08:20	02:00	0.63	01:00	1:09:20	18.75
4.0	1:08:50					
3.0	1:10:20	01:30	1.00	00:45	1:11:05	40.00
2.5	1:12:05	01:45	0.50	00:52	1:12:58	17.14
2.0	1:13:10	01:05	0.50	00:33	1:13:43	27.69
4.0	1:13:55					
3.0	1:16:00	02:05	1.00	01:02	1:17:03	28.80
2.3	1:18:25	02:25	0.75	01:13	1:19:38	18.62
4.0	1:18:40					
3.0	1:20:40	02:00	1.00	01:00	1:21:40	30.00
2.0	1:22:55	02:15	1.00	01:07	1:24:03	26.67
1.5	1:26:25	03:30	0.50	01:45	1:28:10	8.57
4.0	1:26:55					
3.0	1:28:35	01:40	1.00	00:50	1:29:25	36.00
2.0	1:32:20	03:45	1.00	01:53	1:34:12	16.00
1.8	1:33:10	00:50	0.25	00:25	1:33:35	18.00
4.0	1:34:15					
2.8	1:36:30	02:15	1.25	01:07	1:37:37	33.33
2.0	1:38:10	01:40	0.75	00:50	1:39:00	27.00
1.8	1:39:25	01:15	0.25	00:37	1:40:02	12.00
4.0	1:39:50					
3.0	1:42:05	02:15	1.00	01:07	1:43:12	26.67
2.0	1:44:50	02:45	1.00	01:22	1:46:12	21.82
4.0	1:46:30					
3.0	1:48:20	01:50	1.00	00:55	1:49:15	32.73
4.0	1:49:30					
3.4	1:50:50	01:20	0.63	00:40	1:51:30	28.12
2.5	1:53:50	03:00	0.88	01:30	1:55:20	17.50
4.0	1:54:30					
3.5	1:57:00	02:30	0.50	01:15	1:58:15	12.00
2.5	1:59:35	02:35	3.50	01:17	2:00:52	81.29

shaded cells in table are formulas

At 2 hours, Infiltration Rate = 21.6 (in/hr)



Infiltration Rate Plot - Oshkosh #5
y = 6.40x-0.49
R² = 0.64
600.0
500.0
400.0
300.0
200.0
100.0
0.0
Infiltration Rate (in/hr)
0:00
0:15
0:30
0:45
1:00
1:15
1:30
1:45
2:00
Time (min)

L:\work\projects\60268145\400_Technical\403_GIS\Figures\InfiltrationTesting\Prop_Locations_Landuse.mxd


Legend
Municipal Limits
Infiltration Testing Locations
Grass Swales
Open Space
AGR
CEM
ISOLATED
PARK
RAIL
OSUD
OSUD_EX
Institutional
AIR
HOSP
INST
SCH
UWO
Water
SW POND
WTR
Industrial
LI
MI
Residential
LDR
HDRNA
HDRWA
MDNRA
MDRNA
MDRWA
MFRNA
MOBH
Commercial
CDT
OFPK
SHOP
SCOM
N
Test #1
Test #2
Test #3
Test #4
Test #5
Test #6
Test #7
Test #8
Test #9
Test #10
0 625 1,250 2,500
Feet
60268145
Nov. 2014
Grass Swales
Proposed Infiltration Testing Locations
Land Use
City of Oshkosh, WI
AECOM

Test Site 1

Test Site 2

Test Site 3

Test Site 4

Test Site 5

Test Site 6

Test Site 7

Test Site 8

Test Site 9

Test Site 10


GMC
623-JLK

Appendix D

Description of Wet Detention Basins Considered for Stormwater Pollution Control

Table D-1
City of Oshkosh
Status of Proposed BMPs from 2008 Plan for 2013 Plan Update

Proposed BMP ID	Subbasin	Address	Common Name	Practice	2013 Status	Reason Removed From Consideration in 2013 Plan
9	Sawyer Creek2	S Oakwood Dr	Oakwood Rd	New Basin	Out	Built
34	Campbell Creek	S Westhaven Dr	Westhaven Golf Course - East Basin	New Basin	Out	Replaced by other BMPS
35	Sawyer Creek2	S Westhaven Dr	Westhaven Golf Course - West Basin	New Basin	Out	Rejected by Common Council
36	Libbey Ave / Nicolet Ave	N Main St	Libby Ave/N Main St	New Basin	Proposed BMP	Alternative Site was recommended - Wet Detention Basin is within 5 year CIP.
18	Sawyer Creek2	2850 S Oakwood Rd	Gambrinus Enterprises Dry Basin	Retrofit	Out	Replaced by other BMPS
28	Stringham Creek2	S Washburn St	South Washburn/STH 44	New Basin	Out	-
22	Campbell Creek1	325 S Eagle St	Tipler Jr High School	New Basin	Out	Built
2	Sawyer Creek	S Westhaven Dr	Westhaven Golf Club - Existing Pond Retro-fit	Retrofit	Out	Replaced by other BMPS
30**	19th Ave	1942 S Main St	Fugleberg Park & Boat Landing	New Basin	Out	The watershed wsa studied, but a wet detention basin is not feasible because of storm sewer elevations and lake level.

****** BMP not Proposed because it would require a stormwater lift station

[Shaded cells] BMP not proposed because it is part of another drainage area, These BMPs serve as an alternate location if other BMPs cannot be constructed

Table D-2
City of Oshkosh
Potential BMP Sites Removed from Consideration after Initial Evaluation - Determined to be Not Feasible

Proposed BMP ID	Subbasin	Address	Common Name	Practice	Drainage Area to BMP (acres)	Preliminary TSS Load (tons/yr)	Preliminary Estimated Control (%)	Preliminary Pollution Control (tons/yr)	Reason Removed From Consideration	Comments
14	Gallups/ Merritts Creek	Bradley St	East of Bradley, North of Waukau Ave	New Basin	249	43.2	80	34.5	Basin would have inflow from a navigable stream - WDNR typically does not approve permits for on-line basins	Adjacent navigable channel; 4.5 ac permanent pool; DNR resistance to taking low flows from channel - want base flow in channel
19	Fernau Ave	2920 N Main St	Fernau Ave Basin	New Basin	377	55.7	80	44.6	Basin would have inflow from a navigable stream - WDNR typically does not approve permits for on-line basins	Adjacent navigable channel; 5.0 ac permanent pool; probably DNR resistance to taking low flows from channel - want base flow in channel
21	Stringham Creek1	1601 Knapp St	Stringham Creek1 Basin Knapp St	New Basin	60	7.9	80	6.3	Site is a closed landfill - would require excavation of the landfill; Environmental concern with excavating landfill.	Part of drainage area for BMP #4; Retired landfill; 0.6 ac permanent pool; Option for parcel to south of land fill - but would be next to Elementary School
17	Glatz Greek1	1135 W 20th Ave	Hilton Garden Inn Dry Pond	Retrofit	10	0.7	80	0.5	Removed because area is not included in analyzed area; FAA would have resistance to implementation of a wet detention facility in close proximity to the airport	Property not included in base load b/c airport owned property; 0.2 ac permanent pool; Airport against adjacent ponds
32	Irving Ave	1200 E Irving Ave	Menominee Park South	New Basin	199	25.4	80	20.3	Lift station would be required; Storm sewer is approximately 1.5-3 ft submerged - thus site deemed not feasible	Adjacent to lake; 1.9 ac permanent pool; Sawdust Days location
32	East New York Ave & Baldwin Ave	1200 E Irving Ave	Menominee Park North	New Basin	199	25.4	80	20.3	Lift station would be required; Storm sewer is approximately 3-5 ft submerged - thus site deemed not feasible	Adjacent to lake; 1.7 ac permanent pool; Neighborhood association objected to fishing pier; Site also located near School - part of site is currently used as athletic fields
24	Sawyer Creek4	613 N Eagle St	Red Arrow Park	New Basin	152	20.1	80	16.1	Landfill/excavation concerns, sanitary sewer problems, and lift station requirements all contribute to site being removed from consideration	City park; 2.1 ac permanent pool: "Garbage Hill" - aka landfill - permit/excavation issues; submerged storm sewer system; need low flow lift station; Large sanitary sewer also located in area of proposed pond
12	Campbell Creek2	400 N Sawyer St	Southland Ave/Josslyn St	New Basin	57	10.0	80	8.0	Lift Station would likely be needed; Land acquisition cost estimated at $1 million; Cost per ton removed estimated at $225,000 - cost per ton removed deemed too expensive	0.8 ac permanent pool; submerged storm sewer pipes, Likely feasible only with a Low Flow Lift Station

City of Oshkosh
Wet Stormwater Quality Basins Site Descriptions

Proposed Wet Basin Sites

Site Number:	4
Site Name:	South Park Basin Expansion
Practice:	Existing Wet Basin Expansion/Retro-fit
Subbasin:	Stringham Creek1
Location:	Northeast of intersection of Georgia Street and South Park Street

Looking Northeast from Bridge

Description:	Existing basin is located within park, currently three pools to the basin with drop structures separating each pool, also significant erosion along banks. Project would remove drop structures and increase the size of the permanent pool. The proposed 6 acre permanent pool achieved an estimated 69% TSS reduction (removal of 78 tons of TSS annually) and 55% TP reduction (removal of 323 lbs of TP annually). Basin would serve a 718 acre mixed-use drainage area. A project in this location was previously proposed as part of the Stringham Creek flood study and is currently under study as part of the expanded Stringham Creek analysis and as part of the South Park Master Plan. Basin would combine flood control and pollution control goals.

Site Number:	6
Site Name:	Washburn St/Westowne Ave Basin
Practice:	Existing Wet Basin Expansion/Retro-fit
Subbasin:	Omro Rd
Location:	Northwest of intersection of Westowne Avenue and Washburn Street

Looking Southeast at Existing Basin

Description:	An existing wet basin is located adjacent to a dry basin. This project proposes to expand the wet basin by approximately 10,000 square feet to include the area occupied by the dry basin. A drainage area of 77 acres of commercial land would be served. It is estimated that the basin would achieve an additional 0.5 ton reduction in TSS and 157 lbs in TP because

	of the expansion.

Site Number:	7	
Site Name:	Pheasant Creek Dry Basin	
Practice:	Dry Basin Retro-fit	
Subbasin:	Sawyer Creek2	
Location:	Northeast of intersection of Fairfax Drive and Pheasant Creek Drive	
		Looking East from Pheasant Creek Dr
Description:	Existing dry basin serving a drainage area of 69 acres of residential land would be retro-fit to a wet detention basin with a 0.62 acre permanent pool. A TSS pollution removal of 6 tons and 35 lbs of TP would be achieved annually. Basin is located directly adjacent to residential back-yard.	

Site Number:	15	
Site Name:	Island View Estates Dry Basin	
Practice:	Dry Basin Retro-fit	
Subbasin:	Sunnyview Rd North	
Location:	4660 Sherman Road	
		Looking Northwest from Zacher Dr
Description:	Existing dry basin serves an approved, but incomplete, residential subdivision. This project would retro-fit the dry basin to achieve water quality benefits. Basin would achieve an 80% TSS reduction and remove 2 tons of TSS and 11 lbs of TP annually.	

Site Number:	26
Site Name:	Bowen Street
Practice:	Wet Basin
Subbasin:	Anchorage Ct
Location:	Southwest of intersection of Murdock Avenue and Bowen Street

Looking Southeast from Murdock Ave

Description:	Wet basin would be located in vacant parcel east of existing grocery store, and north of convenience store. There is an abandoned gas station that could possibly be included, and could also cause contamination concerns. Proposed basin would treat a 340 acre mixed use drainage basin and achieve a 56% pollutant reduction. 23 tons of TSS and 135 lbs of TP would be removed annually. A 4.5 acre permanent pool would be needed to achieve 80% TSS reduction, this option estimates a permanent pool of 1.1 acres could be created. Option: Combine Site #26-1 and #26 into one basin to increase the pollutant removal.

Site Number:	29
Site Name:	Oakwood & 20th / Fox Tail Ln
Practice:	Wet Basin
Subbasin:	Sawyer Creek2
Location:	North of Trager School & Southwest Corner of Intersection of 20th Ave and Oakwood Rd

Looking West from end of Fox Tail Dr

Description:	Wet basin would be located southwest of intersection of 20th Avenue and Oakwood Road in vacant lot. Runoff from a 53 acre, primarily industrial land use, drainage are would be treated by a 1.3 acre permanent pool. Also, within the drainage basin a wet basin would be located north of Trager School, next to Sawyer Creek. Basin would receive runoff from 154 acres of residential and school land uses. Potential conflicts with a sanitary interceptor located at the site, and with location near school. Proposed basins would achieve an 80 percent TSS reduction (remove 19 tons TSS annually) and 64% TP reduction (removed 79 lbs TP annually). Additional modeling would need to be completed to ensure basins

	function separately for TSS removal.

<table>
<tr><td>Site Number:</td><td>35</td><td rowspan="5">
2014 Microsoft Corporation Pictometry Bird's Eye</td></tr>
<tr><td>Site Name:</td><td>Westhaven Golf Course – West Basin</td></tr>
<tr><td>Practice:</td><td>Wet Basin</td></tr>
<tr><td>Subbasin:</td><td>Sawyer Creek2</td></tr>
<tr><td>Location:</td><td>Existing Westhaven Golf Course – West of Westhaven Drive</td></tr>
<tr><td>Description:</td><td colspan="2">To construct this basin City would purchase the entire golf course. This basin would be constructed to provide water quality benefits and flood control benefits (flood control benefits part of a separate study). The basin would be built in between the fairways. Basin would treat a 261 acre drainage basin made up of primarily residential land uses. Proposed basin would provide an 80% TSS reduction (18 tons TSS annually) and provide a 64% TP reduction (114 lbs TP annually), approximately 19 tons annually. Permanent pool size of 2.1 acres would be needed.</td></tr>
</table>

Site Number:	31
Site Name:	9th and Washburn
Practice:	Wet Basin
Subbasin:	Campbell Creek
Location:	9th Avenue and Washburn St

2014 Microsoft Corporation Pictometry Bird's Eye

Description:	Basin would be located behind existing homes/businesses at the intersection of 9th Ave and Washburn St. The basin would treat 287 acre drainage basin at 83.8% pollutant removal rate with a permanent pool size of 8.8 acres. Approximately 19.2 tons of TSS would be removed. This is an alternative to Site #34, along with Site #2.

Site Number:	36
Site Name:	Libby Ave/N Main St
Practice:	Wet Basin
Subbasin:	Libby Ave/Nicolet Ave
Location:	Northeast of intersection of Main Street and Libbey Avenue

Looking South from Packer Ave

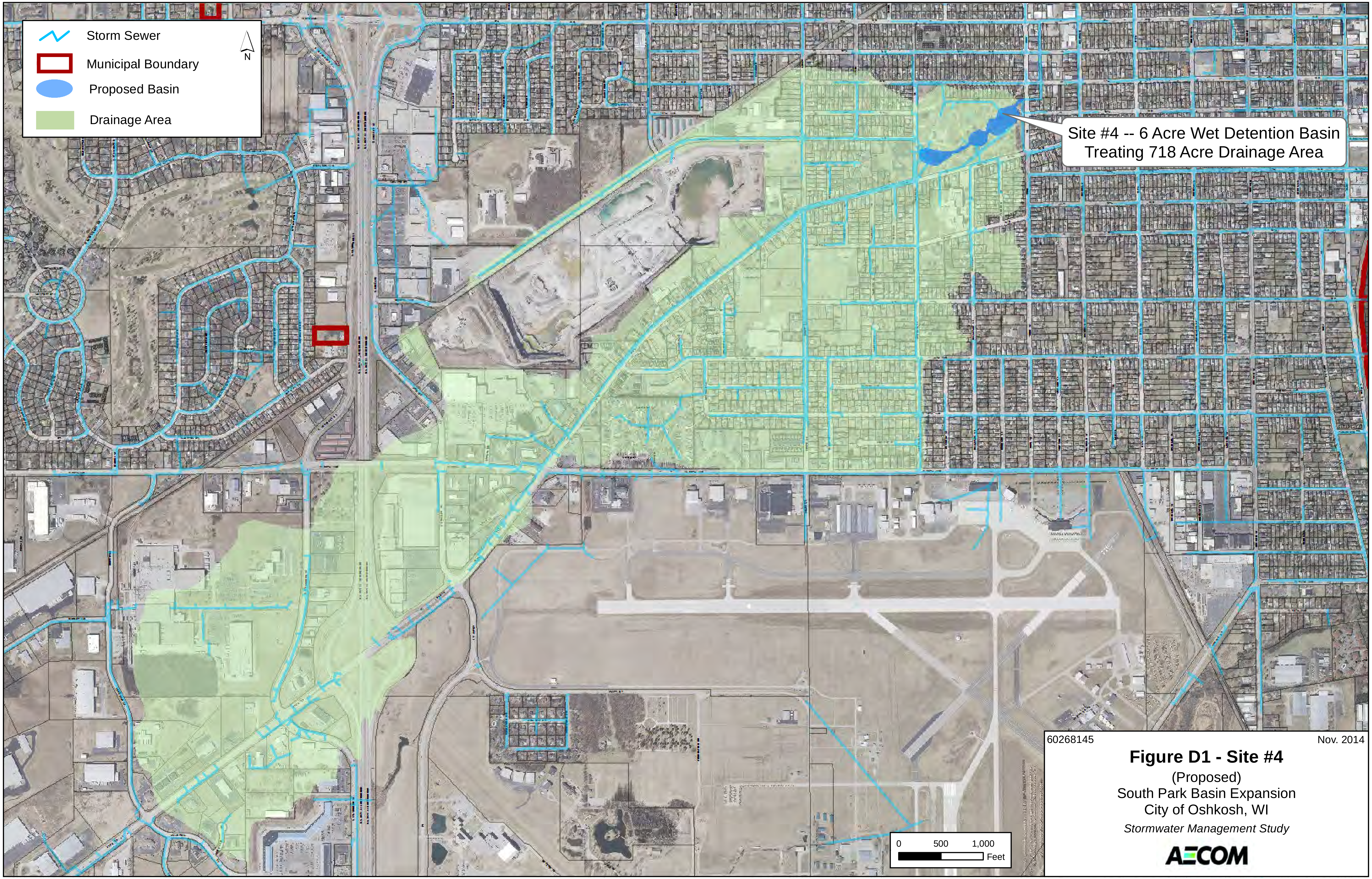
Description:	A 480 acre mixed use drainage from the Libbey and Nicolet Ave watersheds would be treated by a wet basin with 3.5 acre permanent pool. The runoff would enter the basin from the south via the Libbey/North Main Street Inlet Channel. This basis will achieve 67% TSS reduction and 53.6% TP reductions. Approx. 37 tons of TSS and 151 lbs of TP would be removed annually.

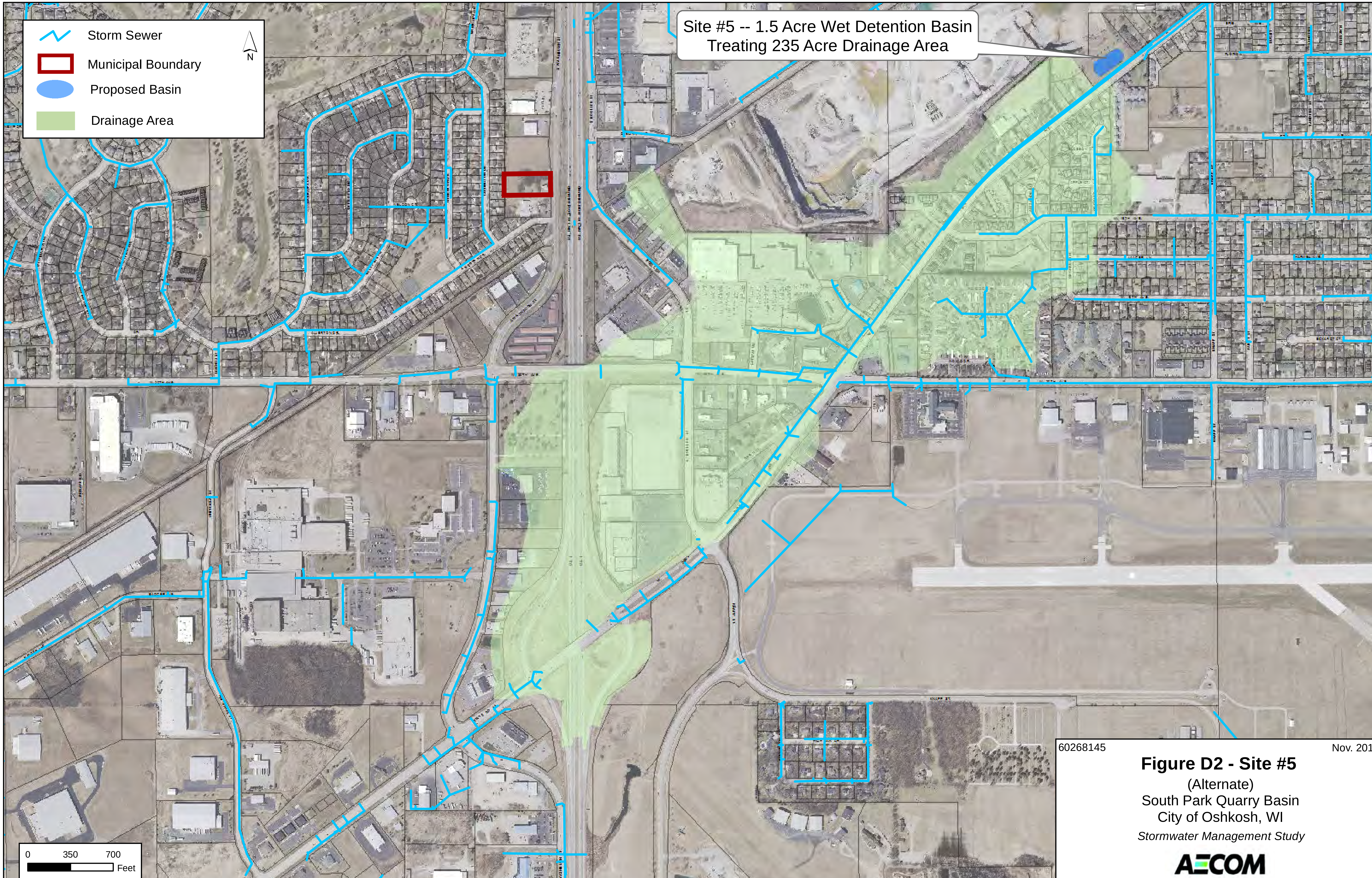
Alternative Sites to Proposed Projects

Site Number:	5	
Site Name:	South Park Quarry Basin	
Practice:	Wet Basin	
Subbasin:	Stringham Creek1	
Location:	North of South Park Avenue, South of existing Quarry in Vacant Parcel	
		Looking Northwest from South Park St
Description:	Would construct a basin in a vacant parcel adjacent to the existing quarry. Basin would serve a mixed use drainage area of 235 acres, provide a 37% TSS reduction (remove 14 tons of TSS annually) and 30% TP reduction (55 lbs of TP annually). A permanent pool of 7.7 acres would be needed for an 80% TSS reduction, a feasible permanent pool size of 0.75 acres is estimated. This site is an alternative location to Site #4 – Site #4 serves a larger drainage area and removes a large amount of TSS.	

Site Number:	16	
Site Name:	Miles Kimball Dry Basin	
Practice:	Dry Basin Retro-fit	
Subbasin:	Sawyer Creek2	
Location:	2155 S Oakwood Road	2014 Microsoft Corporation Pictometry Bird's Eye
Description:	Existing site has two dry basins treating stormwater runoff from the site. Proposed practice would retro-fit basins to create 0.9 acres of wet pools to improve water quality. Site would achieve an 80% TSS reduction (remove 4 tons of TSS annually) and 64% TP reduction (removed 15 lbs of TP annually). The drainage area is 40 acres and limited to the extent of the Miles Kimball property. This is an alternative site to Site #29.	

<table>
<tr><td>Site Number:</td><td>26-1</td><td rowspan="6">
Looking Southwest from Murdock Ave</td></tr>
<tr><td>Site Name:</td><td>Bowen Street</td></tr>
<tr><td>Practice:</td><td>Wet Basin</td></tr>
<tr><td>Subbasin:</td><td>Anchorage Ct</td></tr>
<tr><td>Location:</td><td>Southwest of intersection of Murdock Avenue and Bowen Street</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td>Description:</td><td colspan="2">This basin is an alternative site to Site #26. This site is located west of Site #26, and is directly in front of grocery store – it would be located between the entrance/exit drives. The drainage area would be the same, however, the site is smaller and would achieve a 20% TSS reduction and 16% TP reduction, which would remove about 9 tons of TSS annually and 49 lbs of TP annually. Permanent pool size allowed by site would be 0.8 acres. Option: Combine Site #26-1 and #26 into one basin connected by large culverts to increase the pollutant removal.</td></tr>
</table>


Storm Sewer
Municipal Boundary
Proposed Basin
Drainage Area
N
Site #4 -- 6 Acre Wet Detention Basin
Treating 718 Acre Drainage Area
0
500
1,000
Feet
60268145
Nov. 2014
Figure D1 - Site #4
(Proposed)
South Park Basin Expansion
City of Oshkosh, WI
Stormwater Management Study
AECOM


Storm Sewer
Municipal Boundary
Proposed Basin
Drainage Area
N
Site #5 -- 1.5 Acre Wet Detention Basin
Treating 235 Acre Drainage Area
0
350
700
Feet
60268145
Nov. 2014
Figure D2 - Site #5
(Alternate)
South Park Quarry Basin
City of Oshkosh, WI
Stormwater Management Study
AECOM

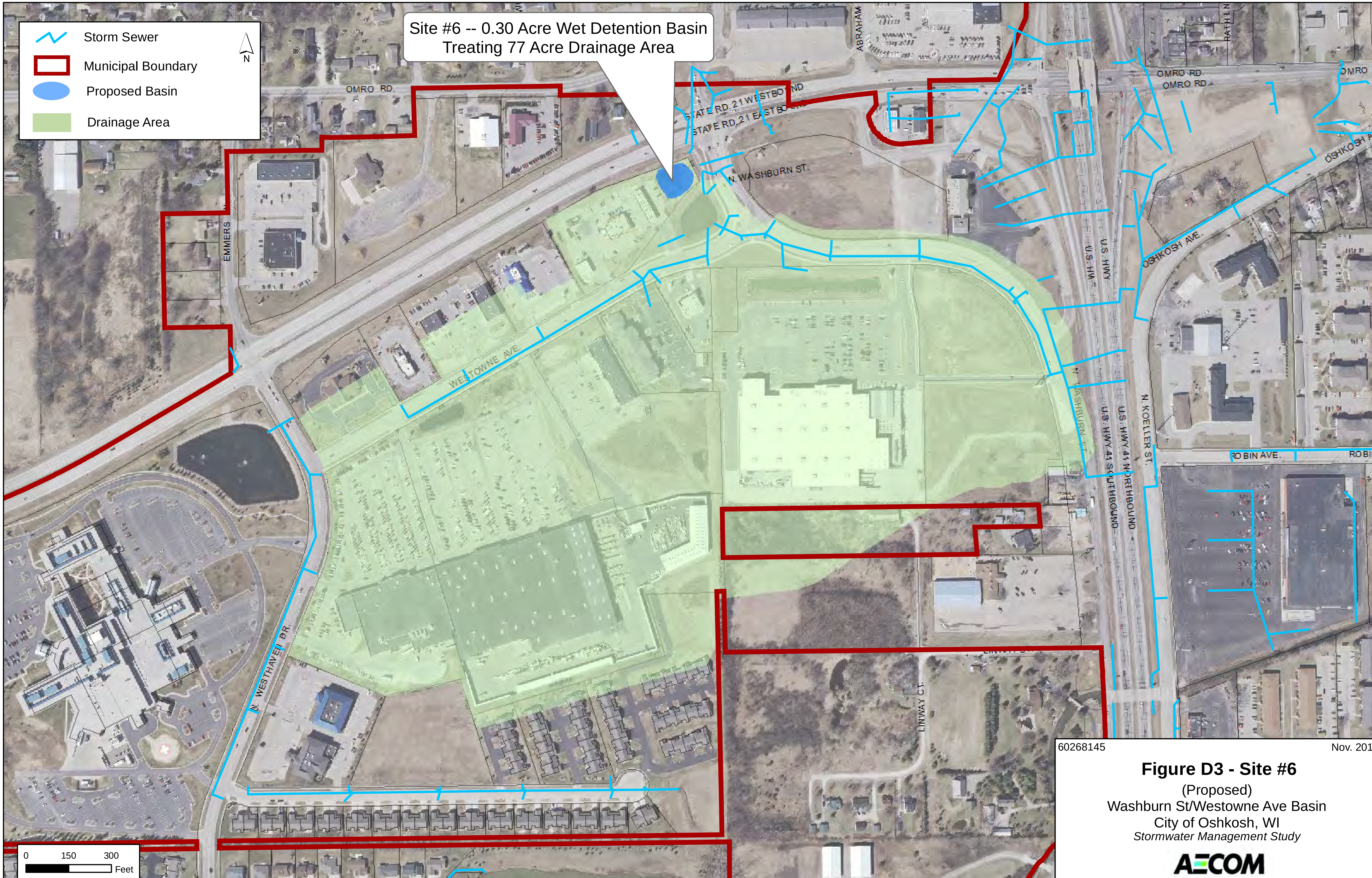

Storm Sewer
Municipal Boundary
Proposed Basin
Drainage Area
N
Site #6 -- 0.30 Acre Wet Detention Basin
Treating 77 Acre Drainage Area
OMRO RD.
STATE RD. 21 WESTBOUND
STATE RD. 21 EASTBOUND
N. WASHBURN ST.
WESTOWNE AVE.
EMMERS
N. WESTHAVEN DR.
ABRAHAM
OSHKOSH AVE.
U.S. HWY 41 SOUTHBOUND
U.S. HWY 41 NORTHBOUND
N. KOELLER ST.
ROBIN AVE.
LINWAY CT.
0
150
300
Feet
60268145
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Figure D3 - Site #6
(Proposed)
Washburn St/Westowne Ave Basin
City of Oshkosh, WI
Stormwater Management Study
AECOM

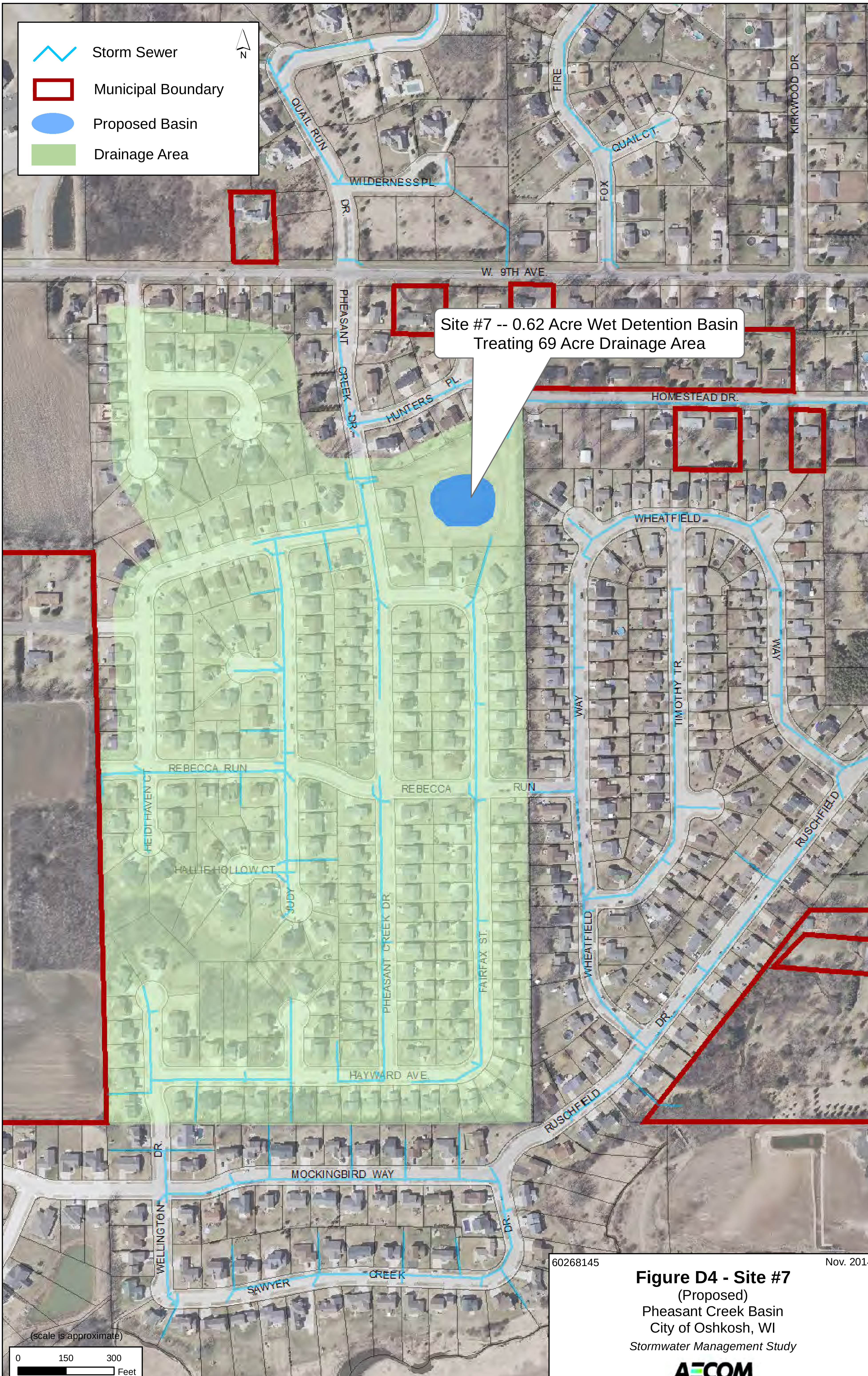

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Figure D4 - Site #7
(Proposed)
Pheasant Creek Basin
City of Oshkosh, WI
Stormwater Management Study

AECOM

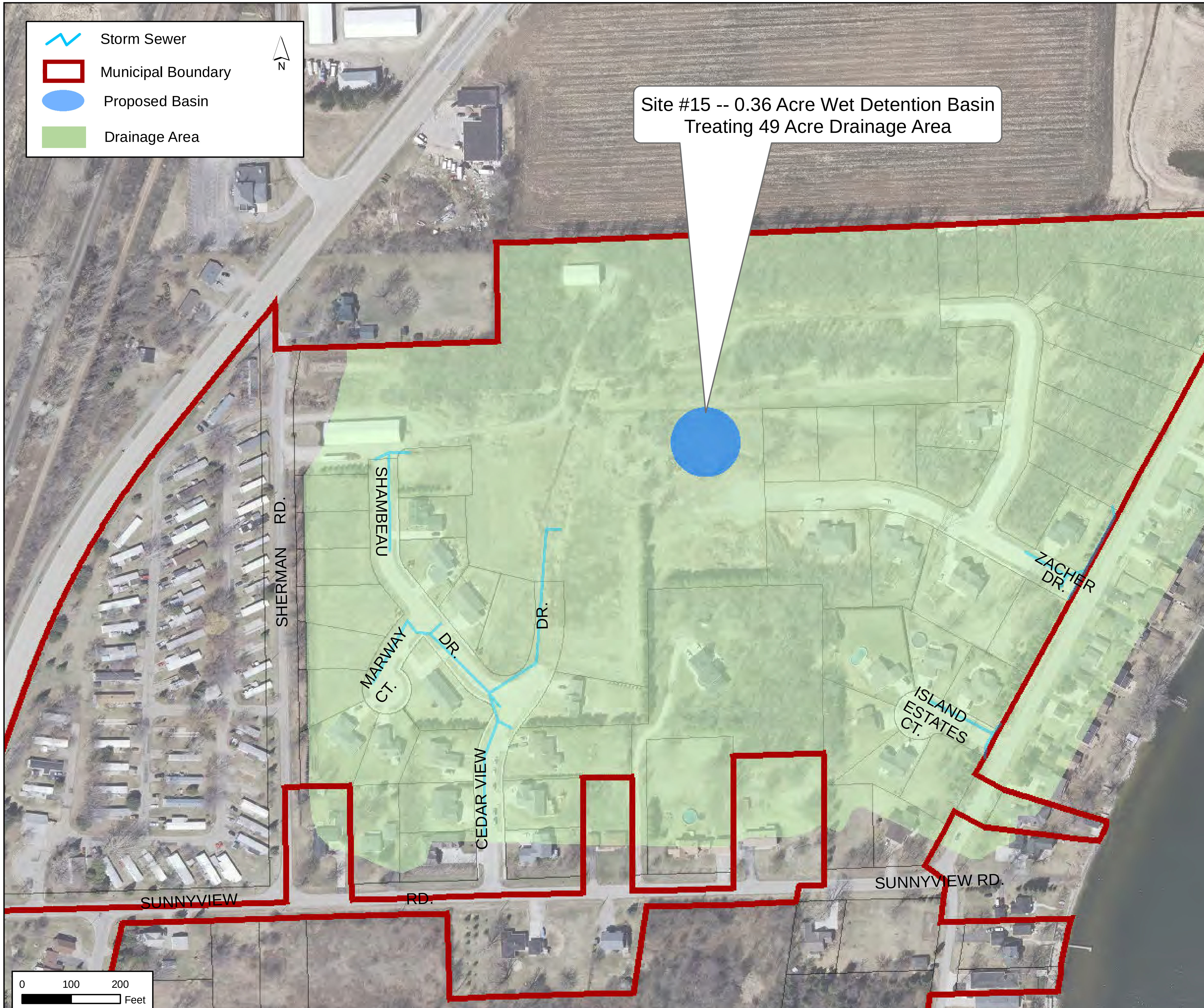

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Figure D5 - Site #15

(Proposed)

Island View Estates - Dry Basin

City of Oshkosh, WI

Stormwater Management Study

AECOM

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Figure D6 - Site #16

(Alternate)
Miles Kimball Dry Basin
City of Oshkosh, WI

Stormwater Management Study

AECOM

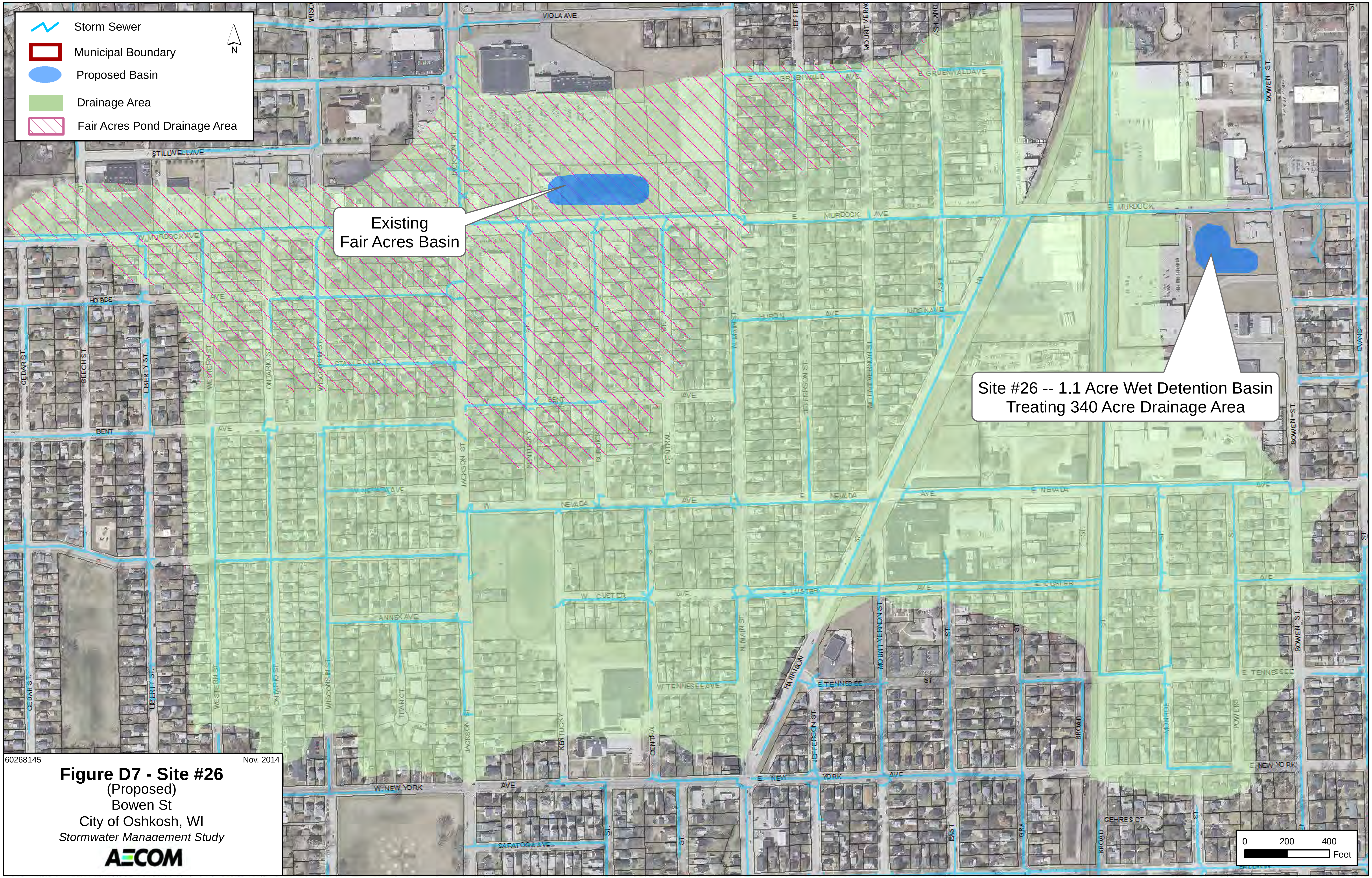

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Figure D7 - Site #26
(Proposed)
Bowen St
City of Oshkosh, WI
Stormwater Management Study
AECOM

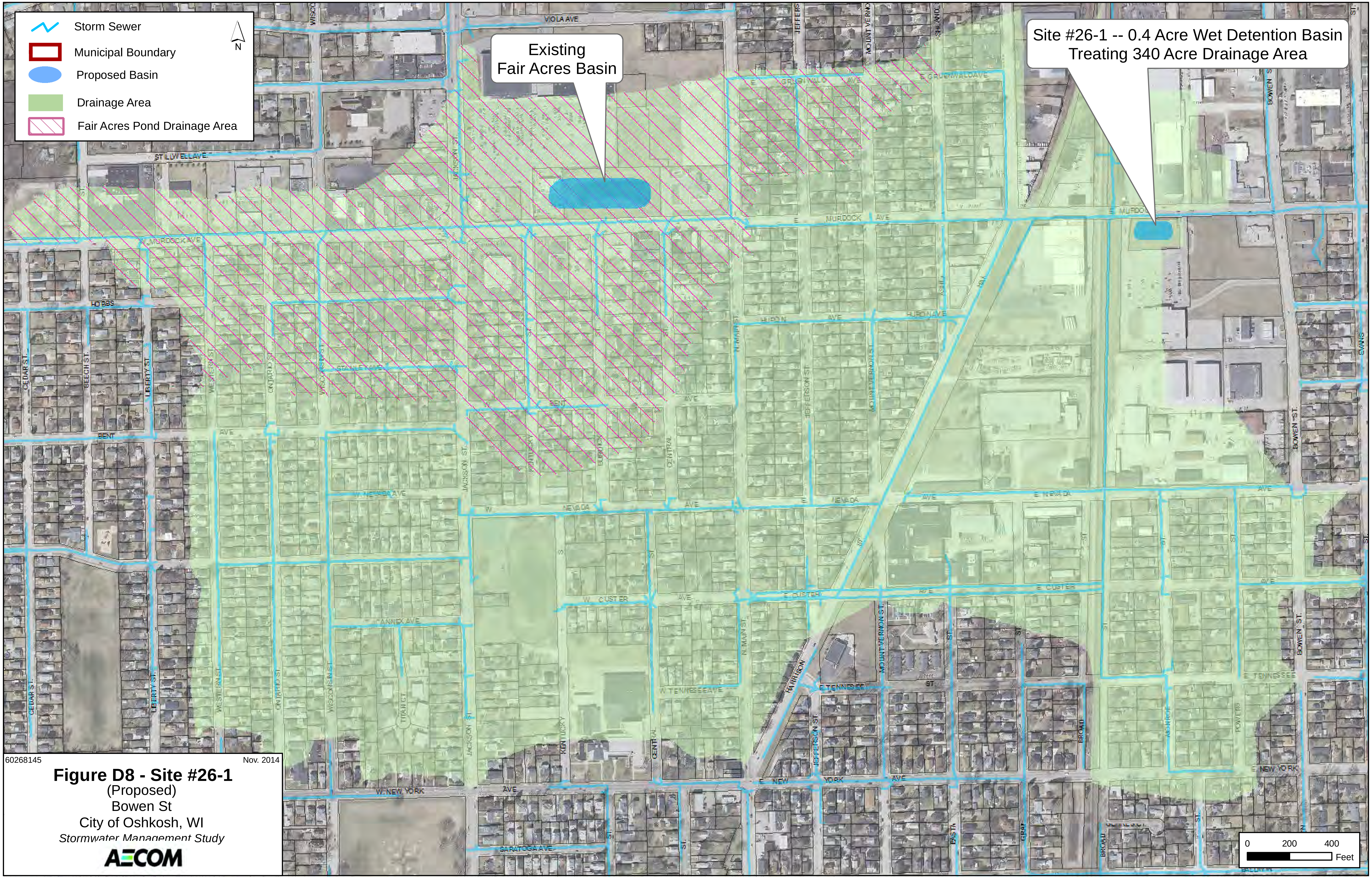

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Figure D8 - Site #26-1
(Proposed)
Bowen St
City of Oshkosh, WI
Stormwater Management Study
AECOM

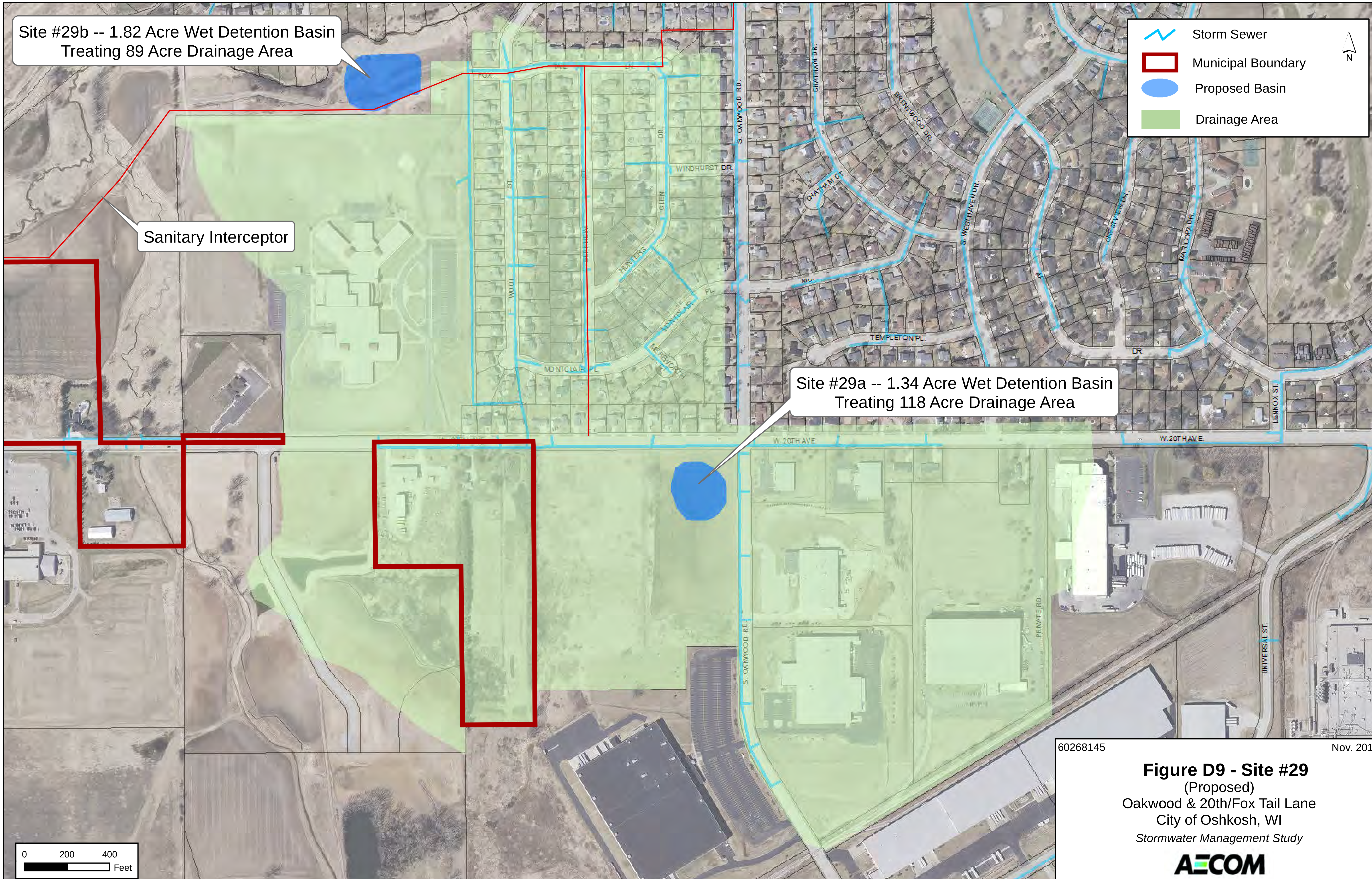

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Figure D9 - Site #29

(Proposed)

Oakwood & 20th/Fox Tail Lane

City of Oshkosh, WI

Stormwater Management Study

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Storm Sewer
Municipal Boundary
Proposed Basin
Drainage Area
N
Site #31 -- 8.9 Acre Wet Detention Basin
Treating 286.3 Acre Drainage Area
0 300 600
Feet
60268145
Nov. 2014
Figure D10 - Site #31
(Proposed)
9th & Washburn
West Basin
City of Oshkosh, WI
Stormwater Management Study
AECOM

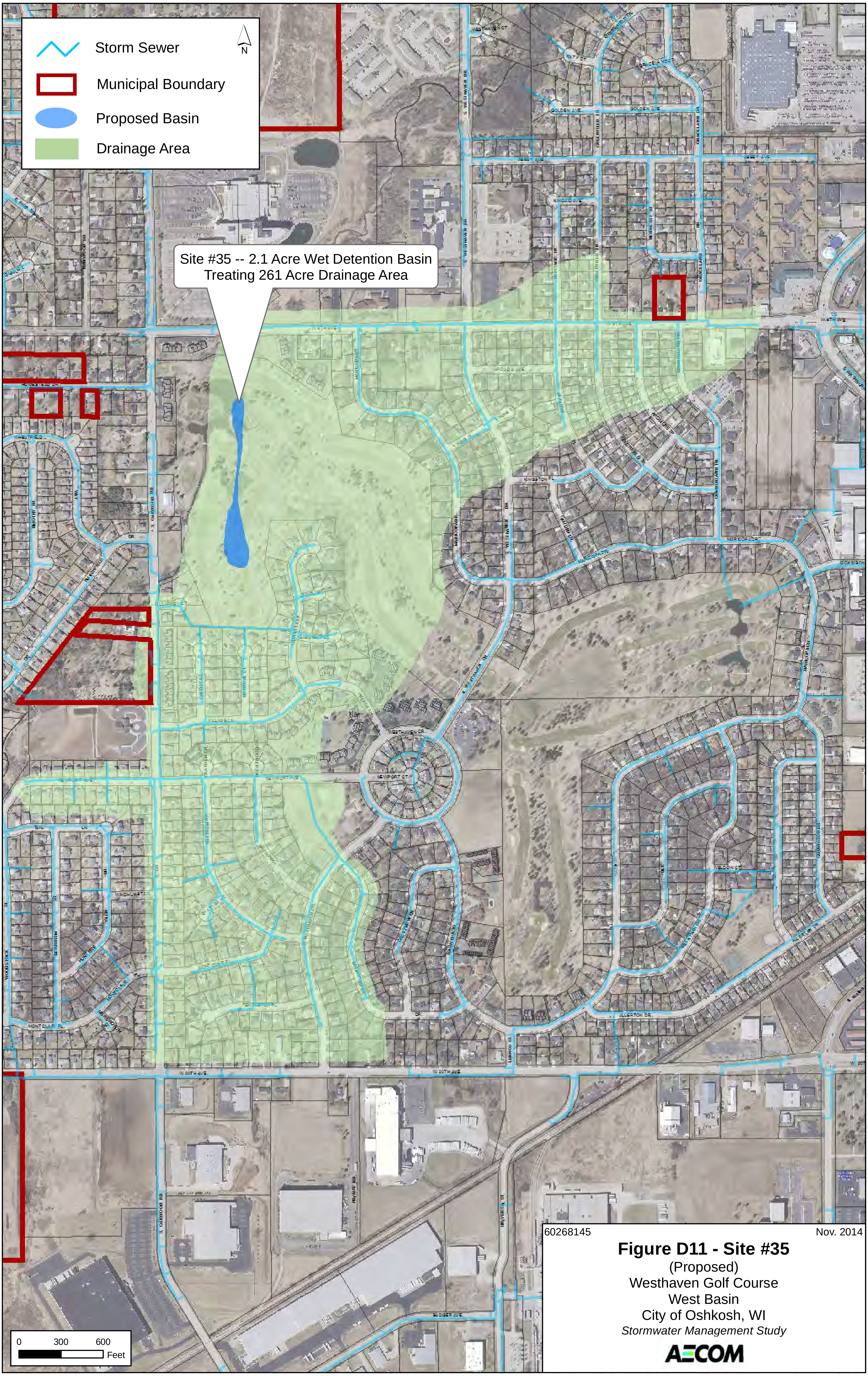

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Figure D11 - Site #35
(Proposed)
Westhaven Golf Course
West Basin
City of Oshkosh, WI
Stormwater Management Study

AECOM

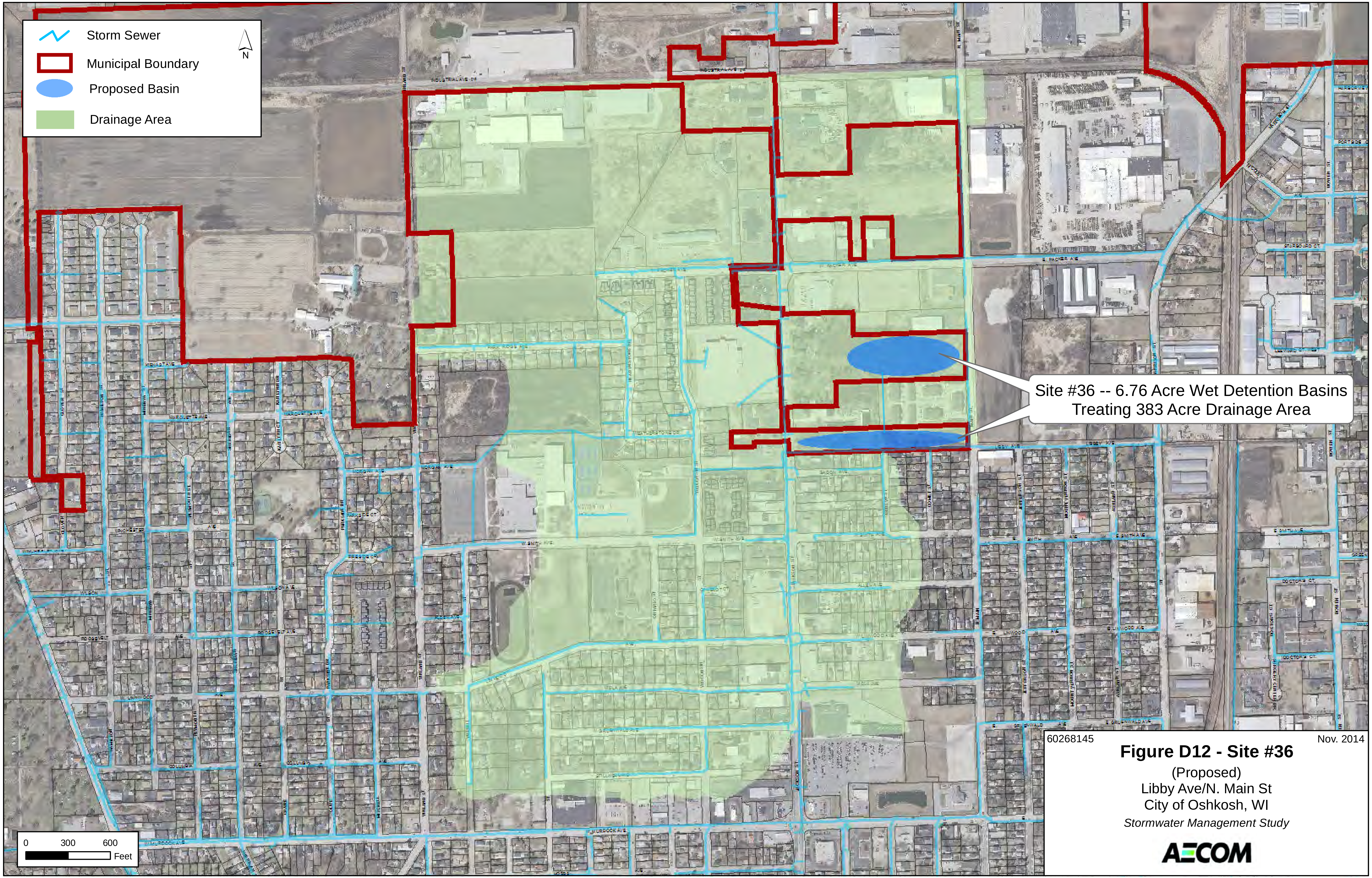


Figure D12 - Site #36
(Proposed)
Libby Ave/N. Main St
City of Oshkosh, WI
Stormwater Management Study

Appendix E

Proposed BMP Implementation Schedule

Capital Project Schedule 2014-2023
City of Oshkosh

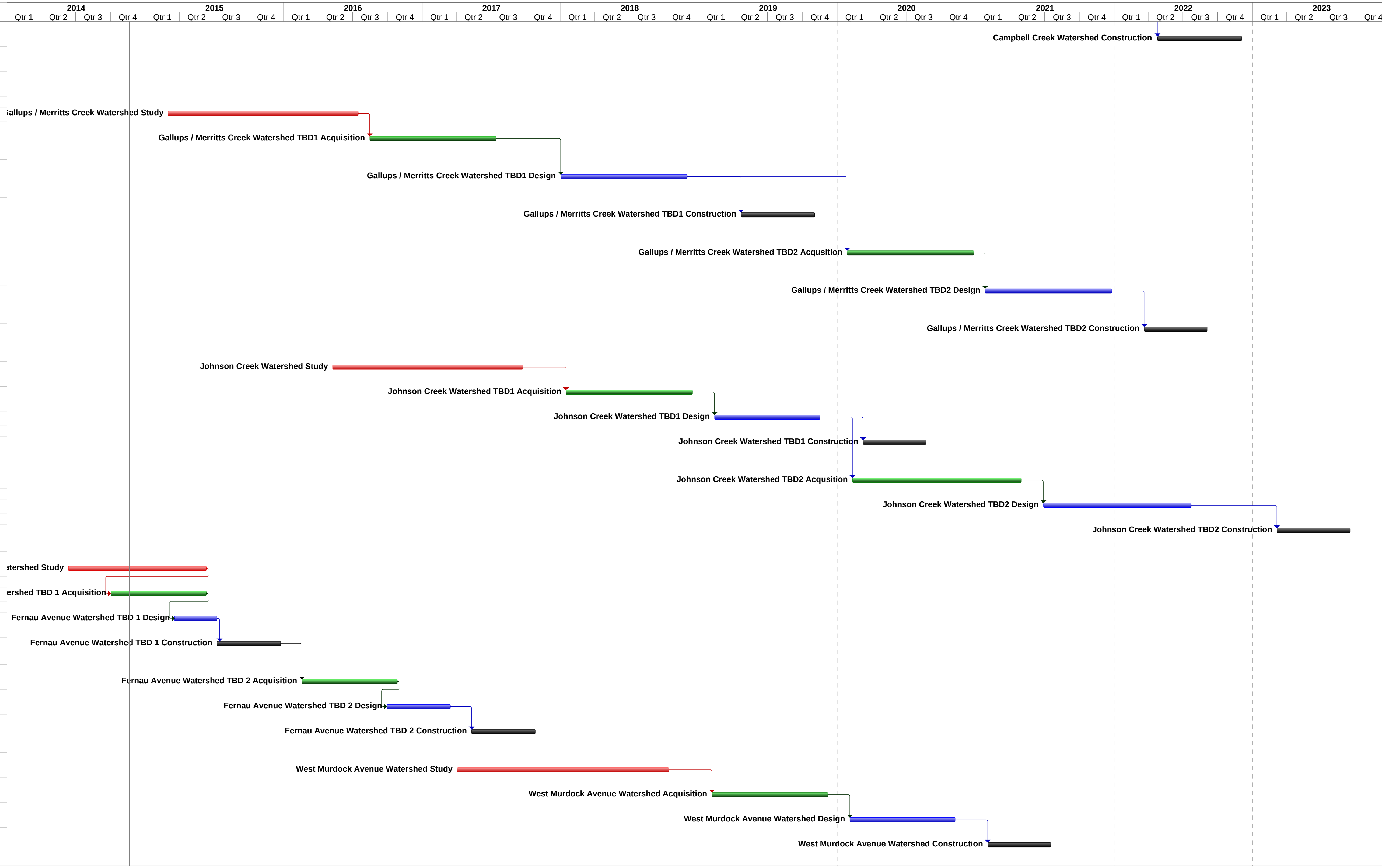
ID	Task Name
1	Stringham Creek Watershed Study
2	
3	South Park Area Basin Retrofit Design
4	
5	South Park Area Basin Retrofit Construction
6	
7	Stringham Creek Watershed Acquisition
8	
9	Stringham Creek Watershed Design
10	
11	Stringham Creek Watershed Construction
12	
13	James Road Area Detention Design
14	
15	James Road Area Detention Construction
16	
17	Sawyer Creek Dredging Design
18	
19	Sawyer Creek Dredging Construction
20	
21	Sawyer Creek Watershed Study Update
22	
23	Sawyer Creek Watershed Acquisition
24	
25	Sawyer Creek Watershed Design
26	
27	Sawyer Creek Watershed Construction
28	
29	Water Quality Study Update
30	
31	Washburn Water Quality Basin Acquisition
32	
33	Washburn Water Quality Basin Design
34	
35	Washburn Water Quality Basin Construction
36	
37	Glatz Creek Watershed Study
38	
39	Glatz Creek Watershed Phase 1 Relief Sewer Design
40	
41	Glatz Creek Watershed Phase 1 Relief Sewer Construction
42	
43	Glatz Creek Watershed Phase 2 Relief Sewer Design
44	
45	Glatz Creek Watershed Phase 2 Relief Sewer Construction
46	
47	Libbey / Nicolet Watersheds Acquisition
48	
49	Libbey / Nicolet Watersheds Design
50	
51	Libbey / Nicolet Watersheds Construction
52	
53	Armory Detention Basin Design
54	
55	Armory Detention Basin Acquisition
56	
57	Armory Detention Basin Construction
58	
59	9th & Washburn Acqusition
60	
61	9th & Washburn Design
62	
63	9th & Washburn Construction
64	
65	Campbell Creek Study Update
66	
67	Campbell Creek Watershed Acqusition
68	
69	Campbell Creek Watershed Design

Project: City Wide SWMP Scheduling-
Date: Thu 11/20/14

Task	Milestone	Project Summary	External Milestone	Inactive Milestone	Manual Task	Manual Summary Rollup	Start-only	Progress			
Split	Summary	External Tasks	Inactive Task	Inactive Summary	Duration-only	Manual Summary	Finish-only	Deadline			

Capital Project Schedule 2014-2023
City of Oshkosh

ID	Task Name
70	
71	Campbell Creek Watershed Construction
72	
73	City Hall Detention Design
74	
75	City Hall Detention Construction
76	
77	Gallups / Merritts Creek Watershed Study
78	
79	Gallups / Merritts Creek Watershed TBD1 Acquisition
80	
81	Gallups / Merritts Creek Watershed TBD1 Design
82	
83	Gallups / Merritts Creek Watershed TBD1 Construction
84	
85	Gallups / Merritts Creek Watershed TBD2 Acquisition
86	
87	Gallups / Merritts Creek Watershed TBD2 Design
88	
89	Gallups / Merritts Creek Watershed TBD2 Construction
90	
91	Johnson Creek Watershed Study
92	
93	Johnson Creek Watershed TBD1 Acquisition
94	
95	Johnson Creek Watershed TBD1 Design
96	
97	Johnson Creek Watershed TBD1 Construction
98	
99	Johnson Creek Watershed TBD2 Acquisition
100	
101	Johnson Creek Watershed TBD2 Design
102	
103	Johnson Creek Watershed TBD2 Construction
104	
105	Fernau Avenue Watershed Study
106	
107	Fernau Avenue Watershed TBD 1 Acquisition
108	
109	Fernau Avenue Watershed TBD 1 Design
110	
111	Fernau Avenue Watershed TBD 1 Construction
112	
113	Fernau Avenue Watershed TBD 2 Acquisition
114	
115	Fernau Avenue Watershed TBD 2 Design
116	
117	Fernau Avenue Watershed TBD 2 Construction
118	
119	West Murdock Avenue Watershed Study
120	
121	West Murdock Avenue Watershed Acquisition
122	
123	West Murdock Avenue Watershed Design
124	
125	West Murdock Avenue Watershed Construction



Project: City Wide SWMP Scheduling-
Date: Thu 11/20/14

Task | Split | Milestone | Summary | Project Summary | External Tasks | External Milestone | Inactive Task | Inactive Milestone | Inactive Summary | Manual Task | Duration-only | Manual Summary Rollup | Manual Summary | Start-only | Finish-only | Progress | Deadline

Figures

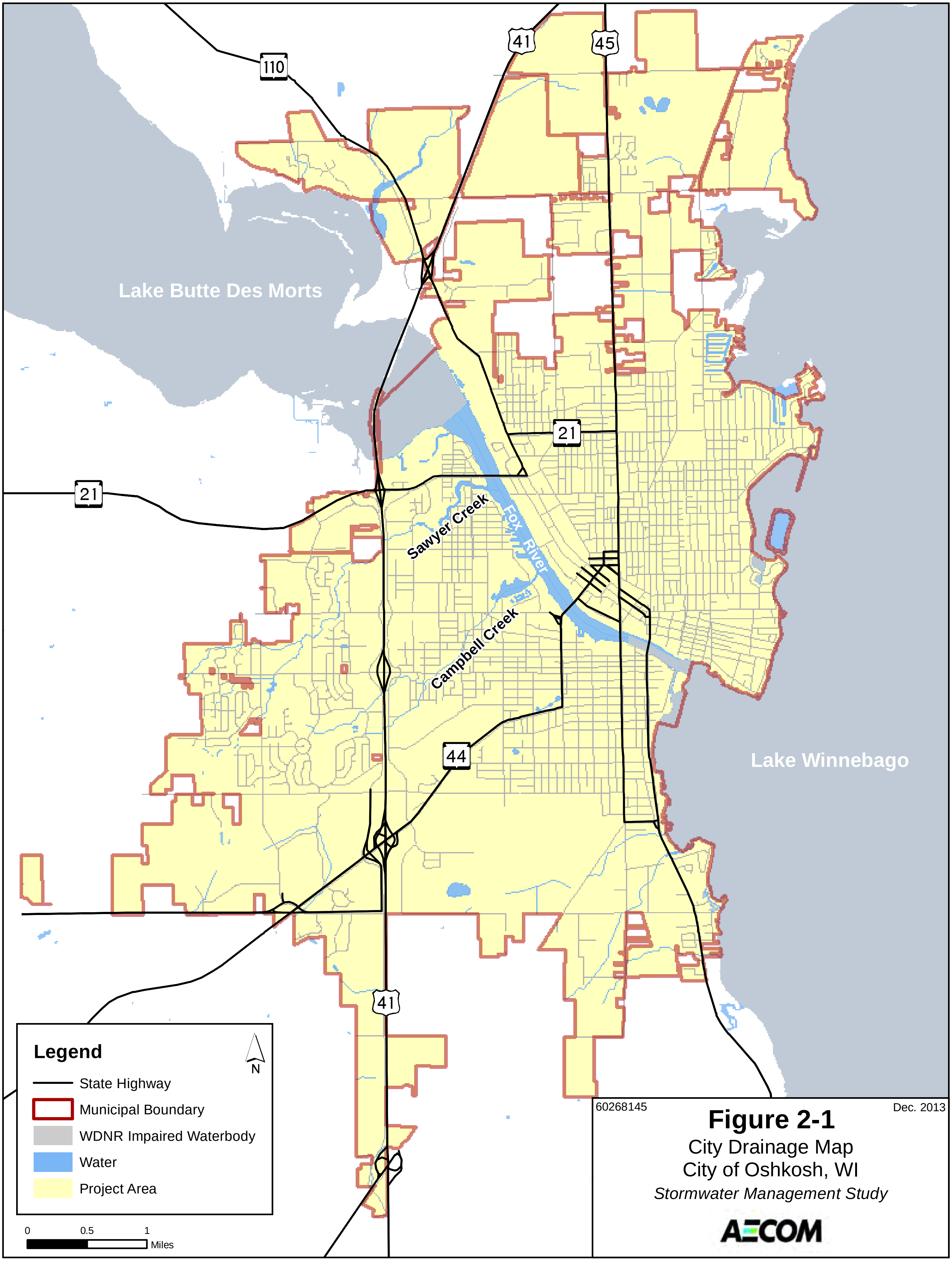


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Figure 2-1

City Drainage Map
City of Oshkosh, WI
Stormwater Management Study

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Figure 4-1

Project Basins and Water Resources
City of Oshkosh, WI
Stormwater Management Study

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Figure 4-2

2004 MS4 Existing Land Use
City of Oshkosh, WI
Stormwater Management Study

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Figure 4-3

2013 TMDL Existing Land Use
City of Oshkosh, WI
Stormwater Management Study

AECOM

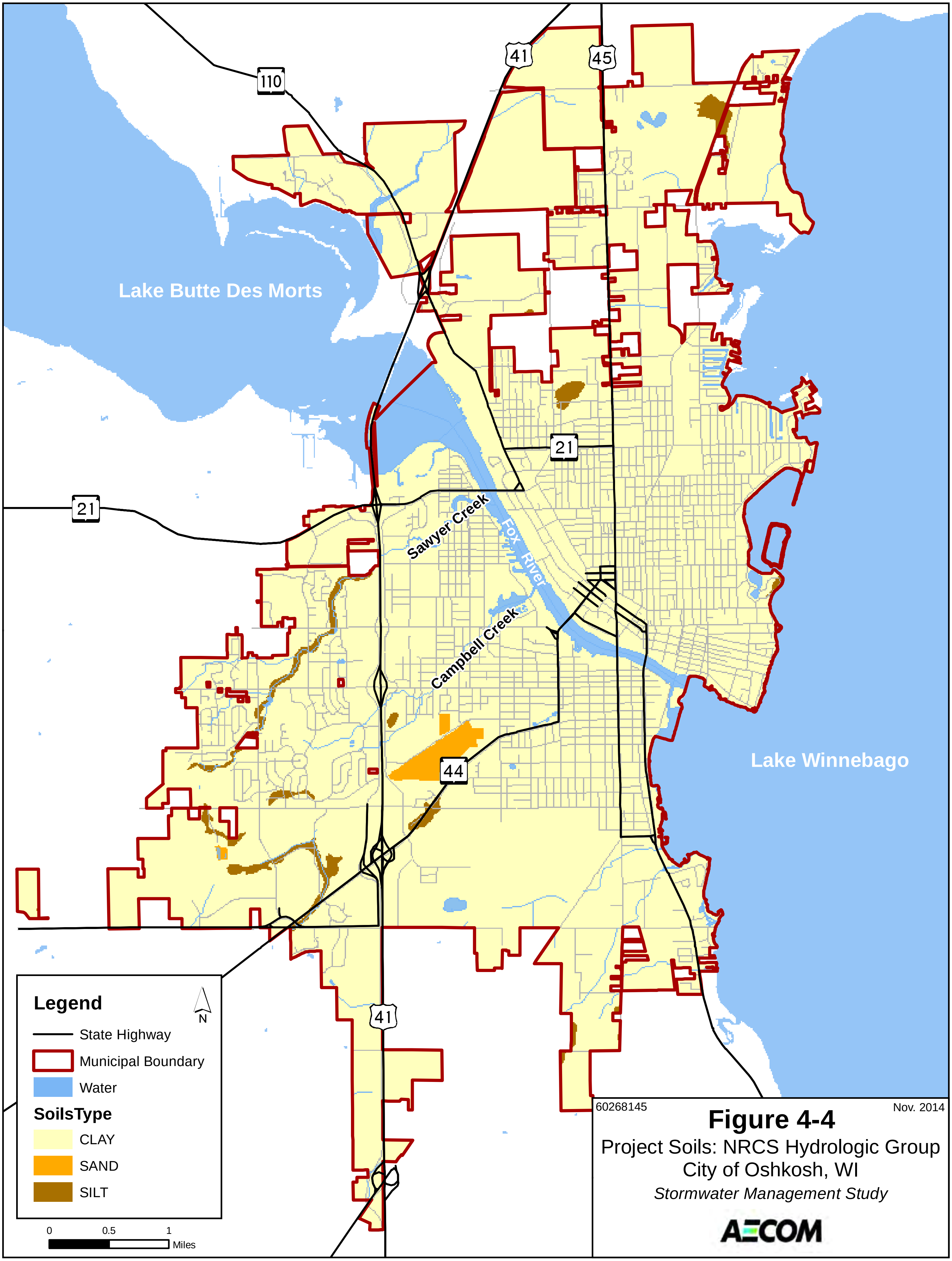

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Figure 4-4

Project Soils: NRCS Hydrologic Group
City of Oshkosh, WI
Stormwater Management Study

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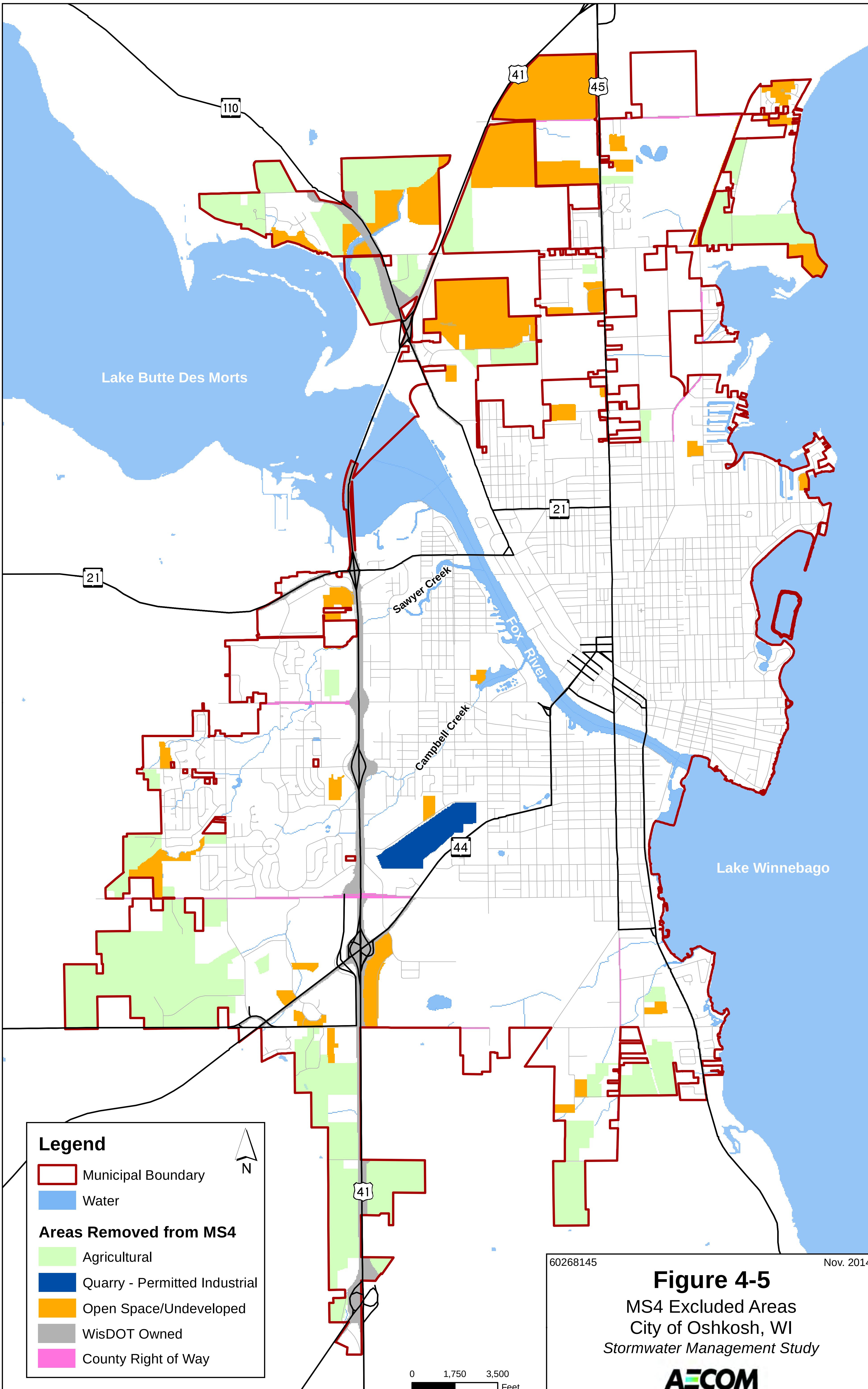

Figure 4-5
MS4 Excluded Areas
City of Oshkosh, WI
Stormwater Management Study

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Figure 4-6a

MS4 Base TSS Conditions
Annual Pollutant Load by Land Use
City of Oshkosh, WI

Stormwater Management Study

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Figure 4-6b

MS4 Base TP Conditions
Annual Pollutant Load by Land Use
City of Oshkosh, WI

Stormwater Management Study

AECOM

Figure 4-7a

MS4 Base TSS Conditions
Annual Pollutant Load by Watershed
City of Oshkosh, WI

Stormwater Management Study

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Figure 4-7b

MS4 Base TP Conditions
Annual Pollutant Load by Watershed
City of Oshkosh, WI

Stormwater Management Study

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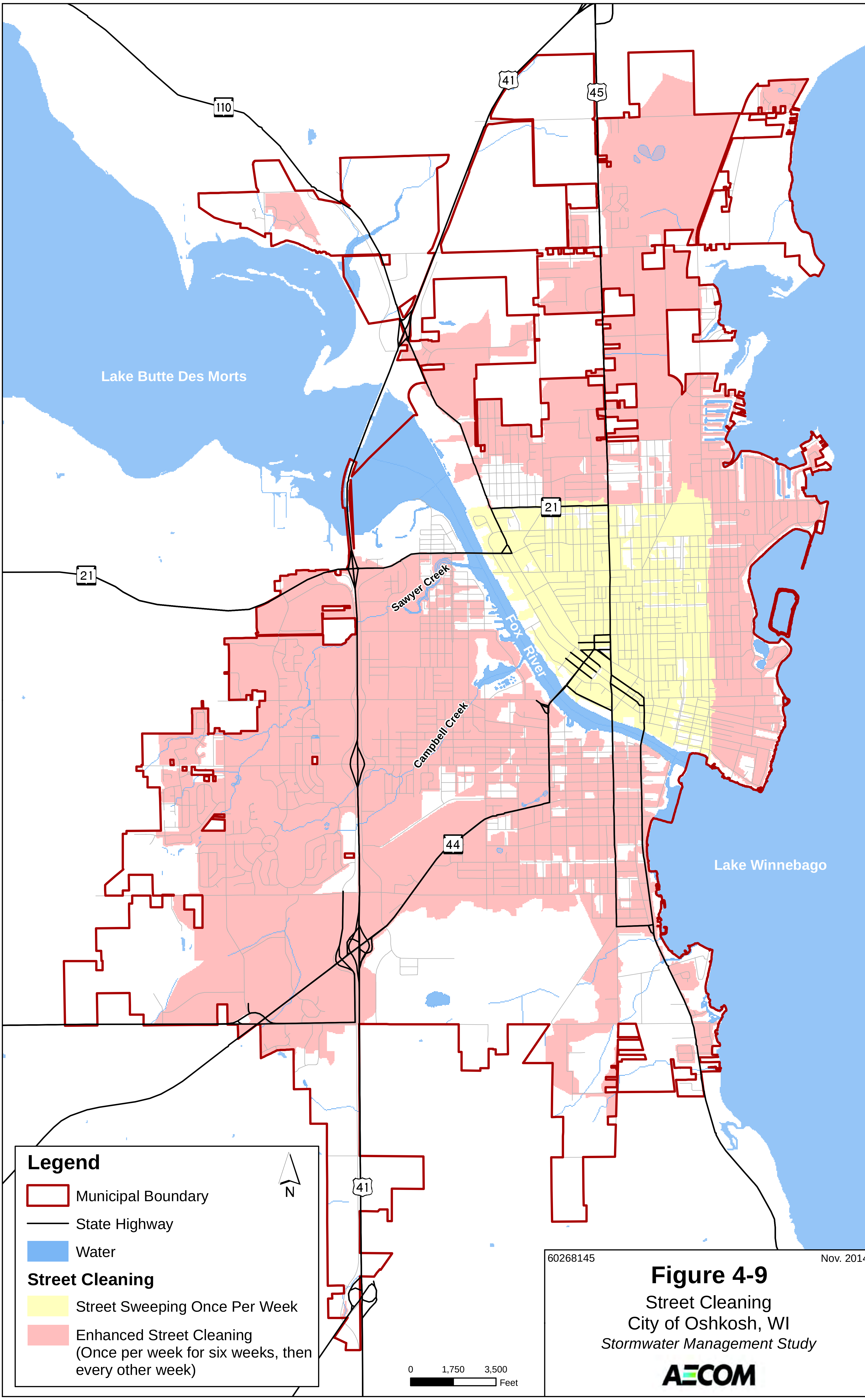

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Figure 4-9

Street Cleaning
City of Oshkosh, WI
Stormwater Management Study

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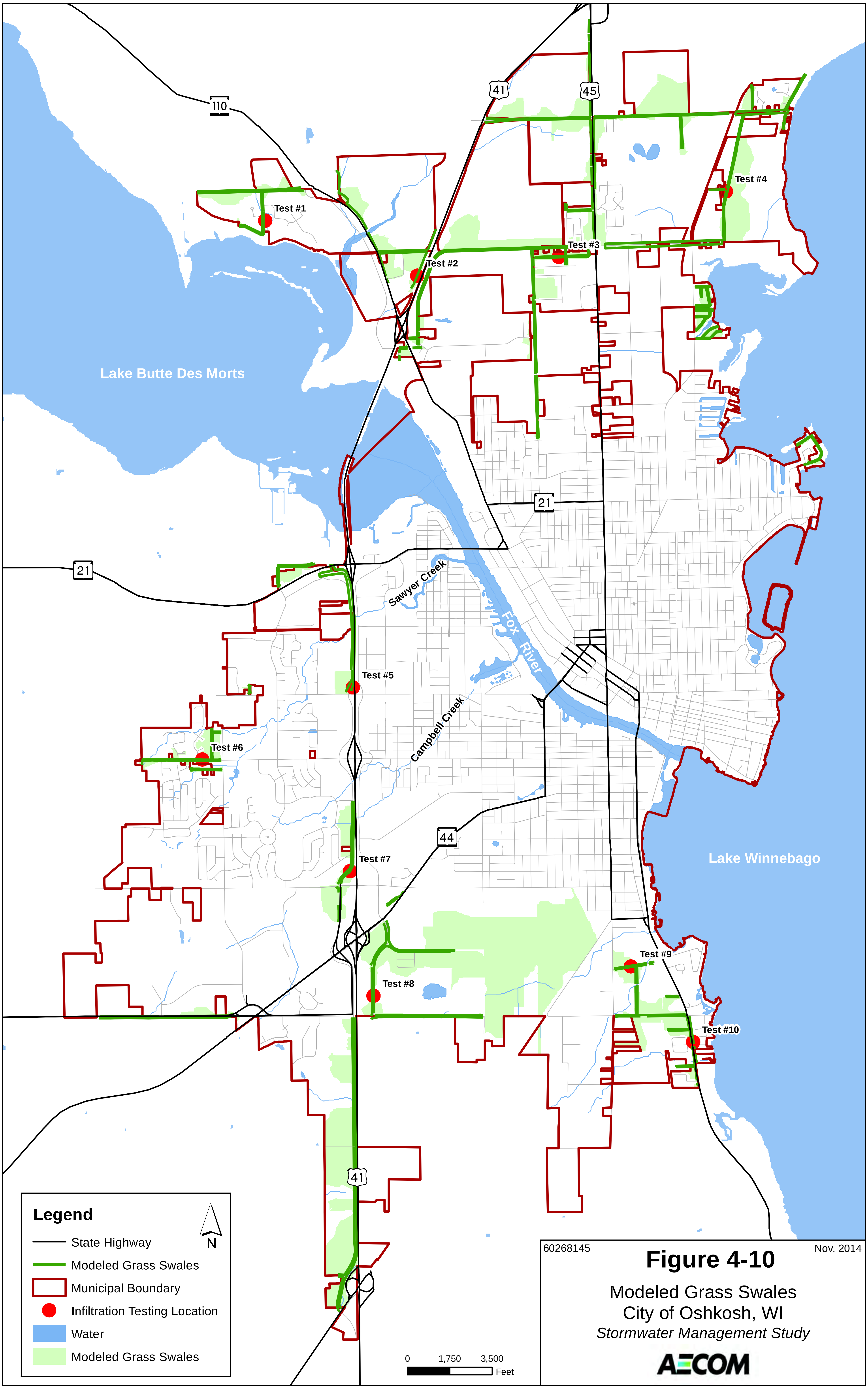

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Figure 4-10

Modeled Grass Swales
City of Oshkosh, WI
Stormwater Management Study

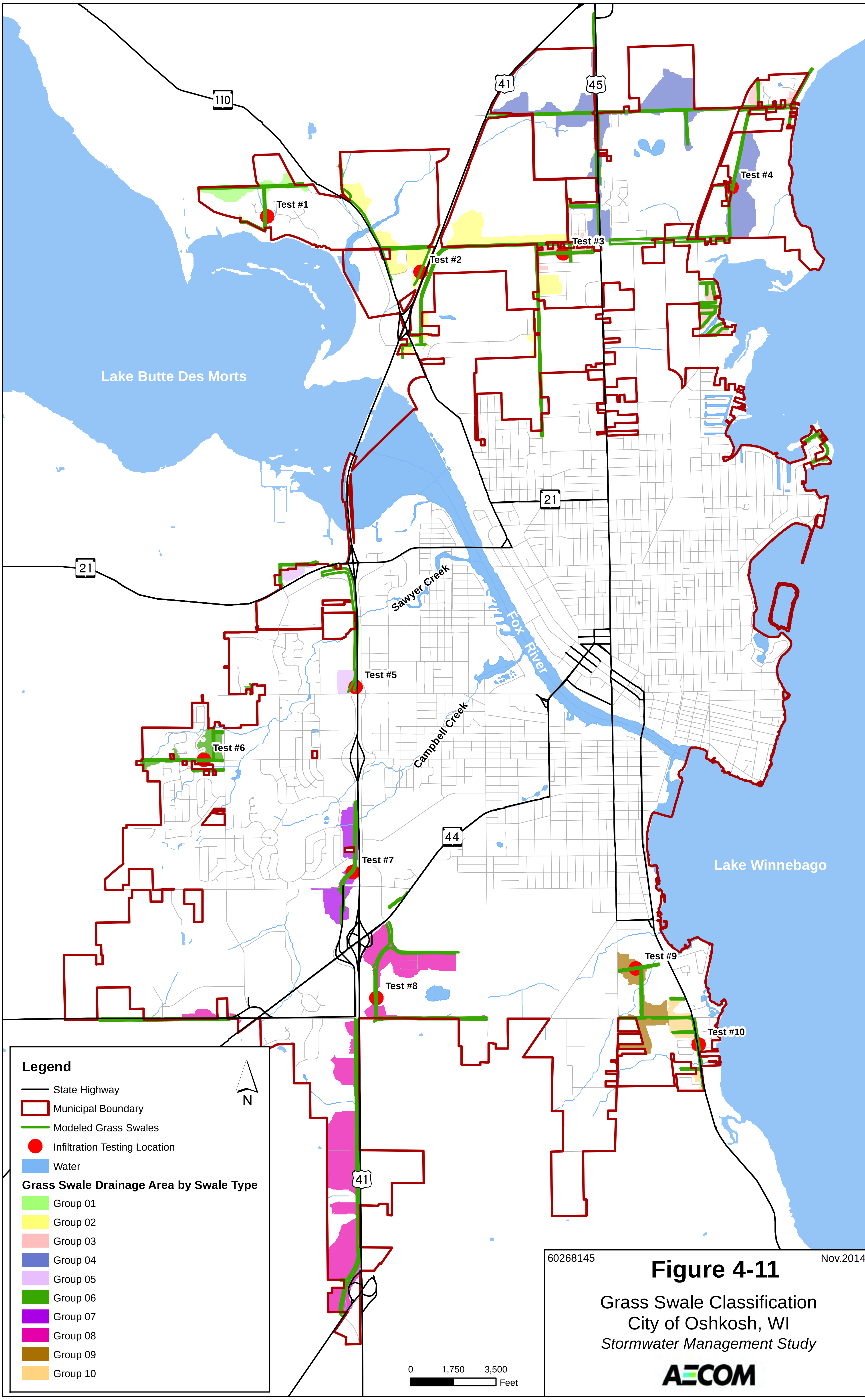

Figure 4-11

Grass Swale Classification
City of Oshkosh, WI
Stormwater Management Study

Figure 4-12
Structural BMP's
City of Oshkosh, WI
Stormwater Management Study
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Figure 4-13
All Existing BMP's
City of Oshkosh, WI
Stormwater Management Study

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Figure 4-14a

MS4 Existing TSS Conditions
Annual Pollutant Load by Land Use
City of Oshkosh, WI

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Figure 4-14b

MS4 Existing TP Conditions
Annual Pollutant Load by Land Use
City of Oshkosh, WI

Stormwater Management Study

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Figure 4-15a
MS4 Existing TSS Conditions
Annual Pollutant Load by Watershed
City of Oshkosh, WI
Stormwater Management Study
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Figure 4-15b

MS4 Existing TP Conditions
Annual Pollutant Load by Watershed
City of Oshkosh, WI

Stormwater Management Study

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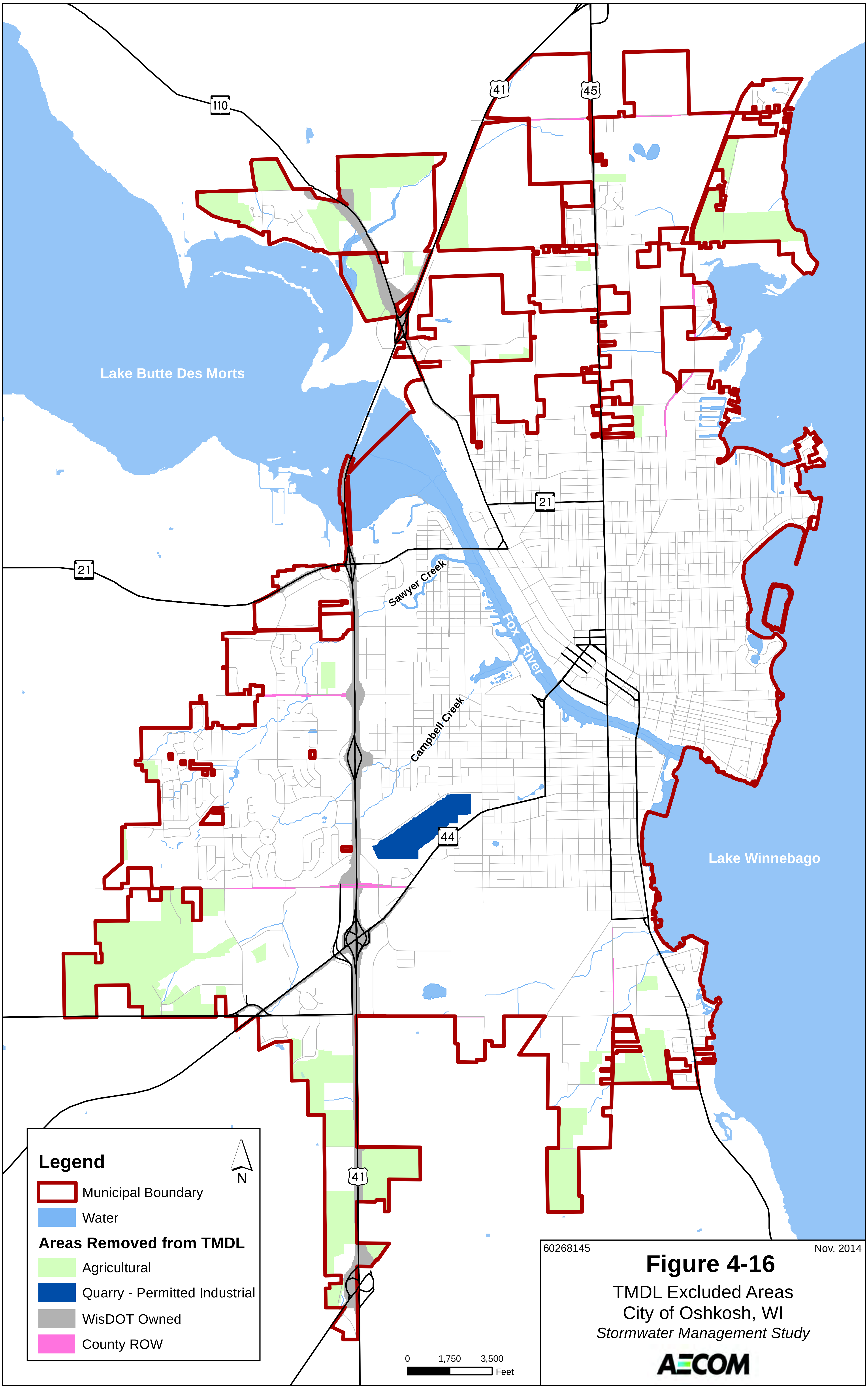
Lake Butte Des Morts
Lake Winnebago
Fox River
Sawyer Creek
Campbell Creek
110
41
45
21
44
Legend
N
Municipal Boundary
Water
Areas Removed from TMDL
Agricultural
Quarry - Permitted Industrial
WisDOT Owned
County ROW
0
1,750
3,500
Feet
60268145
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Figure 4-16
TMDL Excluded Areas
City of Oshkosh, WI
Stormwater Management Study
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Figure 4-18a

TMDL Base TSS Conditions
Annual Pollutant Load by Land Use
City of Oshkosh, WI

Stormwater Management Study

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Figure 4-18b

TMDL Base TP Conditions
Annual Pollutant Load by Land Use
City of Oshkosh, WI

Stormwater Management Study

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Figure 4-19a

TMDL Base TSS Conditions
Annual Pollutant Load by Watershed
City of Oshkosh, WI

Stormwater Management Study

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Figure 4-19b

TMDL Base TP Conditions
Annual Pollutant Load by Watershed
City of Oshkosh, WI

Stormwater Management Study

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Figure 4-20a

TMDL Existing TSS Conditions
Annual Pollutant Load by Land Use
City of Oshkosh, WI

Stormwater Management Study

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Figure 4-20b

TMDL Existing TP Conditions
Annual Pollutant Load by Land Use
City of Oshkosh, WI

Stormwater Management Study

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Figure 4-21a

TMDL Existing TSS Conditions
Annual Pollutant Load by Watershed
City of Oshkosh, WI

Stormwater Management Study

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Figure 4-21b

TMDL Existing TP Conditions
Annual Pollutant Load by Watershed
City of Oshkosh, WI

Stormwater Management Study

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Proposed Stormwater Quality Projects
Water Quality Ponds Only
Evaluation and Ranking

Proposed BMP ID	Subbasin	Address	Common Name	Practice	Total Drainage Area to BMP (acres)
4	Stringham Creek1	1300 Georgia St	South Park Basin Expansion	Retrofit	718
35	Sawyer Creek2	S Westhaven Dr	Westhaven Golf Course - West Pond	New Basin	261
36	Libby Ave / Nicolet Ave	N Main St	Libby Ave/N Main St	New Basin	383
7	Sawyer Creek2	Pheasant Creek Dr	Pheasant Creek Dry Basin	Retrofit	69
26	Anchorage Ct	E Murdock & Bowen St	Bowen Street	New Basin	340
6	Omro Rd	Washburn St	Washburn St/Westtowne Ave Basin	Retrofit	77
31	Campbell Creek	9th Ave & Washburn St	9th and Washburn	New Basin	287
15	Sunnyview Rd North	4660 Sherman Rd	Island View Estates Dry Basin	Retrofit	49
29	Sawyer Creek2	3000 W 20th Ave	Oakwood & 20th / Fox Tail Ln	New Basins	207

Figure 5-2
Proposed Best Management Practices
City of Oshkosh, WI
Stormwater Management Study

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