Stormwater Management Plan

Stormwater Quality Management Plan

Prepared For The

TOWN OF ALGOMA
A community connected

WINNEBAGO COUNTY, WISCONSIN

DECEMBER 21, 2018

McM. No. A0018-9-16-00318

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1.0 INTRODUCTION

At the request of the Town of Algoma, McMahon Associates, Inc (McMAHON) prepared the following Stormwater Quality Management Plan. The Town obtained an Urban Nonpoint Source and Stormwater Planning (UNPS&SW) Grant (USP-USP71002Y16) from the Wisconsin Department of Natural Resources (WDNR) to assist with preparation of this plan.

The purpose of this Stormwater Quality Management Plan is to provide the Town with the long-term guidance necessary to comply with Wisconsin Administrative Code NR 216 stormwater regulations, the Town's WPDES Municipal Stormwater Discharge Permit and improve water quality in receiving surface waters. Pursuant to NR 216, the Town obtained a WPDES Municipal Stormwater Discharge Permit from the WDNR in 2006. The Town renewed their WPDES Municipal Stormwater Discharge Permit in 2014 but that permit is set to expire in 2019. As such, the Town re-applied for their WPDES Municipal Stormwater Discharge Permit in 2018. The purpose of the permit is to regulate discharges from municipal separate storm sewer systems (MS4) and reduce urban non-point source pollution.

Relationship to Other Plans

This Stormwater Quality Management Plan compliments and is part of efforts to implement recommendations contained in several other stormwater management or resource management plans. These related plans include the following:

- In 2009, the Town developed a Stormwater Quality Management Plan in order to comply with their WPDES Municipal Stormwater Discharge Permit and NR 216 stormwater

regulations. The 2009 Stormwater Quality Management Plan included goals and recommendations for the six minimum control measures including Public Education and Outreach, Public Involvement and Participation, Illicit Discharge Detection and Elimination, Construction Site Pollutant Control, Post-Construction Site Stormwater Management and Municipal Pollution Prevention. The 2009 Stormwater Quality Management Plan also included a municipal stormwater quality management plan to outline compliance with the 20 and 40 percent total suspended solids (TSS) reduction requirement within NR 151.

This Stormwater Quality Management Plan is intended to update and replace the 2009 municipal stormwater quality management plan based on new or updated stormwater regulations, permit conditions, guidance documents and Total Maximum Daily Loads (TMDL) reports.

- The Wisconsin DNR is currently developing a TMDL for the Upper Fox and Wolf Basins. A Total Maximum Daily Load (TMDL) is the maximum amount of a pollutant that a water body can receive and still meet water quality standards. The TMDL will identify TSS and TP allocations for urban stormwater, wastewater, and agricultural sources located within the Upper Fox River & Wolf River Basins. The Upper Fox and Wolf Basins TMDL is anticipated to be reviewed and approved by the U.S. Environmental Protection Agency (EPA) in 2019. The TMDL will identify pollutant load allocations and percent reductions for urban stormwater in the Lake Butte des Morts and Sawyer Creek Sub-Watersheds for the Town of Algoma.

- The Comprehensive Plan for the Town of Algoma contains several recommendations related to natural resource and stormwater management: (1) Surface water, stream corridors, floodplains and wetlands are highly regulated resources. Local, state and federal regulations and ordinance need to be thoroughly reviewed when development is proposed for property that is in or near any of these resources; (2) Addressing water quality through the management of stormwater is a priority of federal and state regulators. Consideration should be given to developing a stormwater management plan and possibly forming a stormwater utility; (3) The Town should retain the series of an engineer having expertise in stormwater management to review all new development plans for compliance with the Town of Algoma stormwater management standards; (4) The Town needs to consider preserving adequate space to construct regional detention basins to minimize theffects of future development on peak flows.

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2.0 OVERVIEW OF STUDY AREA

The Town of Algoma is located in Winnebago County, Wisconsin. The study area for this Stormwater Quality Management Plan is depicted in Figure 1. The study area contains approximately 2,313 acres of area and is considered the urban planning boundary. The urban planning boundary was defined using the 2010 US Census Bureau developed urban area maps, including any contiguous developed urban areas. The Town of Algoma is part of the Oshkosh Urbanized Area as determined by the US Census Bureau. As shown in Figure 2, several Municipal Separate Storm Sewer System (MS4) jurisdictions are located within and directly adjacent to the Town. It's of note that the Town has a boundary agreement with the City of Oshkosh that protects the green portion of the Town as depicted in Exhibit 2-1. Areas in blue were annexed in 2018 and the red and orange areas annexing in 2023 and 2043, respectively. As such, the Town excluded these areas from their study area for purposes of this Stormwater Quality Management Plan.

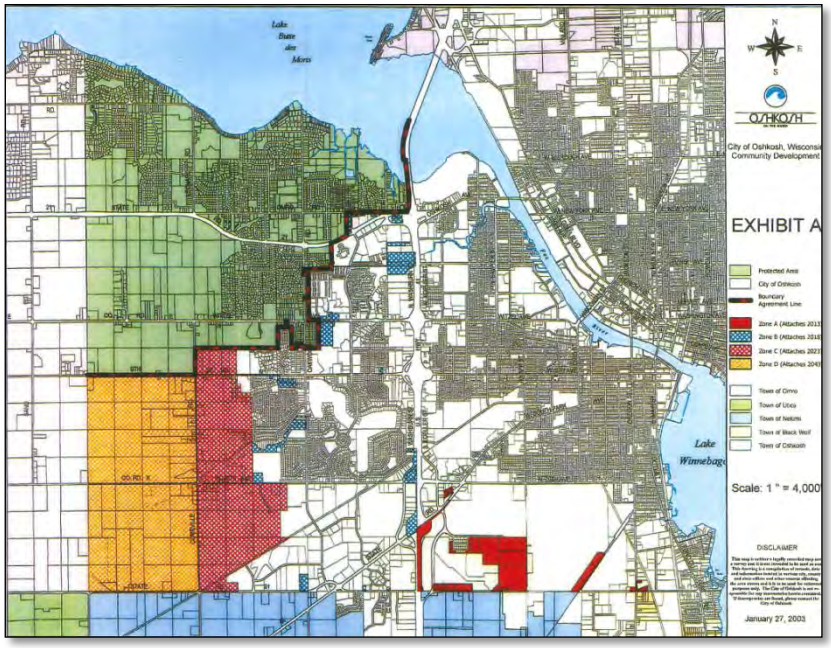


Exhibit 2-1: T. Algoma/C. Oshkosh Boundary Agreement Areas

Basins

The Wisconsin Department of Natural Resources (WDNR) divided the state into 24 basins or Water Management Units (WMU). The Town's study area is located in the Upper Fox River Basin. The basin boundaries are similar to the federally designated 8-digit Hydrologic Unit Code (HUC) boundaries.

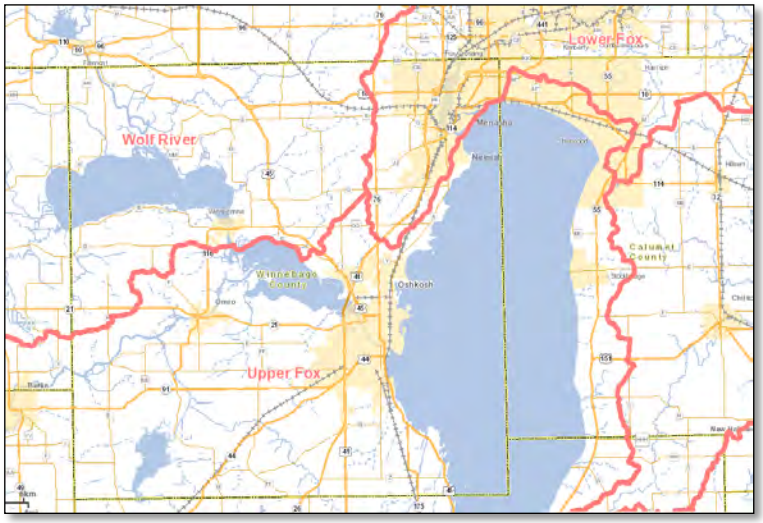
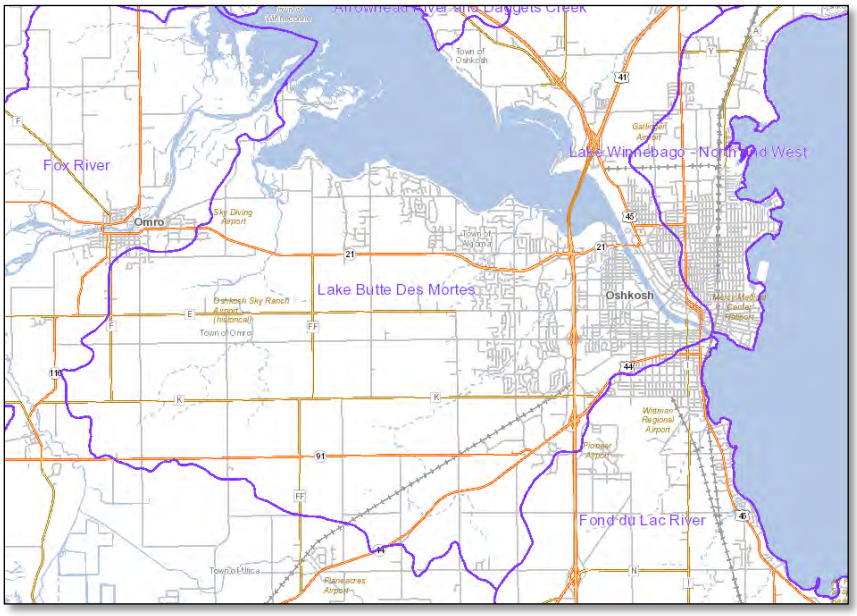


Exhibit 2-2: Upper Fox River Basin

Watersheds

The WDNR divided the Upper Fox River Basin into 15 watersheds and the study area is located in one of these watersheds: Lake Butte Des Morts (UF04).

Exhibit 2-3: Lake Butte Des Morts Watershed



Sub-Watersheds

For purposes of this Stormwater Quality Management Plan, the WDNR Lake Butte des Morts Watershed was divided into two sub-watersheds. The sub-watersheds are depicted in Figure 3 and summarized in Table 2-1. The sub-watersheds were delineated after considering local drainage systems, Winnebago County 2 foot contours, federally designated 12-digit Hydrologic Unit Code (HUC) boundaries, and state designated Total Maximum Daily Load (TMDL) sub-basin boundaries.

Table 2-1: Sub-Watersheds

Sub-Watershed	HUC-12	TMDL Sub-Basin
Lake Butte des Morts	Lake Butte des Morts-Fox River (040302011205)	Lake Butte des Morts
Sawyer Creek	Sawyer Creek (040302011204)	Sawyer Creek

Natural Resources

Natural resource features include surface waters (lakes, rivers, streams), wetlands, and endangered or threatened resources. Natural resource features located in the study area are depicted in Figure 4. Some of these natural resource features are protected with a special regulatory designation such as outstanding resource water, exceptional resource water, 303(d)

impaired water, endangered species, and threatened species. Natural resource features located in the study area with one of these special regulatory designations are identified below.

Outstanding and exceptional resource waters are pristine surface waters which are not significantly impacted by human activities and provide valuable fisheries, unique hydrological or geological features, outstanding recreational opportunities, or unique environmental settings. For example, cold water trout streams and natural waterfalls are typically classified as outstanding or exceptional resource waters. The Town does not discharge stormwater runoff into any outstanding resource waters or exceptional resource waters.

Impaired water bodies are degraded surface waters which are not meeting water quality standards or their potential uses, such as fishing and swimming, due to pollutants and poor water quality. The US EPA requires each state to update its 303(d) impaired waters list every two years, including Wisconsin. The Town's study area discharges stormwater runoff into one 303(d) impaired waters:

- Lake Butte des Morts: Bear Creek is a 303(d) impaired water body due to non-point source pollution. Pollutants of concern include PCBs, total phosphorus, sediment/total suspended solids and Mercury. Impairments include low DO, eutrophication, mercury contaminated fish tissue, excess algal growth and PCBs contaminated fish tissue. The attainable use for Lake Butte des Morts is a fish & aquatic life community. Currently, Lake Butte des Morts is not supporting its attainable use. A TMDL is currently being developed for the Upper Fox & Wolf River Basins, which will include Bear Creek.

Endangered and threatened resources are wild animal and plant species which are either in danger of extinction throughout all or a significant portion of its range or likely to become endangered in the foreseeable future. Typically, the location of an endangered or threatened species is tracked in Wisconsin's Natural Heritage Inventory and is only identified by township. Sensitive species that are particularly vulnerable to collection or disturbance are only identified by county. The Natural Heritage Inventory maps and species lists are routinely updated by WDNR. To prevent collection or disturbance of sensitive species, endangered and threatened resources are not depicted in Figure 4.

Cultural Resources

Cultural resources are places of cultural significance. Some cultural resources are protected with a special regulatory designation such as archeological sites and historical sites. The State of Wisconsin maintains maps and a computer database on the location and nature of archaeological sites. Special permission is required to view these maps and databases. The location of archaeological sites is exempt from public disclosure to prevent collection or disturbance of valuable artifacts. Archeological sites may be located within the study area, but cannot be disclosed by law. The Wisconsin Historical Society's State Register indicates there are two historical sites located within the study area. Historical sites located on the National or State Register are depicted on Figure 4 and summarized in Table 2-2.

Table 2-2: Historical Sites – State Register

I.D.	Historic Name	Location	Reference No.
1	Bell Site Indian Burial Grounds	Outlot 8 – 4th Addition to Bellhaven	92000818

The Wisconsin Historical Society also maintains the Architecture & History Inventory (AHI), which is a list of historic buildings, structures and objects throughout Wisconsin that have no special status, rights or benefits. Most properties became part of the AHI as a result of architectural, archaeological or historical surveys. In many cases, the information may be outdated and some properties may be altered or no longer exist. The inventory is continually changing and should be accessed on the Wisconsin Historical Society's website to find the most updated version. Historical sites currently on the AHI within the Town's study area are depicted on Figure 4.

Remediation & Waste Disposal Sites

Remediation sites are places where cleanup of environmental soil or groundwater contamination is ongoing or completed. Remediation sites may involve hazardous wastes, underground storage tanks, or other contaminant sources. Waste disposal sites are places where solid wastes are stored. Understanding the location of remediation and waste disposal sites is an important consideration when evaluating potential stormwater retrofit locations. The approximate location of WDNR identified remediation sites (open and closed sites) and waste disposal sites (not archived) are depicted in Figure 4.

Soils

Soil information is from the Natural Resource Conservation Service / U.S. Department of Agriculture web soil survey. The U.S. Department of Agriculture has classified soil types into four hydrologic soil groups (HSG). The four hydrologic soil groups (i.e. A, B, C and D) are classified according to the minimum infiltration rate of the soil column. Group A soils have the highest permeability rate or lowest runoff potential, whereas Group D soils have the lowest permeability rate or highest runoff potential. Hydrologic soil groups are depicted in Figure 5.

MS4 System

The municipal separate storm sewer system (MS4) consists of publicly owned or operated conveyance systems including streets, curbs, gutters, catch basins, storm sewers, swales, channels, culverts, and occasionally bridges. The MS4 system is depicted in Figure 6.

The MS4 system contains several structural best management practices (BMPs). The structural BMPs are depicted in Figure 7 and summarized in Table 2-3. Structural BMPs include wet detention ponds and dry detention ponds. Some of these structural BMPs are publicly owned and others are privately owned. As part of their stormwater program, the Town typically

obtains maintenance authority for privately owned BMP's through maintenance agreements. Table 2-3 identifies the private BMP's the Town has maintenance authority over. For purposes of this plan, only Town owned BMP's or private BMP's with maintenance agreements in place were considered for the water quality analysis.

Table 2-3: Structural BMPs

BMP ID	BMP Name	Type of BMP	BMP Owner	Maintenance Authority
1	4th Addition to Bellhaven	Dry Pond	Private	Yes
2	2nd Addition to Bellhaven	Dry Pond	Private	Yes
3	1st Addition to Bellhaven	Dry Pond	Private	Yes
4	3rd Addition to Bellhaven	Dry Pond	Private	Yes
5	Bell Ridge Pond C	Wet Pond	Private	Yes
6	Bell Ridge Pond B	Wet Pond	Private	Yes
7	Bell Ridge Pond A	Wet Pond	Private	Yes
8	Hunters Court	Wet Pond	Private	Yes
9	Olde Apple Acres West Pond	Wet Pond	Private	Yes
10	Olde Apple Acres East Pond	Wet Pond	Private	Yes
11	Jones Plat	Dry Pond	Private	TBD
12	Algoma Self-Storage Pond	Wet Pond	Private	Yes
13	Jones Park Pond	Wet Pond	Town	Yes
14	Butte Des Morts Meadows Pond	Wet Pond	Town	Yes
15	Butte Des Morts Meadows 1st Addition	Dry Pond	Private	TBD
16	St. Pauls United Church of Christ	Dry Pond	Private	TBD
17	Apex Center Pond	Wet Pond	Private	TBD
18	Algoma Storage	Dry Pond	Private	TBD
19	Wyldewood West	Dry Pond	Town	Yes
20	Eden Meadows Pond	Wet Pond	Private	TBD
21	Wyldewood Baptist Church	Wet Pond	Private	TBD
22	Kobussen Buses	Dry Pond	Private	TBD
23	All Saints Lutheran Church North Pond	Dry Pond	Private	TBD
24	All Saints Lutheran Church South Pond	Dry Pond	Private	TBD
25	Oak Manor Estates	Dry Pond	Private	Yes
26	Church of Jesus Christ of Latter-Day Saints	Dry Pond	Private	TBD
27	Red Bird Meadows	Dry Pond	Town	Yes
28	Oakwood Manor South Pond	Dry Pond	Private	TBD
29	Oakwood Manor North Pond	Dry Pond	Private	TBD
30	Red Bird Meadows	Dry Pond	Private	TBD
31	Coldwell Banker Pond	Wet Pond	Private	TBD
32	Willow Springs	Dry Pond	Private	Yes

TBD – To be determined. Town is researching maintenance agreements

The MS4 system is based on available records. The MS4 system contains three different types of surface drainage: curb & gutter, grass swales, and areas not served by a control measure (no controls). The types of surface drainage are depicted in Figure 8.

WPDES Industrial Permits

As shown in Figure 9 and summarized in Table 2-4, there are 10 industrial operations with coverage under a WPDES Industrial Permit that are currently located within the study area. WPDES Industrial Permits are regulated by the WDNR. Some WPDES Industrial Permits may allow discharges into the MS4 system during dry weather. Understanding the location of the WPDES Industrial Permitted sites is important to effective implementation of the Town's stormwater program.

Table 2-4: WPDES Industrial Permits

I.D.	Facility Name	Facility Address
1	Fox Valley Iron Metal & Auto Salvage	3446 Witzel Avenue
2	Kobussen Buses Limited	3043 Omro Road

Drinking Water System

The Town of Algoma Sanitary District #1 obtains drinking water from three groundwater wells that feed filtration facilities and supply safe municipal water throughout the study area. The municipal wells are depicted on Figure 9. The municipal wells were dug to provide a public water system because of concerns with groundwater quality due to potential high levels of arsenic in the St. Peter Sandstone. Most of the Town of Algoma lies within a WDNR's Arsenic Advisory Area, which is a five-mile boundary surrounding the St. Peter Sandstone. Algoma Sanitary District #1 adopted a Water Utility Ordinance on December 11, 2003, which regulates well abandonment and cross connections from existing wells to a public water system. On February 2, 2004, the DNR approved the Sanitary District's Wellhead Protection Ordinance.

Land Uses

The location of publicly owned parks, recreational areas, open lands, and municipal facilities are depicted in Figure 9. Understanding the location of publicly owned land is important to effective implementation of the municipal stormwater program.

Land uses on or before October 1, 2004 are depicted in Figure 10 and summarized in Table 2-5. Table 2-5 summarizes the 2004 land uses located within the study area. For purposes of the NR 151 pollutant analysis, undeveloped sites less than 5 acres are shown to be developed based on adjoining land uses. Undeveloped sites greater than 5 acres are shown as agriculture, woods, grass, or another undeveloped open space, as appropriate.

2018 land uses are depicted in Figure 11 and summarized in Table 2-5 for the study area. For purposes of the Total Maximum Daily Load (TMDL) pollutant analysis, the undeveloped in-fill sites are shown as agriculture, grass, woods, wetland or another undeveloped open space, as appropriate.

Future land uses are depicted in Figure 12 and summarized in Table 2-5 for the study area. For purposes of the Total Maximum Daily Load (TMDL) pollutant analysis, the future land uses generally match the 2018 land uses, except the appropriate undeveloped sites are converted to a future land use based on adjoining land uses and information from the Town's Comprehensive Plan.

Table 2-5: Land Uses

Land Use	2004 Land Use		2015 Land Use		Future Land Use	
	(acres)	(%)	(acres)	(%)	(acres)	(%)
Residential						
High Density	0	0.0%	0	0.0%	0	0.0%
Low Density	626	27.1%	657	28.4%	663	28.7%
Med Density	778	33.6%	816	35.3%	934	40.4%
Mobile Home	0	0.0%	0	0.0%	0	0.0%
Multi-Family	3	0.1%	12	0.5%	14	0.6%
Suburban	134	5.8%	124	5.4%	118	5.1%
Commercial						
Commercial Strip	38	1.7%	40	1.7%	119	5.1%
Commercial Downtown	0	0.0%	0	0.0%	0	0.0%
Office Park	3	0.1%	3	0.1%	3	0.1%
Shopping Center	0	0.0%	0	0.0%	0	0.0%
Institutional						
Hospital	0	0.0%	15	0.7%	15	0.7%
Misc. Institutional	24	1.1%	24	1.0%	24	1.0%
School	11	0.5%	11	0.5%	11	0.5%
Industrial						
Airport	0	0.0%	0	0.0%	0	0.0%
Light Industrial	14	0.6%	15	0.6%	16	0.7%
Medium Industrial	9	0.4%	9	0.4%	9	0.4%
Open Space						
Cemetery	0	0.0%	0	0.0%	0	0.0%
[1]Park	46	2.0%	65	2.8%	68	2.9%
Quarry	61	2.6%	61	2.6%	61	2.6%
Railroad	0	0.0%	0	0.0%	0	0.0%
[2]Undeveloped	501	21.7%	398	17.2%	196	8.5%
Highway/Freeway/Rural Rd	64	2.8%	63	2.7%	62	2.7%
Total:	2,313	100.0%	2,313	100.0%	2,313	100.0%

[1]Includes grass and water associated with stormwater ponds/facilities.

[2]Undeveloped land includes agriculture, grass, woods, wetlands, and open water.

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3.0 NR 151 POLLUTANT ANALYSIS

Performance Standard

Pursuant to the Municipal Stormwater Discharge (MS4) Permit and NR 151.13, the Town is required to reduce the total suspended solids (TSS) load by 20% and 40% for urban areas developed before October 1, 2004. The TSS reductions are calculated from a baseline load that does not include any stormwater best management practices (BMPs), such as grass swales and wet detention ponds. The compliance schedules for the required TSS reductions are as follows:

- A 20% TSS reduction is required within 2 years of receiving MS4 Permit coverage. The Town received permit coverage from the WDNR on December 15, 2006. As such, the Town was required to achieve the 20% TSS reduction before December 15, 2008.

- A 40% TSS reduction is required before March 31, 2013. If the 40% reduction cannot be achieved by March 31, 2013, the Town is required to prepare a long-term stormwater management plan that identifies the control measures already implemented, the control measures to be implemented, and a schedule for achieving the 40% TSS reduction. As part the MS4 Permit, the Town is required to track phosphorus, but no NR 151.13 performance standard is provided for phosphorus.

The 2011 Wisconsin Act 32 modified the compliance schedule for the NR 151.13 performance standards. According to Wisconsin Act 32, the WDNR may enforce the Town's compliance date for achieving the required 20% TSS reduction, but the WDNR is currently prohibited from enforcing a specific compliance date for achieving the required 40% TSS reduction. Also, the 2011 Wisconsin Act 32 requires that the pollutant reduction benefits associated with all structural BMPs implemented before July 1, 2011 must be maintained.

Methodology

The NR 151 pollutant analysis uses the Source Loading and Management Model for Windows (version 10.3.4). WinSLAMM is a stormwater quality model that predicts runoff volumes and non-point source pollution loads for urban land uses. WinSLAMM also calculates the amount of pollutant removal provided by BMPs such as street sweeping, catch basin cleaning, grass swales, grass filter strips, biofiltration, infiltration basins, wet detention ponds, permeable pavement, proprietary devices, and other BMPs. The NR 151 pollutant analysis uses the series of small rainfall events that occurred between March 29, 1968 and November 25, 1972 in Green Bay, Wisconsin. For purposes of MS4 Permit compliance, this 5-year rainfall series was determined by the WDNR to represent an average annual rainfall condition for municipalities located in Northeast Wisconsin.

The NR 151 pollutant analysis uses data files developed by the United States Geological Survey (USGS) and WDNR for the WinSLAMM model. The data files identify typical runoff volumes, pollutant concentrations, pollutant distributions, pollutant deliveries, and pollutant particle size

distributions for typical urban stormwater runoff. The WinSLAMM data files obtained from the USGS and used in the NR 151 pollutant analysis are as follows:

- WisReg - Green Bay Five Year Rainfall.ran
- WI_GEO03.ppdx
- WI_SL06 Dec06.rsv
- V10.1 WI_avg01.pscx
- WI_Res and Other Urban Dec06.std
- WI_Com Inst Indust Dec06.std
- Freeway Dec06.std
- Nurp.cpz

The NR 151 pollutant analysis is based on the standard land use files developed by the WDNR for WinSLAMM. The standard land use files identify the amount of roof, parking lot, driveway, sidewalk, street, and lawn source areas which are typical for each standard land use. The standard land use files also identify the amount of connected imperviousness for each source area.

The NR 151 pollutant analysis uses the WinSLAMM batch processor to generate baseline (no-controls) pollutant loads for each standard land use file. Baseline pollutant loads for each drainage and BMP catchment area are calculated using batch processor database files and GIS. A WinSLAMM model is developed for each existing and proposed structural BMP to determine the BMP's pollutant reduction. The pollutant reduction provided by each BMP is then applied to each drainage or BMP catchment area, as appropriate.

Analysis Area

The NR 151 pollutant analysis uses the study area depicted in Figure 1 and the 2004 land uses depicted in Figure 10. For purposes of the NR 151 pollutant analysis, the study area contains 2,313 acres. The NR 151 pollutant analysis also uses the developed urban area depicted on the 2010 US Census Bureau Map, including contiguous developed urban areas. Per WDNR guidance, the following areas are either prohibited from inclusion or classified as optional for inclusion in the NR 151 pollutant analysis.

- Agricultural Areas: Lands zoned for agricultural use and operating as such are prohibited from inclusion in the NR 151 pollutant analysis. Of the 2,313 acres within the study area, 221 acres are classified as agriculture and consequently, are excluded from the analysis.

- Internally Drained Areas: Internally drained areas with natural infiltration are prohibited from inclusion in the NR 151 pollutant analysis. There are no internally drained areas within the study area.

- Waters of the State: Waters of the state are optional for inclusion in the NR 151 pollutant analysis. Lakes, rivers, streams and mapped wetlands are classified as "waters of the state".

Of the 2,313 acres within the study area, 141 acres are classified as "waters of the state" and consequently, are excluded from the analysis.

- Undeveloped lands over 5 acres: Undeveloped lands over 5 acres are prohibited from inclusion in the NR 151 pollutant analysis. These areas will be classified as new development in the future and subject to NR 151.12 or 151.24 performance standards when developed. Of the 2,313 acres within the study area, 95 acres are classified as undeveloped lands over 5 acres and consequently, are excluded from the analysis.

- State & County Highways: State freeways, state truck highways, and county highways are typically excluded from the NR 151 pollutant analysis. The Wisconsin Department of Transportation (WisDOT) is responsible for pollutant loads from state freeway and state trunk highway right-of-ways and Winnebago County is responsible for pollutant loads from county highway right-of-ways. The only time the Town is responsible for pollutant loads from a state or county highway right-of-way is if the highway is classified as a "connecting highway" by the WisDOT or if the Town has a bridge structure that allows a Town street to cross over the state or county highway. Of the 2,313 acres within the study area, 51 acres are classified as State (WisDOT) MS4 jurisdiction and 12 acres are classified as County MS4 jurisdiction. The combined 63 acres of state and county highway right-of-way are excluded from the analysis.

- Riparian Areas: Riparian areas are optional to include in the NR 151 pollutant analysis. Riparian areas are private properties that do not discharge runoff into the Town's MS4, but rather discharge directly into a river, stream, or lake. Riparian areas that discharge directly into Lake Butte des Morts, Honey Creek, Sawyer Creek or other navigable streams without passing through the Town's MS4 are depicted in Figure 8. Of the 2,313 acres within the study area, 363 acres are classified as riparian and consequently, are excluded from the analysis.

- MS4 "A" to "B": Areas that discharge into an adjacent municipality's MS4 (Municipality B) without passing through the Town's MS4 (Municipality A) are optional to include in the NR 151 pollutant analysis. Many of these areas are located along state and county right-of-ways where runoff from private property drains directly into a State or County MS4 and then discharges directly into a river, stream, or lake. Of the 2,313 acres within the study area, 55 acres are classified as MS4 "A" to "B" and consequently, are excluded from the analysis.

- WPDES Industrial Permits: Industrial facilities permitted under NR 216 are optional to include in the NR 151 pollutant analysis. The Town plans to achieve the required TSS and TP reductions for these industrial permitted areas for the following reasons: the Town has legal authority to regulate stormwater runoff; it is difficult to determine which portions of an industrial site are covered by a WPDES Industrial Permit; and the pollutant load is the Town's responsibility if the WPDES Industrial Permit is terminated or certified "No

Exposure" in the future. For purposes of the NR 151 pollutant analysis, industrial areas with coverage under a WDPES Industrial Permit are included in the analysis.

Based on the prohibited and optional areas mentioned above, the NR 151 pollutant analysis will apply to the remaining 1,315 acres of developed urban areas that existed on October 1, 2004.

Baseline Condition

The NR 151 baseline loads for the 1,315 acres of developed urban area are summarized in Table 3-1. These baseline or "no control" loads exclude the pollutant reduction benefits of existing BMPs. Per NR 151.13, the baseline or "no control" loads are used to determine the required 20% and 40% TSS load reduction.

Table 3-1: NR 151 Pollutant Analysis - Baseline Loadings (WinSLAMM)

Sub-Watershed	Urban Area (acres)	Baseline TSS Load (lbs/yr)	Required Load Reduction				Baseline TP Load (lbs/yr)
			TSS (%)	TSS (lbs/yr)	TSS (%)	TSS (lbs/yr)	
Lake Butte des Morts	1,250	243,855	20%	48,771	40%	97,542	942
Sawyer Creek	66	12,592	20%	2,518	40%	5,037	49
Total:	1,315	256,447	20%	51,289	40%	102,579	991

As shown in Table 3-1, the baseline TSS and total phosphorus (TP) loads are 256,447 pounds per year and 991 pounds per year, respectively. Based on the total TSS baseline load, the Town is required to achieve a composite 51,289 pound per year TSS reduction in order to achieve compliance with the required 20% TSS reduction.

2008 Best Management Practices

Several BMPs qualified for NR 151 pollutant reduction credit in 2008: street sweeping (high efficiency sweeper, once per four weeks, with parking controls), grass swales and seven wet detention ponds. The 2008 BMPs are depicted in Figure 13. As shown in Table 3-2, the 2008 BMPs provided a 196,651 pound per year TSS reduction and a 725 pound per year TP reduction. As such, the 2008 BMPs provided a 77% TSS reduction and a 73% TP reduction for the developed urban area during 2008. As such, the Town achieved compliance with the required 20% TSS reduction for the developed urban area in 2008. Although no longer required, the Town was also achieving the 40% TSS reduction for the developed urban area in 2008.

Table 3-2: NR 151 Pollutant Analysis - 2008 BMPs (WinSLAMM)

Sub-Watershed	Urban Area (acres)	Total Suspended Solids (TSS)			Total Phosphorus (TP)		
		Baseline Load (lbs/yr)	Load Reduction		Baseline Load (lbs/yr)	Load Reduction	
			(lbs/yr)	(%)		(lbs/yr)	(%)
Lake Butte des Morts	1,250	243,855	190,491	78%	942	702	75%
Sawyer Creek	66	12,592	6,160	49%	49	23	46%
Total:	1,315	256,447	196,651	77%	991	725	73%

2018 Best Management Practices

Several BMPs qualified for NR 151 pollutant reduction credit in 2018: street sweeping (high efficiency sweeper, once per four weeks, with parking controls), grass swales and nine wet detention ponds. The 2018 BMPs are depicted in Figure 14. As shown in Table 3-3, the 2018 BMPs provided a 197,678 pound per year TSS reduction and a 726 pound per year TP reduction. As such, the 2018 BMPs provided a 77% TSS reduction and a 73% TP reduction for the developed urban area during 2018. As such, the Town continues to achieve compliance with the required 20% TSS reduction for the developed urban area.

Table 3-3: NR 151 Pollutant Analysis - 2018 BMPs (WinSLAMM)

Sub-Watershed	Urban Area (acres)	Total Suspended Solids (TSS)			Total Phosphorus (TP)		
		Baseline Load (lbs/yr)	Load Reduction		Baseline Load (lbs/yr)	Load Reduction	
			(lbs/yr)	(%)		(lbs/yr)	(%)
Lake Butte des Morts	1,250	243,855	191,518	79%	942	703	75%
Sawyer Creek	66	12,592	6,160	49%	49	23	46%
Total:	1,315	256,447	197,678	77%	991	726	73%

For reference, more detailed water quality results for the NR 151 analysis can be found in Appendix B.

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4.0 TMDL POLLUTANT ANALYSIS

A Total Maximum Daily Load (TMDL) is the maximum amount of a pollutant that a water body can receive and still meet water quality standards. The goal of a TMDL is to improve water quality so the impaired water body meets it's loading capacity and is no longer considered impaired. A draft TMDL for total phosphorus and total suspended solid pollutants has been developed by the WDNR for the Upper Fox and Wolf Basins. The draft TMDL for the Upper Fox and Wolf Basins is planned to be submitted to the US Environmental Protection Agency (EPA) during 2019 for final review and approval.

The Upper Fox and Wolf Basins have 43 streams and rivers impaired for excess phosphorus, 19 streams and rivers impaired for excess sediment and 19 lakes / reservoirs impaired for excess phosphorus. Excessive amounts of these pollutants cause poor water clarity, increase algae, impact swimming, and degrade aesthetics. The draft Upper Fox and Wolf Basins TMDL was calibrated and developed using stream, river, and lake monitoring data collected by the WDNR and partner groups.

As shown in Figure 6, the Town's storm sewer system discharges to two impaired Upper Fox and Wolf Basins waterways: Lake Butte des Morts and Sawyer Creek. These two impaired waterways are specifically included in the draft Upper Fox and Wolf Basins TMDL. Although the Upper Fox River Basin TMDL report remains draft and subject to change, anticipated pollutant load allocations for Lake Butte des Morts and Sawyer Creek are included in this TMDL pollutant analysis.

Once the Upper Fox and Wolf Basins TMDL is approved by the EPA, the Town will likely have 48 months to develop a written TMDL Plan of Action for the portion of the Town's Urban MS4 discharging into Lake Butte des Morts and Sawyer Creek. However, the Village is not yet regulated or required to develop a TMDL Plan of Action for the portion of the Village's Urban MS4 discharging into Lake Butte des Morts and Sawyer Creek.

Performance Standard

The draft TMDL Report developed for the Upper Fox and Wolf Basin states that a Municipal Stormwater Discharge Permit (MS4) Permit cannot be reissued without a waste load allocation that is consistent with an EPA approved TMDL. WPDES General Permit WI-S050075-2 became effective May 1, 2014 and now includes language for MS4's that discharge to receiving waters with an approved TMDL. The Wisconsin DNR plans to renew the Town's WPDES Municipal Stormwater Discharge Permit during 2019.

The draft TMDL Report developed for the Upper Fox and Wolf Basins identifies waste load allocations for the Town's MS4 area. The TMDL requires specific total phosphorus (TP) and total suspended solids (TSS) reductions that vary by sub-watershed. The TP and TSS waste load allocations and reductions identified in the TMDL Report for the Town's municipal boundary are summarized in Tables 4-1 and 4-2, respectively.

Table 4-1: Phosphorus Allocations from Draft TMDL Report

TMDL Sub-Watershed	Town Urban Area (acres)	Total Phosphorus (TP)			
		Baseline (lbs/yr)	Allocated (lbs/yr)	Reduction (lbs/yr)	Reduction (%)
Lake Butte des Morts	1,012	86.0	15	71	83.0%
Sawyer Creek	97	8.4	1.4	7	83.0%

Table 4-2: Sediment Allocations from Draft TMDL Report

TMDL Sub-Watershed	Town Urban Area (acres)	Total Suspended Solids (TSS)			
		Baseline (lbs/yr)	Allocated (lbs/yr)	Reduction (lbs/yr)	Reduction (%)
Lake Butte des Morts	1,012	2,414	2,414	0	0.0%
Sawyer Creek	97	345	178	167	48.0%

As shown in Tables 4-1 and 4-2, the draft TMDL Report expresses the MS4 allocation as both a load reduction (pounds per year) and a percent reduction. Based on WDNR guidance, the TMDL's percent reduction should be used for MS4 permit compliance, rather than the TMDL's load reduction (pounds per year). It's of note that the draft Upper Fox and Wolf Basins TMDL's baseline condition assumes the Town is achieving the 20% TSS reduction and a correlating 15% TP reduction. As such, WDNR guidance does not require an adjustment to the percent reductions identified in the draft Upper Fox and Wolf Basins TMDL. The draft TMDL percent reductions in Table 4-3 are used for evaluating alternatives for MS4 permit compliance.

Table 4-3: Draft TMDL Percent Reductions

TMDL Sub-Watershed	TP Reduction (%)	TSS Reduction (%)
Lake Butte des Morts	83.0%	0.0%
Sawyer Creek	83.0%	48.0%

Methodology

The TMDL pollutant analysis uses the Source Loading and Management Model for Windows (WinSLAMM version 10.3.4). WinSLAMM is a stormwater quality model that predicts runoff volumes and non-point source pollution loads for urban land uses. WinSLAMM also calculates the amount of pollutant removal provided by Best Management Practices (BMPs) such as street sweeping, catch basin cleaning, grass swales, grass filter strips, biofiltration, infiltration basins, wet ponds, proprietary devices, and other BMPs.

The TMDL pollutant analysis uses the series of small rainfall events that occurred between March 29, 1968 and November 25, 1972 in Green Bay, Wisconsin. For purposes of MS4 Permit compliance, this 5-year rainfall series was determined by the WDNR to represent an average annual rainfall condition for municipalities located in Northeast Wisconsin.

The TMDL pollutant analysis uses data files developed by the United States Geological Survey (USGS) and WDNR for the WinSLAMM model. The data files identify typical runoff volumes, pollutant concentrations, pollutant distributions, pollutant deliveries, and pollutant particle size distributions for typical urban stormwater runoff. The WinSLAMM data files obtained from the USGS and used in the TMDL pollutant analysis are as follows:

- WisReg - Green Bay Five Year Rainfall.ran
- WI_GEO03.ppdx
- WI_SL06 Dec06.rsv
- V10.1 WI_avg01.pscx
- WI_Res and Other Urban Dec06.std
- WI_Com Inst Indust Dec06.std
- Freeway Dec06.std
- Nurp.cpz

The TMDL pollutant analysis is based on the standard land use files developed by the WDNR for WinSLAMM. The standard land use files identify the amount of roof, parking lot, driveway, sidewalk, street, and lawn source areas which are typical for each standard land use. The standard land use files also identify the amount of connected imperviousness for each source area.

The TMDL pollutant analysis uses the WinSLAMM batch processor to generate baseline (no-controls) pollutant loads for each standard land use file. Baseline pollutant loads for each drainage and BMP catchment area are calculated using batch processor database files and GIS. A WinSLAMM model is developed for each existing and proposed structural BMP to determine the BMP's pollutant reduction. The pollutant reduction provided by each BMP is then applied to each drainage or BMP catchment area, as appropriate.

Analysis Area

The TMDL pollutant analysis uses the study area depicted in Figure 1, the sub-watersheds depicted in Figure 3, and the 2018 land uses depicted in Figure 11. For purposes of the TMDL pollutant analysis, the study area contains 2,313 acres. The TMDL pollutant analysis also uses the developed urban area depicted on the 2010 US Census Bureau Map, including contiguous developed urban areas. Per WDNR guidance, the following areas are either prohibited from inclusion or classified as optional for inclusion in the TMDL pollutant analysis.

- Agricultural Areas: Lands zoned for agricultural use and operating as such are optional to include in the TMDL pollutant analysis. Of the 2,313 acres within the study area, 156 acres are classified as agriculture and consequently, are excluded from the analysis.

- Internally Drained Areas: Internally drained areas with natural infiltration are prohibited from inclusion in the TMDL pollutant analysis. There are no internally drained areas within the study area.

- Waters of the State: Waters of the state are optional for inclusion in the TMDL pollutant analysis. Lakes, rivers, streams and mapped wetlands are classified as "waters of the state". Of the 2,313 acres within the study area, 141 acres are classified as "waters of the state" and consequently, are excluded from the analysis.

- State & County Highways: State freeways, state truck highways, and county highways are typically excluded from the TMDL pollutant analysis. The Wisconsin Department of Transportation (WisDOT) is responsible for pollutant loads from state freeway and state trunk highway right-of-ways and Winnebago County is responsible for pollutant loads from county highway right-of-ways. The only time the Town is responsible for pollutant loads from a state or county highway right-of-way is if the highway is classified as a "connecting highway" by the WisDOT or if the Town has a bridge structure that allows a Town street to cross over the state or county highway. Of the 2,313 acres within the study area, 51 acres are State (WisDOT) MS4 jurisdiction and 12 acres are County MS4 jurisdiction. The combined 63 acres of state and county highway right-of-way are excluded from the analysis.

- Riparian Areas: Riparian areas are private properties that do not discharge runoff into the Town's MS4, but rather discharge directly into a river, stream, or lake. Riparian areas that discharge directly into Lake Butte des Morts, Honey Creek, Sawyer Creek or other navigable streams without passing through the Town's MS4 are depicted in Figure 8. Of the 2,313 acres within the study area, 379 acres are classified as riparian and consequently, are excluded from the analysis..

- MS4 "A" to "B": Areas that discharge into an adjacent municipality's MS4 (Municipality B) without passing through the Town's MS4 (Municipality A) are optional to include in the TMDL pollutant analysis. Many of these areas are located along state and county right-of-ways where runoff from private property drains directly into a State or County MS4 and then discharges directly into a river, stream, or lake. Of the 2,313 acres within the study area, 57 acres are classified as MS4 "A" to "B" and consequently, are excluded from the analysis.

- WPDES Industrial Permits: Industrial facilities permitted under NR 216 are optional to include in the TMDL pollutant analysis. The Town plans to achieve the required TSS and TP reductions for these industrial permitted areas for the following reasons: the Town has legal authority to regulate stormwater runoff; it is difficult to determine which portions of an industrial site are covered by a WPDES Industrial Permit; and the pollutant load is the

Town's responsibility if the WPDES Industrial Permit is terminated or certified "No Exposure" in the future. For purposes of the TMDL pollutant analysis, industrial areas with coverage under a WDPES Industrial Permit are included in the analysis.

Based on the prohibited and optional areas mentioned above, the TMDL pollutant analysis will apply to the remaining 1,457 acres of developed urban areas that existed in 2018.

Baseline Condition

The TMDL baseline loads for the 1,457 acres of developed urban area are summarized in Table 4-4. These baseline or "no control" loads exclude the pollutant reduction benefits of existing BMPs. Per WDNR guidance, the "no control" loads are used in conjunction with the adjusted TP and TSS percent reductions to determine the required load reductions.

Table 4-4: TMDL Pollutant Analysis – Baseline Condition (WinSLAMM)

Sub-Watershed	Urban Area (acres)	Total Phosphorus (TP)			Total Suspended Solids (TSS)		
		Baseline Load (lbs/yr)	Required TMDL Load Reduction		Baseline Load (lbs/yr)	Required TMDL Load Reduction	
			(%)	(lbs/yr)		(%)	(lbs/yr)
Lake Butte des Morts	1,391	1,027	83%	852	264,983	0%	0
Sawyer Creek	66	49	83%	41	12,556	48%	6,027

The TMDL baseline loads from WinSLAMM are also summarized by land use in Table 4-4 and Exhibit 4-1. These baseline or "no control" loads exclude the pollutant reduction benefits of existing BMPs. As shown in Table 4-5 and Exhibit 4-1, residential land use comprises the majority of land area, but street and highway land use generates a larger portion of the pollutant loads.

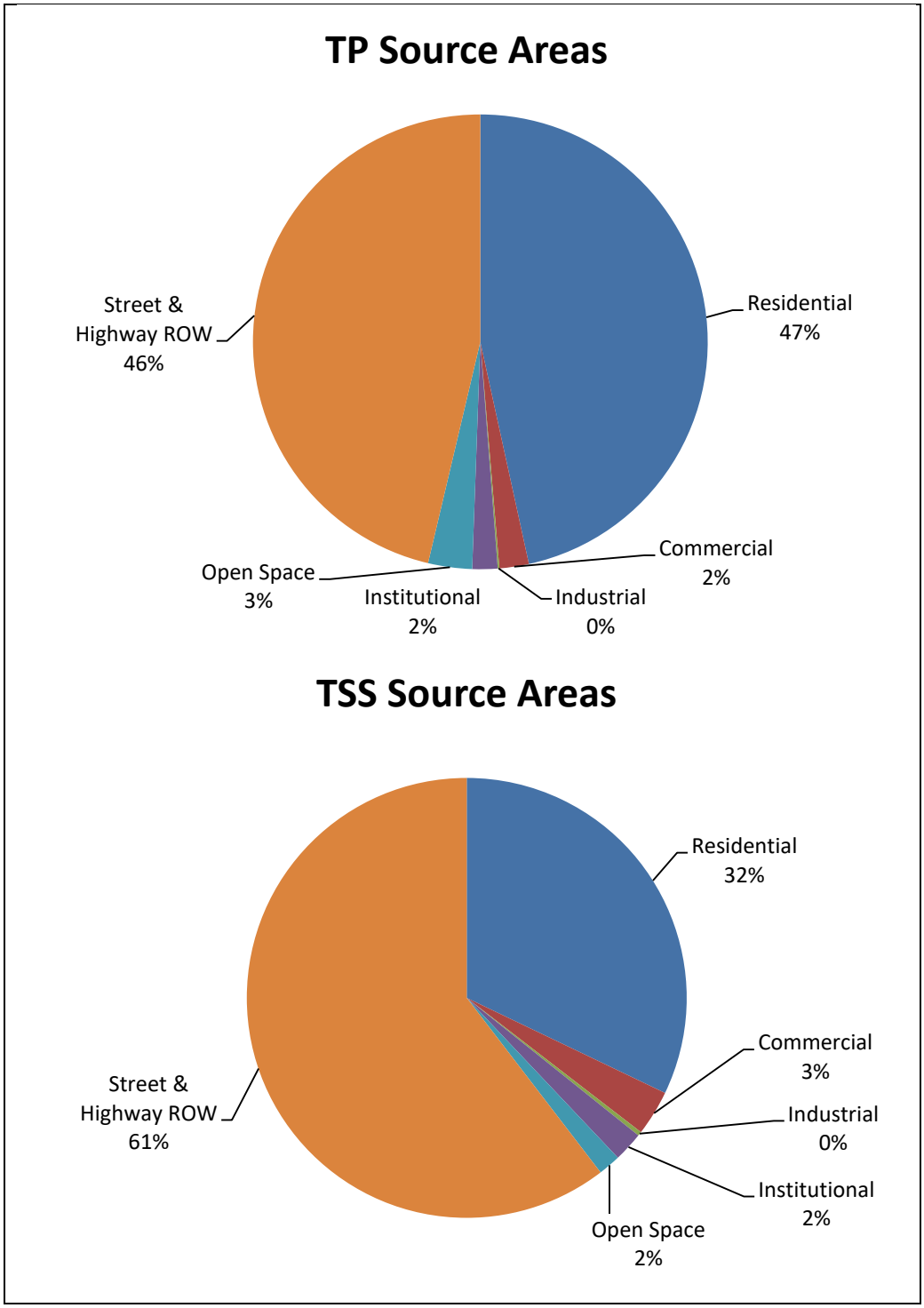
Table 4-5: TMDL Baseline Loads by Land Use (WinSLAMM)

Land Use	Area (acres)	Area (%)	TSS (lbs/yr)	TSS (%)	TP (lbs/yr)	TP (%)
Residential	1,020	70%	89,133	32%	501	47%
Commercial	27	2%	9,256	3%	23	2%
Industrial	2	0%	836	0%	1	0%
Institutional	26	2%	6,083	2%	19	2%
Open Space	99	7%	4,559	2%	34	3%
Street & Highway ROW	284	19%	167,672	60%	498	46%
Total	1,457	100%	277,538	100%	1,076	100%

Appendix A contains a list of TMDL baseline pollutant yields (pounds per acre per year) and baseline loads (pounds per year) from WinSLAMM for total phosphorus and total suspended

solids. The baseline pollutant yields and loads are ranked by both drainage area and BMP catchment area from highest to lowest within the Lake Butte des Morts and Sawyer Creek Sub-Watersheds. Figures in Appendix A depict the TMDL baseline pollutant yields and loads by drainage area and BMP catchment area.

Exhibit 4-1: TMDL Baseline Loads by Land Use (WinSLAMM)



2018 Best Management Practices

Several BMPs qualified for TMDL pollutant reduction credit in 2018: street sweeping (high efficiency sweeper, once per twelve weeks, no parking controls), grass swales and 7 wet detention ponds. The 2018 BMPs are depicted in Figure 14. Water quality results for each sub-watershed are summarized below.

- Lake Butte des Morts: Table 4-6 indicates the 2018 BMPs provided a 72% TP reduction within the Lake Butte des Morts Sub-Watershed, which does not satisfy the 83% TP reduction required in Table 4-3. Also, Table 4-6 indicates the 2018 BMPs provided a 76% TSS reduction within the Lake Butte des Morts Sub-Watershed, which does satisfy the 0% TSS reduction required in Table 4-3. As such, additional BMPs are needed within the Lake Butte des Morts Sub-Watershed to target total phosphorus pollutants.

- Sawyer Creek: Table 4-6 indicates the 2018 BMPs provided a 46% TP reduction within the Sawyer Creek Sub-Watershed, which does not satisfy the 83% TP reduction required in Table 4-3. Also, Table 4-6 indicates the 2018 BMPs provided a 49% TSS reduction within the Sawyer Creek Sub-Watershed, which does satisfy the 48% TSS reduction required in Table 4-3. As such, additional BMPs are needed within the Lake Butte des Morts Sub-Watershed to target total phosphorus pollutants.

Table 4-6: TMDL Pollutant Analysis - 2018 BMPs (WinSLAMM)

Sub-Watershed	Town MS4 (acres)	Total Phosphorus (TP)			Total Suspended Solids (TSS)		
		Baseline Load (lbs/yr)	Provided Load Reduction (lbs/yr)	(%)	Baseline Load (lbs/yr)	Provided Load Reduction (lbs/yr)	(%)
Lake Butte des Morts	1,391	1,027	741	72%	264,983	202,687	76%
Sawyer Creek	66	49	23	46%	12,556	6,160	49%

For reference, more detailed water quality results for the TMDL analysis can be found in Appendix B.

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5.0 POLLUTANT REDUCTION ANALYSIS

WinSLAMM (version 10.3.4) was used in conjunction with national literature to analyze the stormwater quality benefits and cost-effectiveness of proposed urban storwater BMPs such as street sweeping, catch basin cleaning, grass swales, grass filter strips, biofiltration, infiltration basins, wet detention ponds, proprietary devices, and mechanical / biological treatment.

The capital costs contained in Tables 5-1 through 5-14 include the estimated present value capital costs for the BMP. The capital costs include an allowance for construction, land acquisition, engineering, legal, and contingency costs. The 20-year costs provided in the tables are the estimated present value costs per pound of TP removed during a 20-year period. TP was selected for the cost per pound analysis as it is the pollutant of concern for the Town within the Lake Butte des Morts and Sawyer Creek Sub-Watersheds based on the draft Upper Fox & Wolf Basins TMDL. The 20-year costs include an allowance for capital costs and long-term operation and maintenance costs. The 20-year period was determined to be a reasonable life cycle or planning period for evaluating BMP cost-effectiveness. A longer planning period would improve the cost-effectiveness of structural BMPs (e.g. wet detention pond) as compared to non-structural BMPs (e.g. street sweeping). The results of the pollutant reduction analysis are summarized herein. More detailed water quality results are provided in Appendix B.

Street Sweeping

Street sweeping is effective at collecting large sediment particles (sand sized particles), trash, debris and leaves. Limited pollutant removal occurs for fine-grained particles such as silt, clay, metals and nutrients. Research indicates that street pollutants tend to accumulate within 3 feet of the street's curb and gutter. Wind turbulence from traffic tends to blow pollutants toward the curb. The curb acts as a barrier and traps pollutants. For streets without curb, wind turbulence generated by a passing vehicle tends to blow pollutants onto the adjacent grass area. As such, for street sweeping to be effective, the street must have curb.

The effectiveness of a municipal street sweeping program depends on the type of street sweeper, number of curb-miles, sweeping frequency, traffic volume, time of year, rainfall, and operator knowledge. In addition, the benefits of sweeping are significantly reduced when vehicles are parked along the curb. Whenever a street sweeper needs to maneuver around a parked car, the pollutants under the car are not removed. As such, the more cars parked along a street, the less pollutant removal.

There are two types of street sweeper: mechanical and high efficiency. Mechanical street sweepers use a broom to remove pollutants from the street surface and high efficiency street sweepers use a vacuum system to remove pollutants. Typically, the high efficiency sweeper is more effective at removing pollutants as compared to the mechanical sweeper. The Town currently contracts for the use of a high efficiency street sweeper. The Town currently sweeps once every four weeks with parking controls. Table 5-1 summarizes the average annual TSS and

TP costs per pound for various Town-wide sweeping routines. Table 5-1 identifies the percent reduction for the street corridors only.

Table 5-1: Street Sweeping

Sweeper Type, Frequency & Parking Controls for Street Corridor Land Uses	Pollutant Load Reduction		Avg. Annual TP Cost ($/lb)
	TSS (%)	TP (%)	
H.E. Sweeper (Every 4 weeks, with parking controls)*	21%	16%	$660
H.E. Sweeper (Every 2 weeks, with parking controls)	30%	23%	$927
H.E. Sweeper (Every week, with parking controls)	40%	31%	$1,510
H.E. Sweeper (Every 4 weeks, no parking controls)	9%	7%	$1,534
H.E. Sweeper (Every 2 weeks, no parking controls)	13%	10%	$2,110
H.E. Sweeper (Twice each week, with parking controls)	46%	35%	$2,653
H.E. Sweeper (Every week, no parking controls)	20%	15%	$3,118

*Towns current sweeper type, frequency & parking controls

As shown in Table 5-1, street sweeping every 4 weeks with a high efficiency street sweeper and parking controls in place is the most cost effective street sweeping alternative for the Town. As such, the Town's current sweeping routine was used for the TMDL alternatives analysis. The Town may elect to revise their street sweeping routine in the future to provide additional water quality benefits, improving aesthetics, reduce storm inlet clogging, etc.

Catch Basin Cleaning

Catch basin cleaning is effective at collecting large sediment particles (sand sized particles), trash, debris and leaves. Limited pollutant removal occurs for fine-grained particles such as silt, clay, metals and nutrients. Catch basin sumps are effective for parking lots and streets that serve a small drainage area (less than 1 acre). Ideally, a catch basin sump has a minimum 3 foot depth to prevent scouring of previously settled pollutants during a rainfall.

The Town currently does not have any known catch basin sumps within their MS4 system. Table 5-2 summarizes the average annual TSS and TP costs per pound reduced for street catch basin cleaning, including the costs to add catch basin sumps as part of a street retrofit or reconstruction project for various land use corridors.

Table 5-2: Street Catch Basin Cleaning

Street Corridor Land Use	Pollutant Load Reduction		Avg. Annual TP Cost ($/lb)		
	TSS (%)	TP (%)	Cleaning	Retrofit & Cleaning	Reconstruct & Cleaning
Commercial Corridors	16%	14%	$155	$1,207	$994
Industrial Corridors	16%	9%	$132	$969	$800
Institutional Corridors	18%	16%	$106	$924	$758
Residential Corridors	13%	11%	$220	$910	$770
Open Space Corridors	9%	7%	$122	$462	$393

Table 5-3 summarizes the average annual TSS and TP costs per pound reduced for parking lot catch basin cleaning, including the costs to add catch basin sumps as part of a parking lot retrofit or reconstruction project for various land use corridors.

Table 5-3: Parking Lot Catch Basin Cleaning

Street Corridor Land Use	Pollutant Load Reduction		Avg. Annual TP Cost ($/lb)		
	TSS (%)	TP (%)	Cleaning	Retrofit & Cleaning	Reconstruct & Cleaning
Commercial Corridors	15%	13%	$339	$2,662	$2,192
Industrial Corridors	14%	10%	$338	$2,481	$2,047
Institutional Corridors	17%	14%	$302	$2,624	$2,154
Residential Corridors	14%	11%	$877	$3,687	$3,118
Open Space Corridors	12%	8%	$379	$1,439	$1,225

Based on WDNR Guidance, the Town cannot obtain water quality credit for both catch basin cleaning and street sweeping. In the Town, street sweeping is a priority since sweeping helps maintain aesthetics, reduces public complaints, and reduces catch basin grate clogging. For these reasons, the Town prefers street sweeping as compared to catch basin cleaning.

Grass Swales

Grass swales remove pollutants from concentrated stormwater by filtration through the grass and infiltration into the soil. The filtering capacity depends on the flow depth in the swale as compared to the grass height. Typically, when the flow depth is above the grass, filtering is minimal and scouring of previously settled pollutants is a concern. The water quality benefits of a grass swale are largely determined by the infiltrating capacity of underlying soils and depth to groundwater. For instance, a grass swale located in sandy soil has a much higher pollutant removal as compared to a grass swale located in clay soil. Other factors influencing grass swale

performance include longitudinal swale slope, swale cross section, and flow volume. WDNR Technical Standard 1005 – Vegetated Infiltration Swale discusses design criteria for grass swales.

Grass swales are typically located along streets. As shown in Figure 8, most streets in the Town are drained via grass swales, rather than curb and gutter. As shown in Figure 5, soils in the Town are predominately clay (hydrologic soil group C and D). As such, the infiltrating capacity of the underlying soils is limited by the clay soils. As allowed by WDNR guidance, the Town has performed double-ring infiltrometer tests along numerous Town swales. Representative dynamic soil infiltration rates determined from the infiltrometer testing were used to evaluate the water quality credits provided by the Town's grass swales. Figures B4a-B4i within Appendix B depict the Town's existing grass swales and associated catchment areas. Figure B5 depicts various TP percent reductions for all of the Town's grass swales. Detailed water quality results and costs for the Town's existing grass swales can also be found in Appendix B.

Grass Filter Strips

Grass filter strips remove pollutants from stormwater by filtration through the grass and infiltration into the soil. The filtering capacity of a grass filter strip depends on its longitudinal slope, length and grass density. The water quality benefits of a grass filter strip are largely determined by the infiltrating capacity of underlying soils. A grass filter strip located in sandy soil has a higher pollutant removal as compared to a grass filter strip located in clay soil.

Grass filter strips are effective for parking lots that serve small drainage areas (less than 1 acre). Typically, grass filter strips need to be a minimum of 20 feet long, but at least as long as the contributing impervious surface length. A 64 foot wide parking lot would typically require a 64 foot long grass filter strip. As such, grass filter strips require a significant amount of land area as compared to other BMPs. In order for a grass filter strip to be effective, the stormwater flowing into the filter strip cannot be concentrated within a swale, ditch, channel, gutter, or other similar conveyance system. Rather, the stormwater must be flowing across the surface of a parking lot, lawn or other ground surface in a very thin sheet of dispersed water.

As shown in Figure 8, the Town does not currently have any grass filter strips. As shown in Figure 5, soils in the Town are predominately clay (hydrologic soil group C and D), but there are limited areas of silt soils (hydrologic soil group B). Table 5-4 summarizes the cost and water quality benefits of a grass filter strip retrofit of a typical commercial parking lot.

Table 5-4: Grass Filter Strips

BMP	Pollutant Load Reduction		Avg. Annual TP Cost ($/lb)
	TSS (%)	TP (%)	
Grass Filter Strips – Retrofit Parking Lot (Clay Soil)	95%	91%	$2,480

Biofiltration Devices

Biofiltration devices remove pollutants from stormwater by filtration through an engineered soil mixture. Typically, the engineered soil is a minimum of two feet deep and consists of a sand and compost mixture. A diverse mix of prairie flowers, grasses, shrubs and/or trees are typically planted in a mulch layer located above the engineered soil. During a rainfall, stormwater is temporarily stored above the mulch layer until it can be filtered through the engineered soil. A perforated underdrain pipe located beneath the engineered soil collects the filtered water and discharges it into an adjacent storm sewer or other conveyance system. Biofiltration devices are effective for small drainage areas (less than 2 acres).

Biofiltration devices are called a "bioretention" device when the native soils located beneath the engineered soil layer are permeable and the majority of stormwater infiltrates into the native soils. In sandy soils, it may be feasible to eliminate the perforated underdrain pipe to further increase infiltration. Bioretention devices are used to recharge groundwater and improve stormwater quality, whereas biofiltration devices are primarily used to improve stormwater quality. WDNR Technical Standard 1004 – Bioretention for Infiltration discusses design criteria for bioretention and biofiltration. Biofiltration devices are sometimes called a "bio-swale" if the device contains a longitudinal slope to facilitate flow conveyance. Bio-swales are typically installed within parking lots or along streets and have a linear configuration. Bio-swales can be used to recharge groundwater and/or improve stormwater quality. As such, a bio-swale may or may not include a perforated underdrain pipe.

Proprietary biofiltration devices are also available to achieve pollutant reductions. The proprietary devices are pre-manufactured structures which are typically placed along a street or within a parking lot island. The structure is filled with engineered soil with an underdrain system for biofiltration. Examples of proprietary biofiltration devices include Filterra®, TreePod™, UrbanGreen™, and many other products.

Biofiltration devices are able to obtain 100% TSS and TP credit for stormwater that is infiltrated into the underlying soil and an 80% TSS and 0% TP removal credit for stormwater that is filtered through the engineered soil layer and is discharged via an underdrain. Therefore, in clay soils, a biofiltration device is an effective BMP for TSS reduction, but is ineffective for TP reduction due to limited soil infiltration. Biofiltration is much more effective for TP reduction in sandy soils due to higher soil infiltration rates (refer to previous "bioretention" device discussion). As shown in Figure 5, the study area is comprised of mostly clay soils. As such, biofiltration devices were not included in the analysis since TP is the pollutant of concern for the Lake Butte des Morts and Sawyer Creek Sub-Watersheds.

Sand Filters

A sand filter is similar to a biofiltration device except the engineered soil consists of 100% sand meeting one of the gradation options specified in Technical Standard 1004. Per WNDR guidance, a sand filter may obtain 80% TSS and 35% TP reduction for the filtering component of

the devices. The WDNR is currently researching development of an engineered soil mixture that would achieve a greater TP removal credit than a sand filter. The costs to incorporate sand filters into a street retrofit or reconstruction project are summarized in Table 5-6 for sand and clay soils. The percent reductions provided in Table 5-5 are for clay soils, but the cost per pound provides a range depending on soil type.

Table 5-5: Street Sand Filters

Street Corridor Land Use	Pollutant Load Reduction		Avg. Annual TP Cost ($/lb)			
	TSS (%)	TP (%)	Retrofit		Reconstruct	
			Sand	Clay	Sand	Clay
Commercial Corridors	80%	35%	$3,266	$9,663	$1,879	$6,178
Industrial Corridors	80%	35%	$1,734	$5,010	$930	$3,120
Institutional Corridors	80%	35%	$2,218	$6,276	$1,189	$3,909
Residential Corridors	80%	35%	$2,664	$7,097	$1,429	$4,420
Open Space Corridors	80%	35%	$2,585	$6,807	$1,386	$4,240

The costs to incorporate sand filters into a parking lot retrofit or reconstruction project are summarized in Table 5-6 for sand and clay soils. The percent reductions provided in Table 5-6 are for clay soils, but the cost per pound provides a range depending on soil type.

Table 5-6: Parking Lot Sand Filters

Parking Lot Land Use	Pollutant Load Reduction		Avg. Annual TP Cost ($/lb)			
	TSS (%)	TP (%)	Retrofit		Reconstruct	
			Sand	Clay	Sand	Clay
Commercial Corridors	80%	35%	$9,832	$25,081	$6,117	$15,664
Industrial Corridors	80%	35%	$9,942	$27,979	$6,055	$17,042
Institutional Corridors	80%	35%	$7,972	$23,924	$4,856	$14,572
Residential Corridors	80%	35%	$9,850	$14,234	$6,000	$8,670
Open Space Corridors	80%	35%	$3,564	$29,183	$2,171	$17,775

Rain Gardens

Bioretention devices are sometimes called a "rain garden" if the device does not contain an engineered soil layer. Although pollutant removal is provided, rain gardens are typically installed for groundwater recharge purposes rather than stormwater pollutant removal. Often, runoff from a residential roof, patio, sidewalk or driveway is directed to a rain garden. These residential source areas have a low pollutant load but generate a significant amount of runoff volume. Whenever a source area has a high pollutant load (i.e. street or parking lot), an

engineered soil layer is recommended to provide a higher capacity filter media. A high capacity filter media reduces the device's surface area, ponding duration, and clogging potential. If stormwater is allowed to pond on the surface of a rain garden, bioretention device, or biofiltration device for more than 24 hours, the plants may become diseased or die due to wet conditions or poor system hydrology. The costs to retrofit rain gardens on private residential property are summarized in Table 5-7.

Table 5-7: Rain Gardens

BMP	Pollutant Load Reduction		Avg. Annual TP Cost ($/lb)
	TSS (%)	TP (%)	
Rain Garden – Retrofit Residential Lot	98%	98%	$14,959

Infiltration Basins

An infiltration basin is a water impoundment constructed over a highly permeable soil. The purpose of an infiltration basin is to temporarily store stormwater and allow it to infiltrate through the bottom and sides of the infiltration basin. Pollutants are removed by the filtering action of the underlying soil. The primary functions of an infiltration basin are to provide groundwater recharge, reduce runoff volumes, and reduce peak discharge rates. The secondary function of an infiltration basin is water quality. WDNR Technical Standard 1003 – Infiltration Basin discusses design criteria for infiltration basins.

Infiltration basins require pretreatment to prevent clogging and failure. WDNR Technical Standard 1003 - Infiltration Basin requires a pretreatment system to reduce the TSS load entering an infiltration basin by 60% for a residential land use and 80% for a commercial, industrial, or institutional land use. Typically, a wet detention pond or biofiltration device is used as the pretreatment system. The pretreatment system prevents the infiltration basin from failing and helps reduce the risk of groundwater contamination due to pollutants contained in stormwater. Not all stormwater runoff should be infiltrated due to concern for groundwater contamination.

In order for an infiltration basin to be feasible, the depth to groundwater typically needs to be 5 feet or more and the soil needs to be a loam, silt or sand. As shown in Figure 5, soils in the Town are predominately clay (hydrologic soil group C and D). Silt soils are found in limited locations in the Town (hydrologic soil group B). As such, the feasibility of an infiltration basin is very limited within the Town.

Finally, a significant amount of the water quality benefit is provided by the infiltration basin's pretreatment system. Typically, the pretreatment system is a wet detention pond or biofiltration device. From a water quality perspective, an infiltration basin is not cost effective after considering the pretreatment costs. As such, infiltration basin costs are not included in the

analysis; rather pretreatment system costs are included in the analysis (i.e. wet detention ponds and biofiltration devices).

Hydrodynamic Separator Devices

Hydrodynamic separator devices are pre-manufactured underground devices which use cyclonic separation to provide pollutant reduction for stormwater. Hydrodynamic separator devices are typically placed in place of a storm sewer manhole within a storm sewer discharge pipe and are typically used to treat smaller (< 2 acre) drainage areas. Collected pollutants are typically removed with a vacuum truck. Examples of hydrodynamic separators include Vortechs®, CDS™, Aqua-Swirl®, and many other products. The costs to incorporate hydrodynamic separators into a street retrofit or reconstruction project are summarized in Table 5-8.

Table 5-8: Street Hydrodynamic Separator Devices (HSD)

	Pollutant Load Reduction		Avg. Annual TSS Cost ($/lb)	
Street Corridor Land Use	TSS (%)	TP (%)	Retrofit	Reconstruct
Commercial Corridors	21%	18%	$3,379	$2,702
Industrial Corridors	23%	13%	$3,468	$2,767
Institutional Corridors	23%	20%	$2,626	$2,098
Residential Corridors	21%	17%	$3,069	$2,462
Open Space Corridors	21%	17%	$2,837	$2,259

The costs to incorporate hydrodynamic separators into a parking lot retrofit or reconstruction project are summarized in Table 5-9.

Table 5-9: Parking Lot Hydrodynamic Separator Devices (HSD)

	Pollutant Load Reduction		Avg. Annual TP Cost ($/lb)	
Parking Lot Land Use	TSS (%)	TP (%)	Retrofit	Reconstruct
Commercial Corridors	19%	16%	$7,293	$5,824
Industrial Corridors	20%	16%	$8,784	$7,008
Institutional Corridors	20%	15%	$7,366	$5,885
Residential Corridors	21%	15%	$10,403	$8,376
Open Space Corridors	31%	20%	$9,506	$7,570

Stormwater Filtration Devices

Stormwater Filtration devices are pre-manufactured underground stormwater treatment systems that use filters to reduce pollutants in stormwater. The filters are typically media filled cartridges which can be customized to target specific pollutants placed within a pre-cast or cast-

in-place underground concrete structure and are typically used to treat smaller (< 2 acre) drainage areas. As clogging occurs within the filters, they can be cleaned underground and/or replaced when clogged. Examples of Stormwater Filtration include Stormfilter®, Perk Filter™, Aqua-Filter™, and many other products. The costs to incorporate stormwater filtration into a street retrofit project or a street reconstruction project are summarized in Table 5-10.

Table 5-10: Street Stormwater Filtration Devices

	Pollutant Load Reduction		Avg. Annual TP Cost ($/lb)	
Street Corridor Land Use	TSS (%)	TP (%)	Retrofit	Reconstruct
Commercial Corridors	38%	38%	$3,765	$3,267
Industrial Corridors	43%	26%	$3,751	$3,235
Institutional Corridors	42%	42%	$2,831	$2,442
Residential Corridors	39%	35%	$3,278	$2,832
Open Space Corridors	39%	35%	$3,082	$2,657

The costs to incorporate hydrodynamic separators into a parking lot retrofit or reconstruction project are summarized in Table 5-11.

Table 5-11: Parking Lot Stormwater Filtration Devices

	Pollutant Load Reduction		Avg. Annual TP Cost ($/lb)	
Parking Lot Land Use	TSS (%)	TP (%)	Retrofit	Reconstruct
Commercial Corridors	36%	34%	$10,522	$9,997
Industrial Corridors	39%	37%	$11,998	$11,369
Institutional Corridors	39%	35%	$10,024	$9,500
Residential Corridors	42%	34%	$13,859	$13,142
Open Space Corridors	61%	45%	$13,031	$12,347

Permeable Pavement

Permeable pavement is a pavement system which allows stormwater to drain through paved surfaces into the underlying soil or to an underground reservoir for treatment. In addition to pollutant reduction, permeable pavement is also used to reduce peak flow rates and stormwater runoff volumes for development sites. Permeable pavement includes but is not limited to: pervious concrete or asphalt, pervious pavers and open jointed blocks. WDNR allows for 100% TSS & TP credit for the volume of runoff that infiltrates into the native soil. Any runoff that discharges through an underdrain pipe receives a 65% TSS and 35% TP credit. The costs to incorporate a permeable pavement into a street retrofit project or a street reconstruction project are summarized in Table 5-12.

Table 5-12: Permeable Pavement

BMP Location	Pollutant Load Reduction		Avg. Annual TP Cost ($/lb)			
			Retrofit		Reconstruct	
	TSS (%)	TP (%)	Sand	Clay	Sand	Clay
Permeable Pavement-Street	65%	35%	$6,741	$12,987	$4,877	$9,397
Permeable Pavement-Parking Lot	65%	35%	$22,546	$27,003	$15,546	$18,620

Wet Detention Ponds / Wetland Systems

Wet detention ponds and wetland systems are effective at removing sediment, nutrients, heavy metals, oxygen demanding compounds (BOD), hydrocarbons, and bacteria. Pollutant removal within a wet pond and wetland system is primarily due to gravity settling of particulate pollutants and sediment. Filtration, adsorption and microbial decomposition also remove pollutants, particularly within a wetland system. WDNR Technical Standard 1001 – Wet Detention Pond discusses design criteria for wet detention ponds.

Typically, a wet detention pond or wetland system must contain a minimum water depth of 5 feet within a portion of the permanent pool to minimize re-suspension of pollutants during a rainfall event. The WDNR requires that wet detention ponds and wetland systems be sized using the National Urban Runoff Project (NURP) particle size distribution. To achieve an 80% reduction in TSS, a wet detention pond or wetland system typically needs to remove the 3 to 5 micron sediment particle.

Existing dry detention ponds located in the Town were evaluated to determine the feasibility of converting into wet detention ponds. Currently, WDNR does not allow water quality credit for dry detention ponds. Existing dry detention ponds located within the Town are depicted in Figure 7 and summarized in Table 2-3. Generally, wet detention ponds are not recommended for small watersheds (less than 15 to 20 acres in clay soil). A wet detention pond located in a small watershed may develop stagnation problems and become a public nuisance. Public acceptance of stormwater BMPs is important to the success of the Town's stormwater program.

In the 2002 version of the NR 151 rule, best management practices (BMPs) associated with post-construction sites containing new development may not be located in navigable waters to receive credit for meeting any performance standard in Chapter NR 151. This restriction has been retained in the revised rule. Also in the 2002 version of the rule, best management practices for existing development, re-development or in-fill development could receive water quality credit for wet detention ponds / wetland systems constructed within both perennial and intermittent streams if all applicable permits are received. As of January 1, 2011, NR 151.003 only allows water quality credit for newly constructed wet detention ponds / wetland systems constructed within intermittent streams for which all applicable permits are received.

A cost analysis was completed to determine the most cost-effective wet detention ponds / wetland system retrofits within the Town. As part of the analysis, aerial photographs were used to identify potential undeveloped properties that could be used for a retrofit. The location of storm sewer pipes and the watershed size in relation to the undeveloped property was also considered. Table 5-13 summarizes the cost and water quality benefits of those wet detention ponds / wetland systems within the Lake Butt des Morts & Sawyer Creek Sub-Watersheds analyzed for the Town (partial list of analyzed ponds). A detailed structural BMP cost analysis can be found in Appendix C and includes the full list of ponds and other BMP's analyzed within the study area. It's of note that the pollutant reductions identified for each of the proposed ponds is based on pollutant reduction trend data from modeling existing grass swales upstream of wet ponds. This 'treatment train' concept was considered appropriate for the Town since their current drainage system is composed almost entirely of grass swales and they require rural streets in new developments. Concept drawings for all potential wet detention pond retrofits are also provided in Appendix C

Table 5-13: Potential Wet Detention Ponds / Wetland Systems

Wet Detention Pond / Wetland System	Urban Drainage Area (acres)	Pollutant Reduction*		Capital Costs	Capital & O&M Costs Over 20 Years	Avg. Annual TP Cost ($/lb)
		TSS (%)	TP (%)			
Town Hall Pond	37.8	88.7%	74.3%	$297,200	$412,064	$2,347
2nd Addition to Bellhaven Pond	27.7	96.4%	87.9%	$84,100	$150,613	$2,630
Omro Road West Pond	158.5	93.3%	81.7%	$1,121,500	$1,444,616	$2,663
Prairie Wood Pond	62.3	95.1%	86.1%	$304,100	$431,359	$2,888
Bellhaven Park Pond	85.7	92.3%	79.5%	$695,200	$908,669	$3,019
Leonard Point Pond	88.8	96.1%	86.0%	$450,000	$581,391	$3,182
Cambria Ct Pond	22.3	85.9%	68.4%	$375,600	$490,464	$3,277
Kewaunee Park Pond	27.4	94.4%	84.1%	$121,900	$221,269	$3,353
Valley Road Pond	75.0	96.9%	90.4%	$312,000	$449,589	$3,458
3rd Addition to Bellhaven Pond	10.5	94.8%	84.8%	$63,700	$100,555	$4,111
Forest View Pond	44.7	93.8%	84.0%	$485,700	$599,531	$4,300
Pierce Lane Pond	87.3	96.3%	85.1%	$773,300	$1,008,699	$4,330
Elmhurst Lane Pond	12.1	87.7%	69.5%	$267,200	$371,734	$4,642
Sunray Pond	35.0	96.2%	88.8%	$233,700	$340,300	$4,775
Zelhofer Pond	67.5	95.7%	87.7%	$563,500	$731,045	$4,876
Irvine Pond 2	145.0	96.6%	91.1%	$887,600	$1,243,610	$5,574
Oakwood Pond	115.2	96.6%	91.5%	$831,800	$1,001,411	$5,719
Willow Springs Pond	12.6	93.7%	85.4%	$104,700	$211,300	$5,755
Irvine Pond 1	123.6	96.1%	90.1%	$1,026,400	$1,306,754	$6,079
Sheldon Nature Pond 2	139.5	97.1%	92.5%	$844,300	$1,129,040	$6,108

*Based on trend data from modeling grass swales upstream of the wet detention ponds within WinSLAMM

In addition to wet detention ponds, underground detention is another alternative to provide similar pollutant reduction, allowing for full build out of a proposed development site. The detention may be provided with a permanent pool of water in an underground piping system allowing for pavement above the stormwater device. The sediment accumulation is typically removed by vacuum truck or other method. The underground detention system is more expensive than wet detention ponds, but maximizes development area of sites.

Enhanced Settling Treatment

In the future, the Town may want to investigate the feasibility of adding polymers or flocculants such as Alum to wet detention ponds to enhance pollutant removal efficiencies. Polymer or flocculent additions will likely require installation of mechanical injection systems. The WDNR is currently discussing if Wisconsin will allow the use of polymers and flocculants in wet detention ponds. This TMDL pollutant analysis will likely require updating after WDNR guidance documents regarding the use of polymer and flocculants in ponds is completed. It's of note that adding enhanced settling systems to wet ponds will likely result in more frequent dredging operations. As such, future dredging costs should be considered when developing a Plan of Action for TMDL compliance. Table 5-14 summarizes the cost and water quality benefits of those wet detention ponds with enhanced settling treatment analyzed for the Town.

Table 5-14: Potential Wet Detention Ponds with Enhanced Settling Treatment

Wet Detention Pond With Enhance Settling Treatment	Drainage Area (acres)	Pollutant Reduction		Capital Costs	Capital & O&M Costs Over 20 Years	Avg. Annual TP Cost ($/lb)
		TSS (%)	TP (%)			
Mercy Hospital North Pond w/Enhanced Settling	28.0	90.0%	85.0%	$29,800	$232,305	$1,617
Town Hall Pond w/Enhanced Settling	37.8	90.0%	85.0%	$297,200	$412,064	$3,146
Bellhaven Park Pond w/Enhanced Settling	85.7	90.0%	85.0%	$695,200	$908,669	$4,222
Honey Creek Pond w/Enhanced Settling	348.1	90.0%	85.0%	$653,600	$1,203,891	$4,775

Mechanical / Biological Treatment Facilities

Mechanical / biological treatment facilities are not currently used in Wisconsin, with the exception of combined sewer systems that treat wastewater and stormwater. A mechanical / biological treatment facility would be difficult to implement for stormwater given the number of storm sewer outfalls located within the Town. Significant storm sewer pumping would likely be needed to convey stormwater from each outfall to a regional stormwater treatment facility, similar to a wastewater treatment facility. As a result, stormwater treatment facilities are not typically cost effective BMPs. A mechanical / biological treatment facility and associated

pumping systems are estimated to have an average annual cost that is well above $20 per pound of TSS removed. In addition, diverting low flows from all storm sewer outfalls to a regional treatment facility may dry up existing wetlands and streams located near the Town's current storm sewer outfalls.

TMDL Alternatives

Once the Upper Fox & Wolf Basins TMDL is approved, the Town will be required to submit a written TMDL Plan of Action to the WDNR for review. The Plan of Action will need to identify how the Town plans to achieve compliance with the pollutant load percent reductions identified in the final approved TMDL report. In order to assist the Town with their future Plan of Action, three TMDL compliance alternatives were developed. Each alternative will satisfy the draft pollutant load percent reductions identified in listed in Table 4-3 for the Lake Butte des Morts and Sawyer Creek Sub-Watersheds. Each alternative identifies a combination of existing and proposed BMPs that satisfies the TMDL percent reductions for the Town.

The alternatives also consider future development within the Town's boundary agreement growth area. Future development areas will be required to achieve TSS and TP reduction as required by the Town's post-construction stormwater management ordinances. As such, it's recommended that the Town adopt more restrictive TP reduction requirements within wither post-construction stormwater management ordinance for new / redevelopment sites. Specifically, it's recommended that the Town require an 85% TP reduction for new / redevelopment sites to assist with satisfying the 83% TP reduction required by the TMDL for the Lake Butte des Morts and Sawyer Creek Sub-Watersheds. Although this is a significantly higher than normal percent reduction requirement, it should be achievable by utilizing stormwater 'treatment trains' such as infiltrating stormwater BMPs (swales, rain gardens, sand filters, etc) upstream of wet detention ponds.

Alternative 1 – As shown in Figure 15, Alternative 1 includes the following:

- Existing Town BMP's including grass swales, high efficiency street sweeping once every 4 weeks with parking controls and 9 wet detention ponds.

- Within the Lake Butte des Morts Sub-Watershed, verify and/or obtain maintenance authority for the Coldwell Bank Pond and construct 8 new wet detention ponds. Two of the wet detention ponds will have enhanced settling systems.

- Within the Sawyer Creek Sub-Watershed, construct 1 new wet detention pond with an enhanced settling system. It's recommended the Town approach the City of Oshkosh to see if they would be interested in cost-sharing for this pond (Mercy Hospital North Pond) since both communities have developed urban areas that drain to this pond.

Alternative 2 – As shown in Figure 16, Alternative 2 includes the following:

- Existing Town BMP's including grass swales, high efficiency street sweeping once every 4 weeks with parking controls and 9 wet detention ponds.
- Within the Lake Butte des Morts Sub-Watershed, verify and/or obtain maintenance authority for the Eden Meadows Pond and construct 10 new wet detention ponds.
- Within the Sawyer Creek Sub-Watershed, construct 1 new wet detention pond.

Alternative 3 – As shown in Figure 17, Alternative 3 includes the following:

- Existing Town BMP's including grass swales, high efficiency street sweeping once every 4 weeks with parking controls and 9 wet detention ponds.
- Within the Lake Butte des Morts Sub-Watershed, verify and/or obtain maintenance authority for the Eden Meadows Pond and construct 12 new wet detention ponds.
- Within the Sawyer Creek Sub-Watershed, construct 1 new wet detention pond.

The proposed street sweeping program and costs associated with the proposed structural BMPs for each alternative are provided in Table 5-15. The capital costs provided in Table 5-15 are the estimated present value capital costs for the proposed structural BMPs. The capital costs include an allowance for construction, land acquisition, engineering, legal, and contingency costs.

Table 5-15: TMDL Alternatives Analysis

Town MS4 Alternative	Proposed Street Sweeping*			Proposed Structural BMPs
	Type of Sweeper	Sweeping Frequency	Parking Controls	Capital Costs
1	H.E.	Once / 4 Weeks	Yes	$4.0 million
2	H.E.	Once / 4 Weeks	Yes	$4.6 million
3	H.E.	Once / 4 Weeks	Yes	$7.5 million

* Street sweeping begins March 29 and ends November 25 of each year. High efficiency (H.E.). Mechanical (M).

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6.0 IMPLEMENTATION & RECOMMENDATIONS

Below are various recommendations for the Town to consider when implementing this Stormwater Quality Management Plan and working toward MS4 Permit compliance.

Plan of Action

As previously mentioned, the Town will be required to develop a written TMDL Plan of Action that identifies how the Town plans to achieve compliance with the pollutant load percent reductions identified in the final approved Upper Fox & Wolf Basins TMDL report. The Plan of Action also needs to include an anticipated implementation schedule and projected costs. The TMDL Plan of Action is typically due to the DNR within 48 months of a TMDL being approved. It is recommended that pollutants of concern associated with the approved Upper Fox & Wolf Basins TDML be targeted during implementation. Pollutant loads and pollutant yields depicted in Figures A1-A8 in Appendix A can be used to target specific drainage areas with heavier pollutant loads or yields. In addition, the three TMDL alternatives contained in this report can be used to help develop the Town's ultimate TMDL Plan of Action. It's of note that the Town's TMDL Plan of Action will be a dynamic planning document that will likely be modified as implementation progresses.

Capital Improvement Plan

It is recommended that the Town develop a capital improvement plan (CIP) to go along with the Town's TMDL Plan of Action. It's recommend that the CIP plan include ample time for public education, public input, BMP design, land acquisition, regulatory permits, grant applications, financing, and construction. The CIP should also take into consideration other local capital improvement projects, such as street reconstruction projects, utility projects, and private development projects.

Financing Plan

It is recommended that the Town develop a financing plan. The financing plan will allow the Town to implement its Plan of Action and Capital Improvement Plan. Below is a discussion of various funding sources which may be available to the Town. Depending on the project, funding options may be used individually or in combination.

- Debt / Bonds: General obligation and revenue bonds may be used to secure funding for stormwater projects. Property taxes and revenue fees are used for long-term debt payments.

- Special Assessments: Special assessments may be used to generate funds for a specific project. Property owners that benefit from the project pay the assessment fee. Typically, other funding sources are needed to pay for project costs until property owners pay the assessment.

- Impact Fees: Impact fees may be charged to developers for stormwater projects that benefit the development. Impact fees are usually paid during initial stages of development. Typically, projects include regional stormwater facilities or improvements to deficient downstream infrastructure. Often, other funding sources are needed to pay for project costs until developers and property owners are required to pay the impact fee. Impact fees are recommended as needed to fund the municipal stormwater program.

- Tax Incremental Financing (TIF) District: TIF Districts may be used by the Town to fund stormwater projects that benefit property located within the District. Property value increases within the TIF District generate additional tax revenue that is used for long-term debt payments.

- Stormwater Utility: Stormwater utilities are similar to sanitary and water utilities. Stormwater utilities generate revenue for stormwater related projects by charging property owners an annual service fee. Annual service fees are based upon the amount of runoff generated by a specific property. Properties with more impervious area (i.e. roofs, parking lots, driveways, etc.) are charged a higher fee as compared to properties with less impervious area. All properties, including tax exempt properties, pay the service fee. Rate adjustments are recommended as needed to fund the municipal stormwater program.

- Grants / Loans: State and federal grant / loans are available for certain stormwater projects. Typically, only a certain percent of the total project cost is eligible for grant / loan money with remaining revenues to be generated by the applicant. Below are a few grant / loan programs which the Town may or may not be familiar with. Grant applications are recommended.
  - Urban Non-Point Source and Stormwater Construction Grant
  - Targeted Runoff Management Construction Grant
  - Great Lakes Basin Program
  - Community Development Block Grant
  - Clean Water Fund

Operation & Maintenance

It is recommended that the Town continues to operate and maintain their current stormwater management system. Operation and maintenance is needed in order for the stormwater system to perform as designed. It is recommended that the Town monitor sediment depths within Town-owned ponds. Sediment accumulation rates can be used to predict future dredging activities. This will be particularly important if enhanced settling systems are implemented in the future.

Municipal Leaf Collection Program

It is recommended that the Town review and potentially revise their municipal leaf collection programs after the WDNR and United States Geological Survey (USGS) complete their scientific

research. Currently, the WDNR and USGS are sampling and monitoring stormwater runoff in the City of Madison to determine the amount of phosphorus reduction associated with different municipal leaf collection techniques. The study results will help the Town evaluate their municipal leaf collection programs. The study may indicate that the Town is already using the best leaf collection technique for purposes of reducing phosphorus loads.

Redevelopment Sites

It is recommended that the Town evaluate public / private partnerships with landowners when developing and implementing its TMDL Plan of Action. As required by NR 151.12 and the Town's Post-Construction Stormwater Management Ordinance, redevelopment sites with 1 acre or more of land disturbance are required to achieve a TSS reduction. Compliance with the TSS reduction is only required when a construction project occurs on the site. As such, these redevelopment sites do not have a specific timeline for achieving a TSS reduction. Nonetheless, when redevelopment occurs on commercial, industrial, institutional and multi-family residential parcels, stormwater quality improvements will be required. Public / private partnerships provide an opportunity to work together such that both the landowner and Town benefit.

For example, redevelopment of a 20 acre shopping center may provide an opportunity to increase the site's TSS reduction to 80% or provide an opportunity to provide water quality treatment for other nearby properties or streets. In some instances, cost sharing can be used as a financial incentive or the Town cost share through of public / private partnership with the landowners. Typically, it is more cost effective to incorporate stormwater quality improvements into an already planned construction project as compared to retrofitting a BMP without considering other construction activities in the watershed.

Inter-Governmental Agreements

It is recommended that the Town evaluate inter-governmental agreements when developing and implementing its TMDL Plan of Action. It may be more cost effective to work together with adjoining municipal jurisdictions, such as the Wisconsin Department of Transportation or Winnebago County Highway Department. Also, it may be beneficial to work together with the City of Oshkosh to construct a mutually beneficial stormwater BMP, share equipment, restore a wetland, or improve water quality using other methods.

Stream, Shoreline & Channel Stabilization

It is recommended that the Town undertake high priority stream, shoreline and channel stabilization projects to reduce the discharge of sediment and phosphorus pollutants associated with bed, bank or steep slope erosion. In addition to the water quality benefits, stabilization projects provide an opportunity to improve habitat, remove invasive species, and potentially restore wetland areas. Grant funding is available to assist with stabilization projects.

Water Quality Trading

It is recommended that the Town evaluate the feasibility and cost effectiveness of water quality trading when developing and implementing its Plan of Action. The cost for achieving compliance with TMDL allocations is not uniform among dischargers and source areas. As such, compliance with TMDL allocations may be more cost-effectively achieved by trading with other dischargers. Water quality trading is allowed between wastewater treatment facilities, agricultural landowners, and other urban stormwater dischargers. In order to be eligible for water quality trading, specific criteria needs to be satisfied. The WDNR recently developed a water quality trading framework for Wisconsin. This framework has led to two additional guidance documents for trading implementation.

Watershed Adaptive Management

It is recommended that the Town evaluate the feasibility and cost effectiveness of Watershed Adaptive Management when developing and implementing its Plan of Action. Adaptive management is a watershed approach that focuses on meeting water quality standards within a river, stream or lake in a more cost-effective manner. Watershed Adaptive Management needs to be initiated by a wastewater treatment facility owner, but would likely involve cooperation among other phosphorus dischargers including agricultural, urban stormwater, and wastewater dischargers.

Public Education & Public Involvement

Public education and public involvement are recommended during development and implementation of the Plan of Action. Potential stakeholders include the general public, elected officials, Town Staff, developers, regulatory entities, individual property owners and other regulated entities. Although this stormwater quality management plan includes a cost versus benefit analysis, the plan does not take into consideration intangibles such as public sentiment, public opinion, land availability, etc.

Stormwater or Resource Management Plans

Several stormwater or resource management plans were discussed in Section 1.0 of this Stormwater Quality Management Plan. It is recommended that the priorities and recommendations contained in these plans be incorporated into this plan by reference.

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TOWN OF ALGOMA
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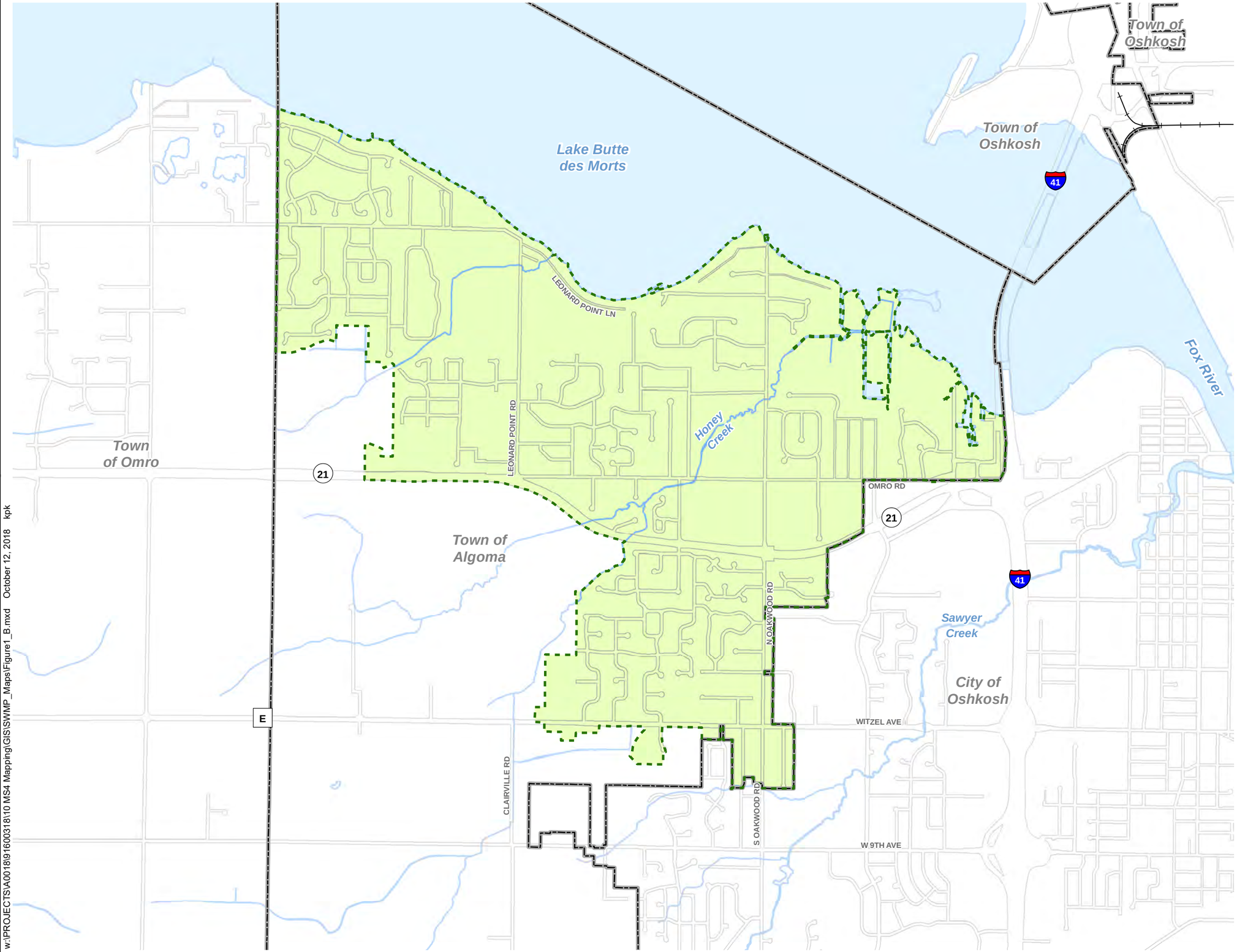

Mapped Features

- Study Area
- Municipal Boundary
- Right-of-Way Line
- Railroad Centerline
- Stream
- Surface Water

Source: Winnebago County, 2016-18.

0 2,000 4,000 Feet

McMAHON ENGINEERS ARCHITECTS
McMAHON ASSOCIATES, INC.

FIGURE 1
STUDY AREA
STORMWATER MANAGEMENT PLAN
TOWN OF ALGOMA
WINNEBAGO COUNTY, WISCONSIN

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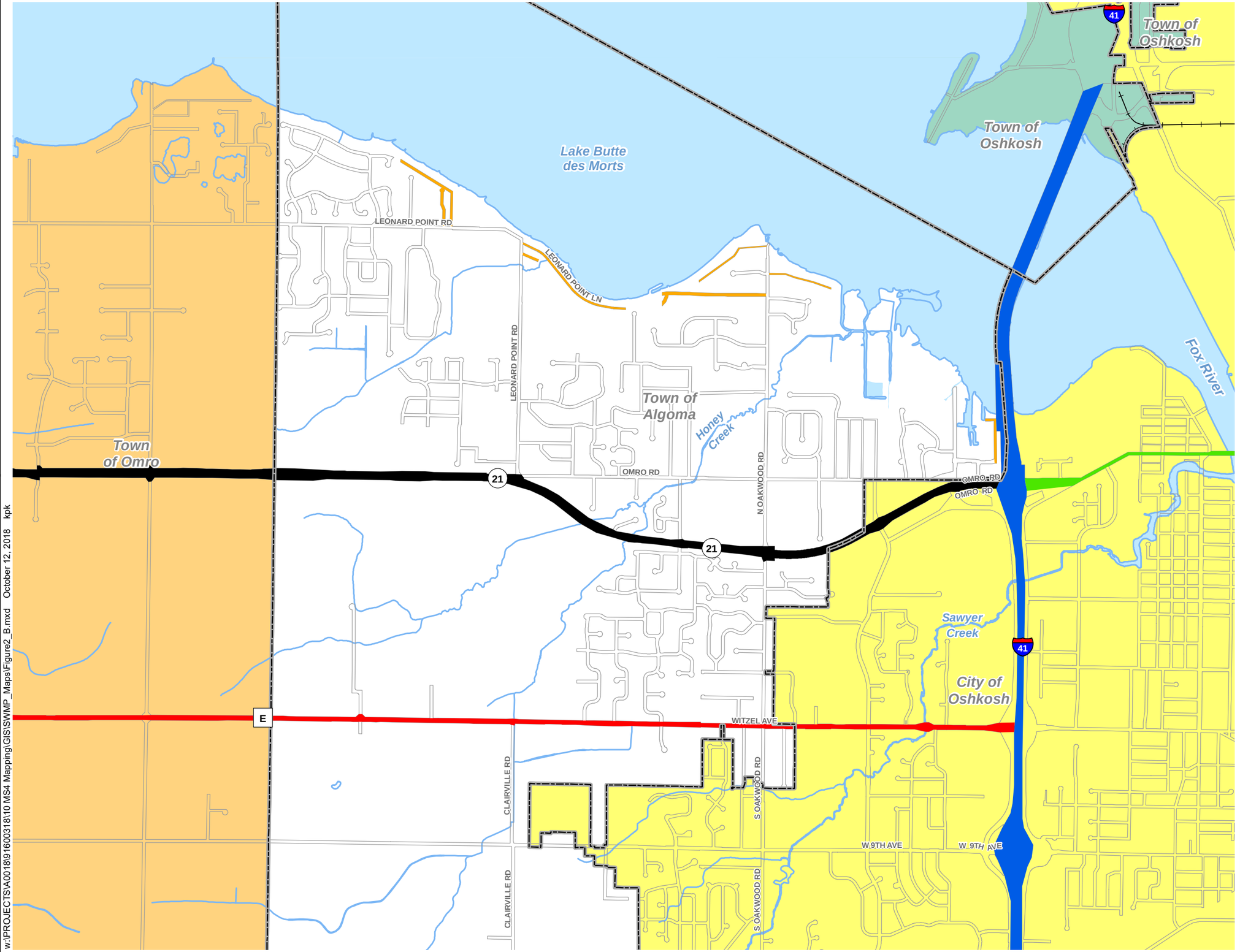

TOWN OF ALGOMA
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Municipal Jurisdiction

- Town of Algoma
- Town of Omro
- City of Oshkosh
- Town of Oshkosh

Highway Jurisdiction

- Connecting Highway
- County Highway
- State Highway
- Federal Freeway
- Private Road

Other Mapped Features

- Right-of-Way Line
- Railroad Centerline
- Stream
- Surface Water

Source: Winnebago County, 2016-18.

Disclaimer: The property lines, right-of-way lines, and other property information on this drawing were developed or obtained as part of the County Geographic Information System or through the County property tax mapping function. McMAHON ASSOCIATES, INC. does not guarantee this information to be correct, current, or complete. The property and right-of-way information are only intended for use as a general reference and are not intended or suitable for site-specific uses. Any use to the contrary of the above stated uses is the responsibility of the user and such use is at the user's own risk.

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0 2,000 4,000 Feet

McMAHON ENGINEERS ARCHITECTS
McMAHON ASSOCIATES, INC.

FIGURE 2
MS4 JURISDICTION
STORMWATER MANAGEMENT PLAN
TOWN OF ALGOMA
WINNEBAGO COUNTY, WISCONSIN

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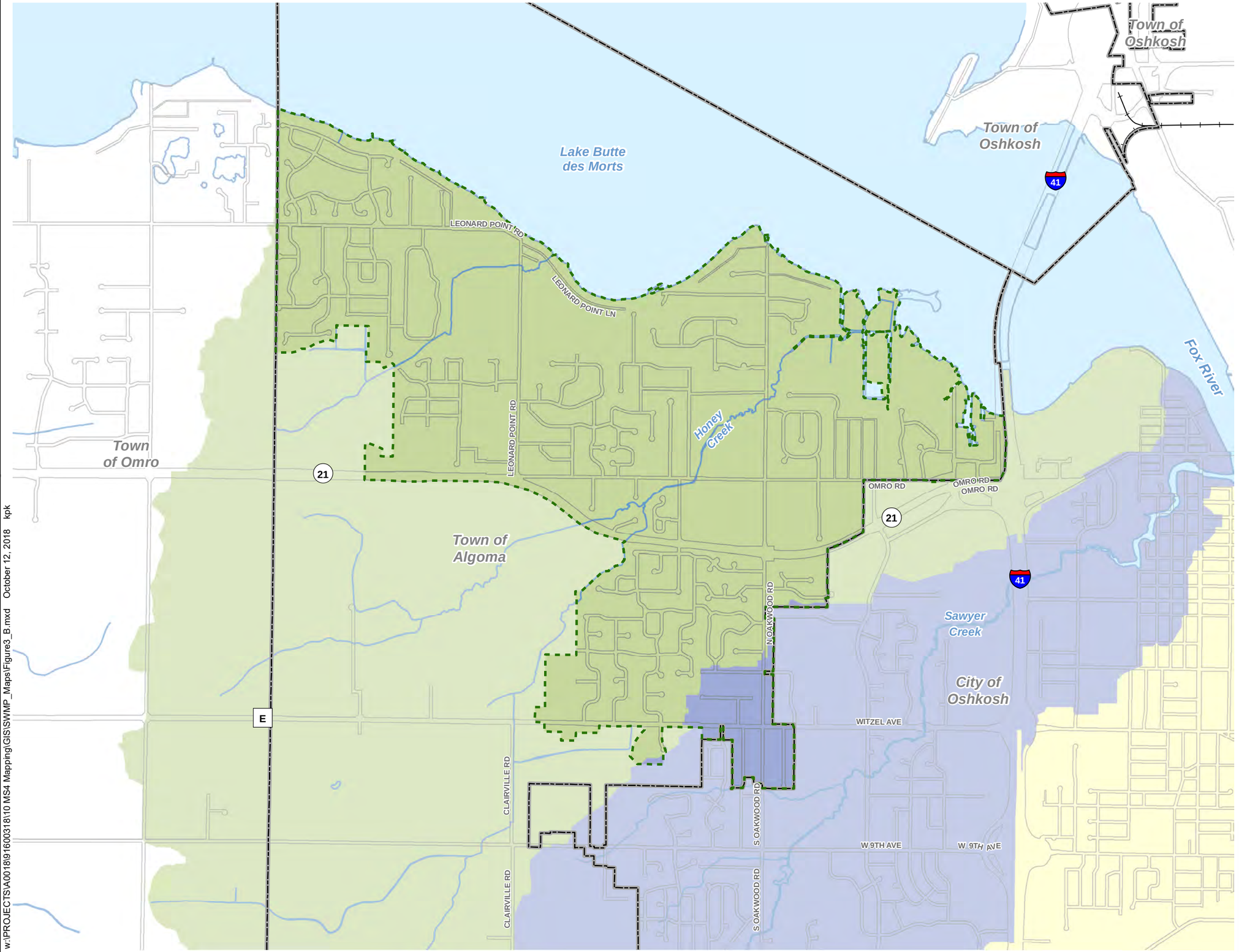

TOWN OF ALGOMA
A community connected

Sub-Watersheds

- Fox River
- Lake Butte des Morts
- Sawyer Creek

Other Mapped Features

- Municipal Boundary
- Study Area Boundary
- Right-of-Way Line
- Railroad Centerline
- Stream
- Surface Water

Source: Winnebago County, 2016-18.

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McMAHON ENGINEERS ARCHITECTS
McMAHON ASSOCIATES, INC.

FIGURE 3
SUB-WATERSHEDS
STORMWATER MANAGEMENT PLAN
TOWN OF ALGOMA
WINNEBAGO COUNTY, WISCONSIN

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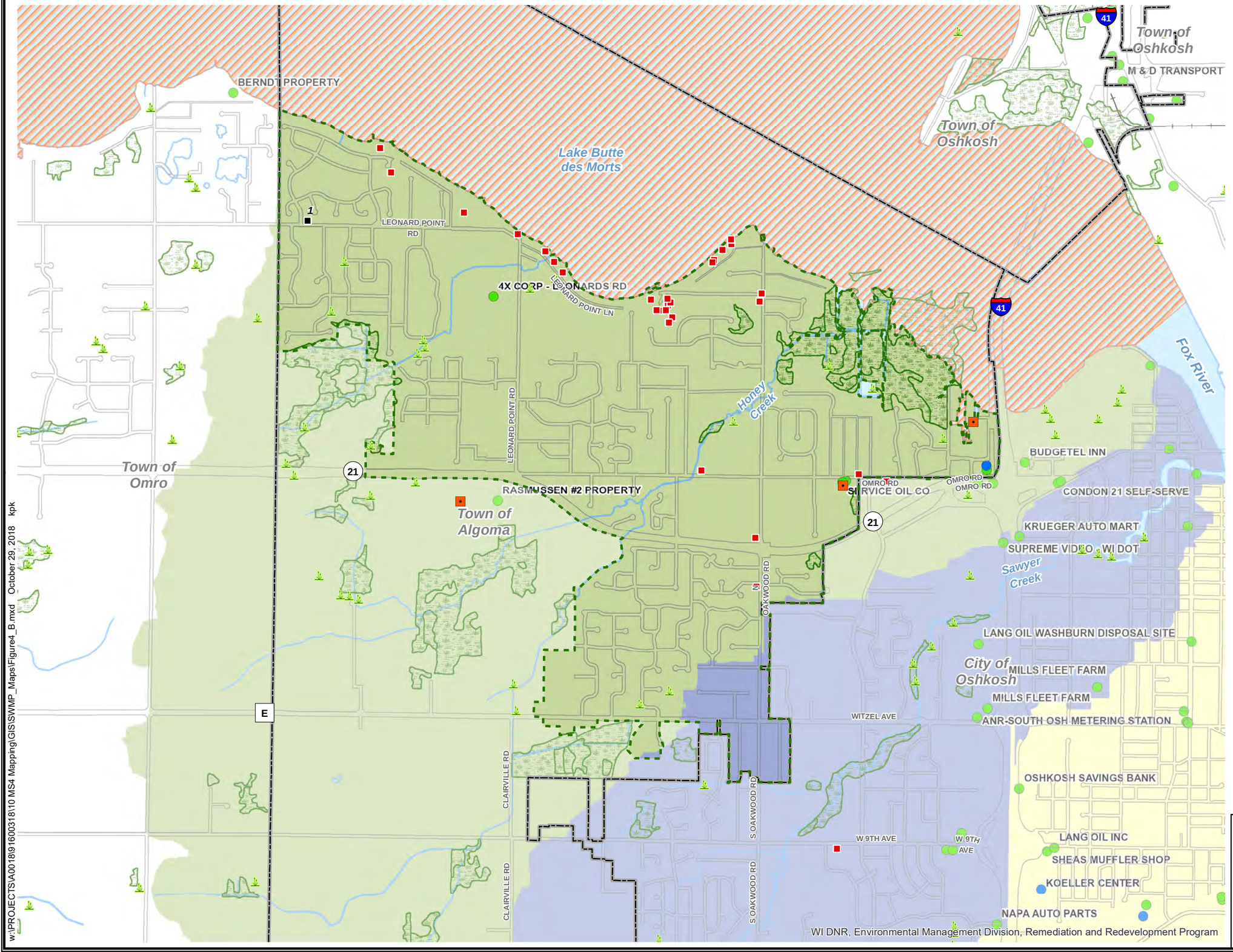

TOWN OF ALGOMA
A community connected

Natural Resources

- WDNR Wetland Inventory (Less Than 2 Acres)
- WDNR Wetland Inventory (2 Acres and Greater)
- 303(d) Impaired Waters
- Stream
- Surface Water

Sub-Watersheds

- Fox River
- Lake Butte des Morts
- Sawyer Creek

Other Mapped Features

- Historic Site ID (On National and/or State Register)
- Historic Site on Architecture and History Inventory
- Historic Waste Disposal Site
- Open DNR Remediation Site
- Closed DNR Remediation Site
- Municipal Boundary
- Study Area Boundary
- Right-of-Way Line
- Railroad Centerline

Source: Winnebago County, 2016-18; WDNR, 2018; Wisconsin Historical Society, 2017.

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McMAHON ENGINEERS ARCHITECTS
McMAHON ASSOCIATES, INC.

FIGURE 4
NATURAL RESOURCES
STORMWATER MANAGEMENT PLAN
TOWN OF ALGOMA
WINNEBAGO COUNTY, WISCONSIN

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TOWN OF ALGOMA
A community connected

Hydrologic Soil Group (HSG)

- HSG A
- HSG B
- HSG C
- HSG D

Other Mapped Features

- Municipal Boundary
- Study Area Boundary
- Right-of-Way Line
- Railroad Centerline
- Stream
- Surface Water

Source: Winnebago County, 2016-18; USDA, 2016.

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McMAHON ENGINEERS ARCHITECTS
McMAHON ASSOCIATES, INC.

FIGURE 5
SOILS
STORMWATER
MANAGEMENT PLAN
TOWN OF ALGOMA
WINNEBAGO COUNTY, WISCONSIN

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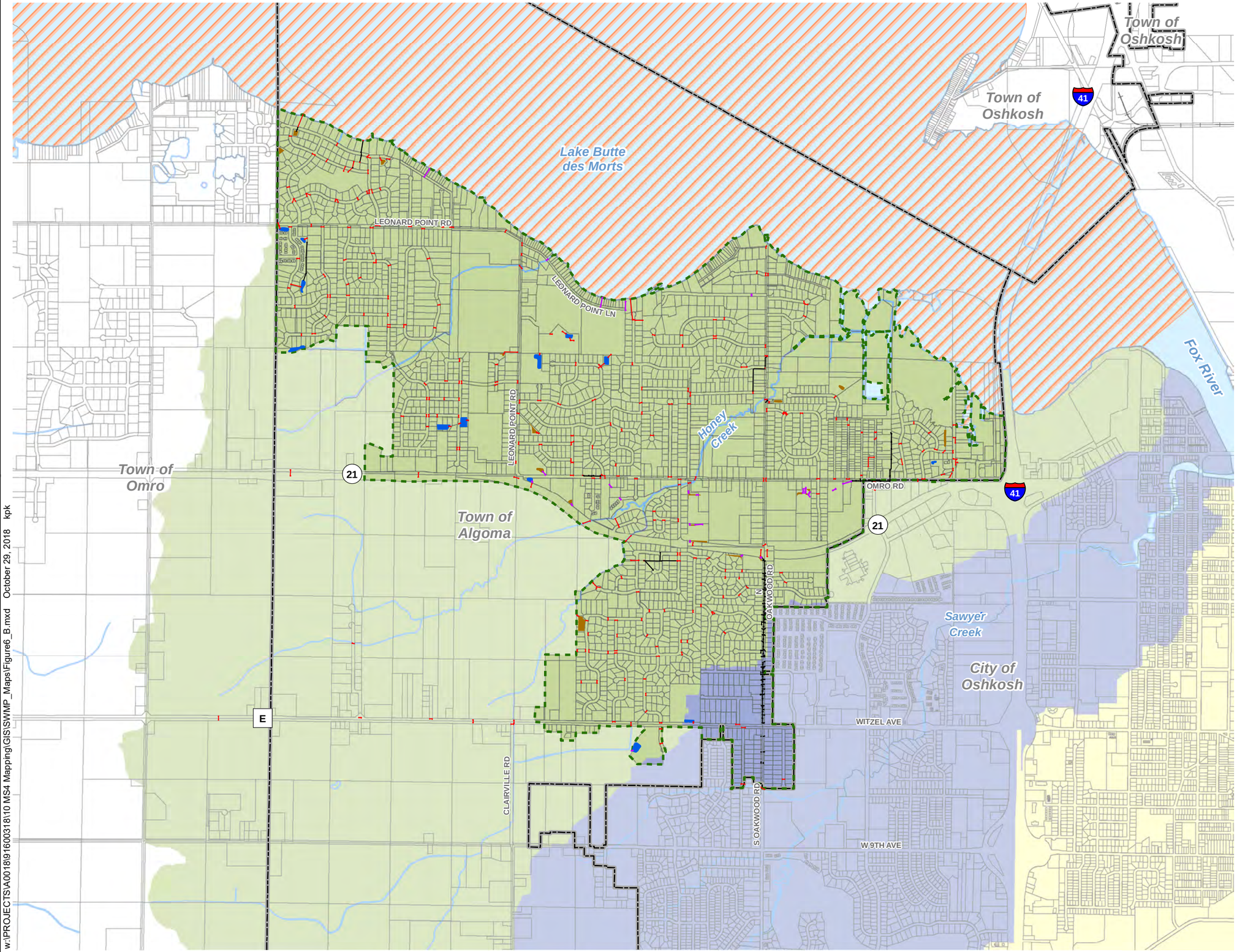

TOWN OF ALGOMA
A community connected

MS4 Drainage System

- Storm Sewer System
- Culvert
- Private Culvert
- Wet Pond
- Dry Pond

Sub-Watersheds

- Fox River
- Lake Butte des Morts
- Sawyer Creek

Other Mapped Features

- Municipal Boundary
- Study Area Boundary
- Parcel Line
- Railroad Centerline
- Stream
- Surface Water
- 303(d) Impaired Waters

Source: Winnebago County, 2016-18.

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McMAHON ENGINEERS ARCHITECTS
McMAHON ASSOCIATES, INC.

FIGURE 6
MS4 SYSTEM
STORMWATER
MANAGEMENT PLAN
TOWN OF ALGOMA
WINNEBAGO COUNTY, WISCONSIN

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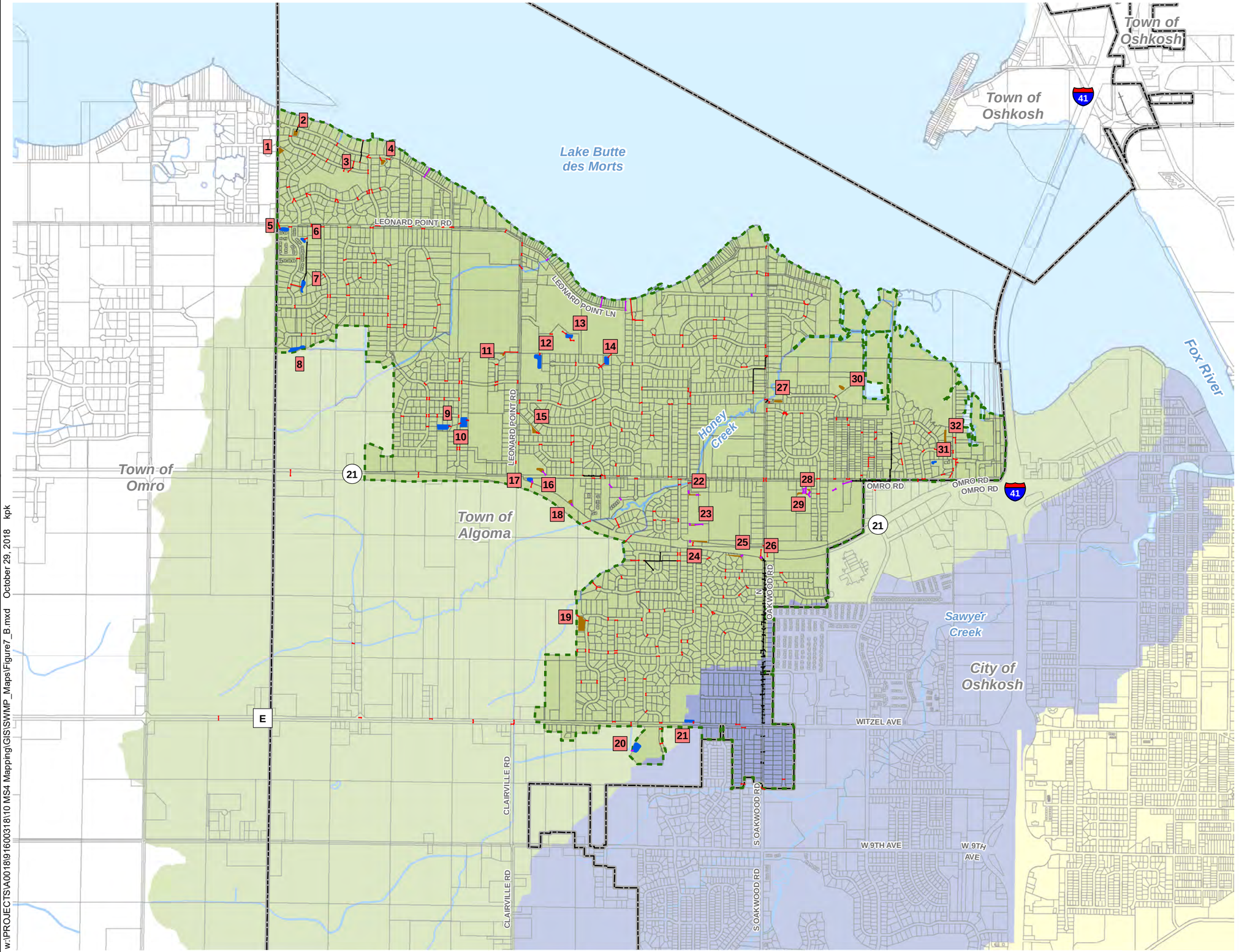

TOWN OF ALGOMA
A community connected

MS4 Drainage System

- 1 Structural BMP ID
- Storm Sewer System
- Culvert
- Private Culvert
- Wet Pond
- Dry Pond

Sub-Watersheds

- Fox River
- Lake Butte des Morts
- Sawyer Creek

Other Mapped Features

- Municipal Boundary
- Study Area Boundary
- Parcel Line
- Railroad Centerline
- Stream
- Surface Water

Source: Winnebago County, 2016-18.

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McMAHON ENGINEERS ARCHITECTS
McMAHON ASSOCIATES, INC.

FIGURE 7
STRUCTURAL BMPs
STORMWATER MANAGEMENT PLAN
TOWN OF ALGOMA
WINNEBAGO COUNTY, WISCONSIN

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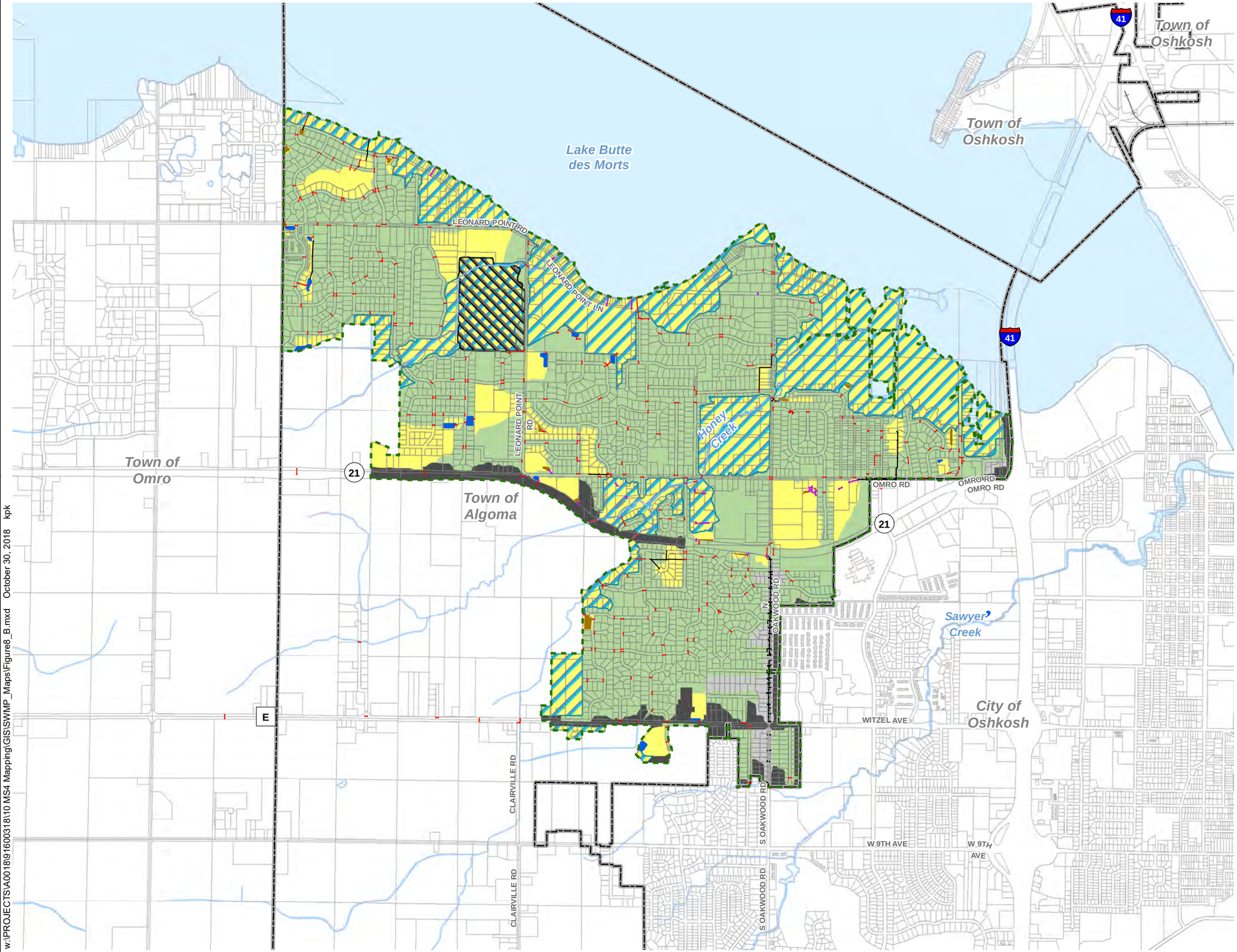

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TOWN OF ALGOMA
A community connected

Surface Drainage
- Curb and Gutter
- No Controls
- Grass Swale

MS4 Drainage System
- Storm Sewer System
- Culvert
- Private Culvert
- Wet Pond
- Dry Pond

Other Mapped Features
- Municipal Boundary
- Study Area Boundary
- Parcel Line
- Railroad Centerline
- Stream
- Surface Water
- Riparian Area
- MS4 'A' to 'B' Area
- Quarry

Source: Winnebago County, 2016-18.

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McMAHON ENGINEERS ARCHITECTS
McMAHON ASSOCIATES, INC.

FIGURE 8
SURFACE DRAINAGE
STORMWATER MANAGEMENT PLAN
TOWN OF ALGOMA
WINNEBAGO COUNTY, WISCONSIN

TOWN OF ALGOMA
A community connected

Lake Butte des Morts

Town of Oshkosh

Fox River

Town of Omro

Town of Algoma

City of Oshkosh

Honey Creek

Sawyer Creek

Jones Park

Well #2

Elevated Storage Tank

Sheldon Nature Area

Steinhilber Wetland Preserve

Oakwood Elementary

Kewaunee Park

Fire Department

Lift Station

Well #1

Town Hall Park

Town Hall

Well #3

LEONARD POINT LN

LEONARD POINT RD

OMRO RD

N OAKWOOD RD

S OAKWOOD RD

WITZEL AVE

W 9TH AVE

CLAIRVILLE RD

21

41

E

1

2

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WPDES Industrial Permits

1 WPDES Industrial Permit ID

Publically Owned Property

- Town of Algoma
- Algoma Sanitary District
- Oshkosh Area School District
- Public Park and Recreation Area
- Municipal Well and 400 Foot Radius Buffer

Other Mapped Features

- Municipal Boundary
- Study Area Boundary
- Parcel Line
- Railroad Centerline
- Stream
- Surface Water

Source: Winnebago County, 2016-18.

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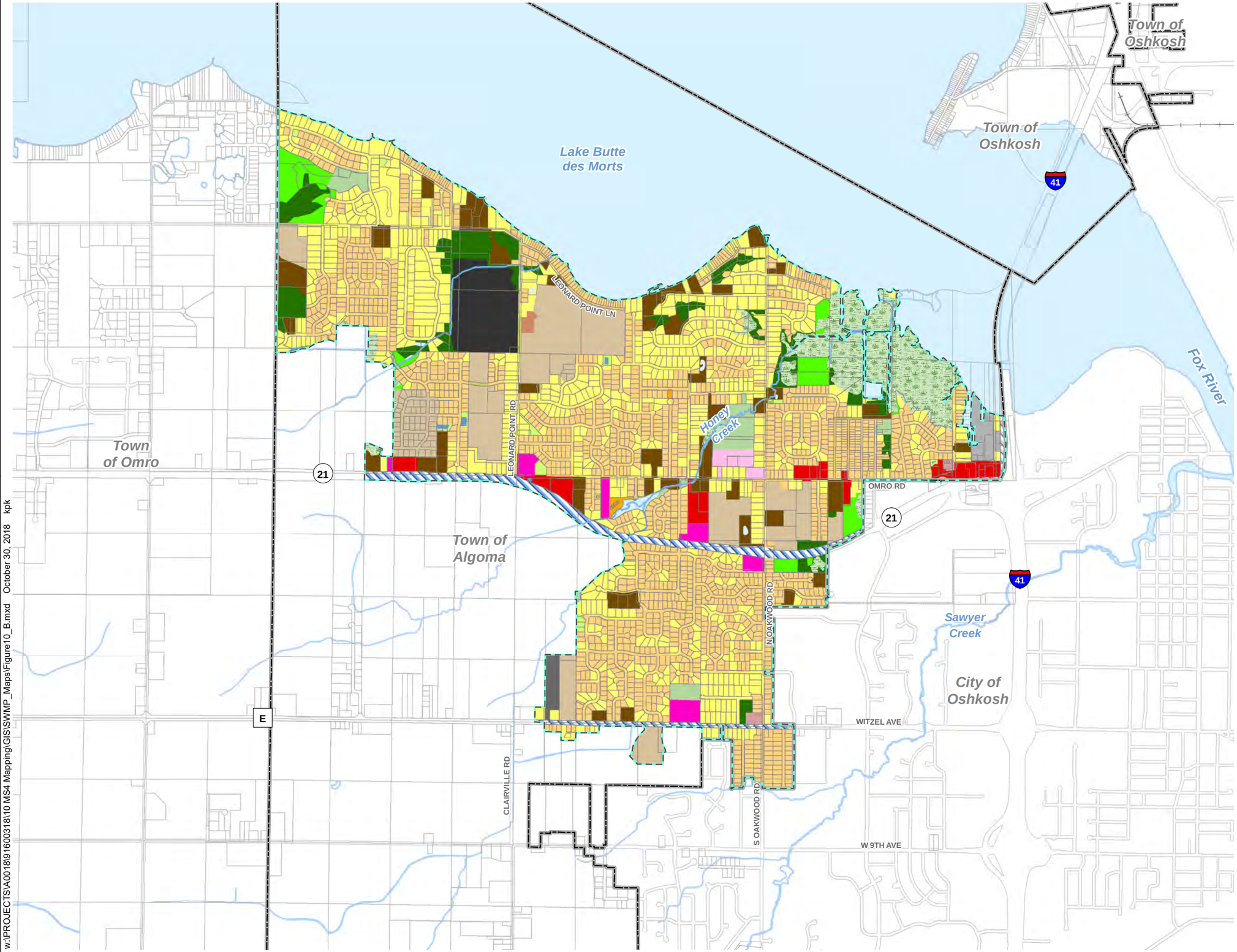
McMAHON ENGINEERS ARCHITECTS
McMAHON ASSOCIATES, INC.

FIGURE 9
WPDES INDUSTRIAL PERMITS
STORMWATER
MANAGEMENT PLAN
TOWN OF ALGOMA
WINNEBAGO COUNTY, WISCONSIN



TOWN OF ALGOMA
A community connected

SLAMM Standard Land Uses

Residential
- LDR - Low Density Single Family Residential (0.5 acre to 1.5 acre lots)
- MDR - Medium Density Single Family Residential (0.25 acre to 0.5 acre lots)
- MDRA - Medium Density Single Family Residential w/Alleys (0.25 acre to 0.5 acre lots)
- HDR - High Density Single Family Residential (0.125 acre lots or smaller)
- HDRA - High Density Single Family Residential w/Alleys (0.125 acre lots or smaller)
- MFR - Multi-Family Residential (3 or more families, 1-3 story height)
- HRR - High Rise Residential (1.5 acre to 5 acre lots, > 3 story)
- SUBR - Suburban Residential (1.5 acre to 5 acre lots)
- MOBR - Mobile Home or Trailer Park Residential

Institutional
- SCHOOL - Public or Private School
- UNIV - University, College, Technical School, etc.
- HOSP - Medical Facilities including Nursing Homes, Hospitals, etc.
- MISC - Miscellaneous Facilities (Churches, Institutional Property)

Commercial
- CDNTN - Downtown Commercial and Institutional Areas
- CSTRIP - Strip Commercial Areas (Courthouses, Police Stations, etc.)
- SHCNTR - Shopping Centers (parking lot is 2.5 times building area)
- OFFPRK - Office Parks (non-retail, multi-story, insurance, government)

Industrial
- LIGHTI - Light Industrial Areas (storage and distribution of goods for retail or sale)
- MEDI - Medium Industrial Areas (lumber, junk, or auto salvage yard, ag., co-op, oil tank farm, coal and salt storage, slaughter house)
- AIRPRT - Airport Facilities
- QUARRY

Open Space
- CEM - Cemeteries, including grounds, roads, and buildings)
- PARK - Outdoor Recreational Areas (golf course, arboretums, botanical gardens, municipal playgrounds, and natural areas)
- RAIL - Railroad ROW (Excludes road ROW, storage yards)
- FRMSTD - Farmsteads, including limited houses, buildings, driveways and parking areas
- AGRIC - Agriculture fields
- GRASS - Undeveloped land that is vegetated (Excludes road ROW)
- GRASS_SWPOND - Vegetated land around a stormwater pond (Excludes road ROW)
- WOODS - Forested or Wooded Areas with Leaf Litter
- WETLND - DNR Wetland Inventory Map
- WATER - Waters of the State and Other Open Waters
- WATER_SWPOND - Open water associated with stormwater pond

Transportation
- FREE - Limited Access Highways and Interchanges, including vegetated ROW
- HWY - State or County Highway
- RURALRD - Rural Road

Other Mapped Features
- Municipal Boundary
- Parcel Line
- Streams
- Urban Planning Boundary

Source: Winnebago County, 2005-18.

N

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McMAHON ENGINEERS ARCHITECTS
McMAHON ASSOCIATES, INC.

FIGURE 10
2004 LAND USE
STORMWATER MANAGEMENT PLAN
TOWN OF ALGOMA
WINNEBAGO COUNTY, WISCONSIN

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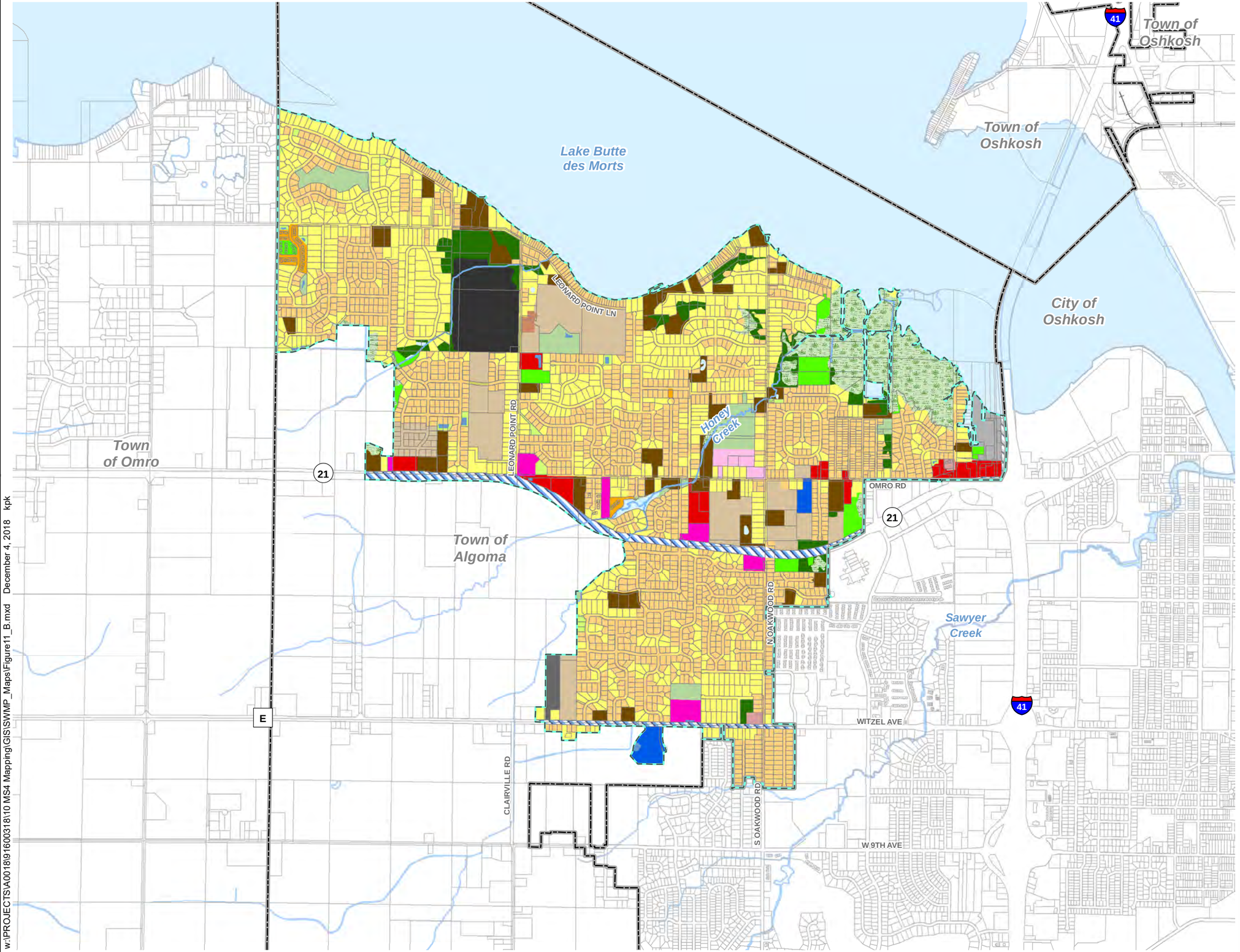

TOWN OF ALGOMA
A community connected

SLAMM Standard Land Uses

Residential
- LDR - Low Density Single Family Residential (0.5 acre to 1.5 acre lots)
- MDR - Medium Density Single Family Residential (0.25 acre to 0.5 acre lots)
- MDRA - Medium Density Single Family Residential w/Alleys (0.25 acre to 0.5 acre lots)
- HDR - High Density Single Family Residential (0.125 acre lots or smaller)
- HDRA - High Density Single Family Residential w/Alleys (0.125 acre lots or smaller)
- MFR - Multi-Family Residential (3 or more families, 1-3 story height)
- HRR - High Rise Residential (1.5 acre to 5 acre lots, > 3 story)
- SUBR - Suburban Residential (1.5 acre to 5 acre lots)
- MOBR - Mobile Home or Trailer Park Residential

Institutional
- SCHOOL - Public or Private School
- UNIV - University, College, Technical School, etc.
- HOSP - Medical Facilities including Nursing Homes, Hospitals, etc.
- MISC - Miscellaneous Facilities (Churches, Institutional Property)

Commercial
- CDNTN - Downtown Commercial and Institutional Areas
- CSTRIP - Strip Commercial Areas (Courthouses, Police Stations, etc.)
- SHCNTR - Shopping Centers (parking lot is 2.5 times building area)
- OFFPRK - Office Parks (non-retail, multi-story, insurance, government)

Industrial
- LIGHTI - Light Industrial Areas (storage and distribution of goods for retail or sale)
- MEDI - Medium Industrial Areas (lumber, junk, or auto salvage yard, ag., co-op, oil tank farm, coal and salt storage, slaughter house)
- AIRPRT - Airport Facilities
- QUARRY

Open Space
- CEM - Cemeteries, including grounds, roads, and buildings)
- PARK - Outdoor Recreational Areas (golf course, arboretums, botanical gardens, municipal playgrounds, and natural areas)
- RAIL - Railroad ROW (Excludes road ROW, storage yards)
- FRMSTD - Farmsteads, including limited houses, buildings, driveways and parking areas
- AGRIC - Agriculture fields
- GRASS - Undeveloped land that is vegetated (Excludes road ROW)
- GRASS_SWPOND - Vegetated land around a stormwater pond (Excludes road ROW)
- WOODS - Forested or Wooded Areas with Leaf Litter
- WETLND - DNR Wetland Inventory Map
- WATER - Waters of the State and Other Open Waters
- WATER_SWPOND - Open water associated with stormwater pond

Transportation
- FREE - Limited Access Highways and Interchanges, including vegetated ROW
- HWY - State or County Highway
- RURALRD - Rural Road

Other Mapped Features
- Municipal Boundary
- Parcel Line
- Streams
- Urban Planning Boundary

Source: Winnebago County, 2016-18.

N

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McMAHON ENGINEERS ARCHITECTS
McMAHON ASSOCIATES, INC.

FIGURE 11
2018 LAND USE
STORMWATER MANAGEMENT PLAN
TOWN OF ALGOMA
WINNEBAGO COUNTY, WISCONSIN

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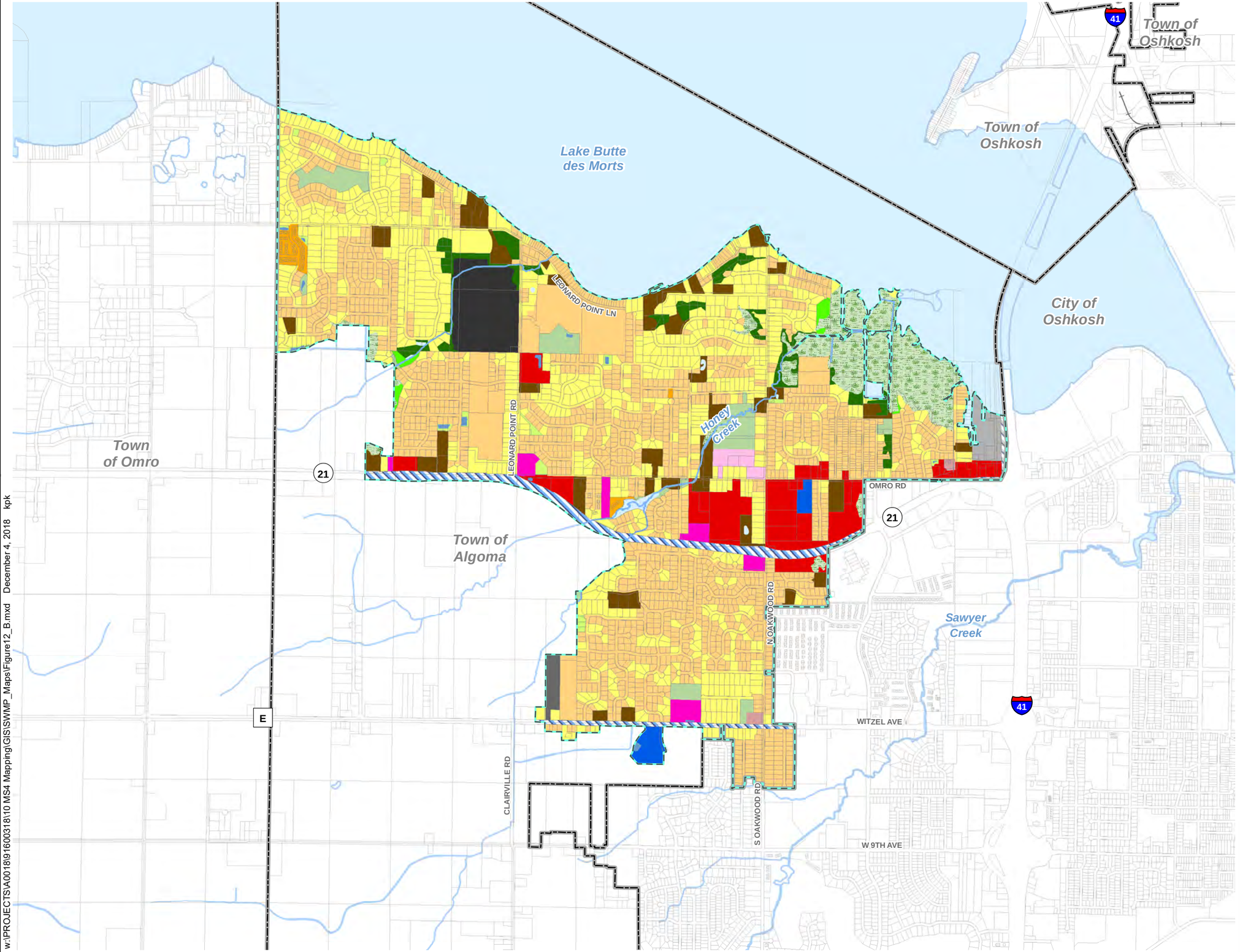

TOWN OF ALGOMA
A community connected

SLAMM Standard Land Uses

Residential
- LDR - Low Density Single Family Residential (0.5 acre to 1.5 acre lots)
- MDR - Medium Density Single Family Residential (0.25 acre to 0.5 acre lots)
- MDRA - Medium Density Single Family Residential w/Alleys (0.25 acre to 0.5 acre lots)
- HDR - High Density Single Family Residential (0.125 acre lots or smaller)
- HDRA - High Density Single Family Residential w/Alleys (0.125 acre lots or smaller)
- MFR - Multi-Family Residential (3 or more families, 1-3 story height)
- HRR - High Rise Residential (1.5 acre to 5 acre lots, > 3 story)
- SUBR - Suburban Residential (1.5 acre to 5 acre lots)
- MOBR - Mobile Home or Trailer Park Residential

Institutional
- SCHOOL - Public or Private School
- UNIV - University, College, Technical School, etc.
- HOSP - Medical Facilities including Nursing Homes, Hospitals, etc.
- MISC - Miscellaneous Facilities (Churches, Institutional Property)

Commercial
- CDNTN - Downtown Commercial and Institutional Areas
- CSTRIP - Strip Commercial Areas (Courthouses, Police Stations, etc.)
- SHCNTR - Shopping Centers (parking lot is 2.5 times building area)
- OFFPRK - Office Parks (non-retail, multi-story, insurance, government)

Industrial
- LIGHTI - Light Industrial Areas (storage and distribution of goods for retail or sale)
- MEDI - Medium Industrial Areas (lumber, junk, or auto salvage yard, ag., co-op, oil tank farm, coal and salt storage, slaughter house)
- AIRPRT - Airport Facilities
- QUARRY

Open Space
- CEM - Cemeteries, including grounds, roads, and buildings)
- PARK - Outdoor Recreational Areas (golf course, arboretums, botanical gardens, municipal playgrounds, and natural areas)
- RAIL - Railroad ROW (Excludes road ROW, storage yards)
- FRMSTD - Farmsteads, including limited houses, buildings, driveways and parking areas
- AGRIC - Agriculture fields
- GRASS - Undeveloped land that is vegetated (Excludes road ROW)
- GRASS_SWPOND - Vegetated land around a stormwater pond (Excludes road ROW)
- WOODS - Forested or Wooded Areas with Leaf Litter
- WETLND - DNR Wetland Inventory Map
- WATER - Waters of the State and Other Open Waters
- WATER_SWPOND - Open water associated with stormwater pond

Transportation
- FREE - Limited Access Highways and Interchanges, including vegetated ROW
- HWY - State or County Highway
- RURALRD - Rural Road

Other Mapped Features
- Municipal Boundary
- Parcel Line
- Streams
- Urban Planning Boundary

Source: Winnebago County, 2016-18.

N

0 2,000 4,000 Feet

McMAHON ENGINEERS ARCHITECTS
McMAHON ASSOCIATES, INC.

FIGURE 12
FUTURE LAND USE
STORMWATER MANAGEMENT PLAN
TOWN OF ALGOMA
WINNEBAGO COUNTY, WISCONSIN

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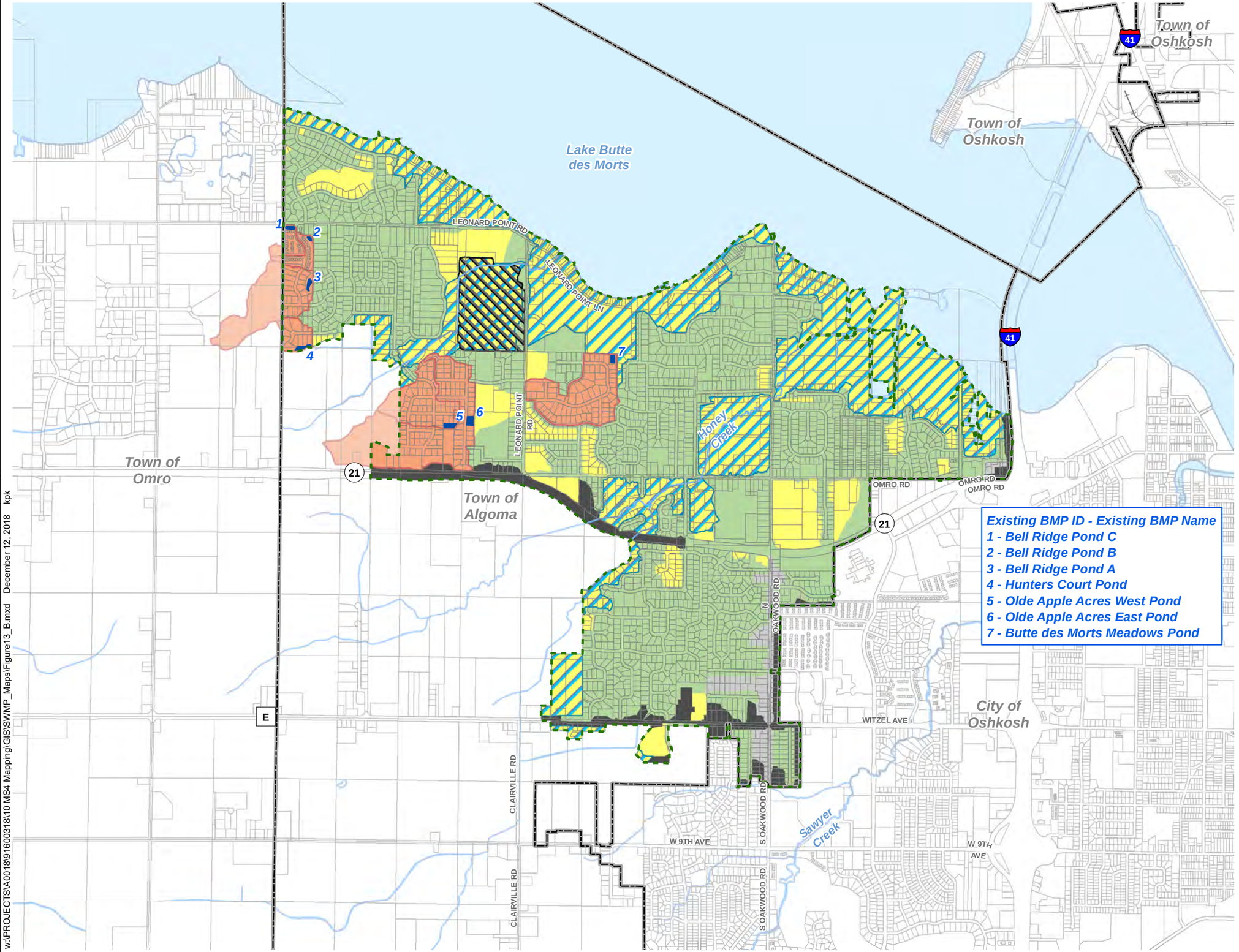

TOWN OF ALGOMA
A community connected

Structural BMPs
- Existing BMP Watershed
- Pond Location

Surface Drainage
- Curb and Gutter (HE Sweeper, Once Every 4 weeks, WPC)
- No Controls
- Grass Swale

Other Mapped Features
- Municipal Boundary
- Study Area Boundary
- Parcel Line
- Railroad Centerline
- Stream
- Surface Water
- Riparian Area
- MS4 'A' to 'B' Area
- Quarry

Source: Winnebago County, 2016-18.

N

0 2,000 4,000 Feet

McMAHON ENGINEERS ARCHITECTS
McMAHON ASSOCIATES, INC.

FIGURE 13
2008 BMPs
STORMWATER MANAGEMENT PLAN
TOWN OF ALGOMA
WINNEBAGO COUNTY, WISCONSIN

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TOWN OF ALGOMA
A community connected

Structural BMPs
- Existing BMP Watershed
- Pond Location

Surface Drainage
- Curb and Gutter (HE Sweeper, Once Every 4 weeks, WPC)
- No Controls
- Grass Swale

Other Mapped Features
- Municipal Boundary
- Study Area Boundary
- Parcel Line
- Railroad Centerline
- Stream
- Surface Water
- Riparian Area
- MS4 'A' to 'B' Area
- Quarry

Existing BMP ID - Existing BMP Name
1 - Bell Ridge Pond C
2 - Bell Ridge Pond B
3 - Bell Ridge Pond A
4 - Hunters Court Pond
5 - Olde Apple Acres West Pond
6 - Olde Apple Acres East Pond
7 - Butte des Morts Meadows Pond
8 - Algoma Self-Storage Pond
9 - Jones Park Pond

Source: Winnebago County, 2016-18.

Disclaimer: The property lines, right-of-way lines, and other property information on this drawing were developed or obtained as part of the County Geographic Information System or through the County property tax mapping function. McMAHON ASSOCIATES, INC. does not guarantee this information to be correct, current, or complete. The property and right-of-way information are only intended for use as a general reference and are not intended or suitable for site-specific uses. Any use to the contrary of the above stated uses is the responsibility of the user and such use is at the user's own risk.

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McMAHON ENGINEERS ARCHITECTS
McMAHON ASSOCIATES, INC.

FIGURE 14
2018 BMPs
STORMWATER MANAGEMENT PLAN
TOWN OF ALGOMA
WINNEBAGO COUNTY, WISCONSIN

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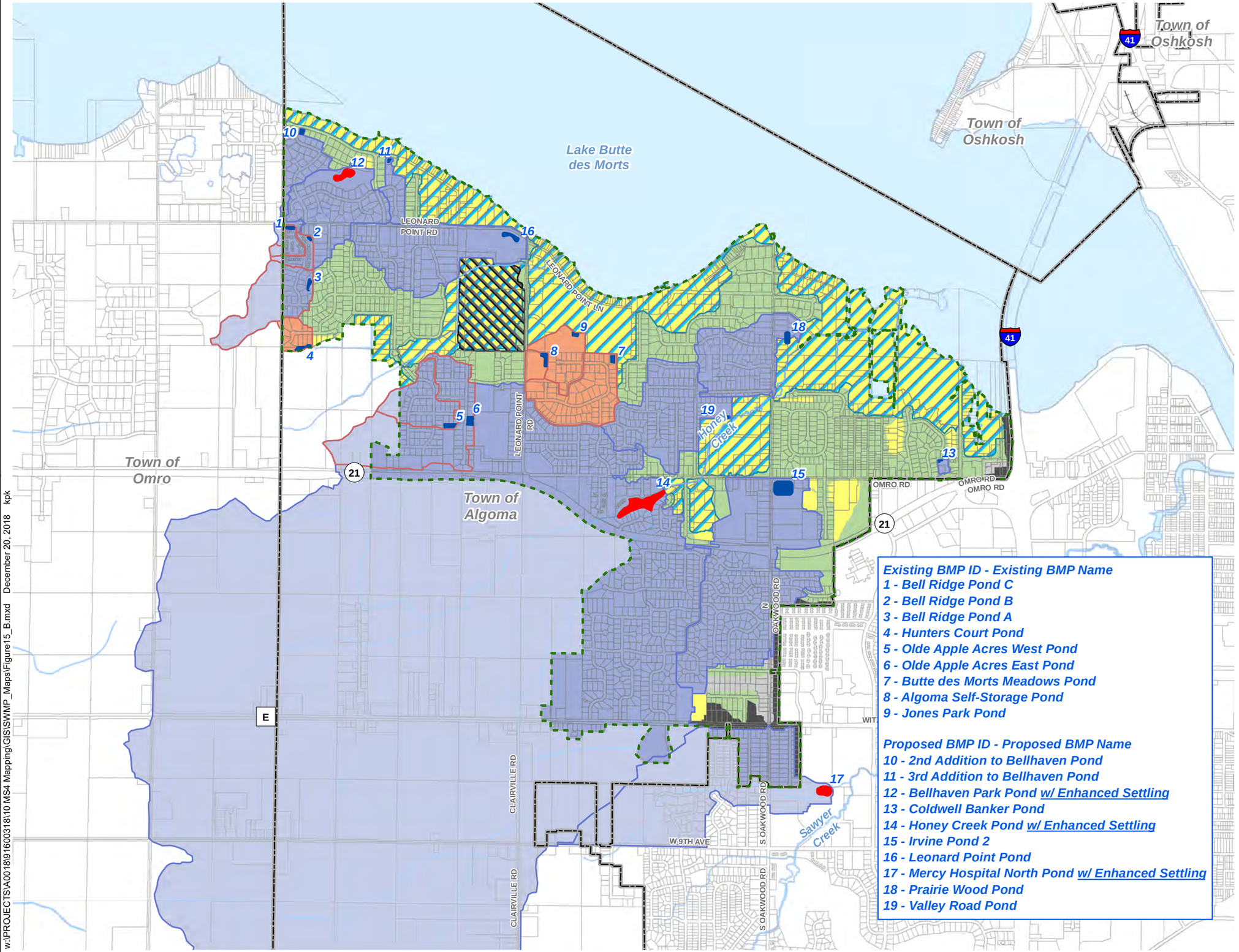

TOWN OF ALGOMA
A community connected

Structural BMPs
- Existing BMP Watershed
- Proposed BMP Watershed
- Wet Pond Location
- Wet Pond Location w/ Enhanced Settling

Surface Drainage
- Curb and Gutter (HE Sweeper, Once Every 4 weeks, WPC)
- No Controls
- Grass Swale

Other Mapped Features
- Municipal Boundary
- Study Area Boundary
- Parcel Line
- Railroad Centerline
- Stream
- Surface Water
- Riparian Area
- MS4 'A' to 'B' Area
- Quarry

Source: Winnebago County, 2016-18.

Existing BMP ID - Existing BMP Name
1 - Bell Ridge Pond C
2 - Bell Ridge Pond B
3 - Bell Ridge Pond A
4 - Hunters Court Pond
5 - Olde Apple Acres West Pond
6 - Olde Apple Acres East Pond
7 - Butte des Morts Meadows Pond
8 - Algoma Self-Storage Pond
9 - Jones Park Pond

Proposed BMP ID - Proposed BMP Name
10 - 2nd Addition to Bellhaven Pond
11 - 3rd Addition to Bellhaven Pond
12 - Bellhaven Park Pond w/ Enhanced Settling
13 - Coldwell Banker Pond
14 - Honey Creek Pond w/ Enhanced Settling
15 - Irvine Pond 2
16 - Leonard Point Pond
17 - Mercy Hospital North Pond w/ Enhanced Settling
18 - Prairie Wood Pond
19 - Valley Road Pond

0 2,000 4,000 Feet

McMAHON ENGINEERS ARCHITECTS
McMAHON ASSOCIATES, INC.

FIGURE 15
ALTERNATIVE 1
TMDL ANALYSIS
STORMWATER MANAGEMENT PLAN
TOWN OF ALGOMA
WINNEBAGO COUNTY, WISCONSIN

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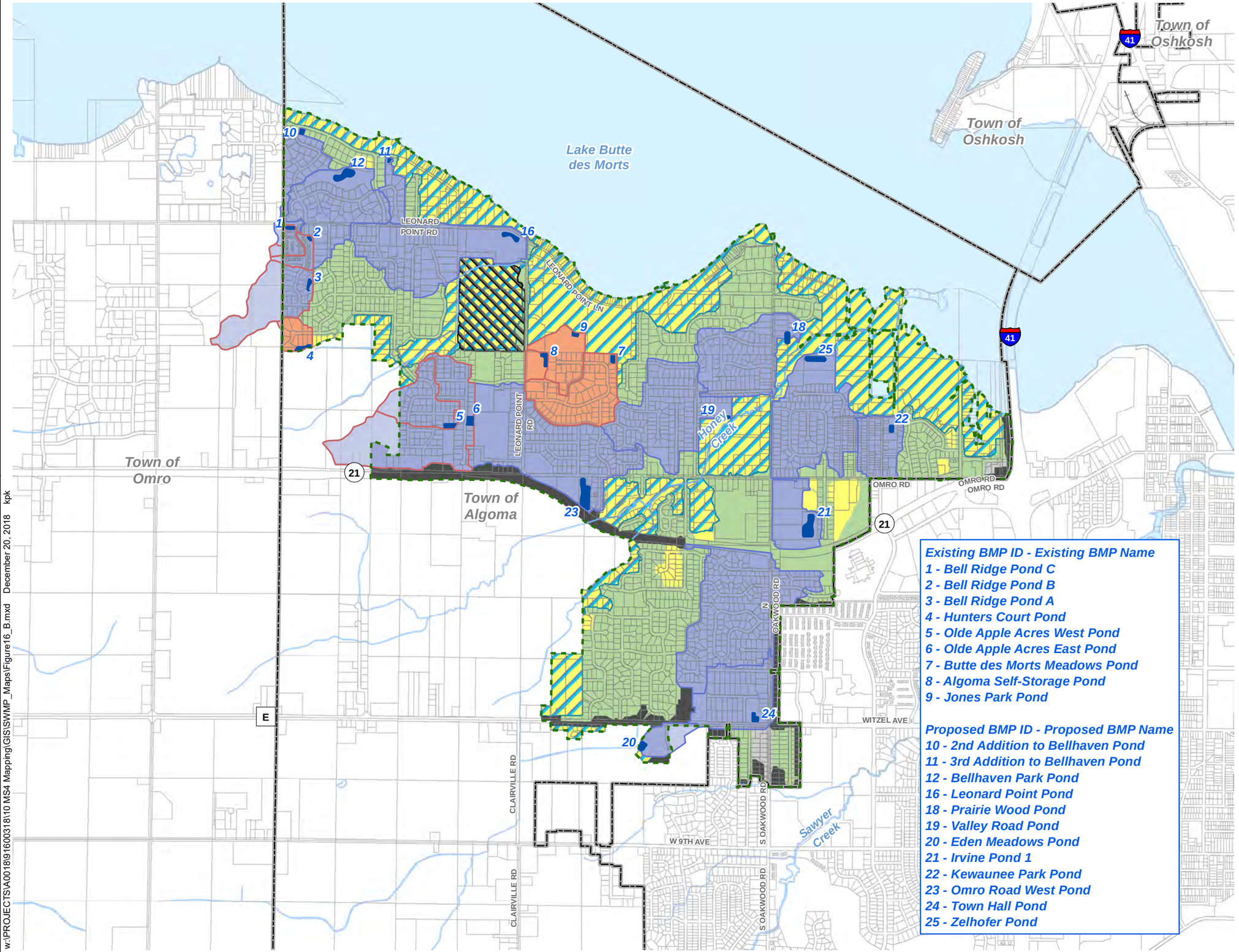

Existing BMP ID - Existing BMP Name
1 - Bell Ridge Pond C
2 - Bell Ridge Pond B
3 - Bell Ridge Pond A
4 - Hunters Court Pond
5 - Olde Apple Acres West Pond
6 - Olde Apple Acres East Pond
7 - Butte des Morts Meadows Pond
8 - Algoma Self-Storage Pond
9 - Jones Park Pond

Proposed BMP ID - Proposed BMP Name
10 - 2nd Addition to Bellhaven Pond
11 - 3rd Addition to Bellhaven Pond
12 - Bellhaven Park Pond
16 - Leonard Point Pond
18 - Prairie Wood Pond
19 - Valley Road Pond
20 - Eden Meadows Pond
21 - Irvine Pond 1
22 - Kewaunee Park Pond
23 - Omro Road West Pond
24 - Town Hall Pond
25 - Zelhofer Pond

TOWN OF ALGOMA
A community connected

Structural BMPs
- Existing BMP Watershed
- Proposed BMP Watershed
- Wet Pond Location

Surface Drainage
- Curb and Gutter (HE Sweeper, Once Every 4 weeks, WPC)
- No Controls
- Grass Swale

Other Mapped Features
- Municipal Boundary
- Study Area Boundary
- Parcel Line
- Railroad Centerline
- Stream
- Surface Water
- Riparian Area
- MS4 'A' to 'B' Area
- Quarry

Source: Winnebago County, 2016-18.

N

0 2,000 4,000 Feet

McMAHON ENGINEERS ARCHITECTS
McMAHON ASSOCIATES, INC.

FIGURE 16
ALTERNATIVE 2
TMDL ANALYSIS
STORMWATER MANAGEMENT PLAN
TOWN OF ALGOMA
WINNEBAGO COUNTY, WISCONSIN

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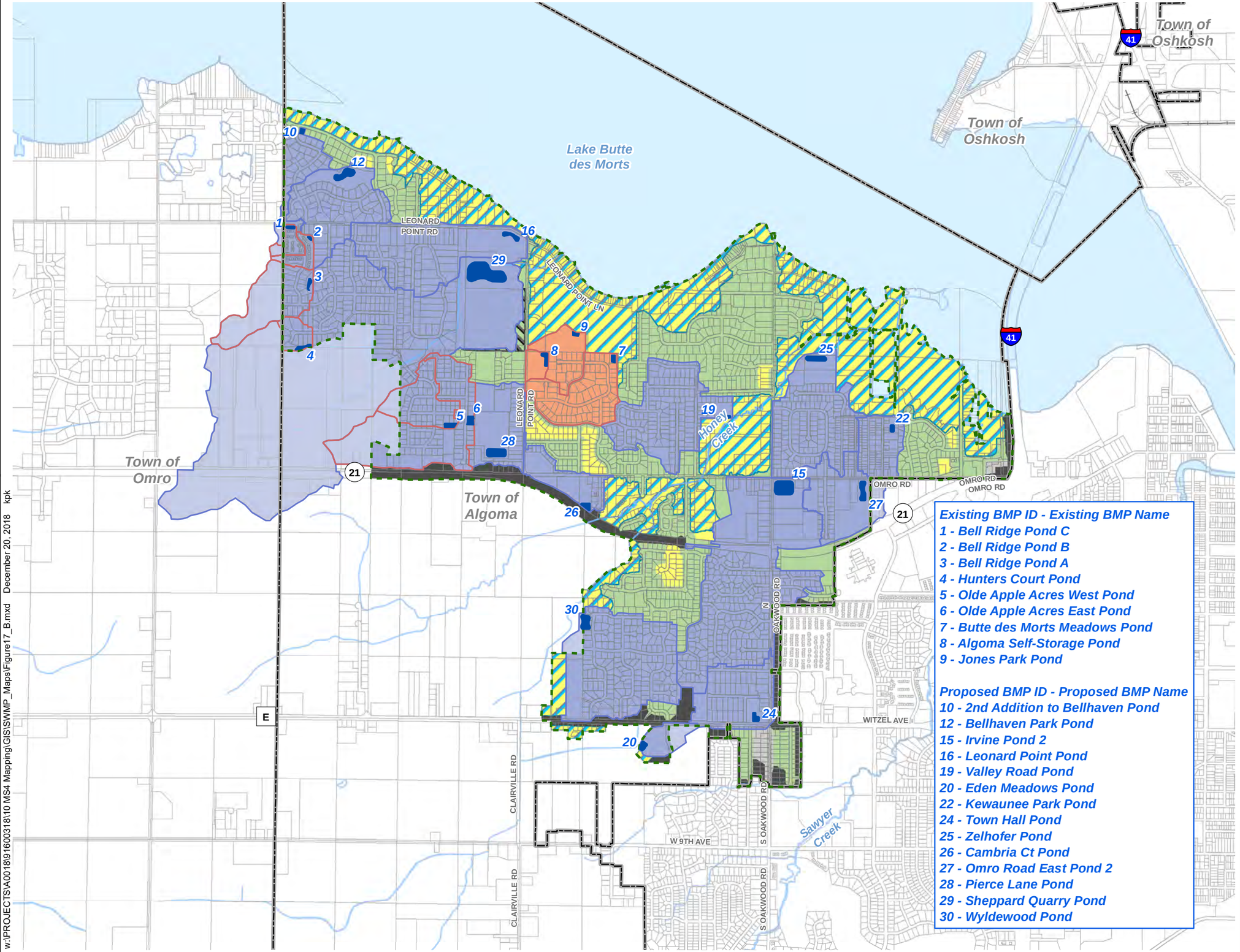

Existing BMP ID - Existing BMP Name
1 - Bell Ridge Pond C
2 - Bell Ridge Pond B
3 - Bell Ridge Pond A
4 - Hunters Court Pond
5 - Olde Apple Acres West Pond
6 - Olde Apple Acres East Pond
7 - Butte des Morts Meadows Pond
8 - Algoma Self-Storage Pond
9 - Jones Park Pond

Proposed BMP ID - Proposed BMP Name
10 - 2nd Addition to Bellhaven Pond
12 - Bellhaven Park Pond
15 - Irvine Pond 2
16 - Leonard Point Pond
19 - Valley Road Pond
20 - Eden Meadows Pond
22 - Kewaunee Park Pond
24 - Town Hall Pond
25 - Zelhofer Pond
26 - Cambria Ct Pond
27 - Omro Road East Pond 2
28 - Pierce Lane Pond
29 - Sheppard Quarry Pond
30 - Wyldewood Pond

TOWN OF ALGOMA
A community connected

Structural BMPs
- Existing BMP Watershed
- Proposed BMP Watershed
- Wet Pond Location

Surface Drainage
- Curb and Gutter (HE Sweeper, Once Every 4 weeks, WPC)
- No Controls
- Grass Swale

Other Mapped Features
- Municipal Boundary
- Study Area Boundary
- Parcel Line
- Railroad Centerline
- Stream
- Surface Water
- Riparian Area
- MS4 'A' to 'B' Area
- Quarry

Source: Winnebago County, 2016-18.

0 2,000 4,000 Feet

McMAHON ENGINEERS ARCHITECTS
McMAHON ASSOCIATES, INC.

FIGURE 17
ALTERNATIVE 3
TMDL ANALYSIS
STORMWATER MANAGEMENT PLAN
TOWN OF ALGOMA
WINNEBAGO COUNTY, WISCONSIN

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