City of Madison TMDL 2020 SLAMM Analysis

City of Madison
Madison, Wisconsin
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Table of Contents

Table of Contents i
List of Figures (see Appendix A) iii
List of Tables iii
List of Abbreviations iv
1 Introduction 1
  1.1 MS4 & NR151 Developed Urban Area Performance Standard for Pollution Reduction 1
  1.2 TMDL and Pollution Reduction Targets 2
  1.3 Summary of Past Reports 3
2 Study Area 3
  2.1 Permitted Area 3
  2.2 Watershed/Reachsheds 4
    2.2.1 Maunesha River (WBIC 888100) 5
    2.2.2 Pheasant Branch Creek (WBIC 805900) 5
    2.2.3 Spring (Dorn) Creek (WBIC 805600) 6
    2.2.4 Nine Springs Creek (WBIC 804200) 6
    2.2.5 Yahara River (WBIC 798300) 7
    2.2.6 Lake Mendota (WBIC 805400) 7
    2.2.7 Lake Monona (WBIC 804600) 8
    2.2.8 Lake Waubesa (WBIC 803700) 8
    2.2.9 Lake Kegonsa (WBIC 802600) 9
  2.3 Subbasin/Treatment Area Delineation 9
  2.4 Precipitation 10
  2.5 Soils 10
  2.6 Land Use 11
    2.6.1 General Background 11
    2.6.2 Data Sources and Methods 11
3 Methodology and Results 12
  3.1 Methodology 12
  3.2 Results: No-controls 14
  3.3 Results: Existing Management Conditions 15
    3.3.1 Street cleaning 15
    3.3.2 Leaf Management 16
    3.3.3 Private Stormwater Treatment Practices 18
    3.3.4 Catch Basin and Proprietary Device Cleaning 19
    3.3.5 Coanda Screen Structure Cleaning 20
    3.3.6 Stormwater SCMs 20
    3.3.7 Summary of Results 30

4 Analysis 32
  4.1 Goals 32
    4.1.1 Reduction of 40% TSS/27% TP from No Controls 32
    4.1.2 Removal of TP in Excess of 27% as Required to Meet TMDL Requirements 33
  4.2 Future Plans 34
Appendix A : Figures 35
Appendix B : Models and Input Files 106
Appendix C : Limitations 107
Appendix D : References 108
Appendix E : WDNR Documents 109

List of Figures (see Appendix A)

Figure 1A: Rock River TMDL Reachsheds in the City of Madison, WI
Figure 1B: Rock River TMDL Watersheds in the City of Madison, WI
Figure 1C: Rock River TMDL Subbasins in the City of Madison, WI
Figure 2: Areas Excluded from Rock River TMDL Modeling in the City of Madison, WI
Figure 3: Rock River TMDL Soils in the City of Madison, WI
Figure 4: Land Use in the City of Madison, WI for Use in Rock River TMDL Modeling
Figure 5: Model Areas
Figure 6: Annual TP Reductions per Leaf Management Guidance By Reachshed

List of Tables

Table 1-1. Reduction targets relative to the TMDL baseline and required reduction targets from no-controls condition for each reachshed. 2
Table 2-1. Area, City acreage, modeled area, and omitted area for each watershed. 4
Table 2-2. Project Area Soil Hydrologic Groups 11
Table 2-3. Land use coverage for the City. 12
Table 3-1. WinSLAMM support files provided by USGS. 14
Table 3-2. Average annual no-controls pollution results for the City 14
Table 3-3. Average annual no-controls load per reachshed. 14
Table 3-4. Leaf management TP reductions by reachshed. 18
Table 3-5. Private stormwater treatment practice TSS and TP removal, by reachshed (lbs/yr). 19
Table 3-6. TSS and TP pollution reduction effectiveness of the existing structural SCMs, catch basin and proprietary device sumps and cleaning, and Coanda screen structure sumps and cleaning by reachshed. 29
Table 3-7. TSS reduction by practice by reachshed. 30
Table 3-8. Annual overall TSS reductions by reachshed. 31
Table 3-9. Annual overall TP reductions by reachshed. 31
Table 4-1. TSS Reductions Required to Achieve 40% TSS Reduction from No Controls by Reachshed 32
Table 4-2. TP Reductions Required to Achieve 27% TP Reduction from No Controls by Reachshed. 33
Table 4-3. TP Quantities to be Purchased Through Yahara WINS Adaptive Management Program 33

List of Abbreviations

ADT	Average daily traffic
BMP	Best management practice
cfs	cubic feet per second
City	City of Madison
EPA	Environmental Protection Agency
GIS	Geographical Information System
HTU	High-traffic urban
MDRNA	Medium density residential – no alleys
MMSD	Madison Metropolitan Sewerage District
MS4	Municipal Separate Storm Sewer System
NRCS	Natural Resource Conservation Service
NRCS	Natural Resource Conservation Service
Plan	Stormwater Management Plan
RI	Remedial Investigation
ROW	Right-of-Way
SCM	Stormwater Control Measures
TMDL	Total Maximum Daily Load
TP	Total Phosphorus
TSS	Total Suspended Solids
USDA	U.S. Department of Agriculture
USGS	Unites States Geological Survey
WAC	Wisconsin Administrative Code
WBIC	Waterbody Identification Code
WDNR	Wisconsin Department of Natural Resources
WinSLAMM	Windows Source Loading and Management Model
WisDOT	Wisconsin Department of Transportation
WLAs	Waste Load Allocations
WPDES	Wisconsin Pollutant Discharge Elimination System

1 Introduction

City of Madison (City) stormwater discharge quality is regulated by a joint Wisconsin Department of Natural Resources (WDNR) Municipal Separate Storm Sewer System (MS4) Permit WI-S058416-4. The most recent permit was issued in 2019. The permit requires the City to conduct various stormwater management programs including reducing stormwater pollution originating from its existing upstream storm sewer system.

In September 2011 the U.S. Environmental Protection Agency (EPA) approved the document: Total Maximum Daily Load and Watershed Management Plan for Total Phosphorus (TP) and Total Suspended Solids (TSS) in the Rock River Basin (WDNR 2012). The Rock River total maximum daily load (TMDL) report specifies waste load allocations (WLAs) for each reachshed (i.e. drainage area) within the City. The 2019 MS4 permit specifies a schedule and requirements for the City to meet TMDL pollution reduction targets. The first step to meet permit compliance is to develop an updated citywide stormwater management plan (Plan) that meets MS4 permit Section 1.8 and 3.7 requirements.

In December 2017 the City completed its Modeling Post-Construction Stormwater Management and Treatment NR151, Wisconsin Administrative Code (City of Madison 2017). This plan focused on mainly the City’s current progress at meeting the revised Chapter NR 151.13 Wisconsin Administrative Code (WAC) standards and the Rock River TMDL WLAs. The 2017 plan documented the City’s stormwater pollution loads and the reduction achieved using the City’s current stormwater control measures (SCMs).

This 2020 update builds upon data generated during the 2017 effort and incorporates new guidance and model updates released since that time. The methodology used, analytical approach, and results are described in this Plan, which fulfills TMDL stormwater planning requirements for the City.

1.1 MS4 & NR151 Developed Urban Area Performance Standard for Pollution Reduction

The developed urban area performance standard for MS4 permit holders has been in place since October 2004, when the City acknowledged WAC NR 151 runoff management targets. This standard requires municipalities to reduce pollution from areas within the city developed since October 2004. When this standard was implemented, the City had to meet TSS pollution reductions from a 20 percent no-controls condition by March 31, 2008, and 40 percent no-controls condition by March 31, 2013. The City applied this control level to Madison as a whole.

Per Wisconsin State budget bill 2011 Wisconsin Act 32, two provisions have passed that directly impact WAC NR 151 developed urban area performance standards:

- The March 31, 2013, deadline for the 40 percent TSS reduction target was removed. The 20 percent TSS reduction target and all performance standards that address new construction and redevelopment are still enforced.
- All structural best management practices in place on July 1, 2011, must be maintained to the maximum extent practicable in locations where a permitted municipality achieved reduction above the 20 percent TSS performance standard.

The pollution reduction analysis performed during the 2017 study found that the City had achieved approximately 36 percent reduction of TSS citywide. This means that the City complies with current WAC NR 151.13 targets so long as it continues to maintain these management measures.

Additionally, the City met with the WDNR December 19, 2019 to discuss several questions regarding the modeling conducted for this report. One of the questions included what is required for showing compliance with this standard (the NR151 Developed Urban Area Performance Standard). The WDNR indicated that since the City was almost to 40 percent TSS reduction, the modeling for this standard did not need to be completed for the 2021 Annual Report Submittal. The meeting minutes from the meeting where this is discussed can be found in Appendix E.

Therefore, the remainder of this document focuses on the pollution reduction analysis for meeting the TMDL pollution reduction targets.

1.2 TMDL and Pollution Reduction Targets

WDNR finalized the Rock River TMDL (collectively referred to as simply, TMDL) in July 2011, and EPA approved it in September 2011 (Cadmus 2011). The document specifies pollution reduction targets for TSS and TP from the basin reachsheds (i.e., the watershed to an identified segment of a stream, river, or other water body as defined in the 2011 TMDL document). The City has eight reachsheds within the TMDL project area; thus, the City has sixteen different goals to meet (eight reachsheds, each with one TSS and one TP target), instead of one general goal for the NR 151 target.

The actual reduction targets (relative to no-controls conditions) are greater than those listed in the TMDL. This is because the TMDL baseline conditions assume that the City is achieving minimum NR 151 requirements, equivalent to a 40 percent TSS reduction and 27 percent TP reduction. Table 1-1 provides the published reduction targets relative to the TMDL baseline conditions (relative to 40 percent TSS reduction and 27 percent TP reduction from no controls, described above) for each reachshed and required reductions from the no-controls condition. See Figure 1 for graphical images of TMDL reachshed drainage areas. (Figures are included in Appendix A.)

Reachshed	**Waterbody Name**	**Waterbody Extents**	**Target TP % Reduction**		**Target TSS % Reduction**	
			Baseline	**No Controls**	**Baseline**	**No Controls**
47	Maunesha River	Stony Brook to Mile 13.2	0	27	0	40
62	Pheasant Branch Creek	Mile 1 to 9	70	78	70	82
64	Yahara River, Lake Mendota, Lake Monona	Nine Springs Creek to Spring (Dorn) Creek, Pheasant Branch Creek	47	61	55	73
65	Nine Springs Creek	Mile 0 to 6	49	63	46	68
66	Yahara River, Lake Waubesa, Lake Kegonsa	Mile 16 to Nine Springs Creek, Lake Waubesa	37	54	37	62

Table 1-1. Reduction targets relative to the TMDL baseline and required reduction targets from no-controls condition for each reachshed.

This document describes the City’s progress towards meeting the pollution reduction targets as specified by the TMDL.

1.3 Summary of Past Reports

Since the City began tracking its pollution reduction efforts for purposes of MS4 permit compliance, the City has submitted five reports. The section documents the names of the reports and the calculated pollution reductions at that time.

In December 2017 the City released Modeling Post-Construction Stormwater Management and Treatment. This report documented the City's stormwater pollution loads for each reachshed (i.e., drainage area) within the City and the reduction achieved using the City's current stormwater control measures. The results of that analysis were a TSS reduction by 35.9% and a TP reduction by 27.1%.

In March 2011, the City released a stormwater management treatment report. The results, using a model called P8, found a TSS reduction by 40.55% on a Citywide Basins for the NR151 Developed Urban Area Performance Standard. TP was not analyzed as the TMDL requirements had not gone into effect yet.

In 2007 the City completed a WinSLAMM analysis looking at TSS and TP reductions. That analysis was completed via a spreadsheet analysis. The results of that analysis were reductions of TSS by 29.6% and TP by 38.6%.

Prior SLAMM (DOS version) analyses were completed in 1997 and again in approximately 2001 with results reported to the WDNR. At this time those results are only available in paper copy and are not readily accessible.

2 Study Area

2.1 Permitted Area

The City's MS4 permit covers all areas under the ownership, control, or jurisdiction of the "permittee" (the City) contributing to discharges from an MS4. The MS4 regulated areas are further defined as meeting any one of the following conditions:

- An urbanized area, adjacent developing areas, and areas where runoff connects (or will connect) to a MS4 regulated per WAC NR 216, subchapter I
- An area associated with a municipal population of 10,000 or more and a population density of 1,000 or more per square mile, adjacent developing areas, and areas where runoff connects (or will connect) to an MS4 regulated per WAC NR 216, subchapter I
- An area draining to an MS4 that is designated for permit coverage pursuant to WAC NR 216.02(2) or 216.025

As of October 2004, to comply with NR 151.13, the project area comprises all developed lands (October 2004 is when the developed urban area standard was put in place). The project area for Rock River TMDL compliance includes urban developed (non-agricultural) land only, and encompasses all area within the City of Madison that drains to the Rock River (areas draining to Badger Mill Creek are not included). For purposes of this project, the City of Madison used land use files dated to Jan 2020.

WDNR issued a policy memorandum in November 2010 to guide performing the municipal-wide analysis and comply with NR 151. A subsequent WDNR policy memorandum was issued in October 2014 to clarify how municipalities should conduct these TMDL analyses. See Appendix B for both policy memoranda.

Permitted municipalities are responsible for any municipal urban stormwater pollution that discharges from their MS4s. The area the City is responsible for within its municipal boundary is referred to as its “analyzed area.”

Within a municipal boundary some areas may discharge to the MS4; however, the municipality is not responsible for, for example, industrial areas under a separate industrial stormwater permit. There are also areas within the municipal boundary that do not enter the MS4 before discharging to state waters; those that may be excluded from NR 151.13 are:

- Agricultural lands
- Tier 1 and Tier 2 Industrial areas
- WisDOT right-of-ways (ROW)
- Riparian areas
- University of Wisconsin-Madison
- Lands owned by Dane County discharging to a Dane County MS4

The modeled areas in each reach shed are a shown in Table 2-1. This table lists the watershed area, City of Madison acreage in each watershed, city modeled area in each watershed, and the areas omitted (shown in Figure 2).

Reachshed	Omitted Area (ac)[1]	Modeled Area with Pollutants Stripped (ac)[2]	City of Madison Modeled Area (ac)
47	0	226	216
62	0	559	2740
64	6182	3158	22178
65	2811	1026	1346
66	3024	1371	5175
City-wide Total	**12017**	**6340**	**31655**

[1] Omitted areas are areas listed as "excluded" above that do not drain to a City of Madison SCM.
[2] Modeled areas with pollutants stripped are areas listed as "excluded" above that do drain to a City of Madison SCM. Hydrologic loading to Madison SCM is accounted for by removing pollutants and routing to the appropriate SCM.

Table 2-1. Area, City acreage, modeled area, and omitted area for each watershed.

2.2 Watershed/Reachsheds

Madison is located within the Lower Rock Basin. Water resources directly impacted by the City’s MS4 system are the Maunesha River, Pheasant Branch Creek, Spring (Dorn) Creek, Nine Springs Creek, Yahara River, Lake Mendota, Lake Monona, Lake Waubesa, and Lake Kegonsa. Several minor, un-named waterways also exist within the project area.

Each water resource is described briefly below; these descriptions are from WDNR’s “Explore Wisconsin’s Waters” website (WDNR 2020). WDNR includes a Waterbody Identification Code (WBIC) within each stream name for reference purposes.

2.2.1 Maunesha River (WBIC 888100)

This large stream drains parts of Columbia, Dane, Jefferson, and Dodge Counties, and empties into the Crawfish River in Dodge County. Much of the watershed in Dane County is ditched and drained wetland. A large percentage is in cropland and soil loss is high. Deansville Marsh is a large, slightly disturbed wetland adjoining the river. The Department of Natural Resources owns 1,459 acres in the marsh, including 4 miles of frontage on the river. This area provides hunting for pheasants, waterfowl, small game, and deer. Impoundments are found above the Villages of Marshall and Waterloo (Jefferson County). Siltation and agricultural runoff are problems above the Marshall Millpond but water quality is good. Below the Village of Marshall water quality is poor due to the fact that the Marshall wastewater treatment plant is presently overloaded. A new plant is scheduled for completion In June 1983.

The river has been chemically treated to remove rough fish several times in the past and largemouth bass, northern pike, channel catfish, and walleye were restocked. The bass and northern pike have some good survival and growth rates, but information on the catfish and walleye has been unattainable. Carp, bullheads, panfish, and forage species are also present. The possibility of developing a smallmouth bass fishery above Marshall Millpond has been suggested but is not likely. Access is available at numerous road crossings, at one county park which has a boat ramp, and through the public lands in the Deansville Marsh. The Deansville Marsh is a popular hunting area for deer, rabbits, and pheasants.

2.2.2 Pheasant Branch Creek (WBIC 805900)

Pheasant Branch Creek is 7-mile-long stream that drains 22.7 square miles of west-central Dane County. Pheasant Branch Creek begins in the glacial moraine area of the Town of Springfield (T8N, R8E, Sec. 34) and flows south and east through the City of Middleton, entering Lake Mendota on its western lobe. A south branch, mostly ditched and draining an urban area, forms Pleasant Branch above Highway 12. Much of the creek has been straightened and most adjacent wetlands have been drained for agricultural and residential development. One important wetland that remains largely intact is the 311-acre Pheasant Branch Marsh. Located near the mouth of the creek, it offers spawning habitat for northern pike.

The worst problem facing Pheasant Branch Creek is a poor base flow and excessive peak runoff that created a high sediment load which threatens the marsh and contributes to lake sediments. The main source of sediment is the erosion of unconsolidated, unstable glacial deposits at the headwaters. This natural erosion is exacerbated by local land development and could be slowed through improved soil conservation measures. Many farmers owning land along the banks have cooperated in innovative soil and water conservation programs.

Other water quality problems include moderately high alkalinity and fertility in addition to unusually high levels of chloride for a creek that receives no municipal or industrial discharges. However, it does collect urban runoff as it flows through Middleton. The natural, steep-sided configuration of the creek channel and its watershed are conducive to spring flooding. The creek has a low base flow in its upper portions where it supports forage fish. A diverse warm water fishery is found downstream where the creek joins Lake Mendota. Waterfowl use the Pheasant Branch Marsh for nesting, and as a wintering area.

2.2.3 Spring (Dorn) Creek (WBIC 805600)

Spring (Dorn) Creek Six-mile-long Dorn Creek originates in the town of Springfield (T8N, R8E, S13) and flows southeast through agricultural lands and Governor Nelson State Park before meeting Six Mile Creek. The stream drains 12.7 square miles that are 78 percent agricultural and 16 percent wetland. Wetlands adjacent to the creek provide wildlife habitat and spawning for northern pike. The creek supports a mainly tolerant warm water forage fishery. Two intolerant species are also known to inhabit the creek--the Northern Redbelly Dace and Pearl Dace.

Spring Creek is a tributary to Six Mile Creek that drains 12.7 square miles in the southwestern portion of Westport Township. This area includes approximately 325 acres of shallow marsh and sedge meadow located near the mouth of the creek and extending upstream (Dane Cty. Reg. Plann. Comm. 1979a). The areas have remained relatively undisturbed and the state has acquired some of these lands for protection as spawning areas for northern pike and panfish. The fresh meadow and wetlands provide habitat for waterfowl, pheasants, rabbits, deer, and furbearers. The waters of Spring Creek are moderately high in chloride, indicating a pollution source, most likely livestock- related. The creek has a high sediment load, causing heavy silting problems in many areas. The fishery is limited to forage species, panfish, and spawning northern pike. Diversity could be increased by improving soil conservation practices within the watershed.

2.2.4 Nine Springs Creek (WBIC 804200)

Nine Springs Creek is six-miles long and is intermittent until just east of Fish Hatchery Road where it picks up flow from the springs that give the stream its name. It empties into the Yahara River just above Upper Mud Lake. Portions of the stream have been ditched and straightened, and the stream runs through an urbanizing area. Channelization has increased summer water temperatures, reduced habitat, and increased sedimentation and excessive growth of aquatic plants.

Sediment is delivered to the stream from farm fields to the south and from construction sites in the cities of Fitchburg and Madison and their sub-watersheds. The creek's heavy sediment load results in the lower portion occasionally requiring dredging. Urban storm water from the cities of Fitchburg and Madison also deliver pollutants to the creek. As the upper portions of the sub-watershed continue to be developed, this problem is expected to increase. These factors, plus its low gradient, cause “fair” water quality, with channel straightening having a devastating effect on water quality and habitat.

Detectable levels of mercury have been found in low concentrations in Nine Springs sediment taken at Moorland Road. The Madison Metropolitan Sewerage District (MMSD) sludge lagoons are adjacent to the stream, including a Superfund site. The possibility of mercury and other substances moving from the lagoon was evaluated in the Remedial Investigation (RI) conducted as part of the Superfund evaluations for the lagoon site. The RI report concluded that no sludge constituents are migrating through the lagoon dike walls; no patterns between sludge and sediment constituents were found to indicate possible migration; the peat acts as a capture zone that restricts migration of sludge constituents to the aquifer beneath the lagoons; and groundwater is not affected by the lagoon sludge constituents (MMSD).

2.2.5 Yahara River (WBIC 798300)

The Yahara River is a large tributary to the Rock River, draining over 1/3 of Dane County. The river is nearly 40 miles in length with 23 miles in the Yahara-Kegonsa watershed. The stretch of the Yahara River in this watershed flows from the dam at Lake Waubesa and ends at the river's confluence with the Rock River. The river is slow-moving in most areas with an average gradient of 3.6 feet/mile and a baseflow of 68.8 cfs as it passes through the largely agricultural landscape. The Yahara River has undergone only limited channelization projects, but its flow has been interrupted at many points by dams and locks built for navigation.

Although there is some point source pollution to the river, the greatest water quality problem in this stretch of the Yahara is from urban and rural non-point source pollution. Urban stormwater run-off carries sediment and pollutants to area surface waters. Rural sources of non-point pollution come from cropland erosion, pesticides, and runoff from barnyards and cattle exercise lots.

The section of the Yahara that flows south from Lake Kegonsa was added to the 303(d) list in 1996. The 303(d) listed waters are those waters, which have impairment that prohibit them from meeting their potential use. Environmental problems have impacted the level of flow, habitat, fish migration, turbidity, dissolved oxygen, and sedimentation on the Yahara River. Efforts have been made over the past 20 years to reduce non-point and point source pollution. Despite these efforts, however, the Yahara River continues to be on the 303 (d) list of impaired waters. Fishkills, usually due to low dissolved oxygen, also continue to be a problem in the Yahara River below Lake Monona.

Since the majority of Dane County s population resides within the Yahara River Valley, development pressure on the Yahara system has been and continues to be intense.

2.2.6 Lake Mendota (WBIC 805400)

At 9,842 acres, Lake Mendota is the largest of the Yahara lakes and almost three times larger than Lake Monona, with only a slightly greater depth. The lake's potential for diverse habitat in and near its bays and shallows is great. But the lake's wide littoral zone, combined with urban development in the immediate basin and agriculture throughout the watershed, has resulted in channels and embayments filling in and subsequent public requests for dredging for recreational motor craft access. Further, about 50 percent of original wetlands in the lake's watershed (which includes Six Mile and Pheasant Branch Creeks Watershed) have been drained or filled (WDNR 1997).

The lake's two watersheds include the urban areas of Middleton, Maple Bluff, Shorewood Hills, Waunakee, DeForest and large portions of Madison. Lathrop (1989b) observed that agricultural runoff is a much larger source of phosphorous to Lake Mendota than to the other Yahara Lakes because its drainage area is 4 to 5 times larger than the drainage area to the three other lakes. Due to the rapid urbanization of land in the lake's watershed, a number of structural and nonstructural nutrient and sediment reduction and retention projects have been started.

In-lake recreation on Mendota is high and includes use of its warm water fishery, sailing, boating, jet skiing, sail boarding, and swimming. Use of Mendota and adjacent wetlands for aesthetic, shoreline and research activities is also popular. The waterbody is one of the most extensively-researched lakes in the United States. Water quality has improved in Lake Mendota during the last 25 years with reduced phosphorous loads resulting in improved water clarity.

2.2.7 Lake Monona (WBIC 804600)

Lake Monona drains a highly urbanized area and much of its shoreline has been developed. Water quality of this large drainage lake is affected by urban polluted runoff as well as the nutrient loading from Lake Mendota and its watershed. Recreational use of Lake Monona is intense, with boaters, water skiers, sail boaters, wind surfers, anglers and swimmers taking advantage of the lake's attributes. The lake has a diverse fishery of perch, panfish, largemouth bass, northern pike, walleye and muskellunge. However, a fish consumption advisory exists for certain fish in the lake.

Algae blooms and excessive plant growth were reported as early as 1888. Abundant rooted aquatic plant growth has historically occurred in Lake Monona, particularly in Monona Bay and Turville Bay. Because the lake's sediment contains large quantities of nutrients, milfoil and curly leaf pondweed growth will likely continue to be a problem, particularly if water clarity continues to improve.

Chloride levels in the lake have slowly increased since the 1960s. Chloride levels in Monona are higher than in Lake Mendota, reflecting the greater proportion of urban runoff received by Monona. Sodium levels have been relatively steady over the last 25 years. Continued increases of sodium and chloride levels could change the species of algae and aquatic plants found in the lake and is a concern.

Portions of the lake have been filled with sediment in the past. Some of this fill material may include toxic substances. Due to elevated levels of mercury in walleye samples, a fish consumption advisory exists. The city of Madison Public Health Department identified Starkweather Creek as one source of mercury contamination in the lake. Recent core samples show decreasing mercury deposition over time. These decreasing concentrations indicate the possibility of reduced bioaccumulation in fish.

2.2.8 Lake Waubesa (WBIC 803700)

The Yahara River flows unimpeded from the Mendota Locks through Lake Monona and Lake Waubesa. The Lake Waubesa Dam, popularly known as the Babcock Park Lock and Dam, is located at the outlet of Lake Waubesa in the Town of Dunn. Dane County constructed the 10 foot dam in 1938 to control lake levels and aid navigation. The dam holds a very small hydraulic head, often less than a foot and dam is often open during the year because the water level is held up by the channel constriction downstream of the dam. The County passes 50 cfs between April 1 and May 15 to aid the spawning of walleye and other fish downstream of the dam. Walleye prefer to spawn in flowing water over gravel substrate. At all other times, a minimum discharge of at least 10 cfs is maintained.

Water quality of the lake has improved since MMSD diverted its treated wastewater effluent away from the lake. The lake still receives large nutrient loads primarily from upstream. The lake also continues to exhibit effects from past nutrient loading. Dissolved reactive phosphorus and total phosphorus levels in the lake have, however, declined, which may be attributed to reduced direct loadings from its watershed and indirect loads from upstream lakes. Lake sediments also contain high concentrations of phosphorus and will continue to affect water quality in the years to come.

Rooted aquatic plant growth, particularly Eurasian water milfoil, has been resurgent in the lake, corresponding to improved water clarity. A fish consumption advisory exists for walleye. Elevated levels of mercury were found in some fish samples taken by WDNR. WDNR is investigating a connection between red sore disease and pseudomonas bacteria. Red sore tends to occur in fish under some stress, and occurs more frequently in the lower Yahara lakes.

More than 500 acres of wetlands exist in the Lake Waubesa watershed. The lake's southern wetlands provide excellent habitat for fish spawning, migratory waterfowl and other wildlife and has a diversity of plant communities. Much of the wetland is in public ownership. A number of springs in and around the wetland provide a constant source of clean water. The primary threats are from alterations of some of the springs, agricultural polluted runoff, and local development and construction. The lake's 139-acre southeast wetland was identified by the 1990 UW-Madison Water Resources Monitoring Workshop as having significant aesthetic and recreational qualities.

2.2.9 Lake Kegonsa (WBIC 802600)

The Yahara River flows into Lake Kegonsa, a large, highly eutrophic, moderately shallow drainage lake. Lake Kegonsa was formed as glacial deposits dammed the Yahara River. It is the furthest downstream of all of the Yahara River lakes and has a surface area of 3,209 acres and a maximum depth of 31 feet. The Kegonsa dam maintains water levels between 843.0 and 843.5 based upon the 1929 datum. Lake Kegonsa is located outside of the central urban area and it is surrounded primarily by agricultural land with the shoreline dominated by seasonal cottages and year-round homes.

Water quality has improved over the last 40 years since the Madison Metropolitan Sewerage District diverted wastewater from the area's lakes. Yet, excess sediment, nutrient and chloride loads from upstream lakes, from the Yahara River, Door Creek and surrounding agricultural land continue to affect the lake's water quality. Despite overall reductions in nutrient loads, severe blue-green algae blooms still occur during summer, restricting beneficial aquatic plant growth. The health of the lake is also affected by the growth of undesirable, non-native, macrophyte plant growth.

The lake is highly turbid, but modest improvements in water clarity would allow limited growth of aquatic plants, benefiting the lake's fishery. Fish kills have occurred in the past, some attributable to natural causes while the cause of others remains undetermined. Fish sampling in Lake Kegonsa has detected toxic contaminants, but at levels below health concern standards.

2.3 Subbasin/Treatment Area Delineation

Figure 1 (see Appendix A) shows maps of the reachsheds, watersheds, and subbasins in the study area.

The subbasins used for this analysis effort differ significantly from those submitted with the City 2017 report. Changes made to the subbasins were made to increase the accuracy of the subbasin delineations. The subbasin boundaries submitted with the 2017 report were based heavily on City-wide delineations completed in 1993. Since that time, the City of Madison has undergone significant development, changing the boundaries of the subbasins, and in some cases, the watersheds. In addition, more accurate Lidar data has refined staff’s understanding of the topography and the drainage patterns within the City. As a result of these changes, City staff decided that fully re-delineating subbasins within the City would be the best approach to this modeling effort.

Additionally, 2019 marked the beginning of the City’s watershed study program. As part of that program, subbasins in all watersheds studied up to this date have been delineated to a very precise level of detail. In all watersheds that had previously been studied, City staff used the delineations from those studies to construct the subbasins used for the TMDL modeling.

In addition to re-delineating watersheds through the City for this TMDL modeling effort, City staff also chose to delineate subbasins differently than was done previously. The subbasins used in the 2017 modeling effort were delineated to each 36” pipe, and were assigned alpha numeric codes detailing the watershed, major basin, a unique identifier and whether or not treatment was received. Those names were consistent with Dane Country naming convention. However, for the current TMDL modeling effort, the City elected to delineate subbasins to the first downstream treatment device, thus consolidating some of the previous subbasins and sub-dividing others.

This was done due to WinSLAMM program limitations. In the 2017 modeling effort, City staff found that the WinSLAMM program struggled to run large models. Consolidating subbasins based on the treatment device decreased model size without sacrificing accuracy, which allowed City staff to more efficiently construct WinSLAMM models for the City.

2.4 Precipitation

The City used precipitation data as a parameter in WinSLAMM. When modeling stormwater pollution loadings, cumulative runoff and pollution loads from the more frequent “normal” rain events (i.e., 0.25- to 1.5-inch [in.] rains) are more important than pollution from the less frequent “larger” rain events. This is because the normal events (more frequent) generate most urban stormwater runoff volume in any given year. Modeling simulations are performed with rainfall records for a representative time frame per WDNR.

Current WDNR guidance stipulates that rainfall records for a 5-year period should be used during modeling if street sweeping is used as a BMP. Rainfall input files were developed for several locations throughout Wisconsin, and WDNR specified that the file location closest to the project area must be used for the analysis. Thus, the City used the Madison 5-year rainfall file for rain events between 1980 and 1984 for stormwater pollution modeling.

2.5 Soils

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

Per the NRCS Soil Survey, the most predominant soil group within Madison is Group B soils, followed by Group D, then Group C, and the smallest being soil Group A. NRCS Soil Survey (developed to provide general soil characteristics on a regional basis) information shows that these soils exhibit a wide range of properties and infiltration ability. Actual soil conditions for a specific location can vary from the general (i.e., mapped) condition.

WinSLAMM requires inputs that characterize the soil type for the study area. Allowable inputs in the WinSLAMM model are terms like: “Sandy,” “Silty,” or “Clayey.” For this analysis, soils in Hydrologic Group A are “Sandy,” soils in Hydrologic Group B are “Silty,” and soils in Hydrologic Group C or D are

“Clayey.” Table 2-2 summarizes the extent of soil hydrologic groups within the project area. Figure 3 (see Appendix A) displays the soil group distributions within the city.

Hydrologic Soil Group (USDA/NRCS)	Texture	Project Area Percent Coverage (%)
A	Sandy	0.80
B	Silty	54.73
C or D	Clayey	44.47

Table 2-2. Project Area Soil Hydrologic Groups

2.6 Land Use

This section provides general background details, data sources, and methods the City used to create the land use data for this study.

2.6.1 General Background

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

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

2.6.2 Data Sources and Methods

To create the land use categories for this TMDL analysis, the City analyzed land use data collected up to January 2020 by the City of Madison Assessor, and compared that data to the land use information used in the previous plan (2017), the most recent aerial photograph, development data, and the municipal boundary. Each parcel within City boundaries was assigned a WinSLAMM-compatible standard land use based on the above data sources. Areas outside the City of Madison municipal boundary but within the drainage area of a City of Madison SCM were assigned a WinSLAMM-compatible standard land use based on Dane County land use information from 2015. Land use conditions for the TMDL analyzed area include land developed until and including January 2020.

Figure 4 (see Appendix A) shows the land use categories used for the pollution analyses. Table 2-3 summarizes land use coverage for the City’s MS4 for the TMDL. Table 2-3 also shows land use categories that match Windows Source Loading and Management Model (WinSLAMM) categories, and only in the respective analyzed areas.

Land Use	Acres Analyzed	Percentage of City Area (%)
Cemetery	168	0.5%
Downtown	193	0.6%
Duplex	710	2.3%
High-density residential (no alleys)	1405	4.5%
High-density residential (with alleys)	110	0.4%
High rise residential	154	0.5%
Hospital	234	0.7%
Institutional	608	1.9%
Light industrial	1110	3.5%
Low-density residential	606	1.9%
Medium-density residential (no alleys)	6203	19.8%
Medium-density residential (with alleys)	30	0.1%
Medium industrial	1375	4.4%
Mobile home	111	0.4%
Multi-family residential	1922	6.1%
Office park	1557	5.0%
Open space	2971	9.5%
Park	3725	11.9%
School	707	2.3%
Shopping center	931	3.0%
Street (High-Traffic Urban)	441	1.4%
Street (not High-Traffic)	4758	15.2%
Strip mall	1067	3.4%
Suburban	252	0.8%
Total	31349	100.0%

Table 2-3. Land use coverage for the City.

3 Methodology and Results

This section documents the City’s study methodology and current progress toward meeting its stormwater pollution reduction goals.

3.1 Methodology

To calculate urban stormwater pollutant loads and reductions due to SCMs within the City, City staff used WinSLAMM Version 10.4.1, WinSLAMM Version 10.4.225 and WinSLAMM Version 10.5.037. WinSLAMM Versions 10.4.225 and 10.5.037 are non-commercially available “beta” versions of the WinSLAMM program, developed by PV Associates for the City under contract between the City and PV Associates. WinSLAMM Version 10.4.225 was developed to include a copy-paste function for control practices between different WinSLAMM models, and after the de-bugging process is completed will be issued widely as WinSLAMM Version 10.4.2. WinSLAMM Version 10.5.037 was developed to allow inter-model linking of hydrographs and pollutographs, as further described in Section 3.3, and after the de-bugging process is completed will be issued widely as WinSLAMM Version 10.5.1. All WinSLAMM results presented in this report have been generated using WinSLAMM 10.5.037. WinSLAMM is the most widely used small-storm urban pollutant loading and reduction model in Wisconsin.

The City delineated the project area, as described in Section 2, based on WDNR guidelines to meet TMDL compliance targets for the Rock River TMDL. To conduct these analysis in compliance with WDNR guidelines and define the no-controls and with controls conditions, the City created a geographical information system (GIS) database containing information about stormwater pollution and SCMs in the City, including:

- Hydrologic units/subbasins
- Soil types and classifications
- Land use, as of January 7, 2020 (as collected for the City of Madison Assessor’s office database)
- Road meeting the High-Traffic Urban (HTU) definition
- Permitted entities within the municipal boundary (regulated Tier 1 and Tier 2 permitted industrial properties, WisDOT ROWs, Dane County MS4s, and the University of Wisconsin – Madison)
- Permitted entities outside the City of Madison municipal boundary that drain to a City structural SCM
- Existing street cleaning program
- Existing catchbasin/proprietary device/Coanda screen structure cleaning program
- Existing leaf management program
- Private stormwater treatment practices permitted by the City of Madison
- Existing structural SCMs under the City’s jurisdiction

WinSLAMM requires input files that describe soil, land cover, drainage system, and precipitation characteristics, and other factors composing the project area. The model uses a 5-year rainfall record to calculate runoff and pollution loads. The City of Madison used the 1980-1985 rainfall data for Madison for this application (entered in WinSLAMM as the “WisReg – Madison Five Year Rainfall.ran” file).

WinSLAMM also requires support files. The United States Geological Survey (USGS) and WDNR developed versions of these files for use in Wisconsin, which are based on extensive field monitoring and calibration. The latest versions of these WinSLAMM files provided by the USGS with the WinSLAMM program and used for this project are listed in Table 3-1.

Parameter		Input File
Rain File		WisReg – Madison Five Year Rainfall.RAN
Pollutant Probability Distribution File		C:\WinSLAMM Files\WI_GEO03.ppdx
Runoff Coefficient File		C:\WinSLAMM Files\WI_SL06 Dec06.rsvx
Particulate Solids Concentration File		C:\WinSLAMM Files\v10.1 WI_AVG01.pscx
Street Delivery File	Residential LU	C:\WinSLAMM Files\WI_Res and Other Urban Dec06.std
	Institutional LU	C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std
	Commercial LU	C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std
	Industrial LU	C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std
	Other Urban LU	C:\WinSLAMM Files\WI_Res and Other Urban Dec06.std
	Freeways	C:\WinSLAMM Files\Freeway Dec06.std
Source Area PSD and Peak to Average Flow Ratio File		C:\WinSLAMM Files\NURP Source Area PSD Files.csv
Source Area Particle Size Distribution File		C:\WinSLAMM Files\NURP.cpz

Table 3-1. WinSLAMM support files provided by USGS.

3.2 Results: No-controls

The City evaluated pollution loads for the Rock River TMDL area within the City boundary. This section presents the pollution load without SCMs implemented (the no-controls condition).

The City calculated the pollution loading (assuming no controls are implemented) for the City's jurisdictional area. Per the TMDL, the City must target pollution reduction down to the WLA for each reachshed (47, 62, 64, 65, 66) within the City proper. Table 3-2 shows the average annual no-controls pollution results for the City and Table 3-2 shows the results by reachshed.

Rock River TMDL Reachshed ID	No Controls Annual TSS Load (lbs/yr)	No Controls Annual TP Load (lbs/yr)
47	50,991	172
62	675,103	2,247
64	6,930,111	21,706
65	434,983	1,268
66	1,497,920	4,446
City-wide Total	**9,589,108**	**29,839**

Table 3-22. Average annual no-controls pollution results for the City.

Rock River TMDL Reachshed ID	No Controls Annual TSS Load (lbs/yr)	No Controls Annual TP Load (lbs/yr)
47	50,991	172
62	675,103	2,247
64	6,930,111	21,706
65	434,983	1,268
66	1,497,920	4,446
City-wide Total	**9,589,108**	**29,839**

Table 3-2. Average annual no-controls load per reachshed.

The TMDL baseline condition assumes that municipalities have achieved a 40 percent TSS reduction; however, for this analysis the City calculated the pollution loads for each reachshed during a no-controls condition (i.e. the same conditions as the developed urban area standard no-controls conditions).

3.3 Results: Existing Management Conditions

Once the no-controls condition load was established, the City evaluated the City's current SCMs. As defined in the scope of work for this project, the existing practices the City analyzed were:

- Street cleaning
- Catch basin and proprietary device cleaning
- Coanda screen structures
- Leaf management
- Private stormwater treatment practices
- Existing structural SCMs
    - Wet ponds
    - Dry ponds
    - Infiltration basins
    - Large bioretention basins

The City calculated the pollution control effectiveness of these SCMs to determine the level of TSS and TP control to achieve targeted WLAs.

The current WinSLAMM version can route by hydrographs and pollutographs through multiple SCMs within a watershed. This feature prevents "double-counting" pollution control from runoff treated through more than one practice (e.g., street sweeping in a watershed draining to a stormwater pond). Because of this feature, the pollution load reduction from a specific control practice within a watershed cannot be easily reported; therefore, the results in this section will vary based on the types of treatment levels within various watersheds.

For example, street cleaning is included in every watershed because all streets are cleaned by the City. Where additional SCMs exist in a watershed, the pollution load will be reported for the entire watershed reduction (accounting for routing the hydrographs and pollutographs for all types of SCMs). The results for a single SCM will be reported only if there are no other SCMs in the watershed.

While running large models in WinSLAMM, City staff noticed frequent memory errors when the five-year rainfall file was run, two pollutants (TSS and TP) were tracked, and/or street cleaning was included throughout the model as a source-area control practice. To allow these large models to be split but still route the hydrograph and pollutograph correctly through each modeled watershed, the City contracted with PV Associates to modify the WinSLAMM model to allow for the export of a hydrograph and pollutograph from one model and their import into a second model. The City utilized beta version 10.5.037 for all final modeling described in this report; after de-bugging is completed, it will be widely issued as WinSLAMM Version 10.5.1.

3.3.1 Street cleaning

The City performs street cleaning on a regular basis throughout the non-winter season. Through most of the City jurisdictional area, the City sweeps all city streets with curb and gutter drainage once per month throughout the non-winter season. In the City's designated Snow Emergency Area, the City performs street cleaning once per week during the non-winter season. These street cleaning areas are included with this report as Figure 5 (see Appendix A).

In the Snow Emergency Area, which is densely populated, the parking density in WinSLAMM is defined as "Extensive (Short Term)." In all other areas, the parking density in WinSLAMM is defined as "Light." Because the City street cleaners can generally reach the curb when cleaning, parking controls are imposed throughout the City.

The City uses seven mechanical broom sweepers and one vacuum-assisted sweeper. In the Snow Emergency Area, only a mechanical broom sweeper is used. In all other parts of the City, sweeping equipment is rotated. To account for this variability in WinSLAMM, the City designated approximately 1/8 of monthly-swept area in each TMDL reachshed to be swept using the vacuum-assisted sweeper. All other areas were assigned mechanical broom sweeping.

WinSLAMM models can now analyze streets that are considered high-traffic urban. Recent studies reveal that street cleaning is more effective on high-traffic urban streets. For a street to be considered high-traffic urban it must have the following characteristics:

- Average daily traffic (ADT) rate greater than 6,000 vehicles per day
- Posted speed limit is 30 miles per hour or faster
- No parking
- Constructed with the curb and gutter in good condition

Figure 5 shows the high-traffic urban street locations and cleaning frequency throughout the City. Street cleaning is accounted for on a citywide basis and is included in reductions for regional structural SCMs. Table 3-6 lists the TSS reduction results from street cleaning for each reachshed.

3.3.2 Leaf Management

On October 5, 2017, the WDNR released its "Interim Municipal Phosphorus Reduction Credit for Leaf Management Programs." This guidance outlined the WDNR's preliminary approach to quantifying TP reduction credit for municipalities with fall leaf management programs. The City has a robust fall street leaf collection program in place, and is actively partnering with the USGS in Middleton, WI on its leaf study, which aims to provide further data on how leaf management affects dissolved phosphorus in runoff, both overall and seasonally. The City provided comment to the WDNR on the draft guidance on November 9, 2017. The draft guidance is included with this report with Appendix E.

The draft guidance states that municipalities may assume 17% TP reduction in areas where the following conditions are met:

1. Medium Density (2-6 units/acre) Residential (Single-family) land use without alleys. Medium density Residential with alleys land use may be included if the alleys receive the same level of leaf collection and street cleaning as the streets.
2. Curb and gutter with storm sewer drainage systems.
3. A tree cover defined as an average of one or more mature trees between the sidewalk and the curb for every 80 linear feet of curb. Where sidewalk is not present, trees within 10 feet of the curb may be counted toward tree cover. Generally, this equates to a tree canopy over

the street of 17% or greater. Field investigations or aerial photography may be used to document the tree cover.

4. The municipality has an ordinance prohibiting residents from placement of leaves in the street and a policy stating that residents may place leaves on the terrace in bags or piles for collection.
5. Municipal leaf collection provided at least 4 times spaced throughout the months of October and November. Leaves may be pushed, vacuumed, or manually loaded into a garbage vehicles. No leaf piles are left in the street overnight.
6. Within 24 hours of leaf collection, remaining leaf litter in the street must be collected using street cleaning machines, such as a mechanical broom or vacuum assisted street cleaner. A brush attachment on a skid steer is not an acceptable equivalent.

The draft guidance states that “further evaluation is required to determine how leaf collection methods may reduce loading to structural best management practices (BMPs) such as ponds. Therefore, this credit may not be taken in addition to phosphorus reductions from other BMPs in the drainage area at this time.” However, due to complexities of isolating medium density residential – no alleys (MDRNA) land uses from other land uses for each subwatershed, calculating a 17% reduction for just those areas where the canopy cover requirement above is met, and comparing that number to the TP reductions from the use of traditional treatment practices, the City chose to work with the WDNR to develop an acceptable method of calculating a TP reduction credit after modeling was completed.

The Madison USGS leaf study (Selbig 2016) has demonstrated that the leaf leaching contribution to the phosphorus content of runoff water is nearly entirely dissolved phosphorus; as ponds, catchbasins and other traditional treatment practices target particulate phosphorus, the USGS study would suggest that leaf management and traditional treatment devices target phosphorus in separate phases and, thus, are unlikely to overlap in their effect. Additionally, the same study showed that on average, the TP content of runoff is approximately 50% dissolved phosphorus and 50% particulate phosphorus. Therefore, City staff estimated that an assumption of 8.5% TP removal (half of the 17% TP removal allowed in the draft guidance) due to leaf management, applied in addition to TP removals from traditional stormwater practices (calculated in WinSLAMM), for MDRNA land uses that meet the canopy cover requirements outlined in the draft guidance, would be a conservative and scientifically sound value. City staff discussed this methodology with WDNR staff, who approved their approach.

City staff used ArcGIS to isolate MDRNA parcels and intersect those parcels with watershed boundaries to calculate total MDRNA acreage in each watershed. City staff then added the City of Madison Forestry Division tree inventory layer and the City of Madison street centerline layers and cropped them by proximity to MDRNA areas in each watershed, giving a total street length and tree count in MDRNA areas within each watershed. The tree inventory was then limited to trees 10” in diameter and greater to ensure that only trees with significant canopy cover were included in calculations. Finally, the street distance was multiplied by two (to account for two curb lines/street) and divided by the number of trees to obtain the curb length per tree in each watershed. This value was then divided by 80 to obtain an estimate of the percentage of roads, and MDRNA area, in each watershed that meet the draft guidance requirements.

After calculating the applicable area, City staff built a “control” model with one land use (MDRNA, 100 acres) and no controls. This model was used to obtain the “no controls” TP loading for 100 acres of MDRNA, which was calculated to be 96.79 lbs/year. For each watershed, this value was scaled to match the total MDRNA acreage in the watershed, then scaled again to apply only to the calculated applicable area (based on trees/curb length, as discussed in the paragraph above). These calculations resulted in TP loadings for each watershed that the City considered "eligible" for the leaf management TP reduction; for each watershed, the TP reduction due to leaf management efforts was estimated by calculating 8.5% of that eligible TP loading. These leaf management TP reductions are summarized, by reachshed, in Table 3-3 and are shown in Figure 6.

Reachshed	Annual TP Reductions from Leaf Management (lbs)
47	0.0
62	15.4
64	210.1
65	17.0
66	23.9
City-wide Total	**266.4**

Table 3-3. Leaf management TP reductions by reachshed.

3.3.3 Private Stormwater Treatment Practices

The City permits over 500 private stormwater treatment practices within its jurisdictional boundary. During the City's 2017 MS4 water quality modeling effort, City staff worked with WDNR staff to develop an acceptable methodology to take credit for pollutant reductions from private practices without entering them into the City's overall WinSLAMM model. The agreed-upon methodology is included as an email in Appendix E.

For the current analysis, the City reviewed the guidance and determined that applying it for all permitted private stormwater treatment practices in the City would require a significant time expenditure, and that private stormwater treatment practices draining to City SCMs would be unlikely to provide significant pollutant reductions as compared to areas with no SCMs. Therefore, the City identified only those private stormwater treatment practices located in areas that do not drain to an SCM. For those practices, City staff pulled site stormwater management plans to quantify No Controls TSS loads, With Controls TSS loads, and TSS Percent Reductions per year.

Some private sites were missing formal stormwater management reports. In those instances, the stormwater permits were examined and the site area, site land use (commercial, multi-family residential, industrial, or other), and TSS reduction required by permit were recorded. For each represented site land use, a representative WinSLAMM file was run to calculate the annual TSS and TP load for 1 ac of that land use. Using those values and site areas, City of Madison staff were able to calculate No Controls TSS loads, With Controls TSS loads, and No Controls TP loads for sites with permits but without stormwater management reports.

City ordinances do not require permittees to report TP loading or reductions in their site stormwater management plans or water quality calculations. To account for TP load reductions, the City first had to calculate No Controls TP load, which was done using each site's area and land use type and the representative WinSLAMM 1 ac land uses and TP loads (as described above). To calculate TP reductions and With Controls loads for all sites, City staff assumed that an 80% TSS reduction would provide a 60% TP reduction, and used that relationship to calculate the % TP reduction for each private site. Using the

No Controls TP load and the % TP reduction, City staff were able to calculate a With Controls TP load (a TP load reduction) for each site.

For private sites within subbasins without an SCM but with catchbasins, the percent TSS reduction due to catchbasins was calculated and, as outlined in the appended guidance, subtracted from the percent TSS reduction for each private stormwater treatment practice within that area. The TSS load reductions due to private treatment practices were then adjusted as appropriate. TP load reductions were adjusted for catchbasins using the 80% TSS reduction/60% TP reduction relationship described above.

As the City of Madison does not permit public right-of-way area, it was assumed that street cleaning would not impact the reductions in TSS or TP loading due to private stormwater treatment practices. Therefore private practice values were not adjusted for street cleaning.

TSS and TP pollution reduction effectiveness of private stormwater treatment practices for non-SCM-treated areas are shown in Table 3-4.

Reachshed	Annual TSS Reduction (lbs)	Annual TP Reduction (lbs)
62	814	0.0
64	65,677	285.0
65	52,390	5.1
66	36,159	24.5
City-wide Total	**155,040**	**314.6**

Table 3-4. Private stormwater treatment practice TSS and TP removal, by reachshed (lbs/yr).

3.3.4 Catchbasin and Proprietary Device Cleaning

The City has several hundred catch basins and proprietary hydrodynamic devices installed throughout the City. Each catchbasin and proprietary device is cleaned twice each year – once in the spring, and once in the fall. For the purposes of this analysis, catch basins and proprietary hydrodynamic devices were modeled as catchbasins.

The City's records indicates that the City maintains 307 catch basins and proprietary devices with sump depths greater than or equal to 2.0'. For each catch basin or proprietary hydrodynamic device meeting that criteria within the City, a GIS layer was developed recording the sump depth, the depth from street surface to bottom of sump, and the footprint area. For catch basins or devices without recorded depths from street surface to bottom of sump, the depth was estimated at 4' plus the sump depth. For catchbasins or devices without recorded footprint areas, the area was estimated to be 9 sf.

For entry into WinSLAMM models, catchbasins and proprietary devices were aggregated for each subbasin, yielding a number of catch basins/proprietary devices, an average sump depth, average depth from street surface to bottom of sump, and an average footprint area for each subbasin. Catch basins and proprietary devices were entered, where applicable, just downstream of land uses and upstream of any other treatment devices.

TSS and TP pollution reduction effectiveness of catch basins and proprietary device sumps and cleaning are shown with other SCMs in Table 3-5.

3.3.5 Coanda Screen Structure Cleaning

The City has 22 large structures that contain Coanda screens for stormwater treatment. These screens function as inline stormwater filters, capturing floatables, debris, leaves and large sediment particles in a sump and allowing cleaner stormwater to pass through and enter the storm sewer system. Coanda screen structures, like other catch basins and proprietary devices, are cleaned twice annually in the spring and fall.

The City reached out to the WDNR and requested guidance as to how best to incorporate Coanda screen structures into the City's WinSLAMM model. The WDNR's emailed guidance, dated 10/16/20 and included in Appendix E, stated that screen structures should be modeled as catch basins using the appropriate sump depth, depth from street surface to sump bottom, and footprint area. In this analysis Coanda screen structures were entered into WinSLAMM as directed by the WDNR but were not aggregated with other catch basins or proprietary devices as described in section 3.3.4.

TSS and TP pollution reduction effectiveness of Coanda screen structure sumps and cleaning are shown with other SCMs in Table 3-5.

3.3.6 Stormwater SCMs

There are numerous structural SCMs within the City of Madison. In this report, the term "structural SCM" includes biofilters, infiltration basins, dry detention ponds and wet detention ponds. The City evaluated each structural SCM using available data to describe its geometry and drainage area. Figure 5 (see Appendix A) shows these structural SCMs.

The structural SCMs were built to the technical standards applicable at the time of construction; however, some SCMs may not achieve the expected 40 or 80 percent TSS reductions required per current regulatory codes and modeling procedures.

Table 3-5 shows the TSS and TP pollution reduction effectiveness of the existing structural SCMs, catch basin and proprietary device sumps and cleaning, and Coanda screen structure sumps and cleaning. Note that street cleaning is included in all models as a source area treatment practice for street source areas, and pollutant reductions due to street cleaning are not identified separately but included in the overall reachshed-wide reductions.

Control Practice Name	Control Practice Type	Rock River TMDL Reachshed ID	Annual TSS Influent Load (lbs)	Annual TSS Effluent Load (lbs)	Annual TSS Load Reduction (lbs)	Percent TSS Load Reduction (%)
PD 7315-001	Detention Pond	47	37,532	1,686	35,847	95.5%
PD1550-003_Inf	Biofilter	62	259	0	259	100.0%
PD1653-002_Inf	Biofilter	62	1,214	108	1,106	91.1%
PD1753-039_Inf1	Biofilter	62	3,778	3,413	365	9.7%
PD1753-039_Inf2	Biofilter	62	3,413	3,361	52	1.5%
PD2256-007_Inf	Biofilter	62	4,670	1,473	3,197	68.5%
PD2350-020_CB	Catchbasin Cleaning	62	84,046	82,683	1,363	1.6%
PD1550-003_WP	Detention Pond	62	4,763	259	4,504	94.6%
PD1648-047	Detention Pond	62	6,402	1,561	4,842	75.6%
PD1654-002	Detention Pond	62	3,682	1,147	2,536	68.9%
PD1748-035	Detention Pond	62	53,030	12,652	40,377	76.1%
PD1750-028	Detention Pond	62	10,690	3,576	7,114	66.6%
PD1753-039_WP	Detention Pond	62	9,245	3,778	5,467	59.1%
PD1948-022	Detention Pond	62	37,759	21,886	15,873	42.0%
PD2056-030	Detention Pond	62	703	259	444	63.2%
PD2146-005_LS3	Detention Pond	62	281,600	279,600	2,000	0.7%
PD2146-005_LS4	Detention Pond	62	279,600	279,400	200	0.1%
PD2146-005_U_C	Detention Pond	62	340,400	281,600	58,800	17.3%
PD2151-027_WP1	Detention Pond	62	26,755	20,733	6,022	22.5%
PD2151-027_WP2	Detention Pond	62	40,210	26,755	13,455	33.5%
PD2156-048	Detention Pond	62	3,432	1,551	1,881	54.8%
PD2255-025	Detention Pond	62	84,956	54,401	30,555	36.0%
PD2258-002	Detention Pond	62	23,718	17,052	6,666	28.1%
PD2350-020	Detention Pond	62	137,483	127,930	9,553	6.9%
PD2357-007	Detention Pond	62	4,570	3,836	734	16.1%
PD2448-016	Detention Pond	62	211,200	126,990	84,210	39.9%
PD2451-011	Detention Pond	62	399	398	1	0.3%
AC_UWHea_W_D2	Biofilter	64	457	84	373	81.6%

Control Practice Name	Control Practice Type	Rock River TMDL Reachshed ID	Annual TSS Influent Load (lbs)	Annual TSS Effluent Load (lbs)	Annual TSS Load Reduction (lbs)	Percent TSS Load Reduction (%)
AC_UWHea_W_E	Biofilter	64	3,011	457	2,554	84.8%
PD 2955-015_BF	Biofilter	64	27,409	22,079	5,330	19.4%
PD 3346-015	Biofilter	64	1,277	496	780	61.1%
PD 3349-047_BF	Biofilter	64	5,903	5,727	176	3.0%
PD 3449-016_BF	Biofilter	64	1,440	333	1,108	76.9%
PD 6831-055	Biofilter	64	7,903	7,142	762	9.6%
PD 7036-027_Bf	Biofilter	64	2,767	2,657	110	4.0%
NA_MEN_Sw_CB	Catchbasin Cleaning	64	29,315	25,981	3,333	11.4%
NA_MENSH_CB	Catchbasin Cleaning	64	240,400	233,000	7,400	3.1%
NA_MENSM_CB	Catchbasin Cleaning	64	25,613	23,765	1,848	7.2%
NA_MENWC_CB	Catchbasin Cleaning	64	422,000	397,200	24,800	5.9%
NA_MON_CB	Catchbasin Cleaning	64	59,950	57,128	2,822	4.7%
NA_MON_CB	Catchbasin Cleaning	64	98,232	95,432	2,800	2.9%
NA_MON_Sw_CB	Catchbasin Cleaning	64	224,800	210,400	14,400	6.4%
NA_MONMB_Sw_CB	Catchbasin Cleaning	64	186,655	175,435	11,220	6.0%
NA_MONWC_Sw_CB	Catchbasin Cleaning	64	108,573	102,673	5,900	5.4%
NA_SC_CB	Catchbasin Cleaning	64	1,490,400	1,444,000	46,400	3.1%
NA_SC_Sw_CB	Catchbasin Cleaning	64	38,356	35,070	3,286	8.6%
NA_UY_CB	Catchbasin Cleaning	64	60,583	59,153	1,431	2.4%
NA_WI_CB	Catchbasin Cleaning	64	96,015	87,705	8,311	8.7%
NA_WI_Sw_CB	Catchbasin Cleaning	64	65,707	61,903	3,804	5.8%
NA_WINakGC_CB	Catchbasin Cleaning	64	26,525	24,553	1,972	7.4%
NA_YR64_CB	Catchbasin Cleaning	64	240,800	224,600	16,200	6.7%
NA_YR64_Sw_CB	Catchbasin Cleaning	64	186,430	173,778	12,651	6.8%
PD 2756-049_CB	Catchbasin Cleaning	64	220,000	219,200	800	0.4%
PD 4061-006_CB	Catchbasin Cleaning	64	106,232	100,109	6,123	5.8%
PD 5020-054_CB	Catchbasin Cleaning	64	41,860	40,637	1,223	2.9%
PD 5417-009_CB	Catchbasin Cleaning	64	15,295	14,466	829	5.4%

Control Practice Name	Control Practice Type	Rock River TMDL Reachshed ID	Annual TSS Influent Load (lbs)	Annual TSS Effluent Load (lbs)	Annual TSS Load Reduction (lbs)	Percent TSS Load Reduction (%)
PD 6748-011_CB	Catchbasin Cleaning	64	47,763	47,223	539	1.1%
PD 6829-013_CB	Catchbasin Cleaning	64	66,908	64,577	2,331	3.5%
PD2546-021_CB	Catchbasin Cleaning	64	75,817	74,543	1,274	1.7%
PD4664-013_CB	Catchbasin Cleaning	64	56,076	53,156	2,920	5.2%
PD5427-061_CB	Catchbasin Cleaning	64	5,717	4,434	1,283	22.4%
SS 3348-070_CB	Catchbasin Cleaning	64	14,101	13,161	940	6.7%
SS 3348-073_CB	Catchbasin Cleaning	64	176	125	51	29.0%
SS4255-083_CB	Catchbasin Cleaning	64	19,424	17,847	1,578	8.1%
SS4257-098_CB	Catchbasin Cleaning	64	8,498	7,723	776	9.1%
SS5547-017_CB	Catchbasin Cleaning	64	2,609	2,308	301	11.6%
SS5843-072_CB	Catchbasin Cleaning	64	6,539	5,636	903	13.8%
SS5943-065_CB	Catchbasin Cleaning	64	11,294	10,619	675	6.0%
TD 4565-001_CB	Catchbasin Cleaning	64	47,968	46,250	1,718	3.6%
WarnerLgn_CB	Catchbasin Cleaning	64	223,800	215,400	8,400	3.8%
AC_UWHea_E_C	Detention Pond	64	7,679	1,326	6,353	82.7%
AC_UWHea_E_D1	Detention Pond	64	1,326	1,315	10	0.8%
AC_UWHea_N_B	Detention Pond	64	2,084	371	1,714	82.2%
Autumn_Lake	Detention Pond	64	67,845	17,580	50,265	74.1%
ESideWalmart	Detention Pond	64	4,689	1,170	3,519	75.0%
PD 2459-016	Detention Pond	64	31,106	28,934	2,171	7.0%
PD 2756-049_N	Detention Pond	64	120,031	115,320	4,711	3.9%
PD 2756-049_S	Detention Pond	64	248,200	120,031	128,169	51.6%
PD 2952-022_E	Detention Pond	64	9,071	8,931	140	1.5%
PD 2952-022_N	Detention Pond	64	8,931	8,531	400	4.5%
PD 2952-022_W	Detention Pond	64	22,489	9,071	13,418	59.7%
PD 2955-015_WP	Detention Pond	64	52,629	27,409	25,220	47.9%
PD 3158-015	Detention Pond	64	16,028	15,346	683	4.3%
PD 3258-008	Detention Pond	64	32,266	26,530	5,735	17.8%

Control Practice Name	Control Practice Type	Rock River TMDL Reachshed ID	Annual TSS Influent Load (lbs)	Annual TSS Effluent Load (lbs)	Annual TSS Load Reduction (lbs)	Percent TSS Load Reduction (%)
PD 3354-027	Detention Pond	64	38,111	16,074	22,037	57.8%
PD 3356-048	Detention Pond	64	4,004	3,937	67	1.7%
PD 3357-013_N1	Detention Pond	64	15,912	15,726	186	1.2%
PD 3357-013_N2	Detention Pond	64	16,100	15,912	188	1.2%
PD 3357-013_N3	Detention Pond	64	25,119	16,100	9,019	35.9%
PD 3358-013	Detention Pond	64	7,226	7,195	31	0.4%
PD 3362-020	Detention Pond	64	99,928	99,126	802	0.8%
PD 3456-032	Detention Pond	64	5,228	4,807	421	8.0%
PD 3462-001_N1	Detention Pond	64	269,800	112,200	157,600	58.4%
PD 3462-001_N2	Detention Pond	64	112,200	110,036	2,164	1.9%
PD 3564-028	Detention Pond	64	24,147	11,192	12,954	53.6%
PD 4061-006_1	Detention Pond	64	209,600	192,246	17,354	8.3%
PD 4061-006_2	Detention Pond	64	192,246	189,842	2,404	1.3%
PD 4061-006_FB	Detention Pond	64	222,800	209,600	13,200	5.9%
PD 4165-004	Detention Pond	64	13,895	5,642	8,253	59.4%
PD 4264-001_1	Detention Pond	64	30,787	23,971	6,815	22.1%
PD 4264-001_2	Detention Pond	64	23,971	15,397	8,575	35.8%
PD 4564-003	Detention Pond	64	56,802	33,088	23,714	41.7%
PD 5020-054	Detention Pond	64	40,637	13,336	27,301	67.2%
PD 5119-009	Detention Pond	64	20,549	5,072	15,477	75.3%
PD 5219-011	Detention Pond	64	49,839	24,297	25,542	51.2%
PD 5417-009	Detention Pond	64	14,466	7,801	6,665	46.1%
PD 6318-015	Detention Pond	64	3,549	3,506	44	1.2%
PD 6412-023	Detention Pond	64	22,302	21,808	494	2.2%
PD 6416-012	Detention Pond	64	29,069	24,213	4,856	16.7%
PD 6444-019	Detention Pond	64	13,496	3,409	10,087	74.7%
PD 6514-006	Detention Pond	64	19,492	18,946	546	2.8%
PD 6515-001	Detention Pond	64	19,534	14,002	5,532	28.3%

Control Practice Name	Control Practice Type	Rock River TMDL Reachshed ID	Annual TSS Influent Load (lbs)	Annual TSS Effluent Load (lbs)	Annual TSS Load Reduction (lbs)	Percent TSS Load Reduction (%)
PD 6520-001	Detention Pond	64	1,407	747	661	46.9%
PD 6521-013	Detention Pond	64	6,513	1,338	5,176	79.5%
PD 6535-008	Detention Pond	64	16,034	5,893	10,141	63.2%
PD 6546-029	Detention Pond	64	9,835	9,603	232	2.4%
PD 6738-024	Detention Pond	64	65,897	44,311	21,586	32.8%
PD 6748-011	Detention Pond	64	47,223	6,890	40,334	85.4%
PD 6821-006	Detention Pond	64	175,428	70,969	104,459	59.5%
PD 6829-013_Pond	Detention Pond	64	64,577	40,070	24,508	38.0%
PD 6834-021	Detention Pond	64	31,011	22,867	8,144	26.3%
PD 6836-018	Detention Pond	64	31,074	16,705	14,369	46.2%
PD 6914-002	Detention Pond	64	33,986	13,656	20,331	59.8%
PD 6935-077_Dry	Detention Pond	64	3,927	3,204	722	18.4%
PD 6942-013_Dry	Detention Pond	64	3,864	3,844	20	0.5%
PD 7020-084_DS	Detention Pond	64	59,964	59,964	0	0.0%
PD 7020-084_US	Detention Pond	64	60,202	59,964	238	0.4%
PD 7028-006	Detention Pond	64	57,832	28,882	28,950	50.1%
PD 7031-007	Detention Pond	64	5,329	4,109	1,220	22.9%
PD 7032-012	Detention Pond	64	7,863	6,574	1,289	16.4%
PD 7036-027_Wet	Detention Pond	64	6,797	2,767	4,030	59.3%
PD 7143-001	Detention Pond	64	27,572	6,196	21,376	77.5%
PD2546-021	Detention Pond	64	74,543	57,706	16,836	22.6%
PD2847-023	Detention Pond	64	8,385	8,272	113	1.3%
PD3046-006	Detention Pond	64	43,880	25,636	18,244	41.6%
PD3046-028	Detention Pond	64	789	267	522	66.2%
PD3046-029	Detention Pond	64	27,921	26,924	997	3.6%
PD4059-045	Detention Pond	64	58,515	18,332	40,182	68.7%
PD4624-011	Detention Pond	64	37,297	12,249	25,048	67.2%
PD4664-013_FB	Detention Pond	64	54,661	38,023	16,638	30.4%

Control Practice Name	Control Practice Type	Rock River TMDL Reachshed ID	Annual TSS Influent Load (lbs)	Annual TSS Effluent Load (lbs)	Annual TSS Load Reduction (lbs)	Percent TSS Load Reduction (%)
PD4664-013_WP	Detention Pond	64	38,023	26,825	11,198	29.5%
PD4722-014	Detention Pond	64	3,829	3,641	188	4.9%
PD5062-046	Detention Pond	64	1,609	1,448	161	10.0%
PD5362-002	Detention Pond	64	35,492	29,540	5,952	16.8%
PD5427-061_N	Detention Pond	64	4,434	2,769	1,664	37.5%
PD5427-061_S	Detention Pond	64	2,769	2,550	219	7.9%
PD5622-036	Detention Pond	64	17,073	16,874	199	1.2%
PD5730-043	Detention Pond	64	879	864	15	1.7%
PD6034-016	Detention Pond	64	3,440	3,389	51	1.5%
PD6348-037	Detention Pond	64	61,648	54,276	7,372	12.0%
PD6423-015	Detention Pond	64	7,243	4,001	3,243	44.8%
PD6438-016	Detention Pond	64	3,149	1,073	2,076	65.9%
PD6438-017	Detention Pond	64	6,083	5,998	86	1.4%
WarnerLgn	Detention Pond	64	218,000	60,532	157,468	72.2%
SS 3247-020_SS	Screen Structure	64	4,228	3,842	386	9.1%
SS 3348-070_SS	Screen Structure	64	13,161	13,053	108	0.8%
SS 3348-073_SS	Screen Structure	64	125	125	0	0.4%
SS 3349-058_SS	Screen Structure	64	6,441	5,784	657	10.2%
SS 3363-030_SS	Screen Structure	64	16,250	14,881	1,369	8.4%
SS 3862-037_SS	Screen Structure	64	1,734	1,447	287	16.5%
SS 4151-093_SS	Screen Structure	64	11,734	10,819	915	7.8%
SS3246-019	Screen Structure	64	1,453	1,273	180	12.4%
SS4255-083	Screen Structure	64	17,847	17,783	63	0.4%
SS4257-098	Screen Structure	64	7,723	7,486	236	3.1%
SS4455-152	Screen Structure	64	6,955	6,372	583	8.4%
SS4565-037	Screen Structure	64	1,815	1,505	311	17.1%
SS5062-073	Screen Structure	64	1,823	1,586	237	13.0%
SS5159-048	Screen Structure	64	962	761	201	20.9%

Control Practice Name	Control Practice Type	Rock River TMDL Reachshed ID	Annual TSS Influent Load (lbs)	Annual TSS Effluent Load (lbs)	Annual TSS Load Reduction (lbs)	Percent TSS Load Reduction (%)
SS5547-017	Screen Structure	64	2,308	2,225	83	3.6%
SS5843-072	Screen Structure	64	5,636	5,629	6	0.1%
SS5943-065	Screen Structure	64	10,619	10,401	219	2.1%
SS6733-038	Screen Structure	64	4,759	4,186	573	12.0%
SS6733-039	Screen Structure	64	2,389	2,016	373	15.6%
SS7129-021	Screen Structure	64	859	660	199	23.2%
TD 4565-001_SS	Screen Structure	64	46,250	43,008	3,241	7.0%
PD3666-096	Biofilter	65	1,348	154	1,194	88.6%
PD3670-012	Biofilter	65	1,794	625	1,169	65.1%
PD3670-012_CB	Catchbasin Cleaning	65	2,019	1,794	224	11.1%
SS3670-022_CB	Catchbasin Cleaning	65	72,846	69,645	3,201	4.4%
PD 4769-015	Detention Pond	65	44,592	23,826	20,766	46.6%
PD 4970-001	Detention Pond	65	11,518	4,204	7,314	63.5%
PD 5368-018	Detention Pond	65	4,780	3,025	1,755	36.7%
PD 5368-019	Detention Pond	65	1,216	1,210	6	0.5%
PD3770-001	Detention Pond	65	132,768	34,308	98,461	74.2%
SS3670-022	Screen Structure	65	69,645	67,956	1,689	2.4%
PD 6751-024_BF	Biofilter	66	2,478	2,099	378	15.3%
PD 6965-002_inf1	Biofilter	66	1,369	771	598	43.7%
PD 6965-002_inf2	Biofilter	66	771	393	378	49.0%
PD 6966-002_Inf1	Biofilter	66	686	670	17	2.4%
PD 6966-002_Inf2	Biofilter	66	670	66	604	90.2%
PD 6968-017_Inf	Biofilter	66	9,887	6,426	3,461	35.0%
PD 7240-002_Inf	Biofilter	66	1,918	15	1,903	99.2%
PD 7241-030	Biofilter	66	2,164	91	2,073	95.8%
PD 7242-014	Biofilter	66	2,099	145	1,955	93.1%
PD 7366-001_Bf	Biofilter	66	13,380	12,967	414	3.1%
PD 7468-004_Bf	Biofilter	66	5,108	4,611	497	9.7%

Control Practice Name	Control Practice Type	Rock River TMDL Reachshed ID	Annual TSS Influent Load (lbs)	Annual TSS Effluent Load (lbs)	Annual TSS Load Reduction (lbs)	Percent TSS Load Reduction (%)
NA_PE_CB	Catchbasin Cleaning	66	429,800	421,800	8,000	1.9%
PD 6458-002_CB	Catchbasin Cleaning	66	54,581	52,078	2,504	4.6%
PD 6752-004_CB	Catchbasin Cleaning	66	95,615	91,291	4,324	4.5%
PD 7058-001_CB	Catchbasin Cleaning	66	30,451	28,620	1,830	6.0%
PD 6458-002	Detention Pond	66	35,240	15,756	19,484	55.3%
PD 6458-002_FB	Detention Pond	66	52,078	35,240	16,837	32.3%
PD 6751-024_WP	Detention Pond	66	2,099	740	1,359	64.8%
PD 6752-004	Detention Pond	66	91,291	31,782	59,509	65.2%
PD 6761-018	Detention Pond	66	10,506	10,412	94	0.9%
PD 6852-005	Detention Pond	66	22,498	22,284	213	0.9%
PD 6856-001	Detention Pond	66	149,675	42,705	106,969	71.5%
PD 6860-036_Dn	Detention Pond	66	34,441	32,320	2,122	6.2%
PD 6860-036_Up	Detention Pond	66	39,857	34,441	5,416	13.6%
PD 6955-024	Detention Pond	66	11,200	669	10,531	94.0%
PD 6960-006_Pond	Detention Pond	66	18,336	17,979	357	1.9%
PD 6960-006_RB	Detention Pond	66	24,565	18,336	6,229	25.4%
PD 6961-012	Detention Pond	66	2,295	170	2,125	92.6%
PD 6965-001	Detention Pond	66	2,686	1,185	1,501	55.9%
PD 6966-001	Detention Pond	66	724	172	552	76.3%
PD 6967-034	Detention Pond	66	4,860	4,857	3	0.1%
PD 6967-035	Detention Pond	66	4,451	4,283	168	3.8%
PD 6968-017_Ret	Detention Pond	66	10,883	9,887	996	9.2%
PD 7058-001_Pond	Detention Pond	66	28,620	5,290	23,330	81.5%
PD 7065-029_Pond1	Detention Pond	66	7,122	7,106	16	0.2%
PD 7065-029_Pond2	Detention Pond	66	19,031	7,122	11,910	62.6%
PD 7067-014	Detention Pond	66	3,808	1,003	2,805	73.7%
PD 7068-001	Detention Pond	66	467	155	312	66.8%
PD 7069-001	Detention Pond	66	1,994	478	1,516	76.0%

Control Practice Name	Control Practice Type	Rock River TMDL Reachshed ID	Annual TSS Influent Load (lbs)	Annual TSS Effluent Load (lbs)	Annual TSS Load Reduction (lbs)	Percent TSS Load Reduction (%)
PD 7153-056	Detention Pond	66	102,372	28,630	73,742	72.0%
PD 7164-034	Detention Pond	66	9,122	890	8,231	90.2%
PD 7168-035	Detention Pond	66	1,395	1,246	149	10.7%
PD 7169-044	Detention Pond	66	17,210	4,950	12,260	71.2%
PD 7240-002_WP	Detention Pond	66	5,684	1,918	3,766	66.3%
PD 7249-010	Detention Pond	66	18,567	6,346	12,221	65.8%
PD 7263-002	Detention Pond	66	6,530	1,317	5,213	79.8%
PD 7340-001	Detention Pond	66	12,519	7,542	4,977	39.8%
PD 7341-001_PD 7342-003	Detention Pond	66	35,476	9,372	26,104	73.6%
PD 7347-018	Detention Pond	66	8,850	8,211	639	7.2%
PD 7366-001_Wet	Detention Pond	66	23,674	13,380	10,293	43.5%
PD 7441-021	Detention Pond	66	726	721	5	0.7%
PD 7442-022	Detention Pond	66	1,004	996	8	0.8%
PD 7443-024	Detention Pond	66	10,763	4,392	6,370	59.2%
PD 7446-039	Detention Pond	66	3,109	2,244	865	27.8%
PD 7460-005	Detention Pond	66	11,943	2,376	9,567	80.1%
PD 7464-004	Detention Pond	66	16,653	9,639	7,014	42.1%
PD 7468-004_Wet	Detention Pond	66	11,947	5,108	6,839	57.2%
PD 7542-027	Detention Pond	66	11,266	5,268	5,998	53.2%
PD 7644-058	Detention Pond	66	26,039	10,094	15,945	61.2%
PD 7739-001_E	Detention Pond	66	859	695	164	19.1%
PD 7739-001_W	Detention Pond	66	1,827	859	968	53.0%
PD 7840-001	Detention Pond	66	11,217	2,919	8,298	74.0%
PD 7841-002_N	Detention Pond	66	43,725	42,998	727	1.7%
PD 7841-002_S	Detention Pond	66	83,675	43,725	39,950	47.7%

Table 3-5. TSS and TP pollution reduction effectiveness of the existing structural SCMs, catch basin and proprietary device sumps and cleaning, and Coanda screen structure sumps and cleaning by reachshed.

3.3.7 Summary of Results

Rock River TMDL Reachshed ID	Annual TSS No Controls Load (lbs)	Annual TSS With Controls Load (lbs)[1]	Annual TSS Public Practice Reductions (lbs)	Percent TSS Reduction from No Controls (%)	Detention Ponds		
					Total Number of Detention Ponds	Annual TSS Reductions Due to Detention Ponds (lbs)	Percent TSS Reduction Due to Detention Ponds (%)
47	50,991	11,952	39,039	1	1	35,847	70.3%
62	675,103	308,986	365,303	1	20	295,235	43.7%
64	6,930,111	4,828,292	2,036,142	0	85	1,241,094	17.9%
65	434,983	213,892	168,701	0	5	128,302	29.5%
66	1,497,920	782,661	679,101	0	49	534,671	35.7%
City-wide Total	**9,589,108**	**6,145,783**	**3,443,325**	**0**	**160**	**2,235,148**	**23.3%**

Rock River TMDL Reachshed ID	Biofilters/Infiltration Basins			Catchbasin Cleaning		Street Cleaning	
	Total Number of Biofilters	Annual TSS Reductions Due to Biofilters (lbs)	Percent TSS Reduction Due to Biofilters (%)	Annual TSS Reductions Due to Catchbasin Cleaning (lbs)	Percent Reduction Due to Catchbasin Cleaning (%)	Annual TSS Reductions Due to Street Cleaning (lbs)	Percent Reduction Due to Street Cleaning (%)
47	0	0	0.0%	0	0.0%	3,191	6.3%
62	5	4,978	0.7%	1,363	0.2%	63,721	9.4%
64	8	11,193	0.2%	211,472	3.1%	572,375	8.3%
65	3	2,363	0.5%	5,114	1.2%	32,918	7.6%
66	11	12,278	0.8%	16,657	1.1%	115,483	7.7%
City-wide Total	**27**	**30,814**	**0.3%**	**234,606**	**2.4%**	**787,689**	**8.2%**

[1] *Not calculated directly from WinSLAMM models. Includes public practice and private practice reductions.*

Table 3-6. TSS reduction by practice by reachshed.

Reachshed	Area (ac)	Annual TSS No Controls Load (lbs)	Annual TSS With Controls Load (lbs)[1]	Annual TSS Public Practice Reductions (lbs)	Annual TSS Private Practice Reductions (lbs)	Percent Reduction (%)
47	442	50,991	11,952	39,039	0	76.6%
62	3,299	675,103	308,986	365,303	814	54.2%
64	25,200	6,930,111	4,828,292	2,036,142	65,677	30.3%
65	2,372	434,983	213,892	168,701	52,390	50.8%
66	6,545	1,497,920	782,661	679,101	36,159	47.8%
City-wide Total	**37,859**	**9,589,108**	**6,145,783**	**3,288,285**	**155,040**	**35.9%**

[1] *Not calculated directly from WinSLAMM models. Includes public practice and private practice reductions.*

Table 3-7. Annual overall TSS reductions by reachshed.

Reachshed	Area (ac)	Annual TP No Controls Load (lbs)	Annual TP With Controls Load (lbs)[1]	Annual TP Public Practice Reductions (lbs)	Annual TP Private Practice Reductions (lbs)	Annual TP Reductions from Leaf Management (lbs)	Percent Reduction (%)
47	442	172	55	117	0	0.0	67.8%
62	3,299	2,247	1,363	868	0	15.4	39.3%
64	25,200	21,706	16,740	4,470	285	210.1	22.9%
65	2,372	1,268	874	371	5	17.0	31.0%
66	6,545	4,446	2,939	1,459	25	23.9	33.9%
City-wide Total	**37,859**	**29,839**	**21,972**	**7,285**	**315**	**266.4**	**26.4%**

[1] *Not calculated directly from WinSLAMM models. Includes public practice, private practice and leaf management reductions.*

Table 3-8. Annual overall TP reductions by reachshed.

4 Analysis

This section documents the City's progress to date towards meeting the water quality goals required by the Rock River TMDL, and the City's plan to meet those goals through participation in the Yahara WINS Adaptive Management program.

4.1 Goals

The City sees two primary benchmarks that must be achieved to satisfy its water quality requirements under the Rock River TMDL as well as the City's MS4 permit (Wisconsin Pollutant Discharge Elimination System (WPDES) Permit No. WI-S058416-19) via the Yahara WINS Adaptive Management program. These targets, and the City's proposed methods to achieve them, are summarized below.

4.1.1 Reduction of 40% TSS/27% TP from No Controls

As shown in Tables 3-8 and 3-9, the City has met or exceeded 40% TSS and 27% TP removal relative to the No Controls condition in four of the five reachsheds included within the City of Madison municipal boundary. In the fifth, reachshed 64, the City's TSS and TP reductions are at only 30.3% and 22.9%. As the City's area within reachshed 64 is significantly larger than its combined area within 47, 62, 65, and 66, it is not surprising that underachievement in that reachshed negatively weights cumulative City-wide reductions. City-wide, the City of Madison has achieved TSS and TP reductions of 35.9% and 26.4%, or deficits of 4.1% and 0.6% relative to the threshold of 40% TSS and 27% TP removal.

The Yahara WINS Adaptive Management agreement states that MS4s in the Rock River TMDL area may only purchase TP credits to meet their TMDL requirements through participation in the Yahara WINS adaptive management program once the MS4's baseline reduction of 40% TSS and 27% TP removal relative to a no-controls condition has been met. Per the text of the agreement, participating MS4s have until Jan 1, 2036 (the terminus of the current Adaptive Management agreement) to meet these baseline reductions. This position was reiterated by the WDNR during a City of Madison/WDNR meeting on Dec 19, 2019 (meeting minutes included with this report as part of Appendix E). As the City's reductions of both TSS and TP in reachshed 64 and City-wide do not meet this baseline criteria, the City expects to increase its in-City reduction quantities to achieve the minimum 40% TSS/27% TP reduction standard. Tables 4-1 and 4-2 below show the TSS and TP reductions required to achieve compliance with this standard.

Reachshed	Annual TSS No Controls Load (lbs)	Percent TSS Reduction (%)	Baseline 40% Reduction Threshold Met?	Percent TSS Reduction Deficit (%)	Annual TSS Removal Required to Meet Baseline Threshold (lbs)
47	50,991	76.6%	Yes	-	-
62	675,103	54.2%	Yes	-	-
64	6,930,111	30.3%	No	9.7%	670,225
65	434,983	50.8%	Yes	-	
66	1,497,920	47.8%	Yes	-	
City-wide Total	**9,589,108**	**35.9%**	**No**	**4.1%**	**392,318**

Table 4-1. TSS Reductions Required to Achieve 40% TSS Reduction from No Controls by Reachshed.

Reachshed	Annual TP No Controls Load (lbs)	Percent TP Reduction (%)	Baseline 27% Reduction Threshold Met?	Percent TP Reduction Deficit (%)	Annual TP Removal Required to Meet Baseline Threshold (lbs)
47	172	67.8%	Yes	-	-
62	2,247	39.3%	Yes	-	-
64	21,706	22.9%	No	4.1%	895
65	1,268	31.0%	Yes	-	
66	4,446	33.9%	Yes	-	
City-wide Total	**29,839**	**26.4%**	**No**	**0.6%**	**190**

Table 4-2. TP Reductions Required to Achieve 27% TP Reduction from No Controls by Reachshed.

The City has developed an internal plan to achieve a City-wide 40% TSS/27% TP reduction from no controls by Jan 1, 2036 as required by the Adaptive Management agreement. That plan is will guide the City's efforts to remove 392,318 lbs of TSS (4.1% City-wide) and 190 lbs of TP (0.6% TP City-wide) in addition to reductions already achieved by the City's current BMP matrix, and is discussed broadly in Section 4.2 of this report.

4.1.2 Removal of TP in Excess of 27% as Required to Meet TMDL Requirements

The City intends to meet the Rock River TMDL load reductions above the 40% TSS/27% TP reduction from No Controls condition through participation in Yahara WINS adaptive management program, per Appendix A.3 of WPDES Permit No. WI-S058416-4. Table 4-3 below shows the quantity of TP (in lbs) that the City of Madison must purchase annually through Yahara WINS to achieve compliance with the Rock River TMDL in all reachsheds within the City of Madison.

Note that the TP reduction for reachshed 64 has been adjusted from existing conditions to reflect an additional 190 lbs of TP removed annually. This reflects the assumption that the City will achieve 27% TP reduction from No Controls conditions on a cumulative, City-wide basis, outside adaptive management, as described in Section 4.1.1.

Reachshed	City of Madison Annual TP No Controls Load (lbs)	Cumulative City of Madison Annual TP Reduction (lbs)	Target TP Reduction from No Controls (%)	City of Madison TP Reduction from No Controls (%)	City of Madison TP Reduction Deficit to Meet TMDL Standard (%)	City of Madison Annual TP Deficit (lb)
47	172	117	27%	67.8%	**-40.8%**	0
62	2,247	883	78%	39.3%	**38.7%**	869
64	21,706	5,155[1]	61%	**23.7%[1]**	**37.3%**	8,086
65	1,268	394	63%	31.0%	**32.0%**	405
66	4,446	1,507	54%	33.9%	**20.1%**	894
Total TP Annual Purchase Through Yahara WINS						**10,254**

[1] *Cumulative and percent reduction includes 190 lbs TP required to achieve 27% City-wide TP reductions, as shown in Table 4-2*

Table 4-3. TP Quantities to be Purchased Through Yahara WINS Adaptive Management Program

4.2 Future Plans

As described in Section 4.1.2 above, the City of Madison intends to comply with the Rock River TMDL load reduction goals above the 40% TSS/27% TP reduction baseline (relative to No Controls) through the purchase of TP through the Yahara WINS adaptive management program. As shown in Table 4-3, the City's annual TP purchase through Yahara WINS shall be 10,254 lbs.

As described in Section 4.1.1, the Yahara WINS Adaptive Management implementation agreement states that municipalities participating in the program must achieve a baseline of 40% TSS/27% TP reduction from a "no controls" condition within their municipal boundary by the end of the Adaptive Management Program (Jan 1, 2036) to be eligible for participation in the program. The City plans to meet this requirement through a combination of structural BMP additions/improvements and stormwater quality programs, included but not limited to the following:

- Post-construction stormwater standards set by municipal ordinance for both TSS reduction and volume control for redevelopment sites that exceed the WDNR-set uniform state standards for redevelopment post-construction stormwater management.
- Implementation of a City-wide Distributed Green Infrastructure Installation program with public works projects.
- Design and construction of joint flood control/water quality improvement capital projects, including wet pond expansions and dry to wet pond conversion projects, in parallel with the City's Watershed Study program.
- Installation of City-developed Coanda screen structures (see Section 3.3.5) with public works projects to increase in-line stormwater treatment.
- Continued improvement of the City's already-robust leaf management program.
- Continued improvement to the City's weekly sweeping program in the Snow Emergency Area (see Section 3.3.1), including a transition to vacuum-assisted sweeping where practicable.

Appendix A: Figures

Figure 1A: Rock River TMDL Reachsheds in the City of Madison, WI

Figure 1B: Rock River TMDL Watersheds in the City of Madison, WI

Figure 1C: Rock River TMDL Subbasins in the City of Madison, WI

Figure 2: Areas Excluded from Rock River TMDL Modeling in the City of Madison, WI

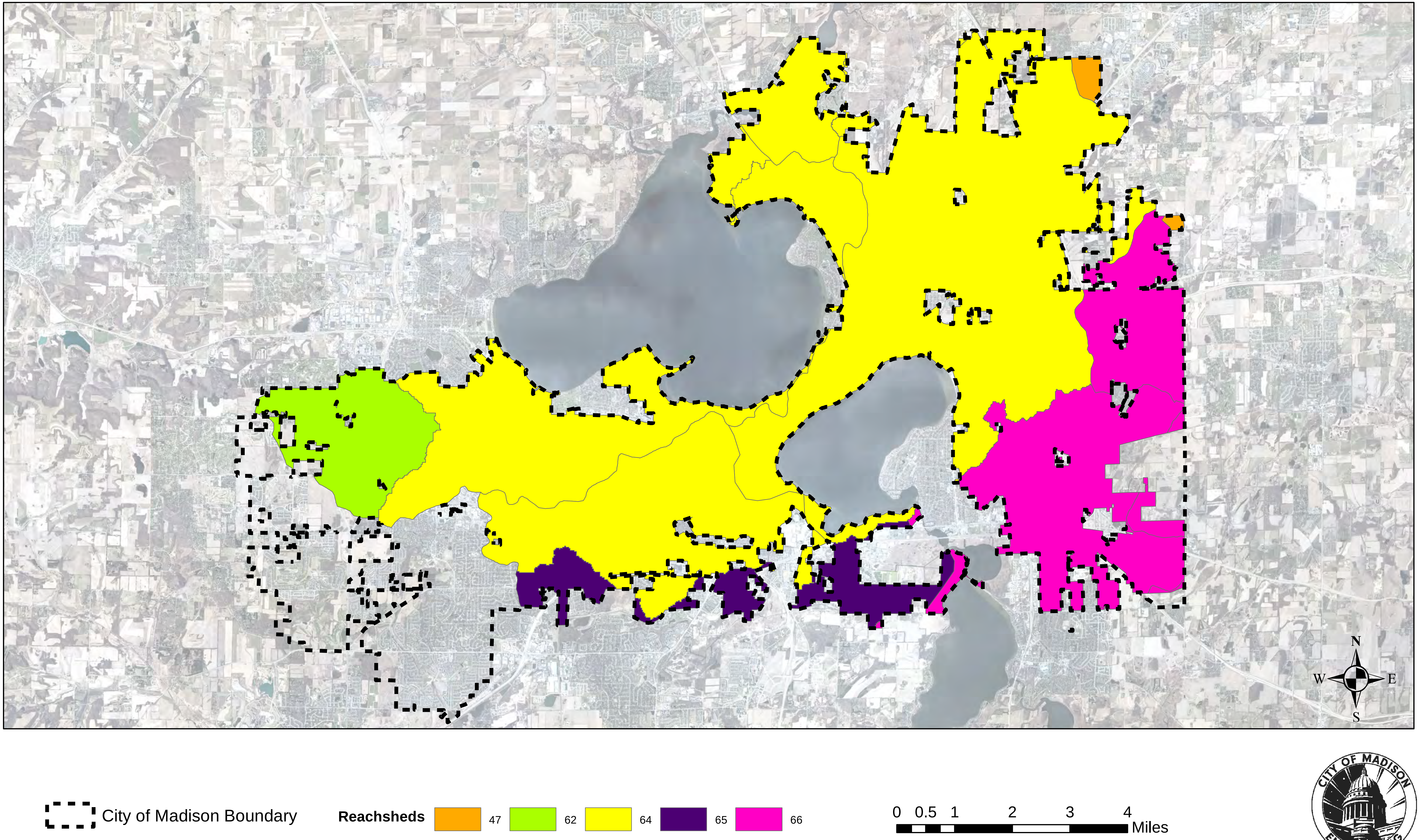
Figure 3: Rock River TMDL Soils in the City of Madison, WI

Figure 4: Land Use in the City of Madison, WI for Use in Rock River TMDL Modeling

Figure 5: Model Areas

Figure 6: Annual TP Reductions per Leaf Management Guidance By Reachshed

Figure 1A: Rock River TMDL Reachsheds in the City of Madison, WI



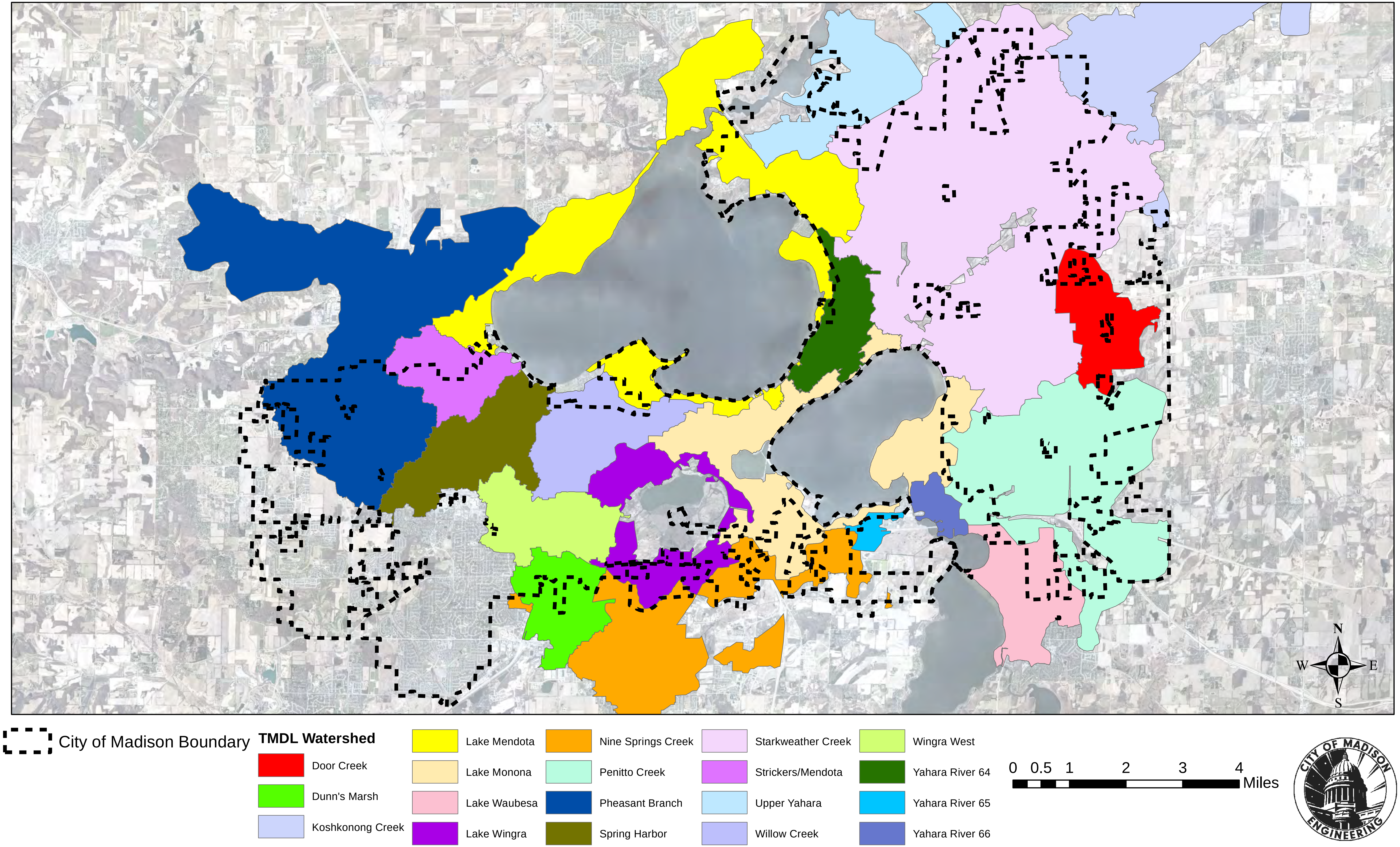


Figure 1B: Rock River TMDL Watersheds in the City of Madison, WI

Figure 1C: Rock River TMDL Subbasins in the City of Madison, WI

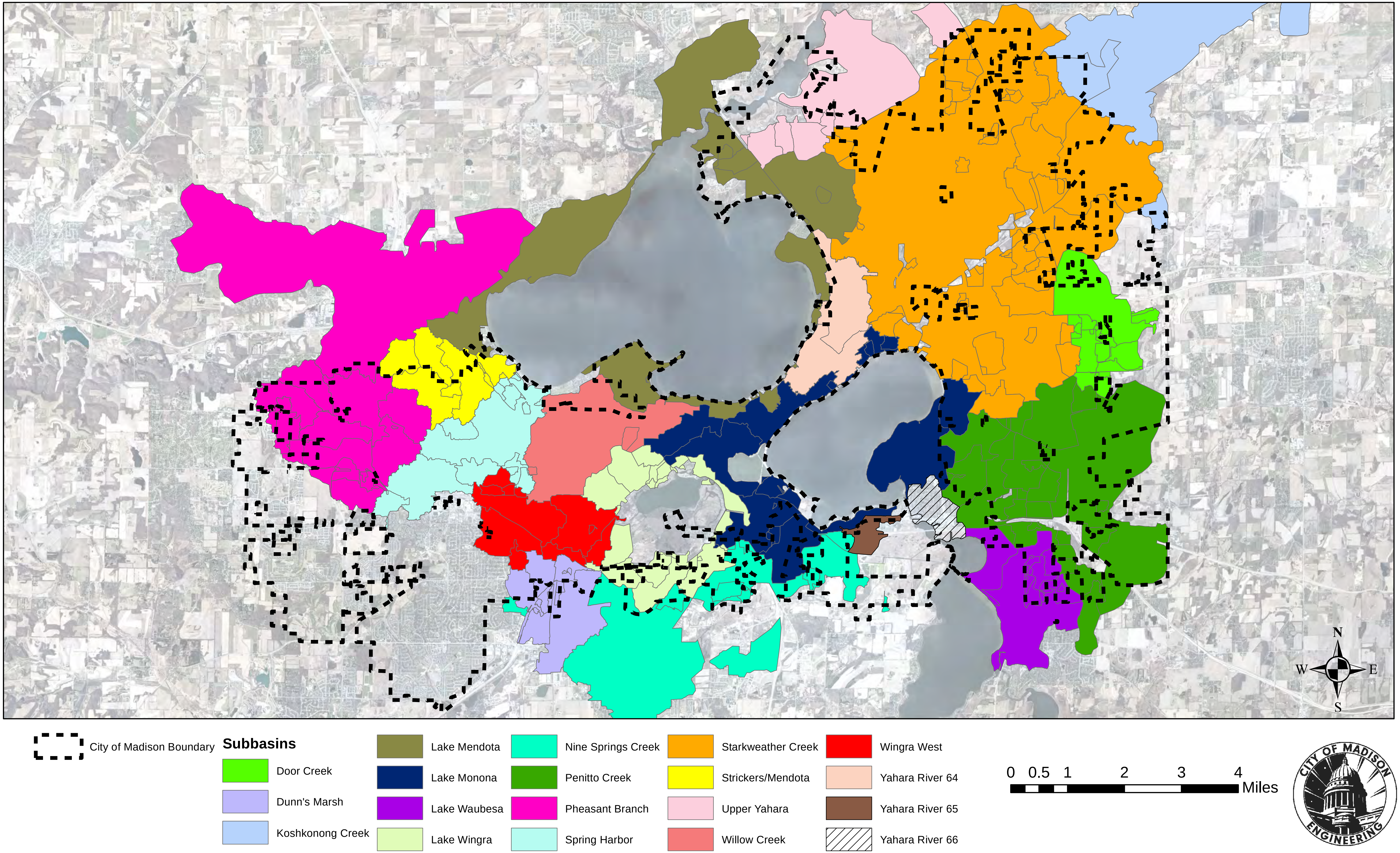


Figure 2: Areas Excluded from Rock River TMDL Modeling in the City of Madison, WI

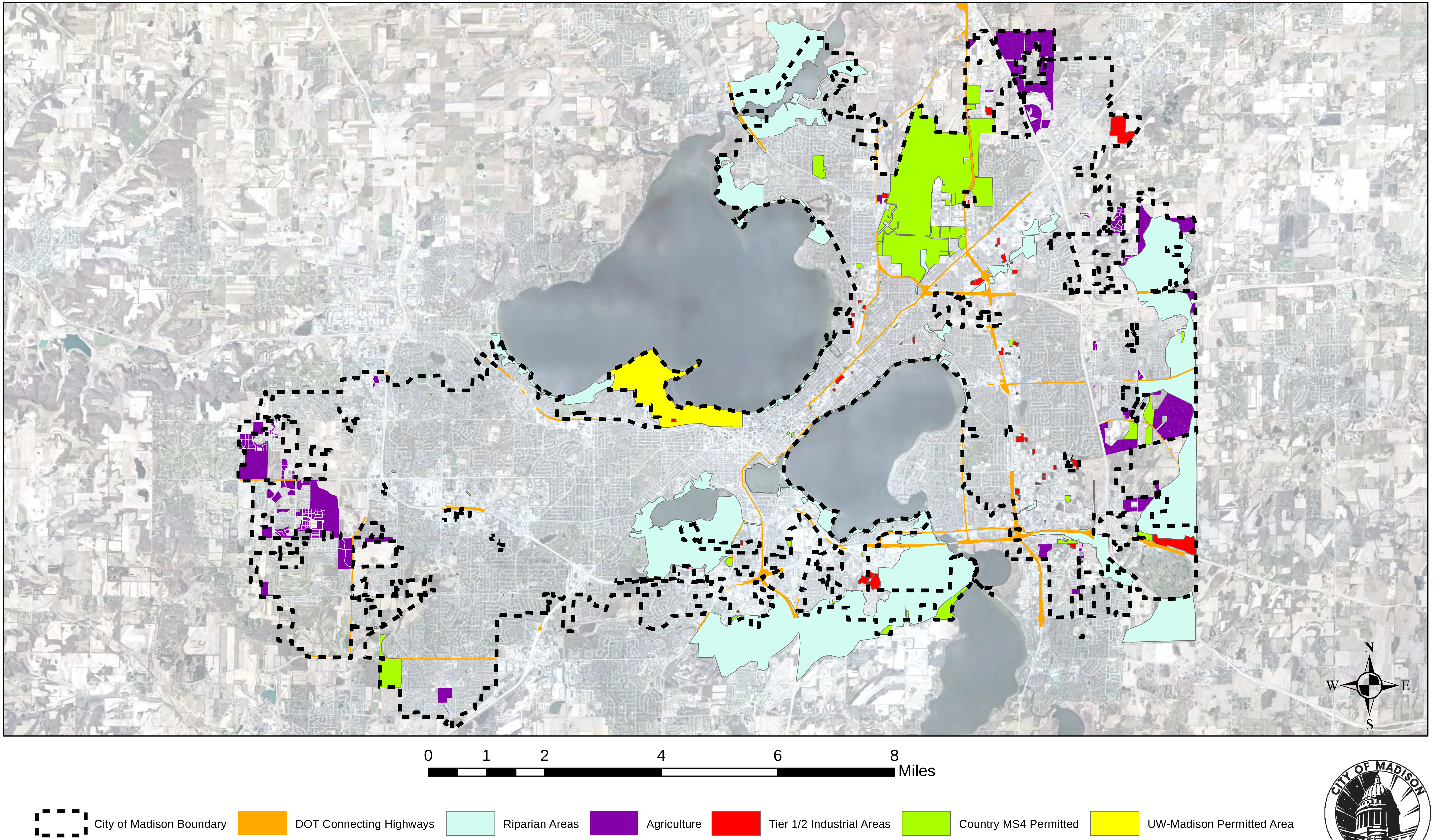


Figure 3: Rock River TMDL Soils in the City of Madison, WI

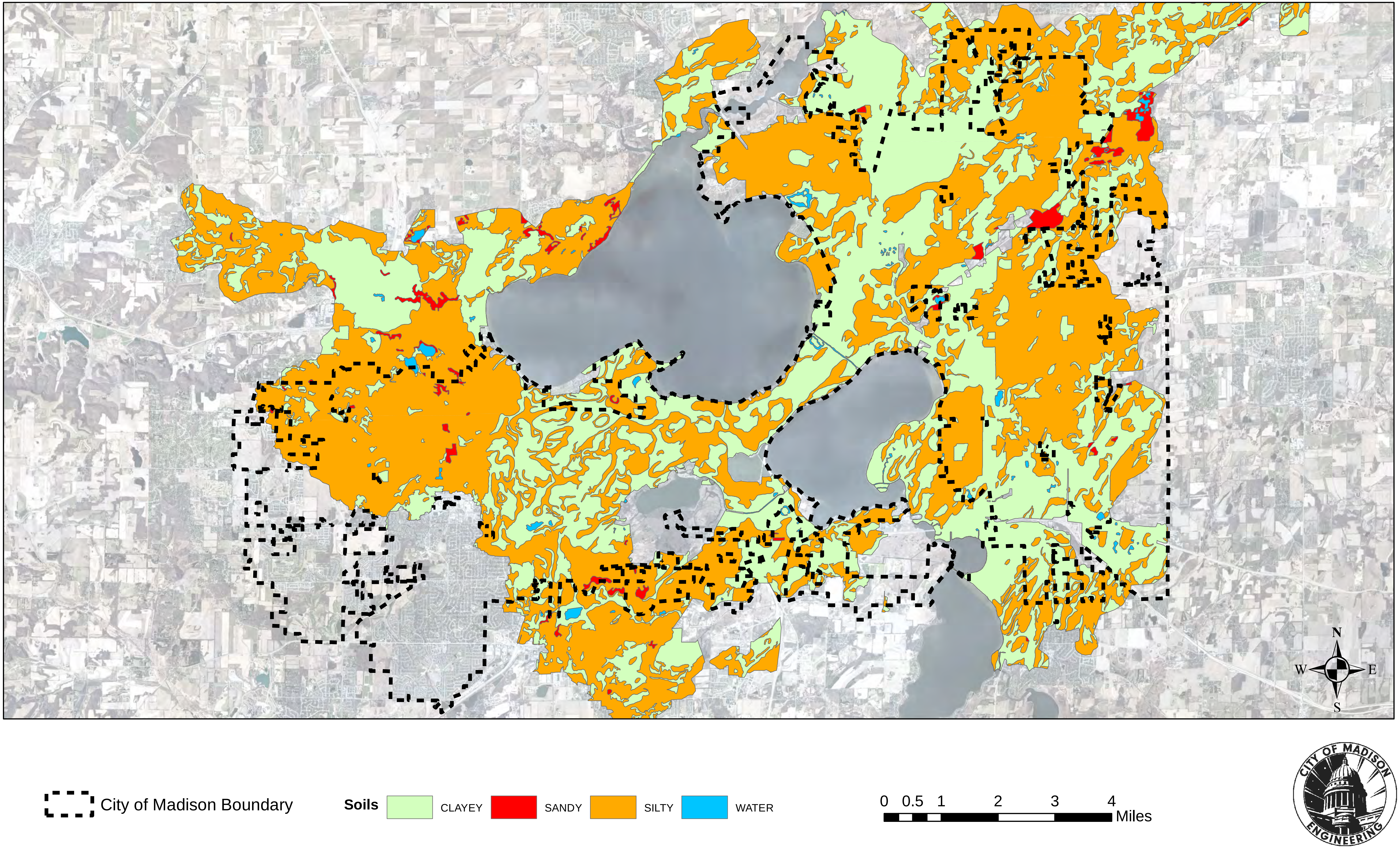


Figure 4: Land Use in the City of Madison, WI for Use in Rock River TMDL Modeling

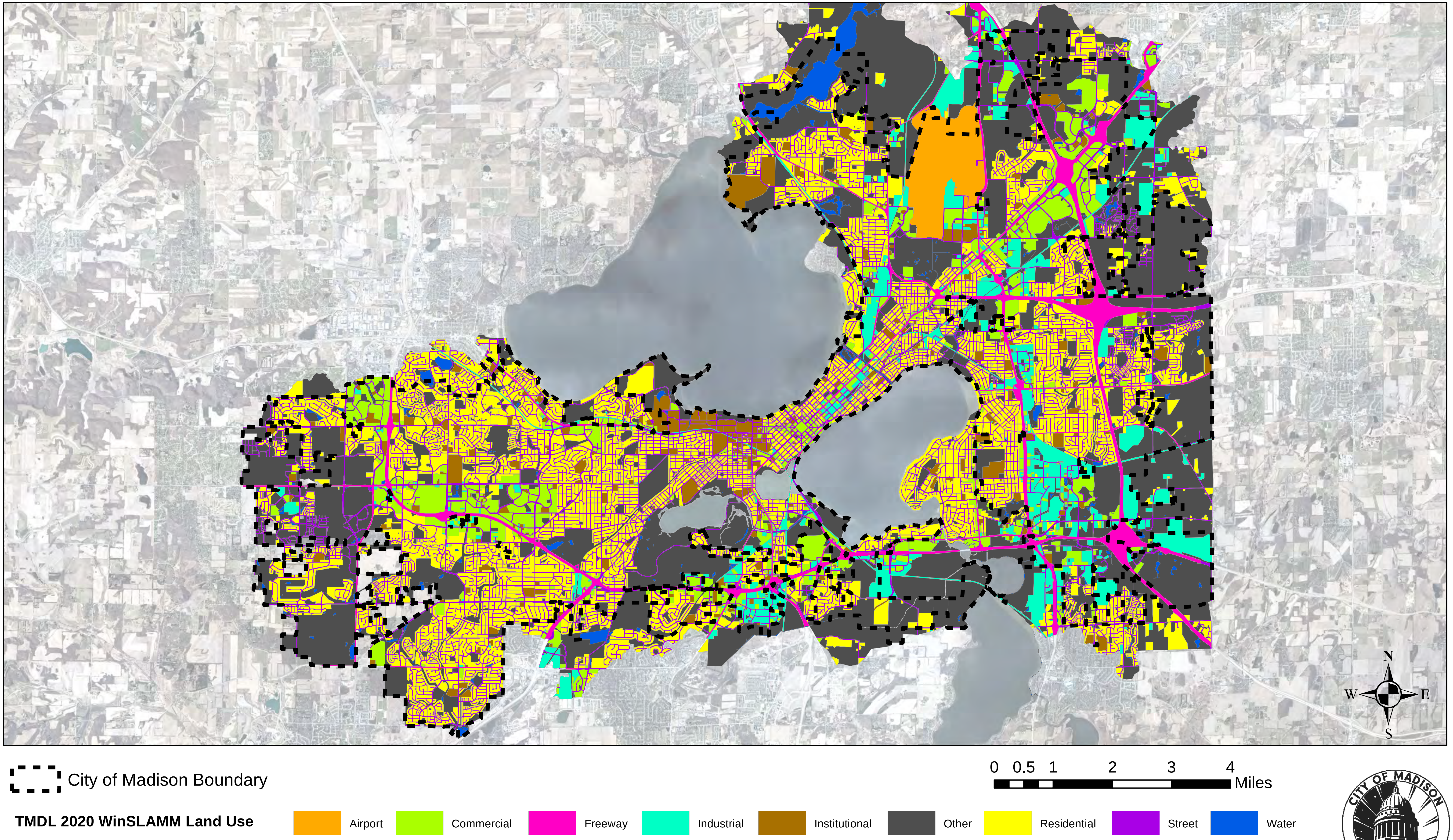


Figure 5: Model Areas

The following figures depict the individual WinSLAMM models used to accomodate model size limitations.

Naming Convention

Models

Model names come from the corresponding watersheds; most of these watersheds needed to be broken into multiple models due to size.

DC	Door Creek
DM	Dunn's Marsh
KO	Koshkonong Creek
MEN	Lake Mendota
MON	Lake Monona
WA	Lake Waubesa
WI	Lake Wingra
NS	Nine Springs Creek
PE	Penitto Creek
PB	Pheasant Branch
SH	Spring Harbor
ST	Starkweather Creek
SM	Strickers/Mendota
UY	Upper Yahara
WC	Willow Creek
WW	Wingra West
Y64	Yahara River (Reachshed 64)
Y65	Yahara River (Reachshed 65)

Subbasins

PD ####	City of Madison public stormwater treatment pond
NA_####	No downstream treatment device
GR ####	City of Madison public greenway
TD####	City of Madison trench ditch
SS####	City of Madison screen treatment device
_SW	More frequent sweeping
_EXP	Excluded pollutants
_MAD	Not excluded

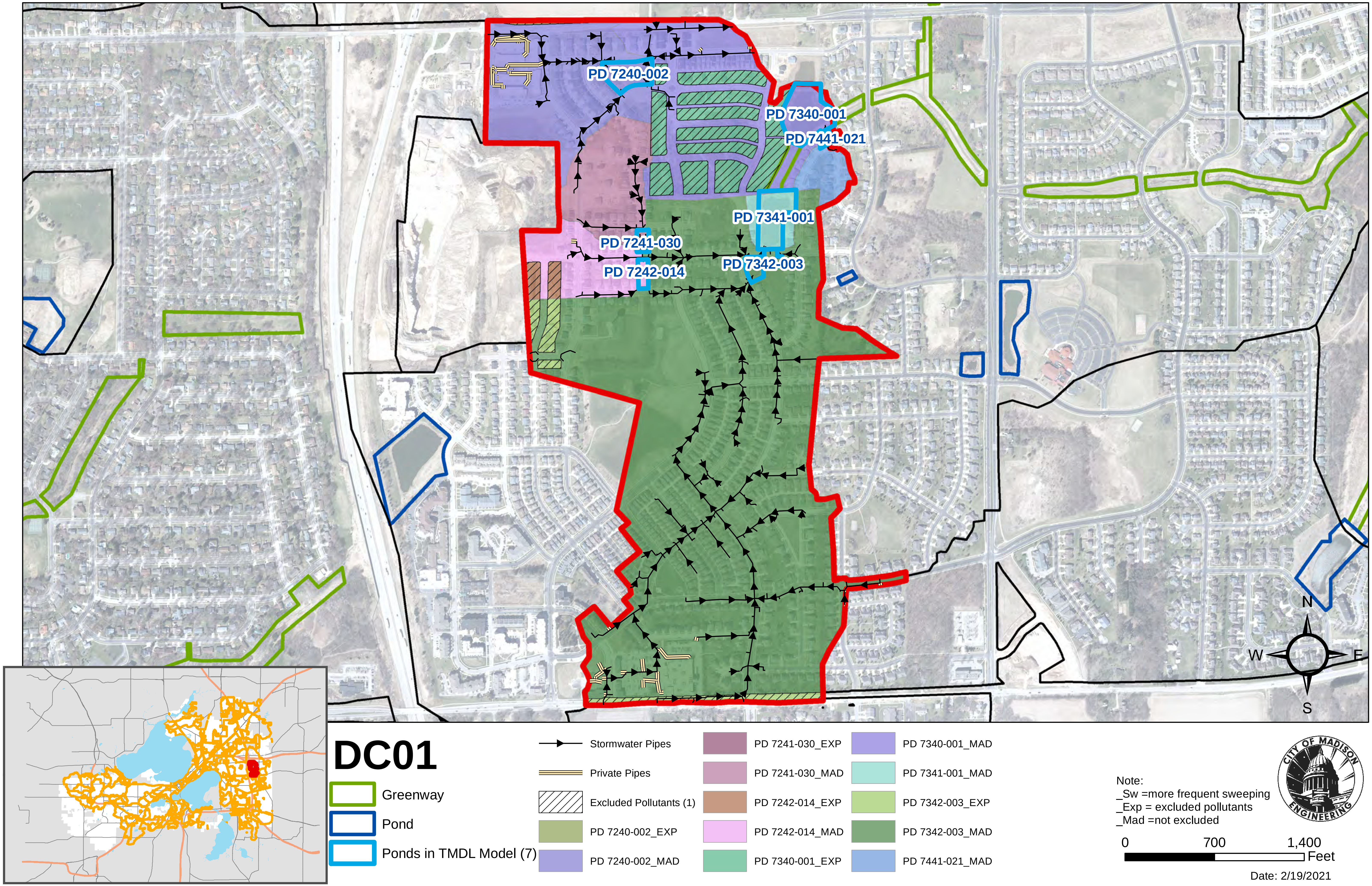
Some modeled ponds are not listed in City of Madison records. Basins draining to those ponds are named using the informal pond names.

Legend

🟥	Model Boundary
🟩	Greenway
🟦	Pond
PD #	Ponds in TMDL Model (# in model)
▨	Excluded Pollutants
▧	Street Sweeping (# in model)

★	Catchbasins (# in model)
✱	ScreenStructures (# in model)
▲	Private Practice (# in model)
→	Stormwater Pipes
═	Private Pipes

DC01



Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

CITY OF MADISON ENGINEERING

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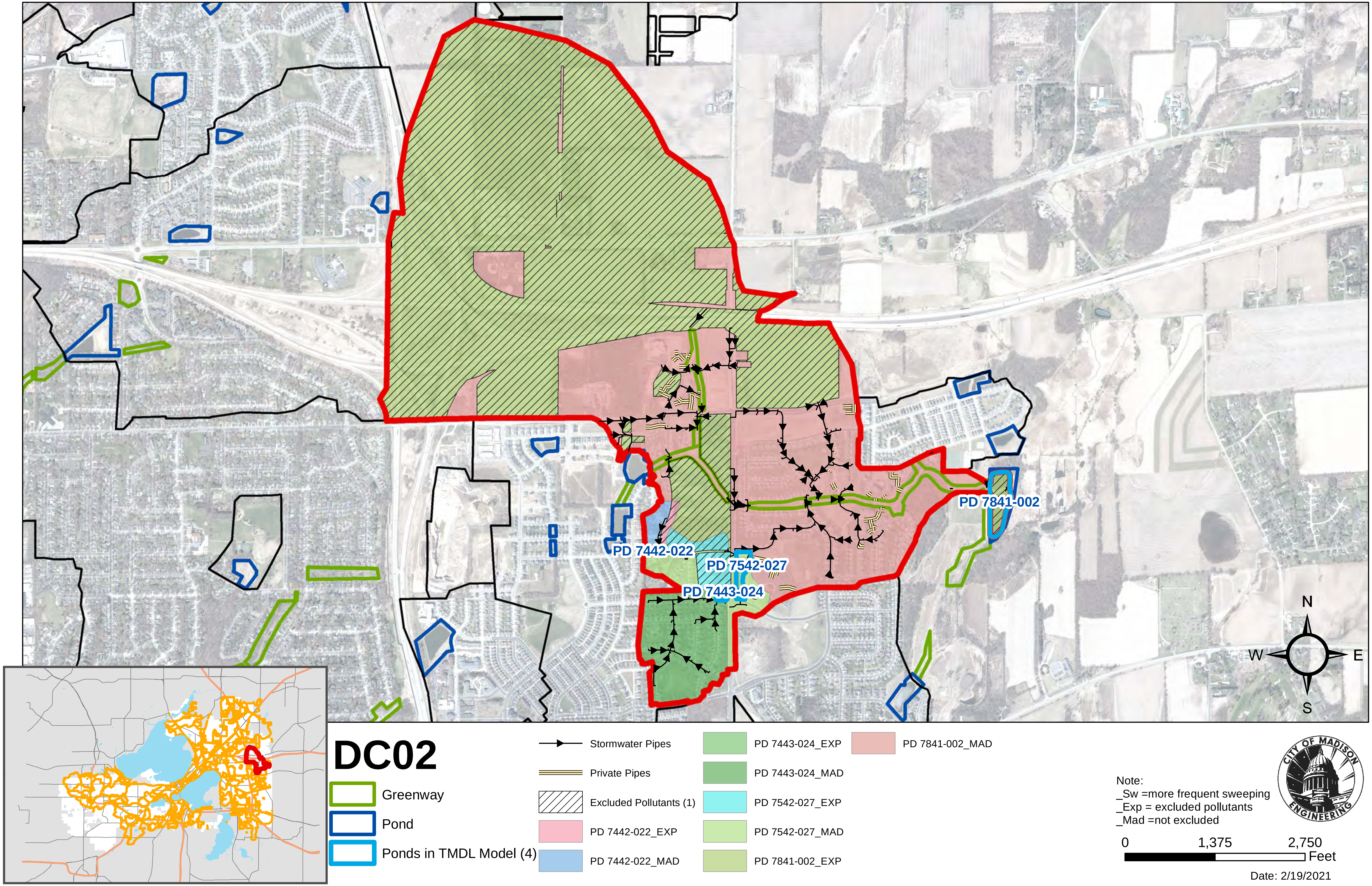

DC02

🟩 Greenway

🟦 Pond

🟦 Ponds in TMDL Model (4)

→ Stormwater Pipes

═ Private Pipes

▨ Excluded Pollutants (1)

🟥 PD 7442-022_EXP

🟦 PD 7442-022_MAD

🟩 PD 7443-024_EXP

🟩 PD 7443-024_MAD

🟦 PD 7542-027_EXP

🟩 PD 7542-027_MAD

🟩 PD 7841-002_EXP

🟥 PD 7841-002_MAD

Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

0 1,375 2,750 Feet

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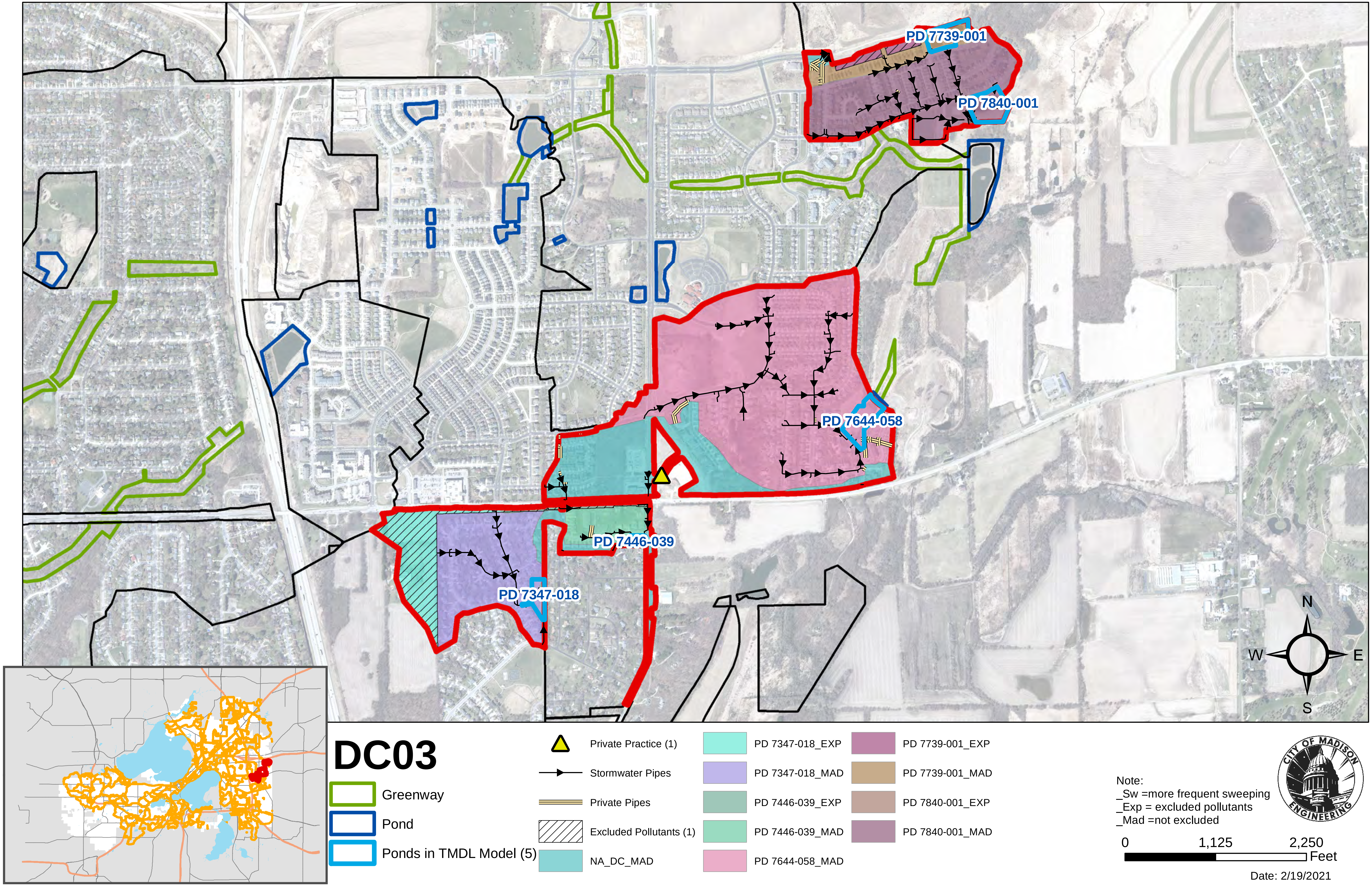

DC03

- 🟩 Greenway
- 🟦 Pond
- 🟦 Ponds in TMDL Model (5)
- ▲ Private Practice (1)
- → Stormwater Pipes
- ═ Private Pipes
- ▨ Excluded Pollutants (1)
- NA_DC_MAD
- PD 7347-018_EXP
- PD 7347-018_MAD
- PD 7446-039_EXP
- PD 7446-039_MAD
- PD 7644-058_MAD
- PD 7739-001_EXP
- PD 7739-001_MAD
- PD 7840-001_EXP
- PD 7840-001_MAD

Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

0 1,125 2,250 Feet

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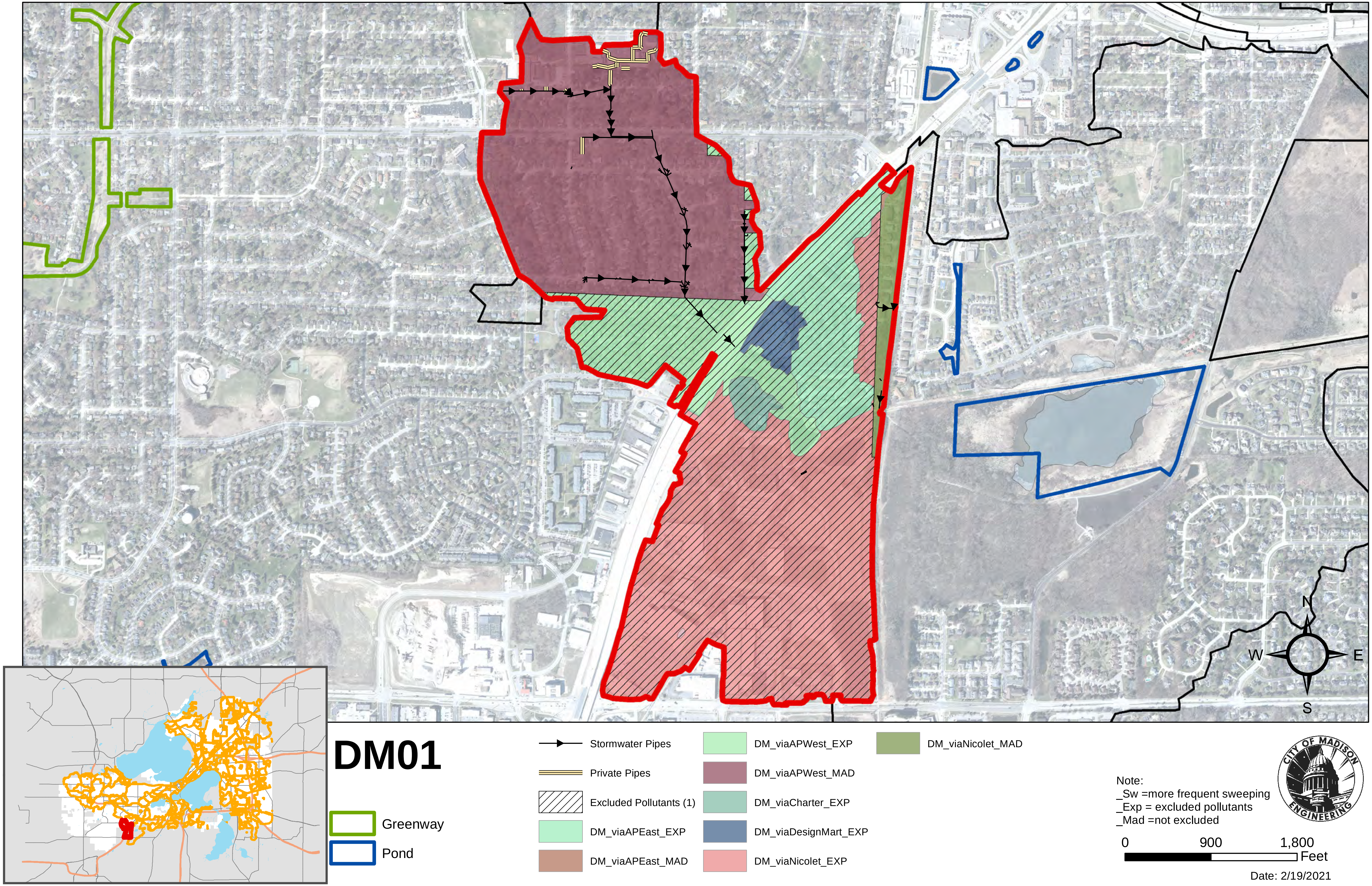

DM01

Greenway

Pond

Stormwater Pipes

Private Pipes

Excluded Pollutants (1)

DM_viaAPEast_EXP

DM_viaAPEast_MAD

DM_viaAPWest_EXP

DM_viaAPWest_MAD

DM_viaCharter_EXP

DM_viaDesignMart_EXP

DM_viaNicolet_EXP

DM_viaNicolet_MAD

Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

Date: 2/19/2021

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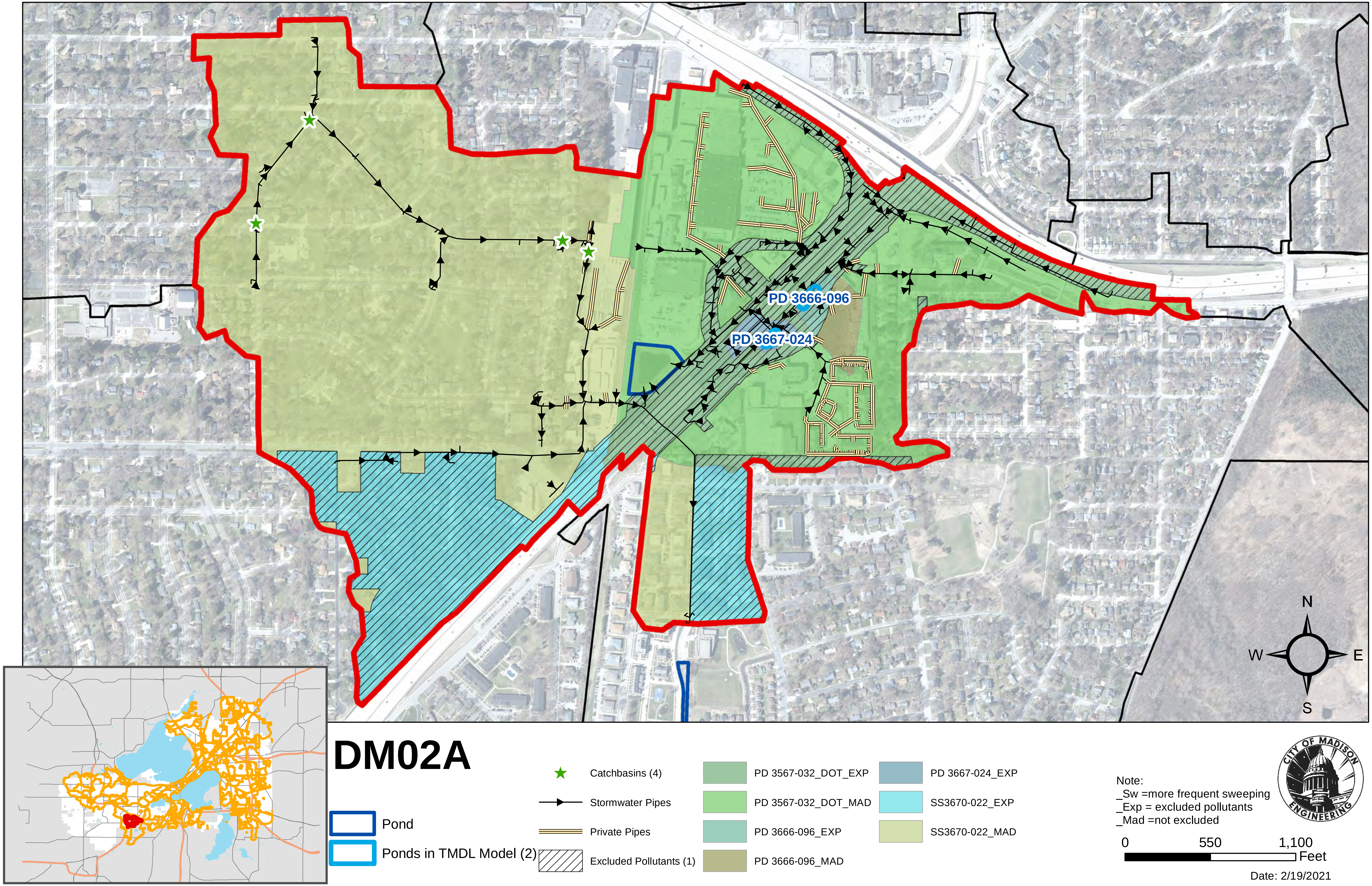

DM02A

★	Catchbasins (4)
➝	Stormwater Pipes
═	Private Pipes
▨	Excluded Pollutants (1)
🟩	PD 3567-032_DOT_EXP
🟩	PD 3567-032_DOT_MAD
🟩	PD 3666-096_EXP
🟫	PD 3666-096_MAD
🟦	PD 3667-024_EXP
🟦	SS3670-022_EXP
🟨	SS3670-022_MAD
☐	Pond
☐	Ponds in TMDL Model (2)

Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

0 550 1,100 Feet

Date: 2/19/2021

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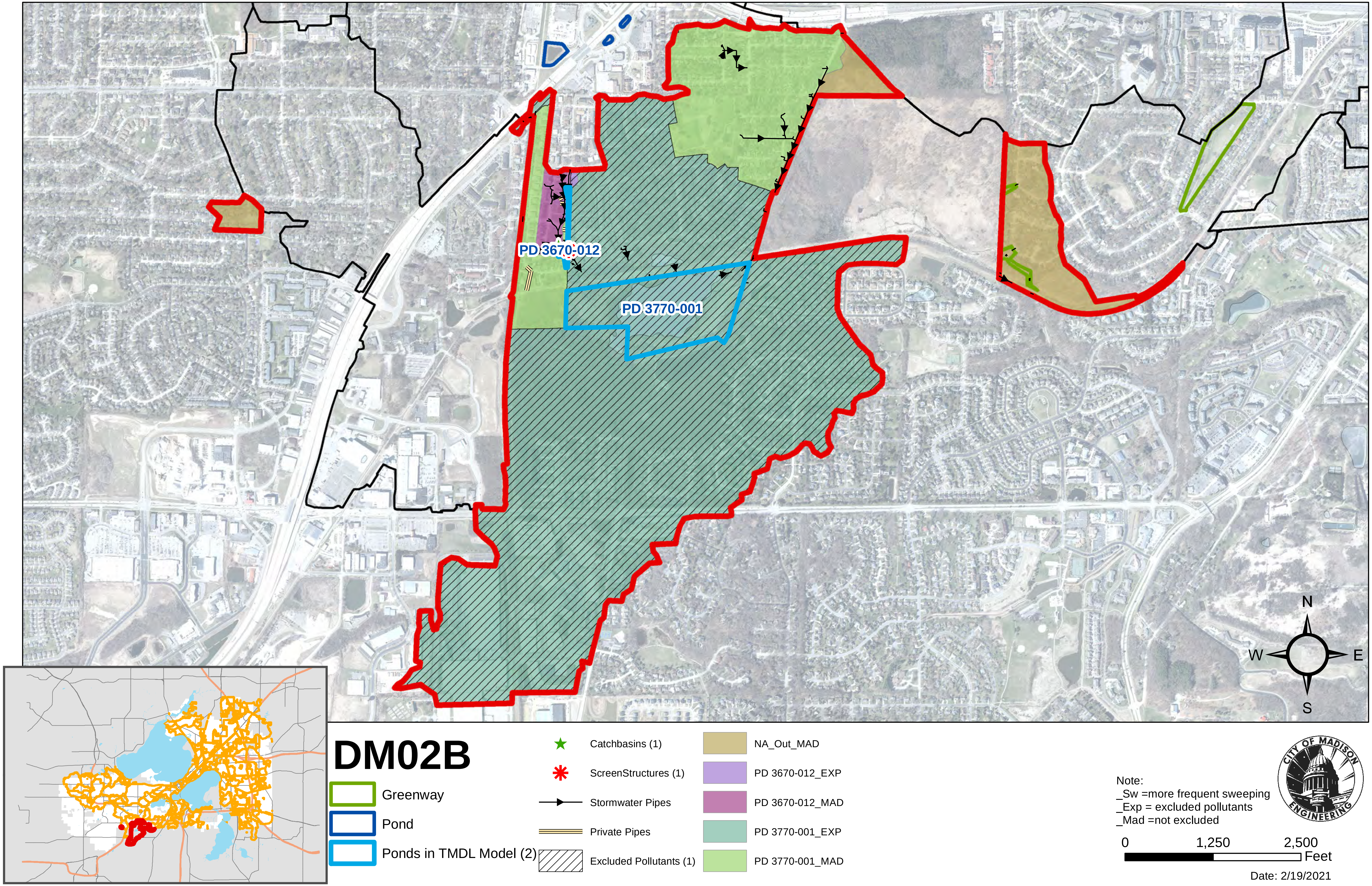

DM02B

- 🟩 Greenway
- 🟦 Pond
- 🟦 Ponds in TMDL Model (2)
- ★ Catchbasins (1)
- ✱ ScreenStructures (1)
- → Stormwater Pipes
- ═ Private Pipes
- ▨ Excluded Pollutants (1)
- 🟫 NA_Out_MAD
- 🟪 PD 3670-012_EXP
- 🟪 PD 3670-012_MAD
- 🟩 PD 3770-001_EXP
- 🟩 PD 3770-001_MAD

Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

0 1,250 2,500 Feet

Date: 2/19/2021

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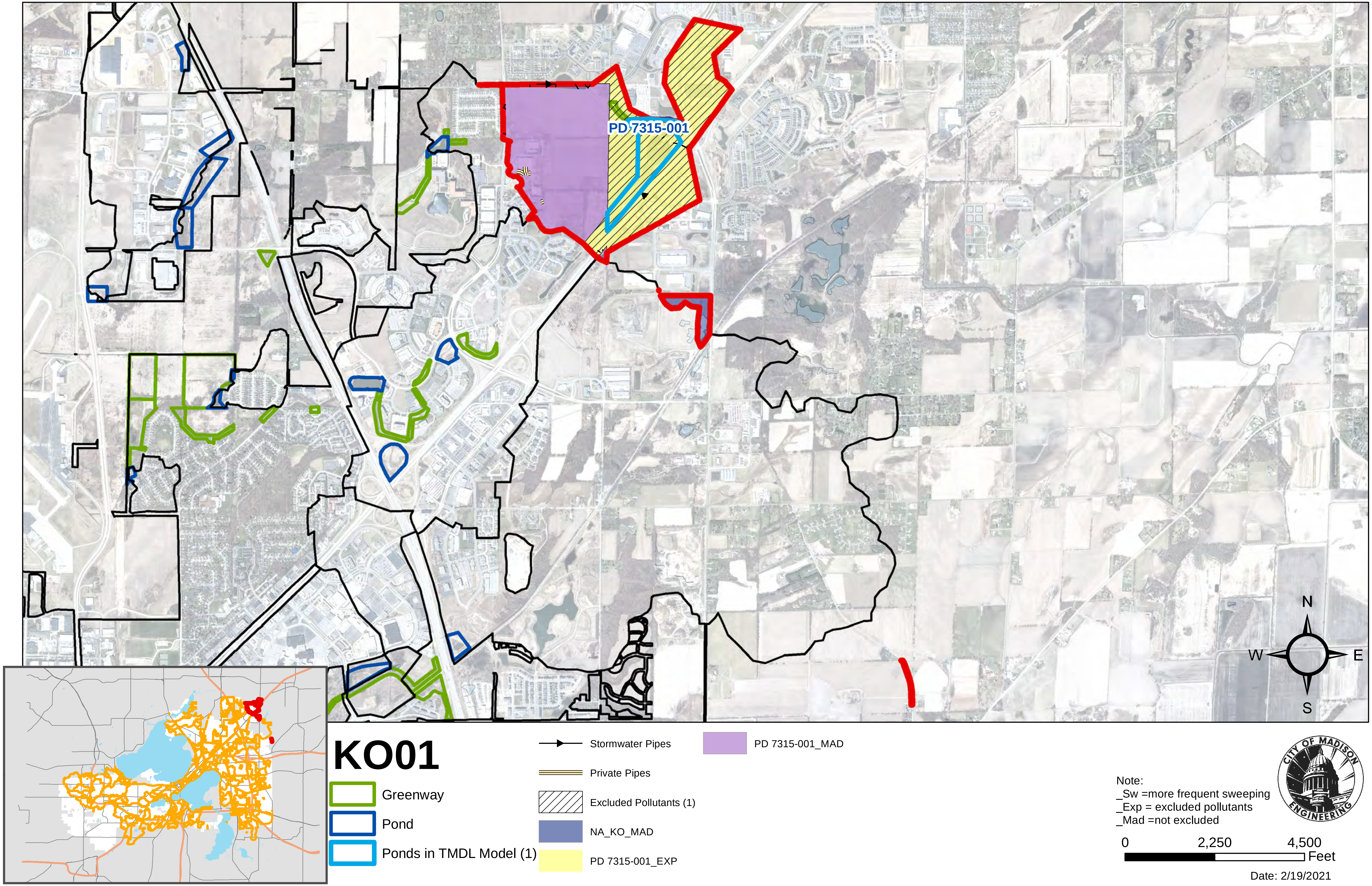
KO01



Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

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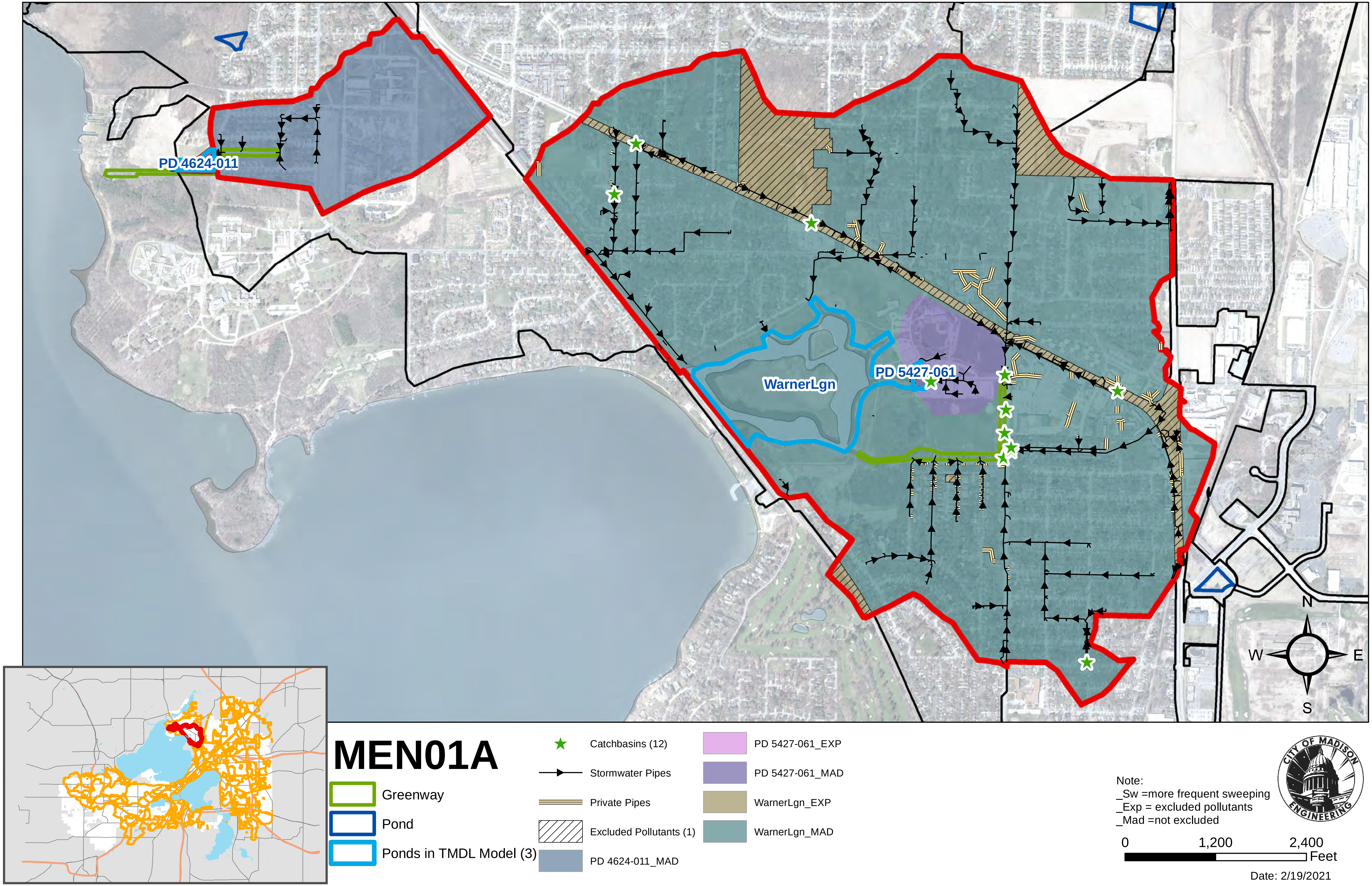

MEN01A

🟩 Greenway

🟦 Pond

🟦 Ponds in TMDL Model (3)

★ Catchbasins (12)

→ Stormwater Pipes

═ Private Pipes

▨ Excluded Pollutants (1)

■ PD 4624-011_MAD

■ PD 5427-061_EXP

■ PD 5427-061_MAD

■ WarnerLgn_EXP

■ WarnerLgn_MAD

Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

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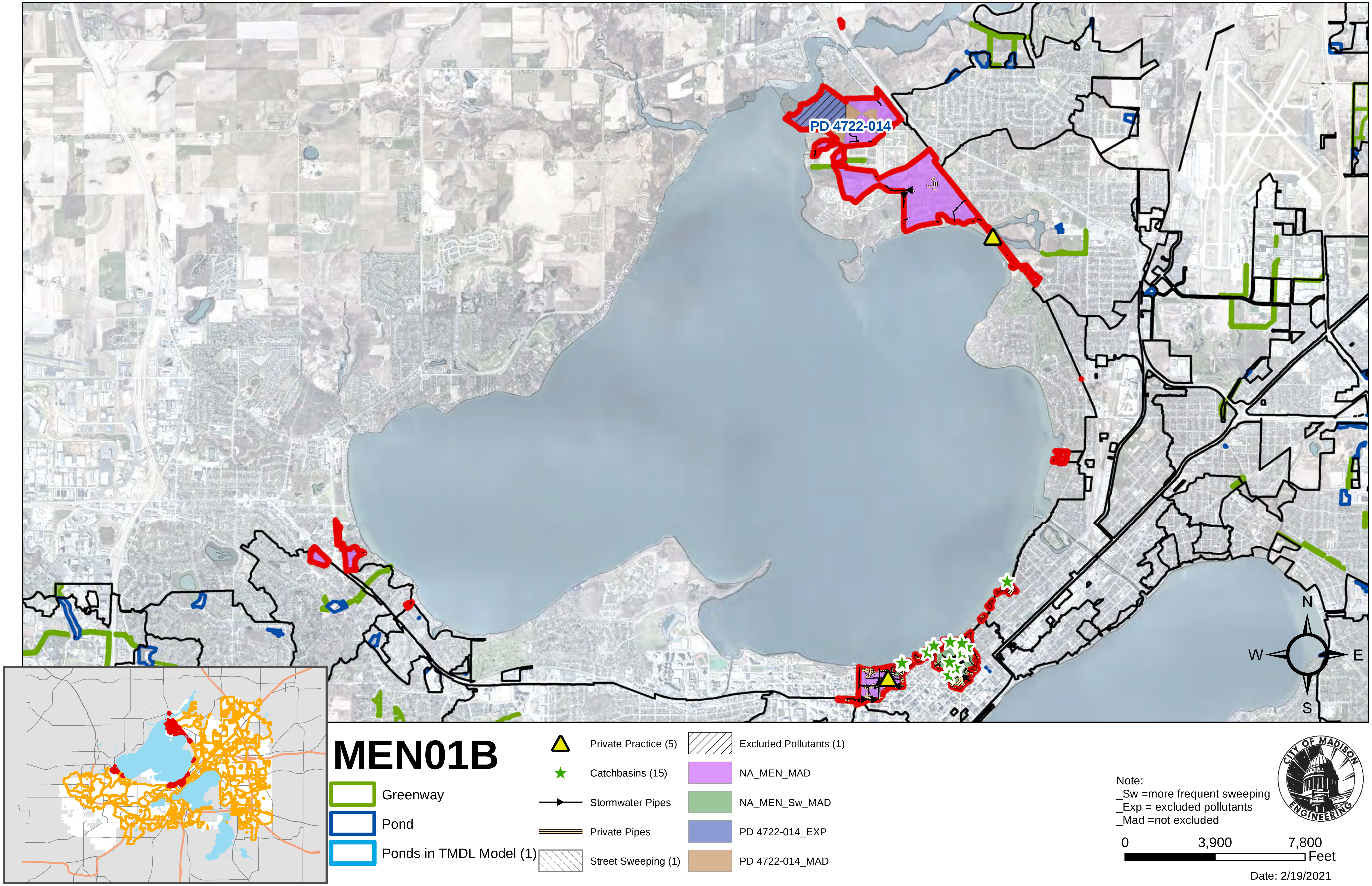

MEN01B

▭ Greenway

▭ Pond

▭ Ponds in TMDL Model (1)

△ Private Practice (5)

★ Catchbasins (15)

→ Stormwater Pipes

═ Private Pipes

▨ Street Sweeping (1)

▨ Excluded Pollutants (1)

🟪 NA_MEN_MAD

🟩 NA_MEN_Sw_MAD

🟦 PD 4722-014_EXP

🟫 PD 4722-014_MAD

Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

0 3,900 7,800 Feet

Date: 2/19/2021

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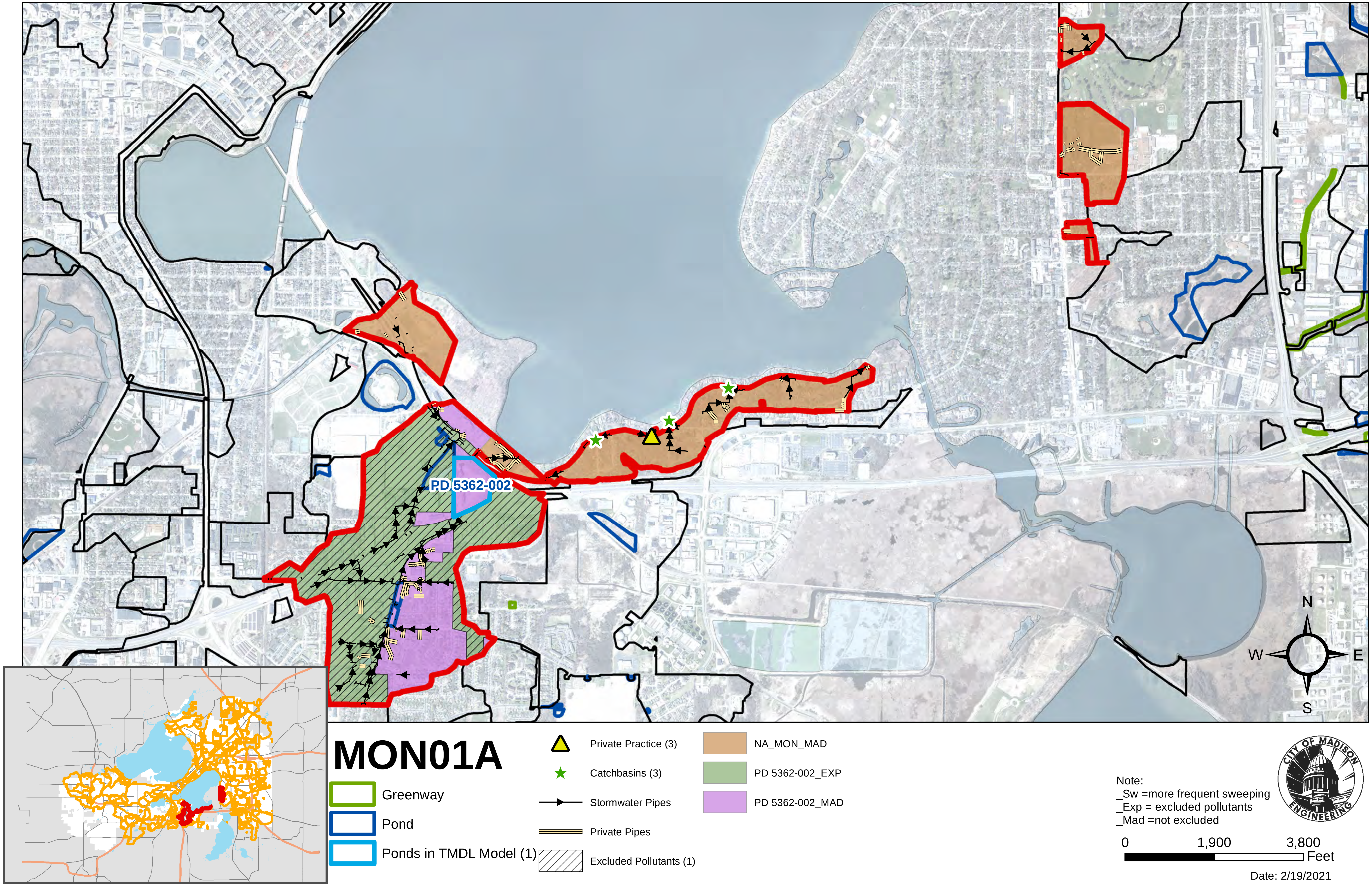

MON01A

- Greenway
- Pond
- Ponds in TMDL Model (1)

- ▲ Private Practice (3)
- ★ Catchbasins (3)
- → Stormwater Pipes
- ═ Private Pipes
- ▨ Excluded Pollutants (1)

- 🟫 NA_MON_MAD
- 🟩 PD 5362-002_EXP
- 🟪 PD 5362-002_MAD

Note:
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_Exp = excluded pollutants
_Mad =not excluded

0 1,900 3,800 Feet

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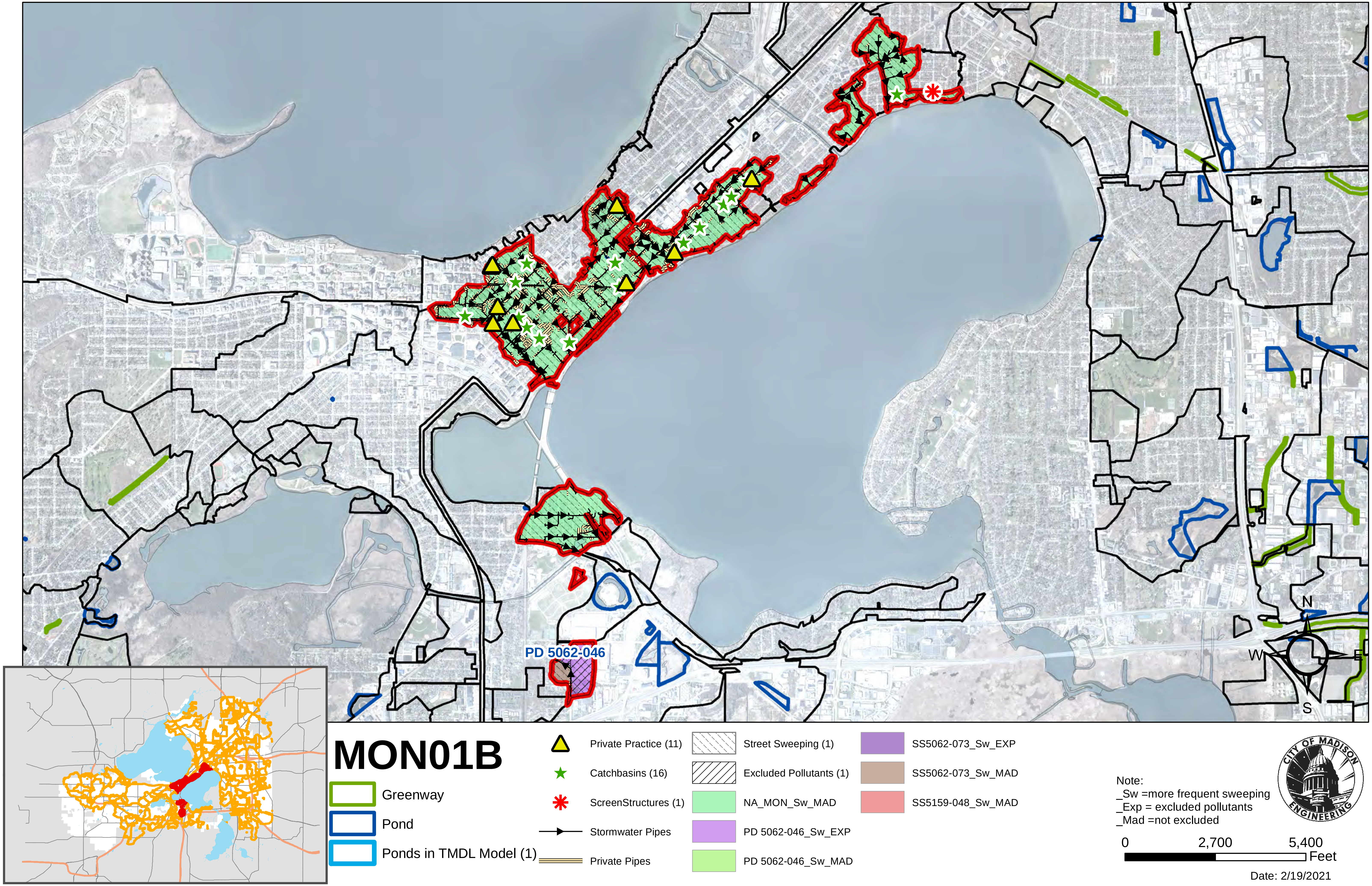
MON01B



🟩 Greenway

🟦 Pond

🟦 Ponds in TMDL Model (1)

▲ Private Practice (11)

★ Catchbasins (16)

✱ ScreenStructures (1)

→ Stormwater Pipes

═ Private Pipes

▨ Street Sweeping (1)

▨ Excluded Pollutants (1)

🟩 NA_MON_Sw_MAD

🟪 PD 5062-046_Sw_EXP

🟩 PD 5062-046_Sw_MAD

🟪 SS5062-073_Sw_EXP

🟫 SS5062-073_Sw_MAD

🟥 SS5159-048_Sw_MAD

Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

0 2,700 5,400
Feet

Date: 2/19/2021

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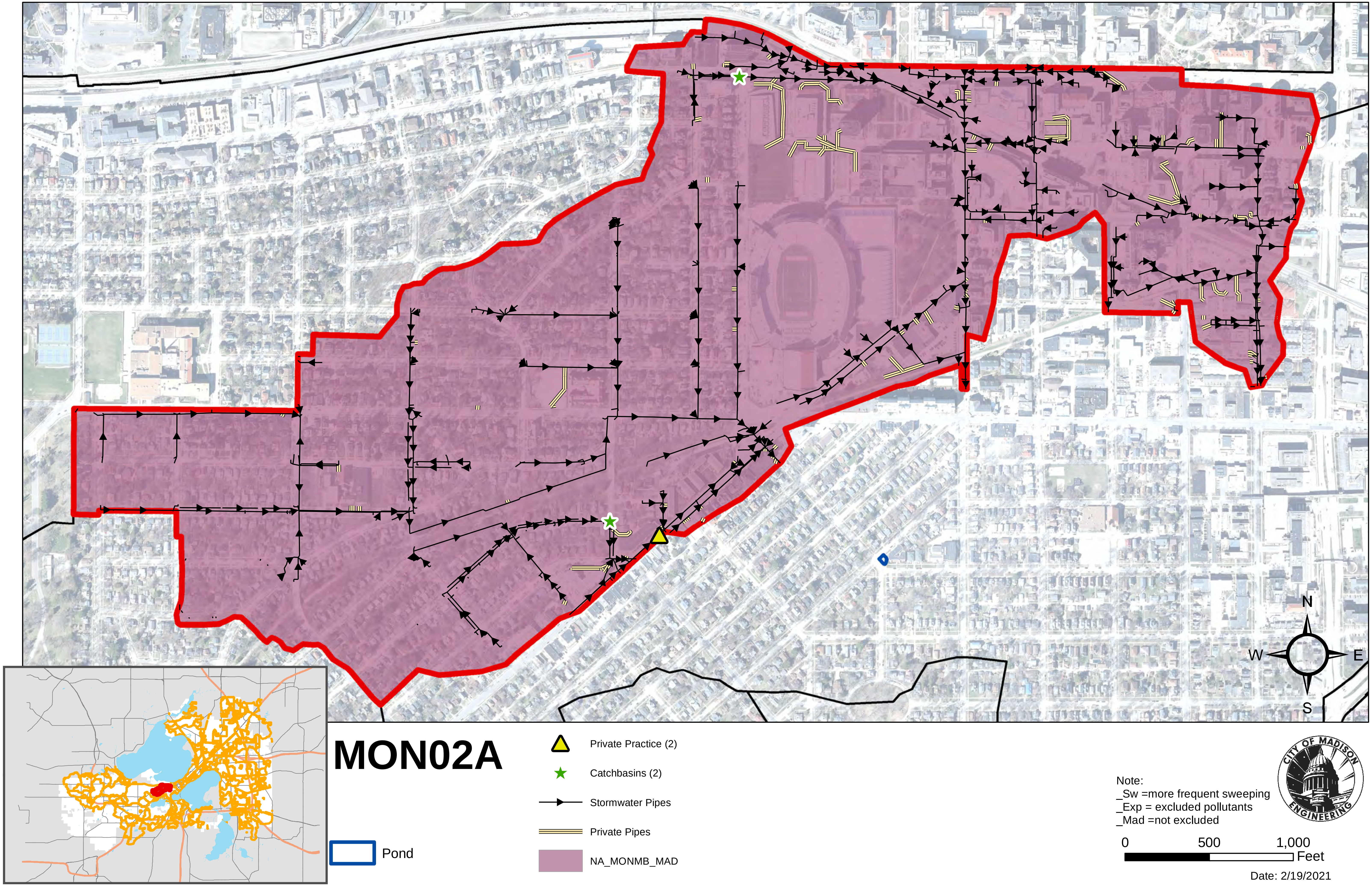

MON02A

▲ Private Practice (2)

★ Catchbasins (2)

Stormwater Pipes

Private Pipes

NA_MONMB_MAD

Pond

Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

Date: 2/19/2021

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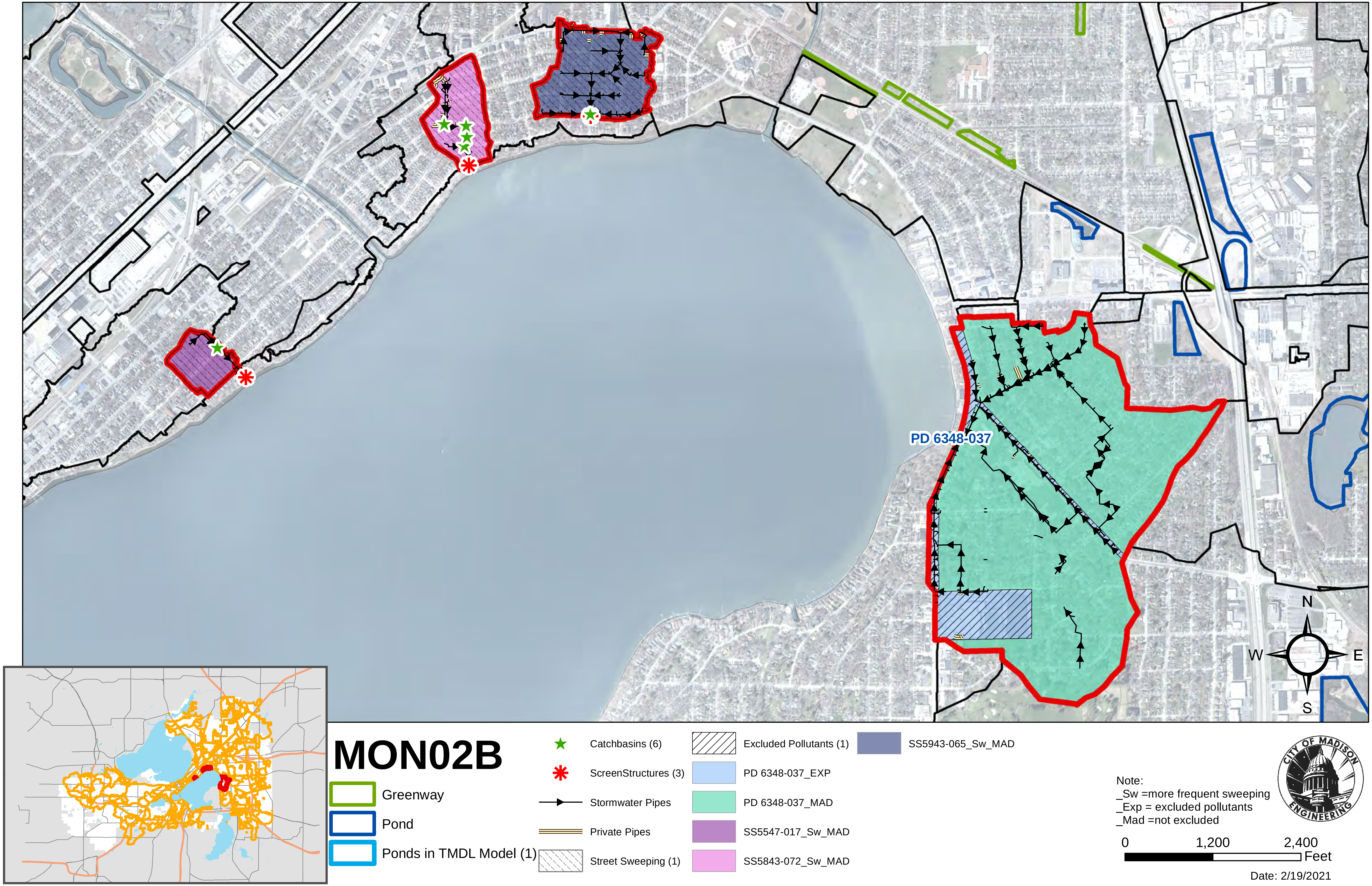

MON02B

- 🟩 Greenway
- 🟦 Pond
- 🟦 Ponds in TMDL Model (1)
- ★ Catchbasins (6)
- ✱ ScreenStructures (3)
- → Stormwater Pipes
- ═ Private Pipes
- ▨ Street Sweeping (1)
- ▨ Excluded Pollutants (1)
- ■ PD 6348-037_EXP
- ■ PD 6348-037_MAD
- ■ SS5547-017_Sw_MAD
- ■ SS5843-072_Sw_MAD
- ■ SS5943-065_Sw_MAD

Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

0 1,200 2,400 Feet

Date: 2/19/2021

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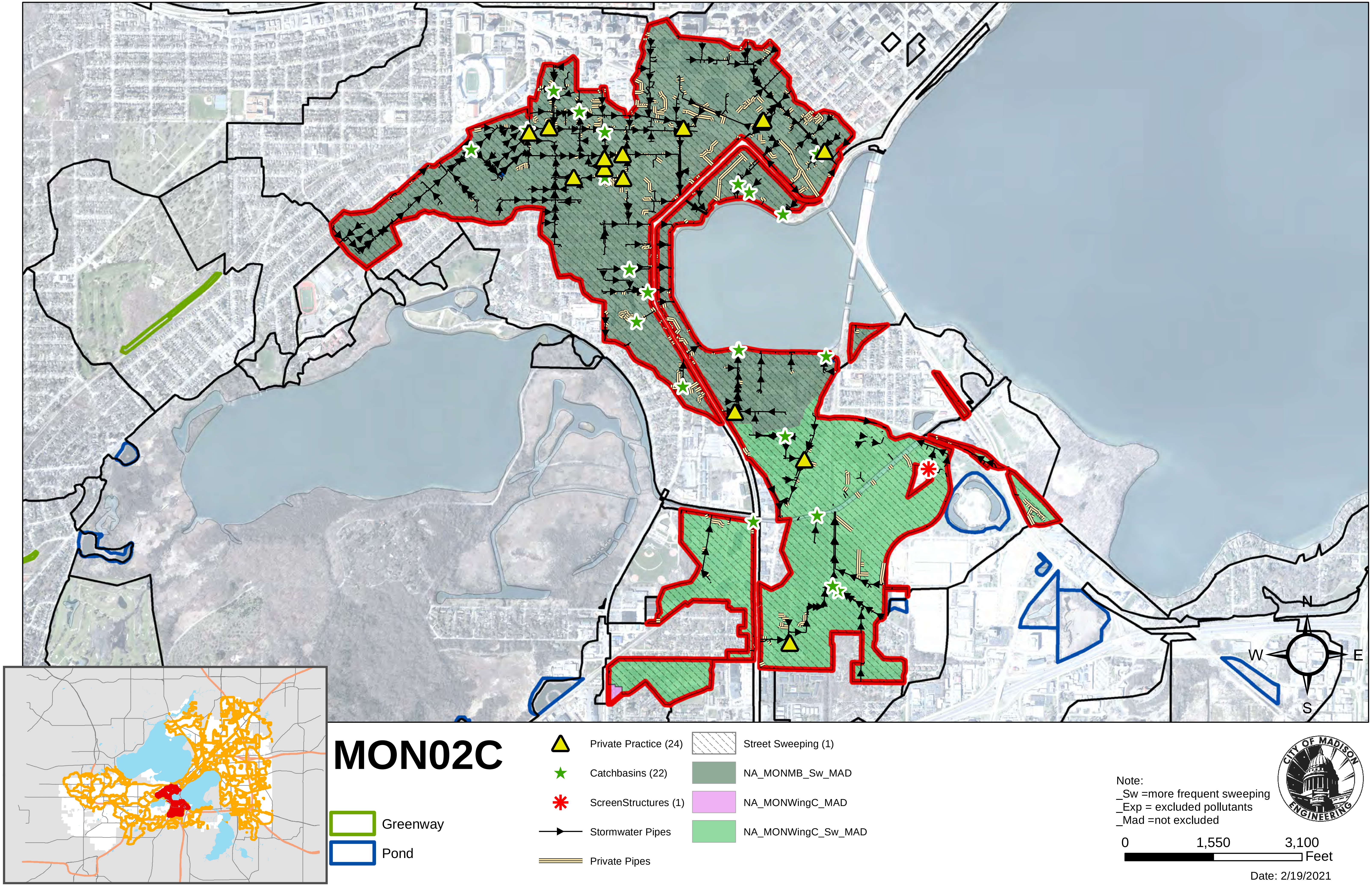
User Name: enles



MON02C

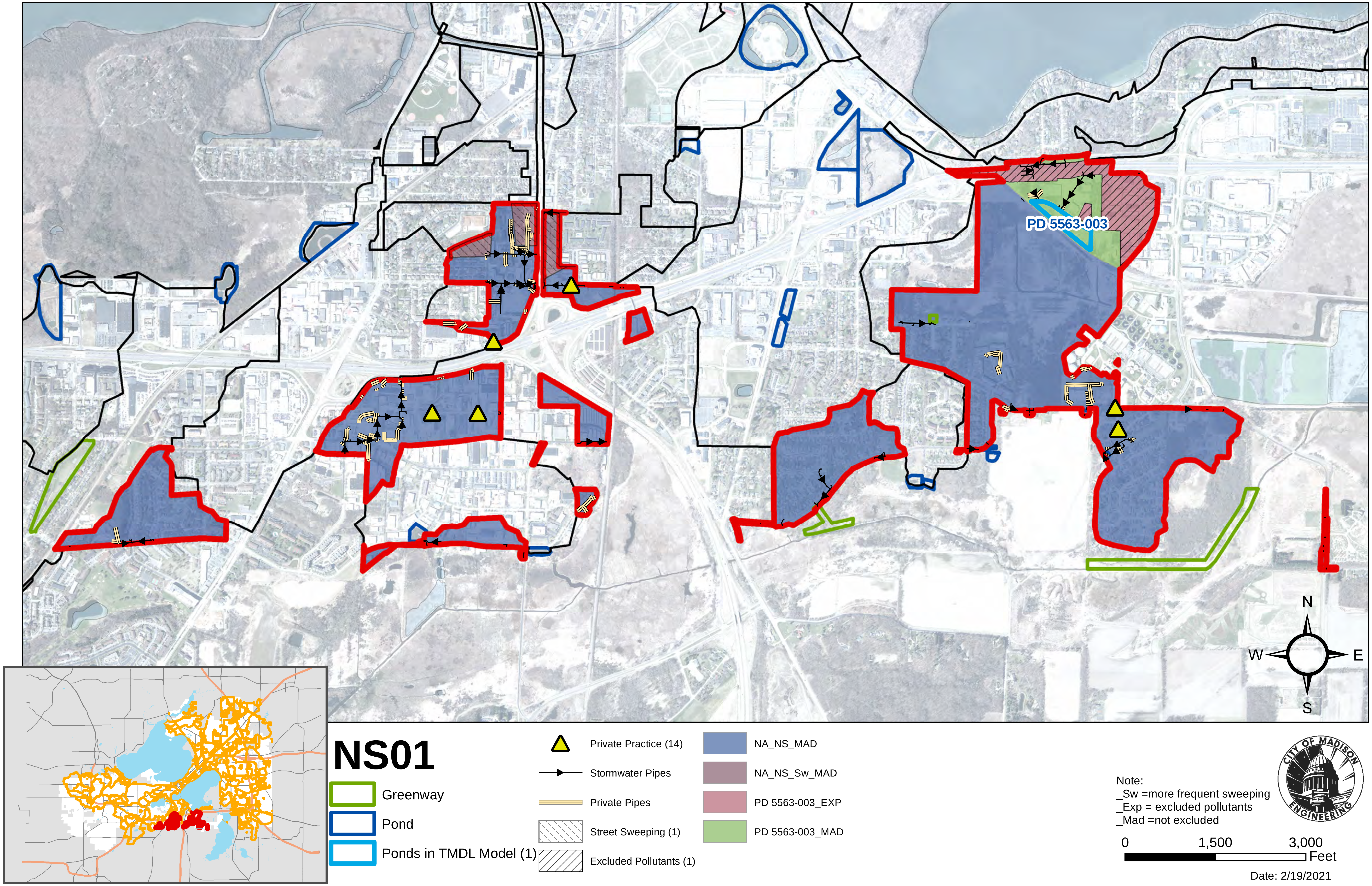
Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

Date: 2/19/2021

Document Path: M:\MS4_WaterQualityModel\2019_2020 Modeling Effort\GIS\WorkingMXDs\ModelAreas_DD.mxd

User Name: enles

NS01

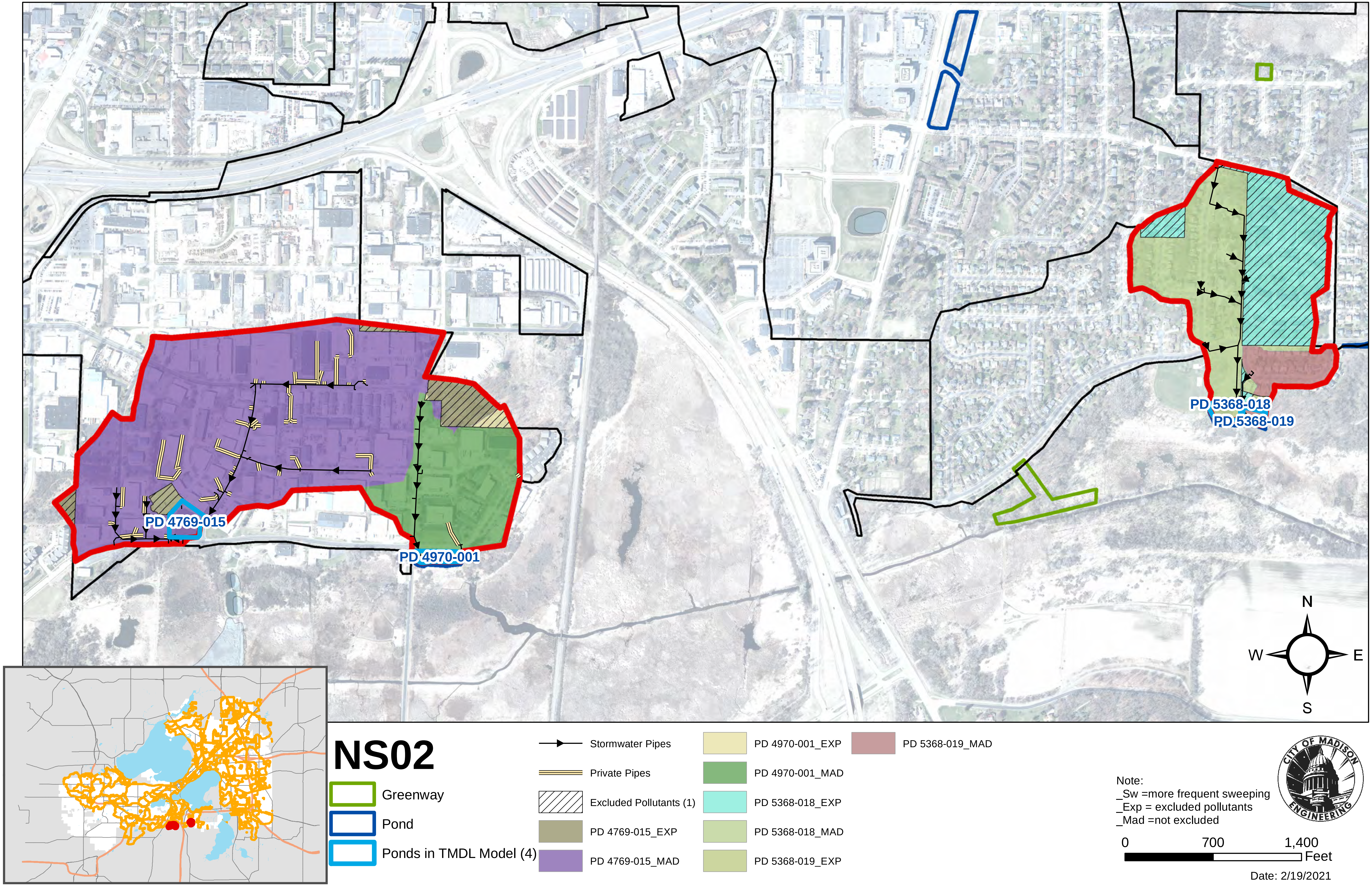


Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

Date: 2/19/2021

Document Path: M:\MS4_WaterQualityModel\2019_2020 Modeling Effort\GIS\Working\MXDs\ModelAreas_DD.mxd

User Name: enles



NS02

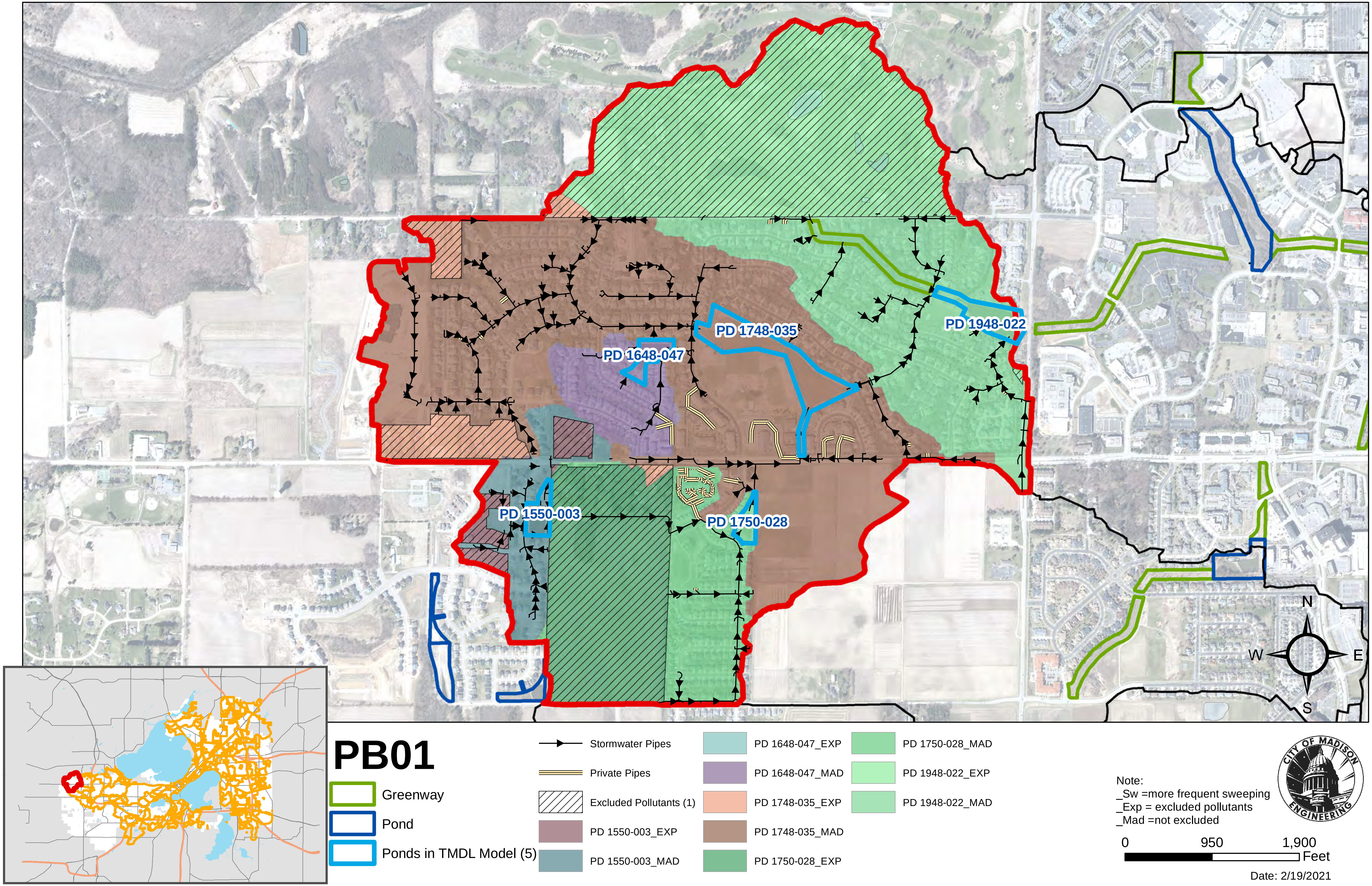
Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

Date: 2/19/2021

Document Path: M:\MS4_WaterQualityModel\2019_2020 Modeling Effort\GIS\Working\MXDs\ModelAreas_DD.mxd

User Name: enles

PB01

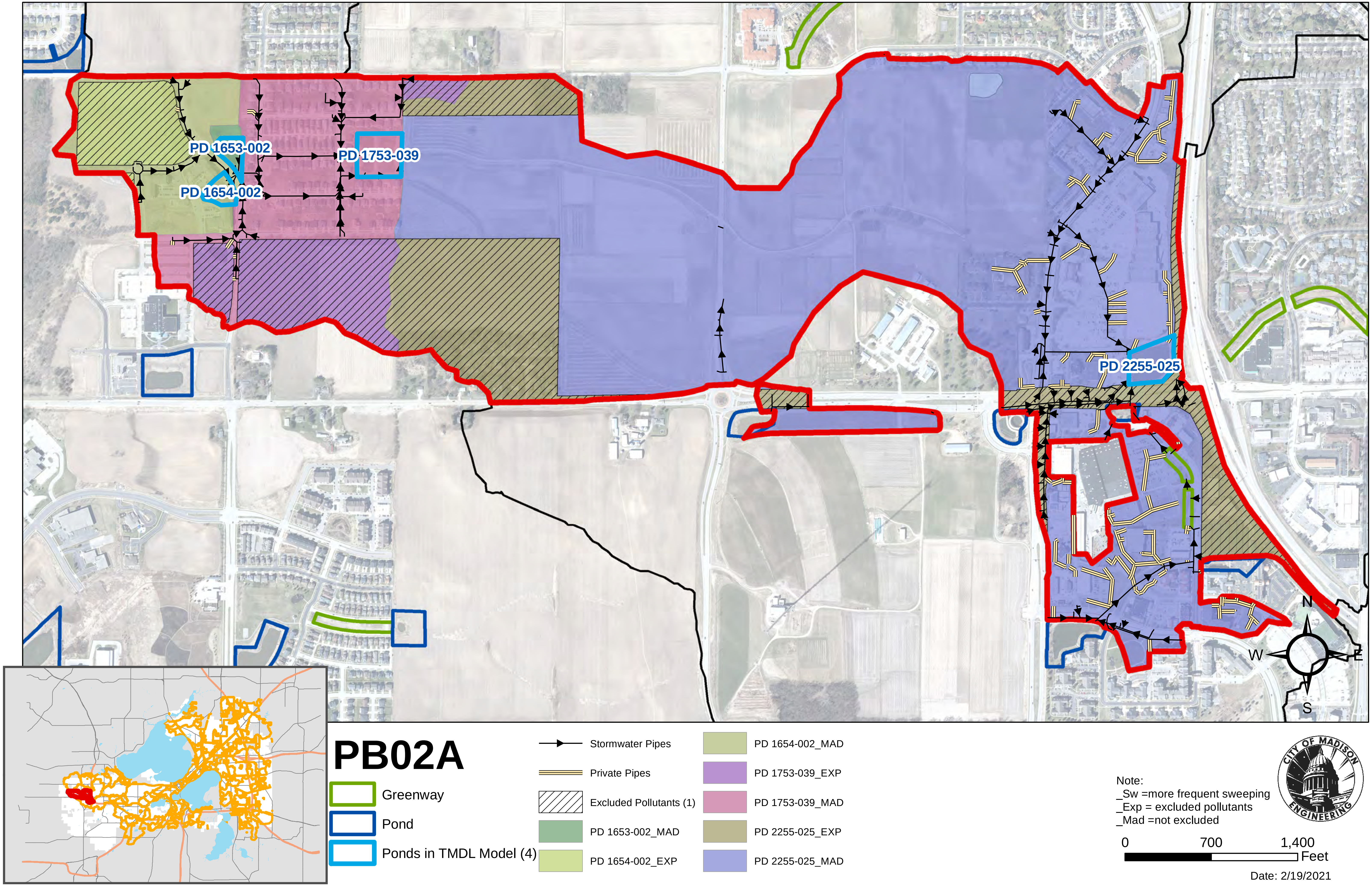


Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

Date: 2/19/2021

User Name: enles

Document Path: M:\MS4_WaterQualityModel\2019_2020 Modeling Effort\GIS\WorkingMXDs\ModelAreas_DD.mxd



PB02A

- Greenway
- Pond
- Ponds in TMDL Model (4)

Stormwater Pipes	PD 1654-002_MAD
Private Pipes	PD 1753-039_EXP
Excluded Pollutants (1)	PD 1753-039_MAD
PD 1653-002_MAD	PD 2255-025_EXP
PD 1654-002_EXP	PD 2255-025_MAD

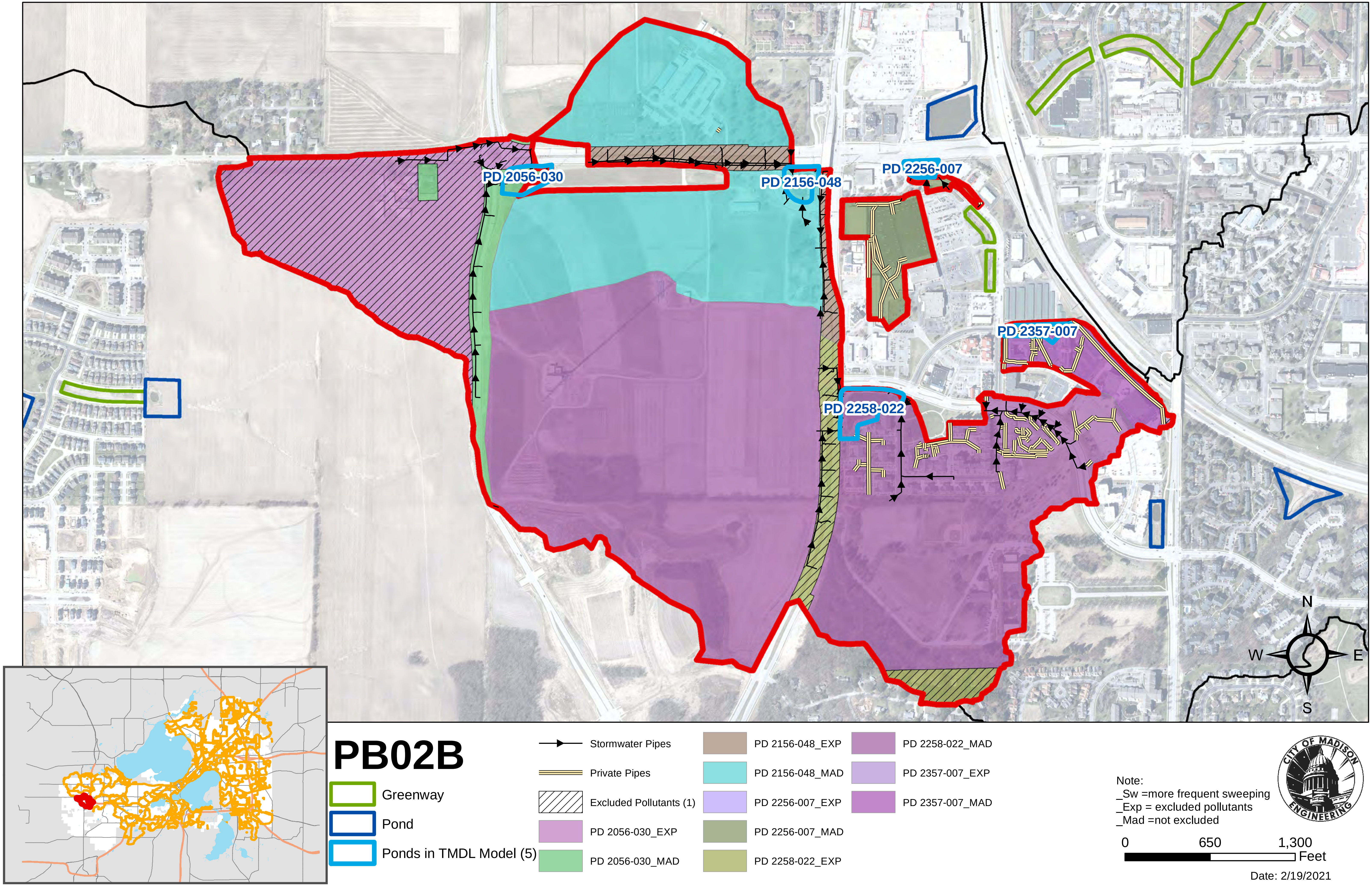
Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

0 700 1,400
Feet

Date: 2/19/2021

Document Path: M:\MS4_WaterQualityModel\2019_2020 Modeling Effort\GIS\Working\MXDs\ModelAreas_DD.mxd

User Name: enles



PB02B

- ☐ Greenway
- ☐ Pond
- ☐ Ponds in TMDL Model (5)
- → Stormwater Pipes
- ═ Private Pipes
- ▨ Excluded Pollutants (1)
- ■ PD 2056-030_EXP
- ■ PD 2056-030_MAD
- ■ PD 2156-048_EXP
- ■ PD 2156-048_MAD
- ■ PD 2256-007_EXP
- ■ PD 2256-007_MAD
- ■ PD 2258-022_EXP
- ■ PD 2258-022_MAD
- ■ PD 2357-007_EXP
- ■ PD 2357-007_MAD

Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

0 650 1,300
Feet

Date: 2/19/2021

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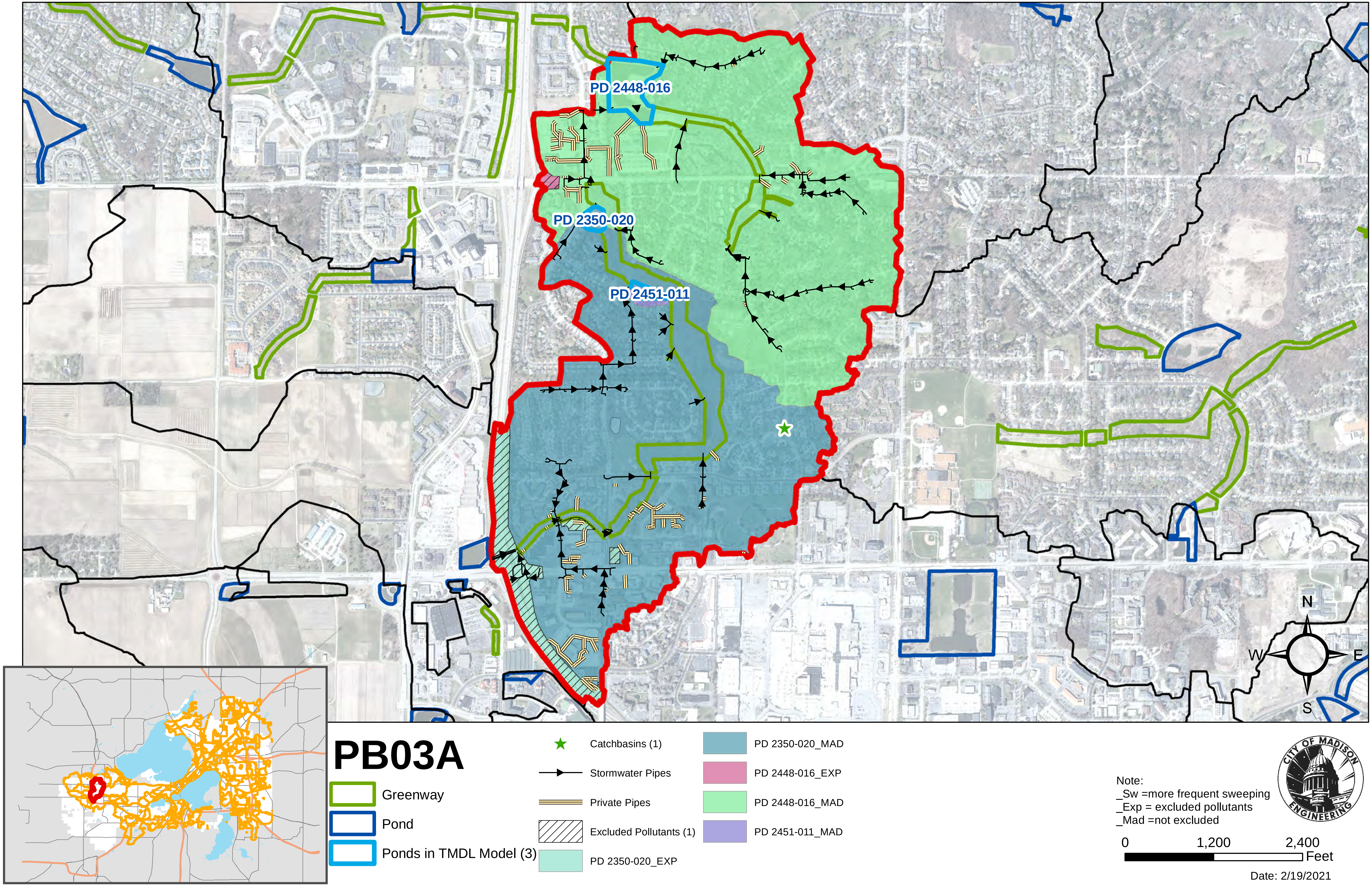
PB03A



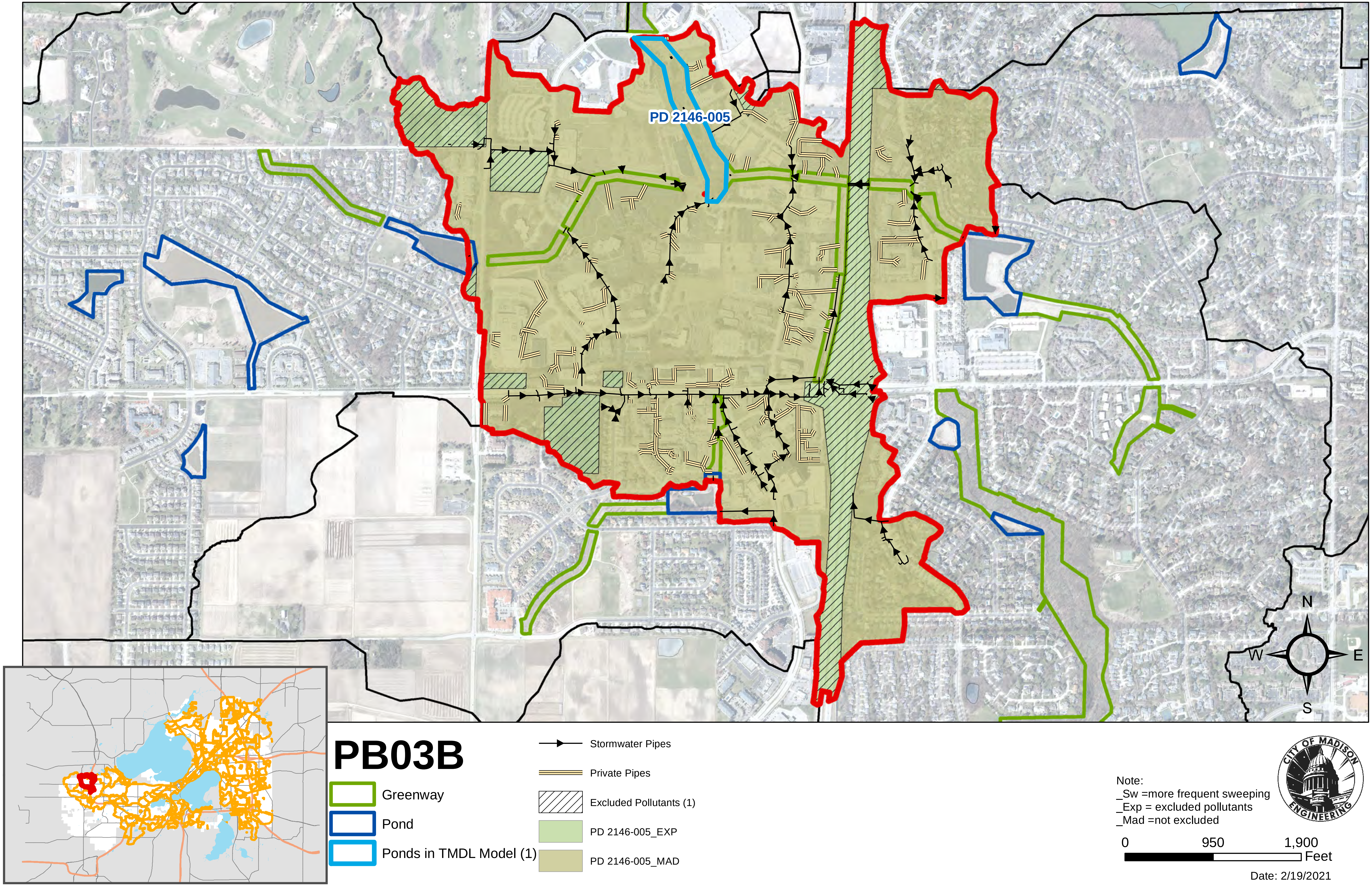
Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

Date: 2/19/2021

Document Path: M:\MS4_WaterQualityModel\2019_2020 Modeling Effort\GIS\Working\MXDs\ModelAreas_DD.mxd

User Name: enles

PB03B



Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

Date: 2/19/2021

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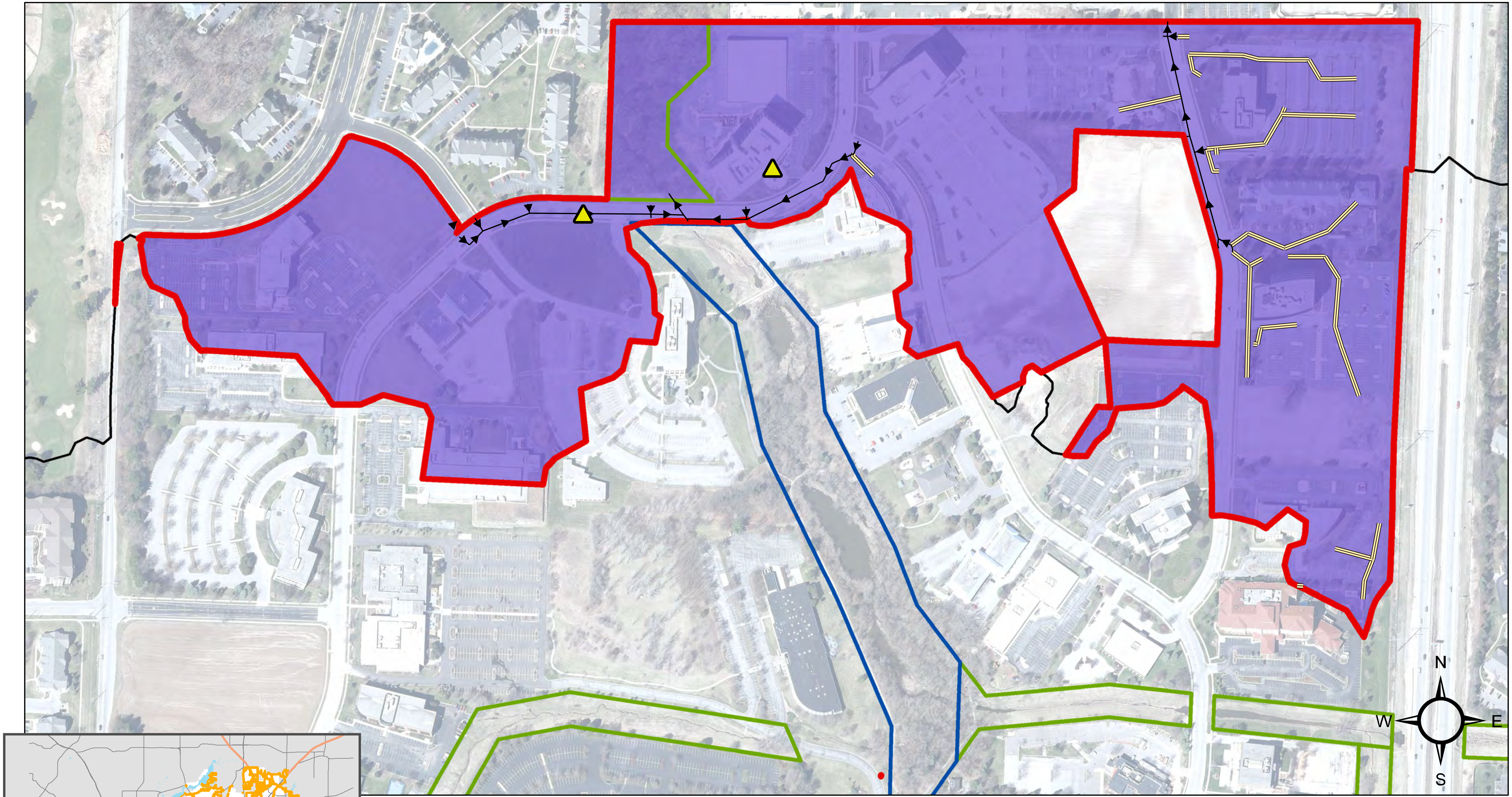
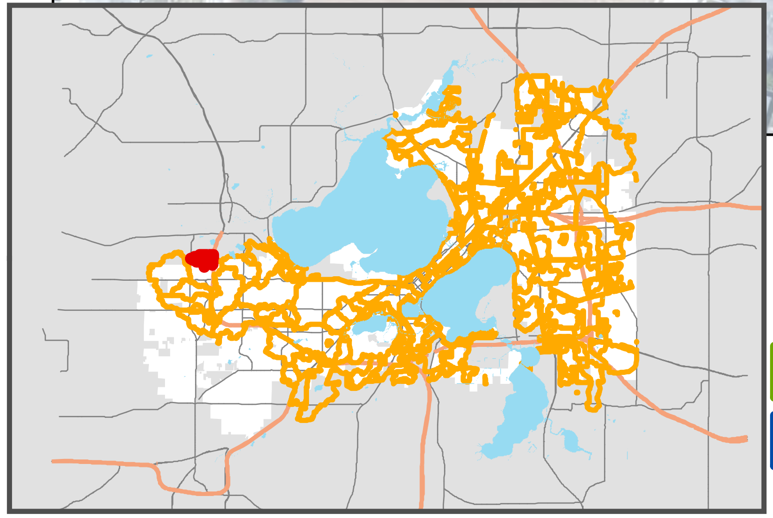
User Name: enles





PB03C

🟩 Greenway

🟦 Pond

△ Private Practice (3)

→ Stormwater Pipes

═ Private Pipes

🟪 NA_PB_MAD

Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

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0 300 600
Feet

Date: 2/19/2021

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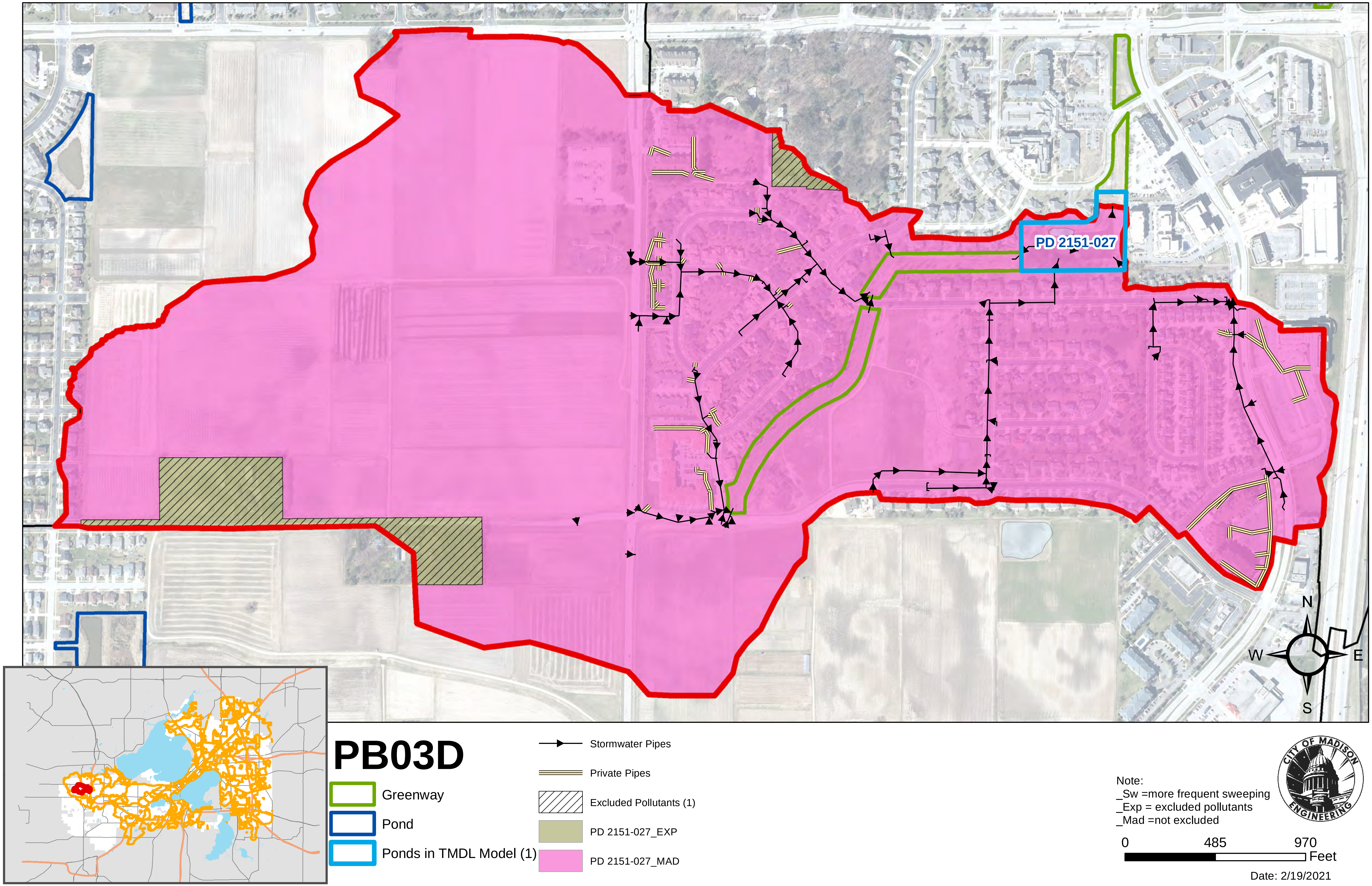
User Name: enles



PB03D

- 🟩 Greenway
- 🟦 Pond
- 🟦 Ponds in TMDL Model (1)
- → Stormwater Pipes
- ═ Private Pipes
- ▨ Excluded Pollutants (1)
- ■ PD 2151-027_EXP
- ■ PD 2151-027_MAD

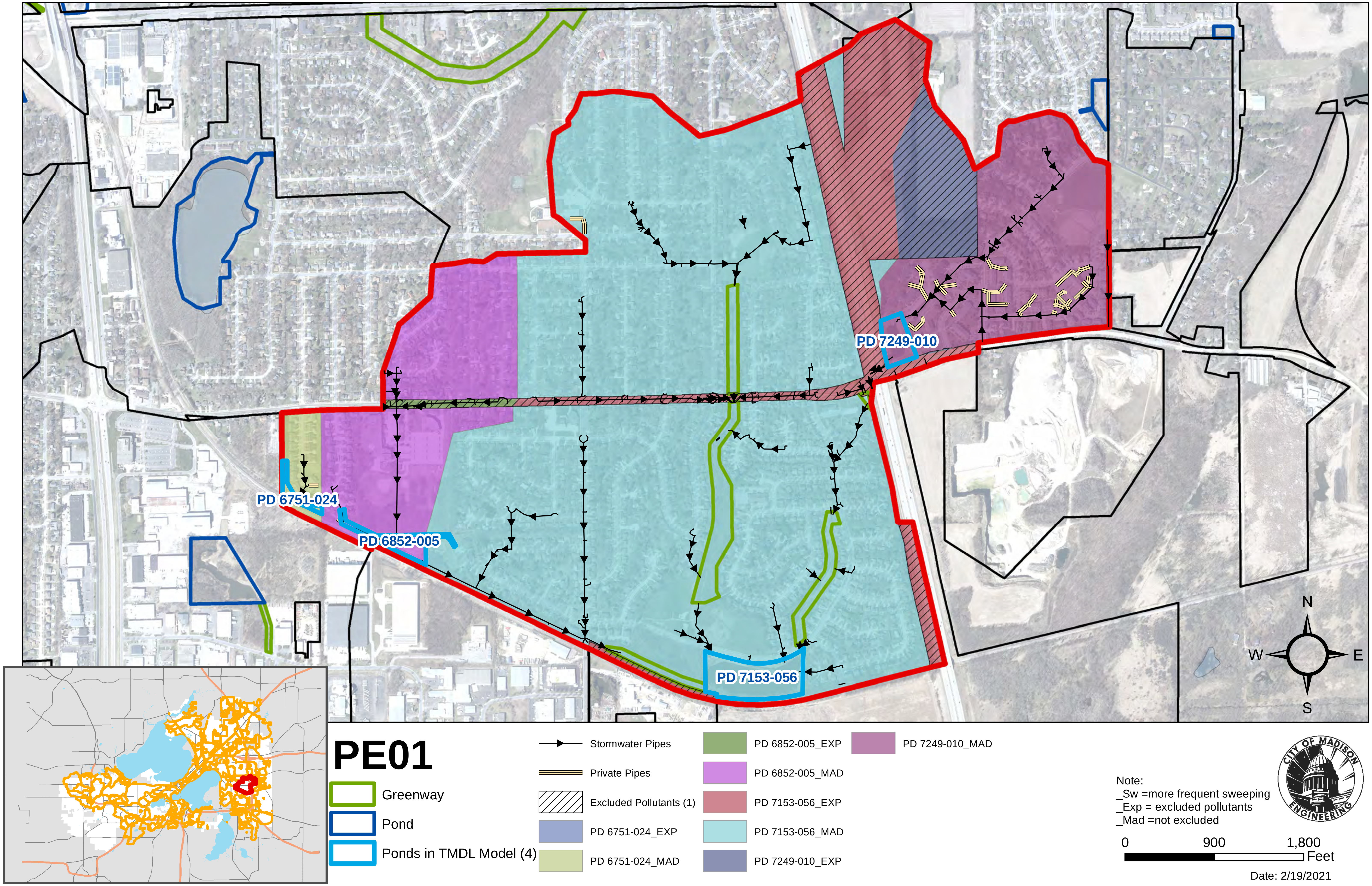
Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

0 485 970 Feet

Date: 2/19/2021

Document Path: M:\MS4_WaterQualityModel\2019_2020 Modeling Effort\GIS\WorkingMXDs\ModelAreas_DD.mxd

User Name: enles



PE01

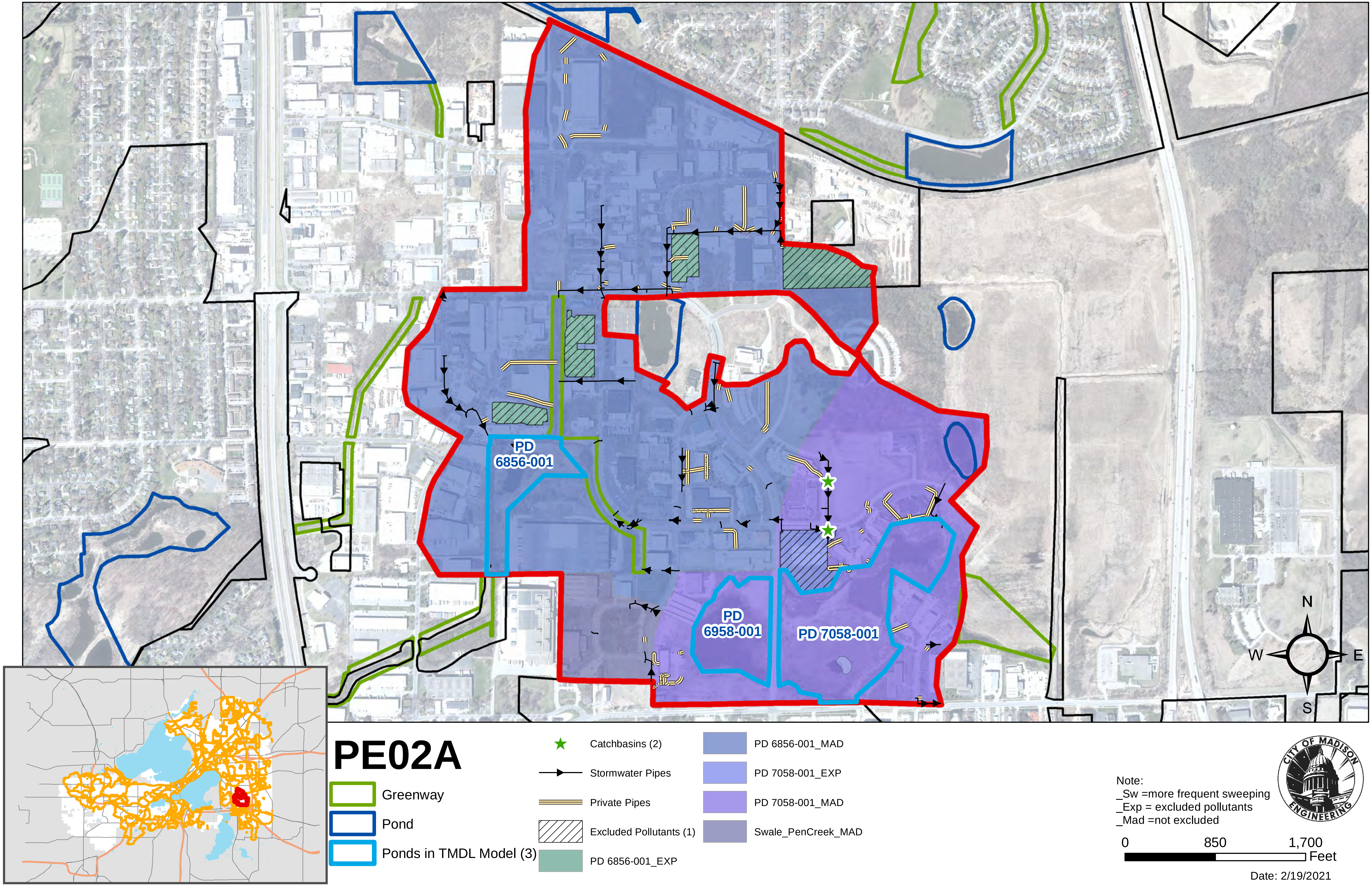
- Greenway
- Pond
- Ponds in TMDL Model (4)
- Stormwater Pipes
- Private Pipes
- ▨ Excluded Pollutants (1)
- PD 6751-024_EXP
- PD 6751-024_MAD
- PD 6852-005_EXP
- PD 6852-005_MAD
- PD 7153-056_EXP
- PD 7153-056_MAD
- PD 7249-010_EXP
- PD 7249-010_MAD

Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

Date: 2/19/2021

Document Path: M:\MS4_WaterQualityModel\2019_2020 Modeling Effort\GIS\Working\MXDs\ModelAreas_DD.mxd

User Name: enles



PE02A

- 🟩 Greenway
- 🟦 Pond
- 🟦 Ponds in TMDL Model (3)
- ★ Catchbasins (2)
- → Stormwater Pipes
- ═ Private Pipes
- ▨ Excluded Pollutants (1)
- ■ PD 6856-001_EXP
- ■ PD 6856-001_MAD
- ■ PD 7058-001_EXP
- ■ PD 7058-001_MAD
- ■ Swale_PenCreek_MAD

Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

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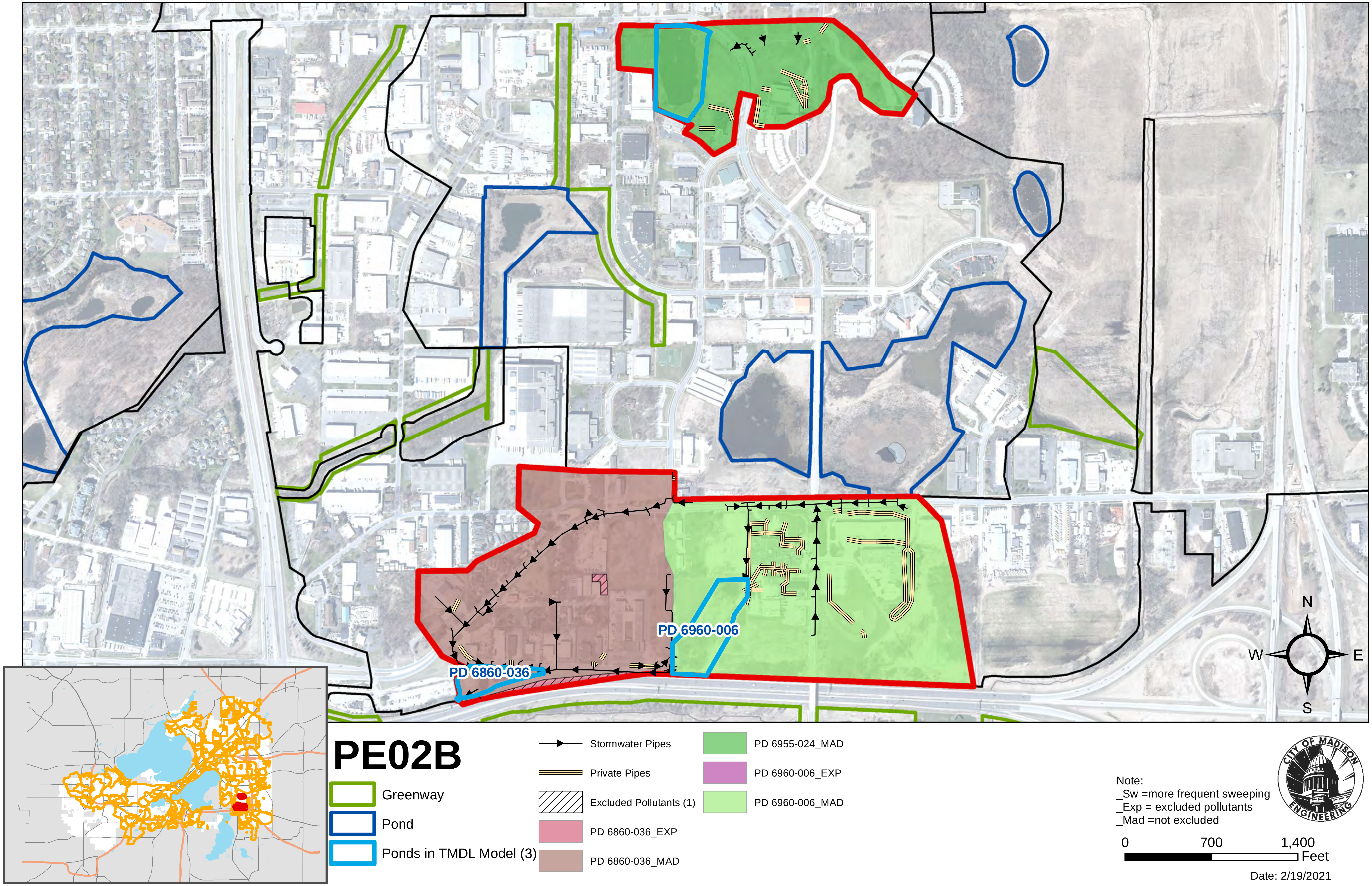
User Name: enles

PE02B

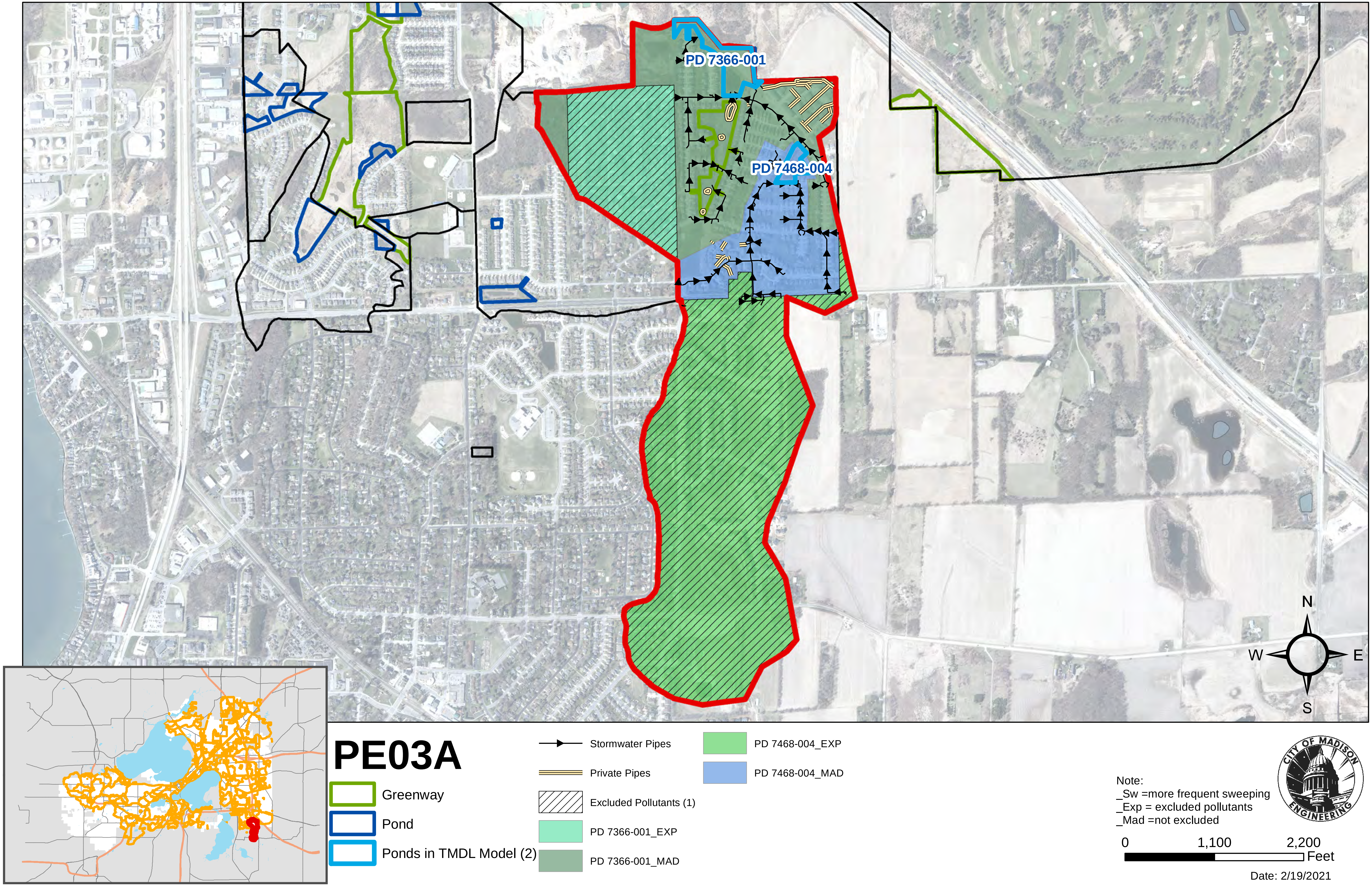


Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

Date: 2/19/2021

Document Path: M:\MS4_WaterQualityModel\2019_2020 Modeling Effort\GIS\Working\MXDs\ModelAreas_DD.mxd

User Name: enles



PE03A

- 🟩 Greenway
- 🟦 Pond
- 🟦 Ponds in TMDL Model (2)
- → Stormwater Pipes
- ═ Private Pipes
- ▨ Excluded Pollutants (1)
- 🟩 PD 7366-001_EXP
- 🟩 PD 7366-001_MAD
- 🟩 PD 7468-004_EXP
- 🟦 PD 7468-004_MAD

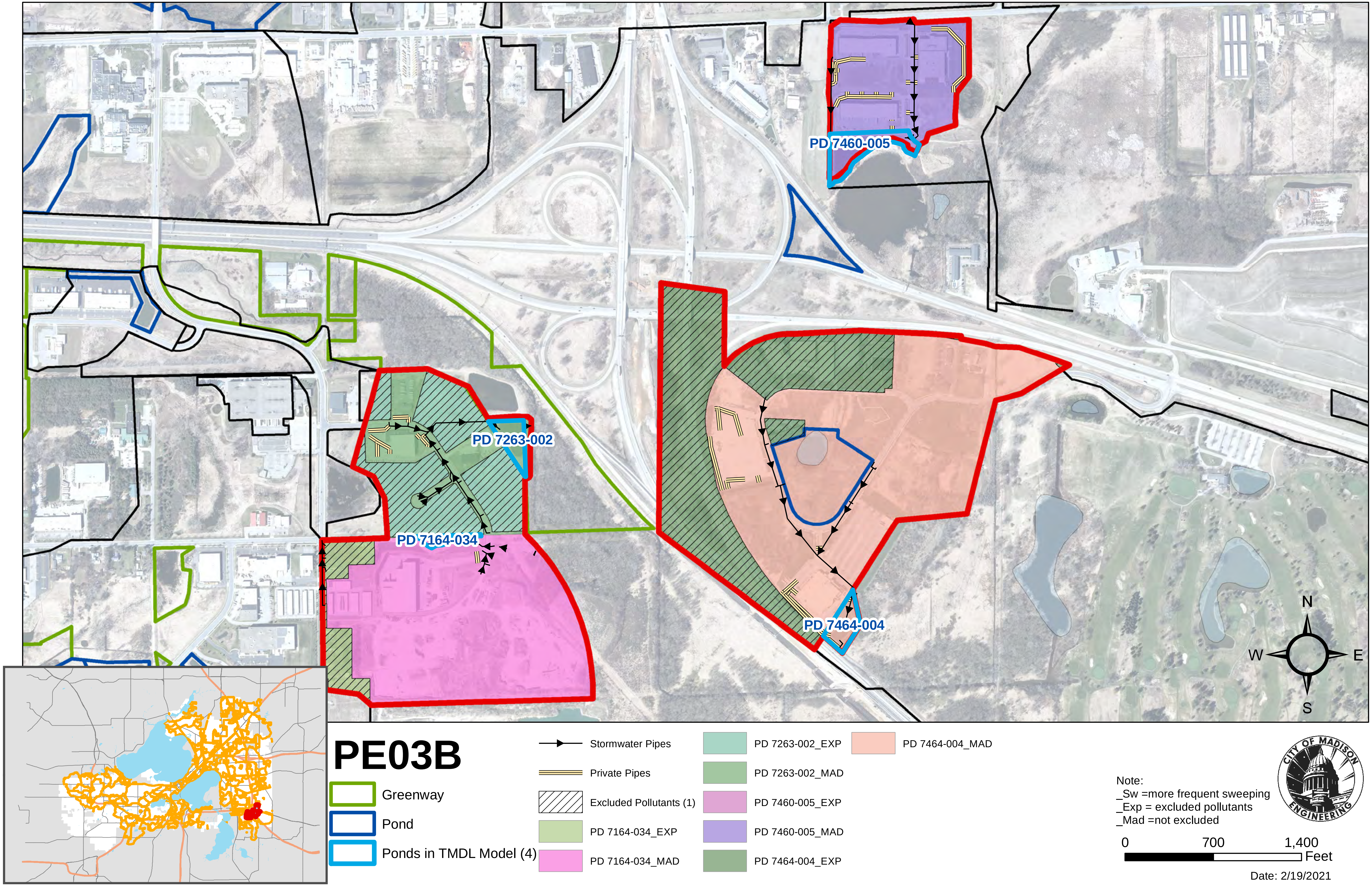
Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

0 1,100 2,200
Feet

Date: 2/19/2021

Document Path: M:\MS4_WaterQualityModel\2019_2020 Modeling Effort\GIS\Working\MXDs\ModelAreas_DD.mxd

User Name: enles



PE03B

- Greenway
- Pond
- Ponds in TMDL Model (4)
- Stormwater Pipes
- Private Pipes
- Excluded Pollutants (1)
- PD 7164-034_EXP
- PD 7164-034_MAD
- PD 7263-002_EXP
- PD 7263-002_MAD
- PD 7460-005_EXP
- PD 7460-005_MAD
- PD 7464-004_EXP
- PD 7464-004_MAD

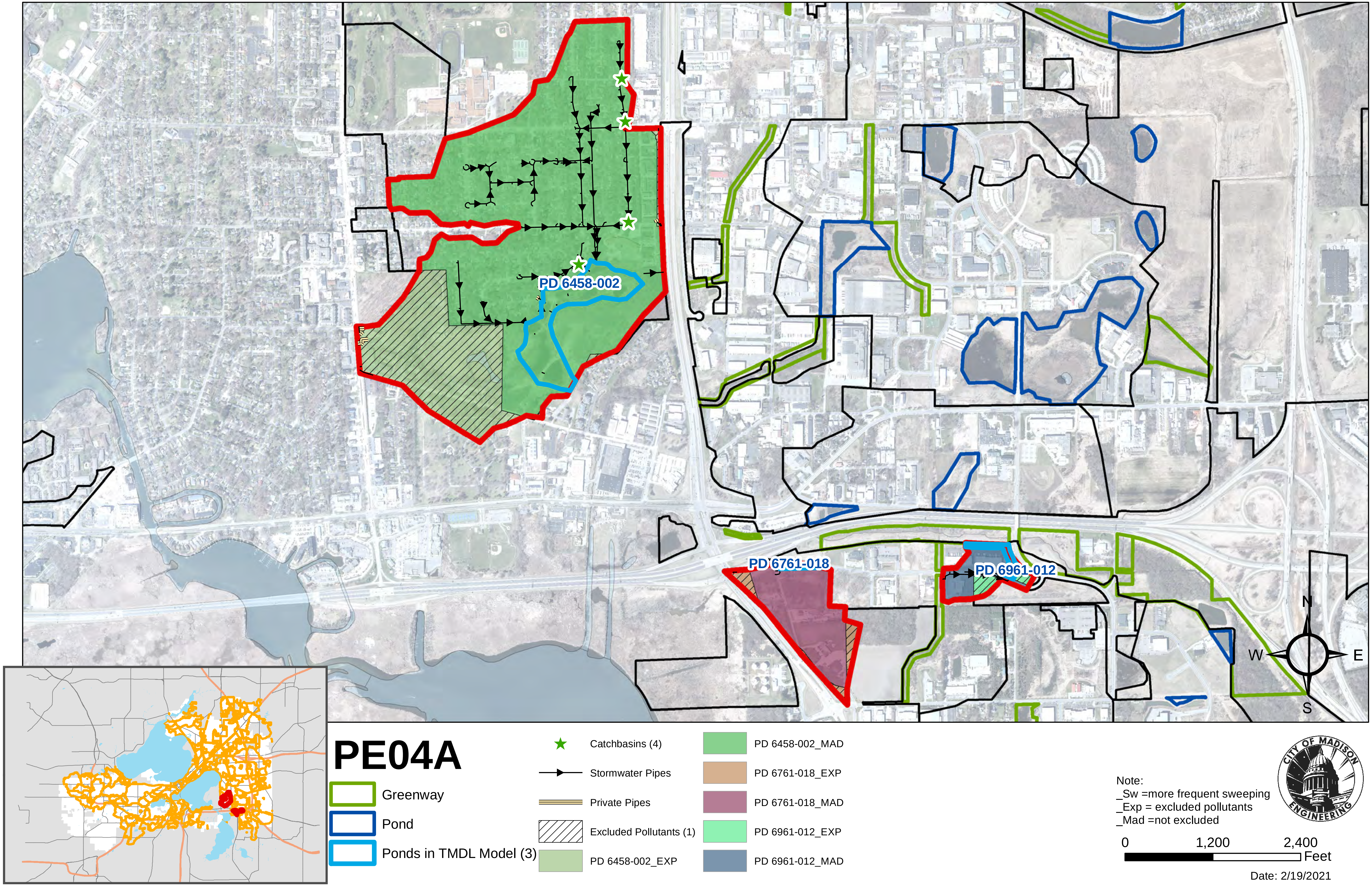
Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

0 700 1,400 Feet

Date: 2/19/2021

Document Path: M:\MS4_WaterQualityModel\2019_2020 Modeling Effort\GIS\Working\MXDs\ModelAreas_DD.mxd

User Name: enles



PE04A

- 🟩 Greenway
- 🟦 Pond
- 🟦 Ponds in TMDL Model (3)
- ★ Catchbasins (4)
- → Stormwater Pipes
- ═ Private Pipes
- ▨ Excluded Pollutants (1)
- 🟩 PD 6458-002_EXP
- 🟩 PD 6458-002_MAD
- 🟫 PD 6761-018_EXP
- 🟪 PD 6761-018_MAD
- 🟩 PD 6961-012_EXP
- 🟦 PD 6961-012_MAD

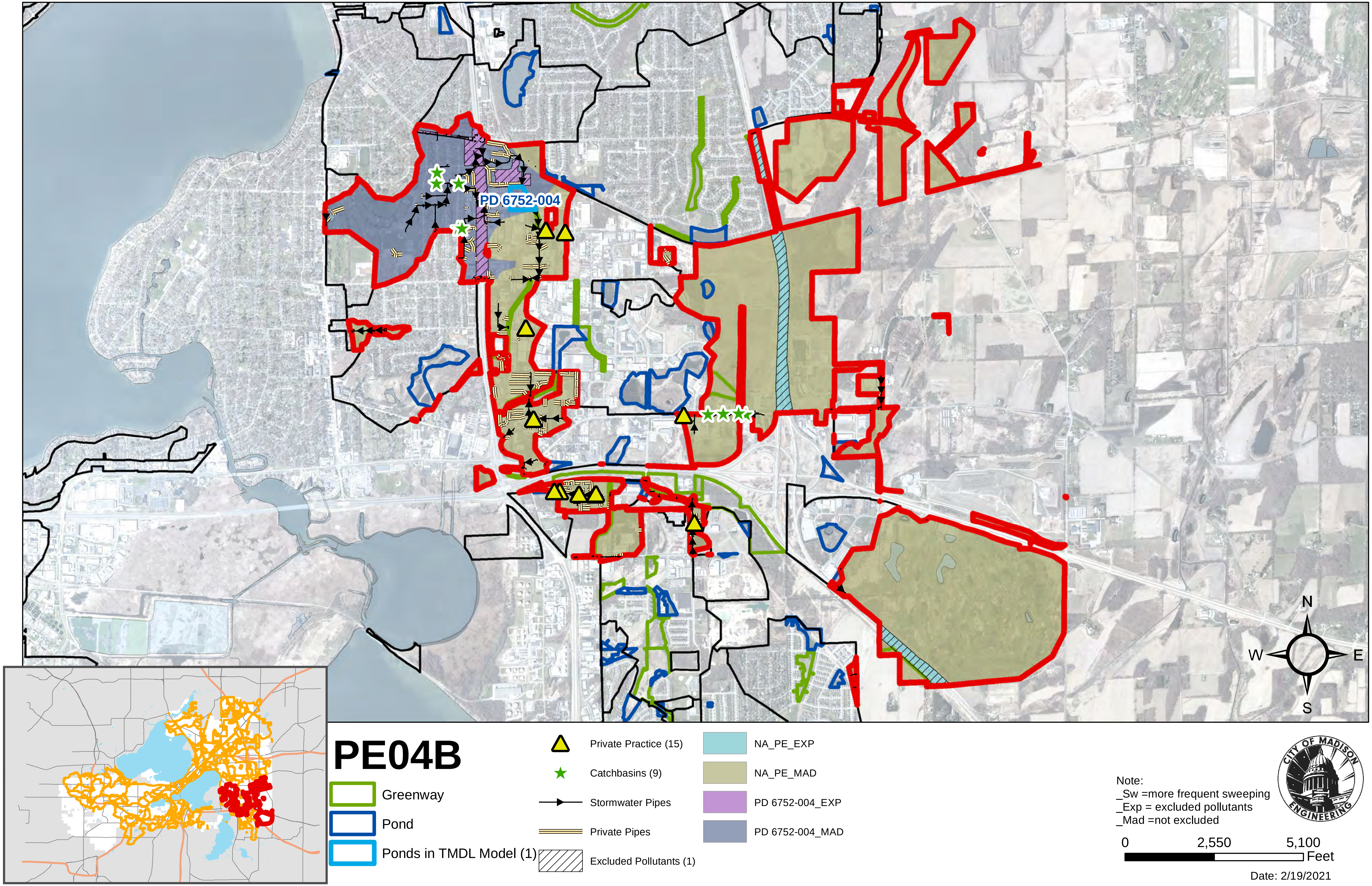
Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

0 1,200 2,400 Feet

Date: 2/19/2021

Document Path: M:\MS4_WaterQualityModel\2019_2020 Modeling Effort\GIS\Working\MXDs\ModelAreas_DD.mxd

User Name: enles



PE04B

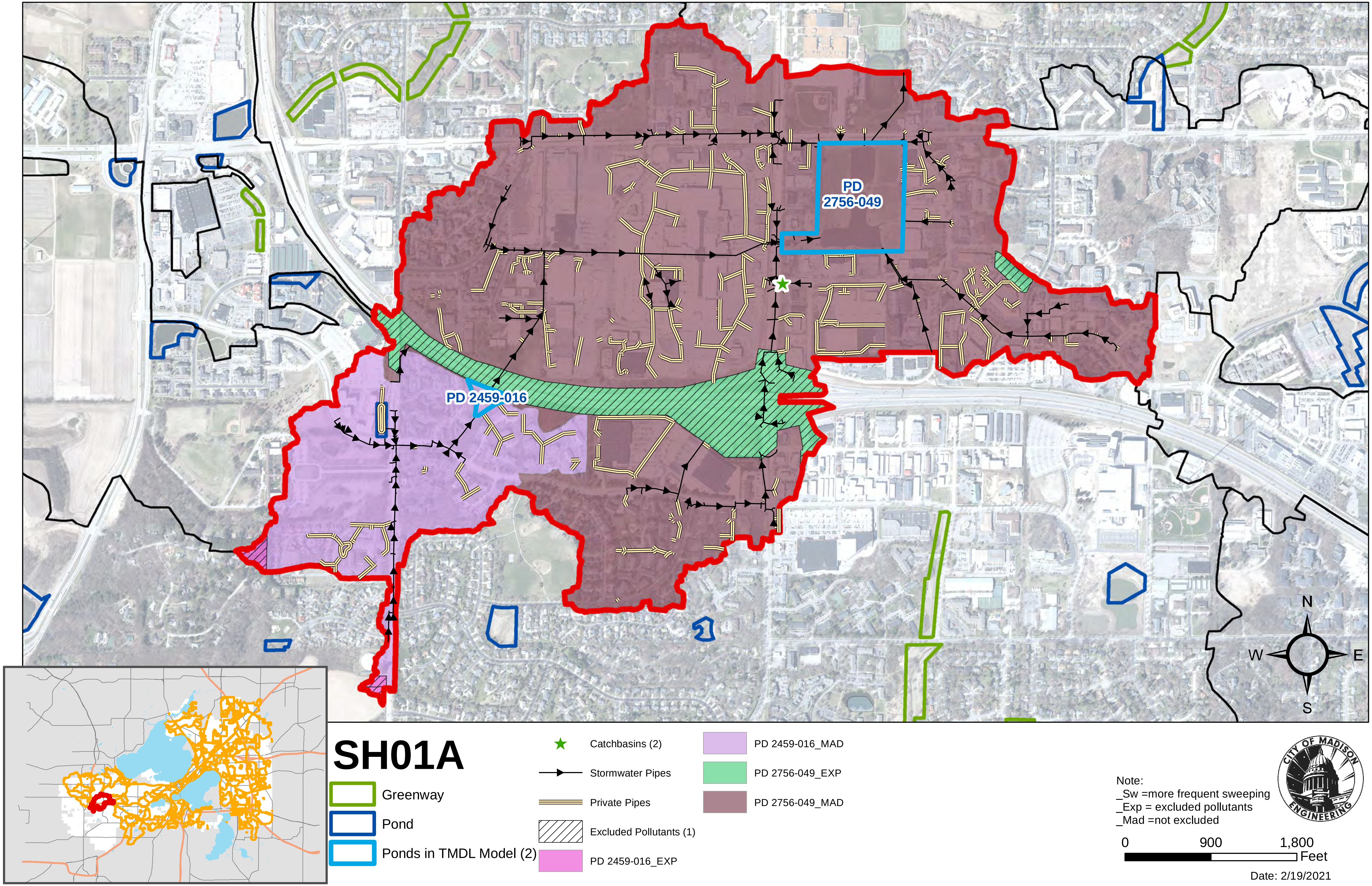
Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

Date: 2/19/2021

Document Path: M:\MS4_WaterQualityModel\2019_2020 Modeling Effort\GIS\Working\MXDs\ModelAreas_DD.mxd

User Name: enles

SH01A

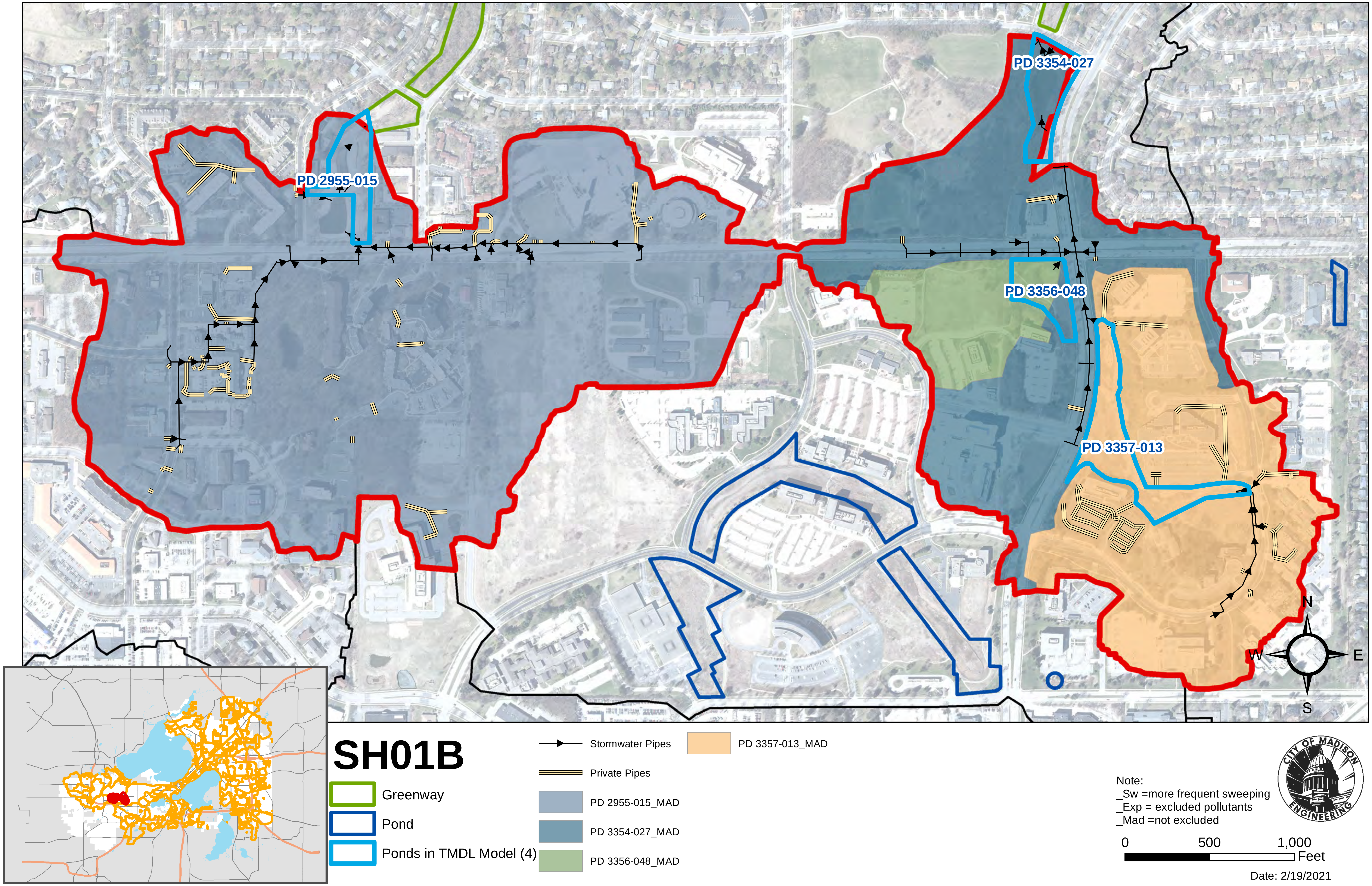


Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

Date: 2/19/2021

Document Path: M:\MS4_WaterQualityModel\2019_2020 Modeling Effort\GIS\Working\MXDs\ModelAreas_DD.mxd

User Name: enles



SH01B

- ▭ Greenway
- ▭ Pond
- ▭ Ponds in TMDL Model (4)
- ➤ Stormwater Pipes
- ═ Private Pipes
- ■ PD 2955-015_MAD
- ■ PD 3354-027_MAD
- ■ PD 3356-048_MAD
- ■ PD 3357-013_MAD

Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

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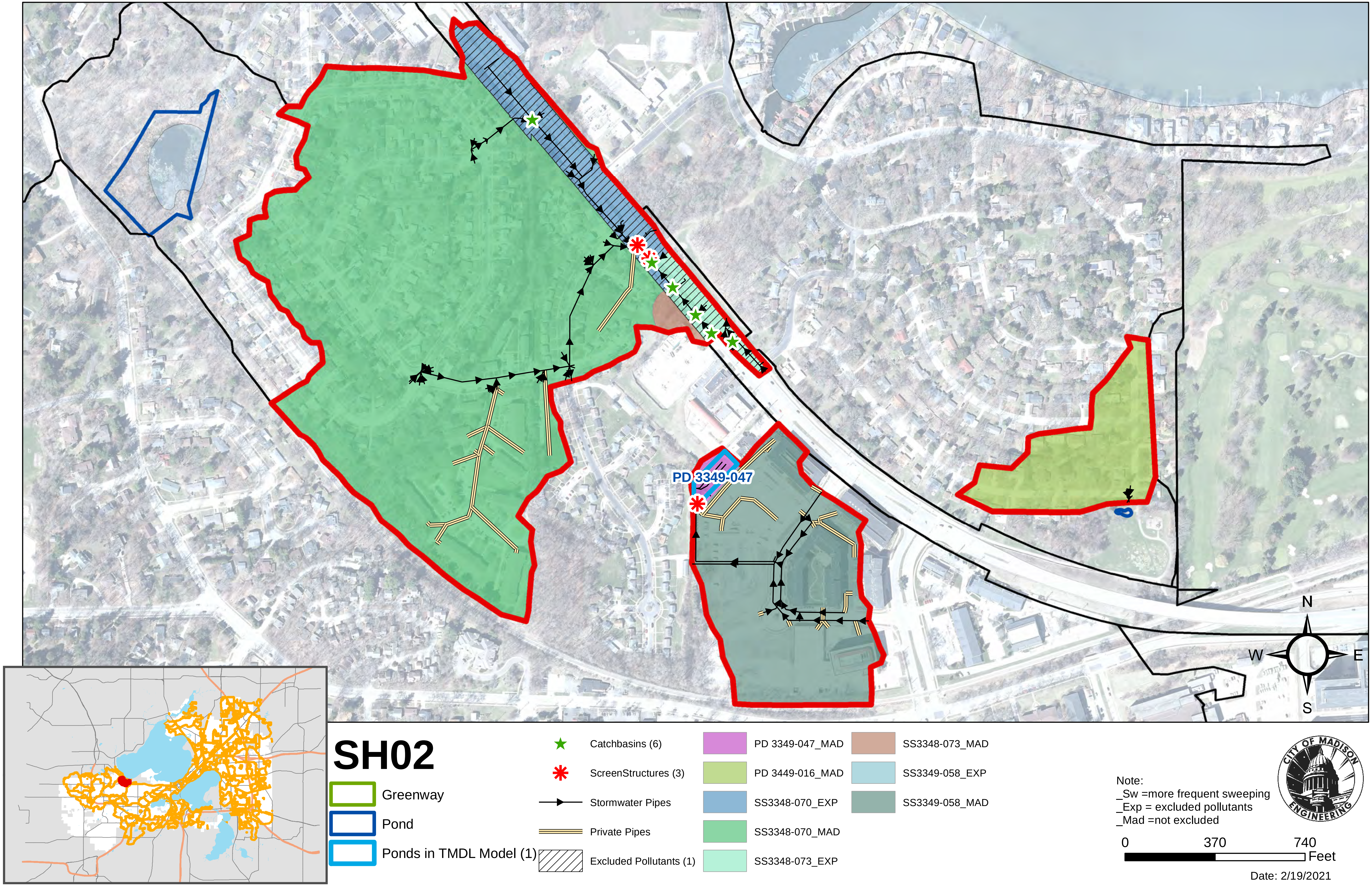
User Name: enles

SH02

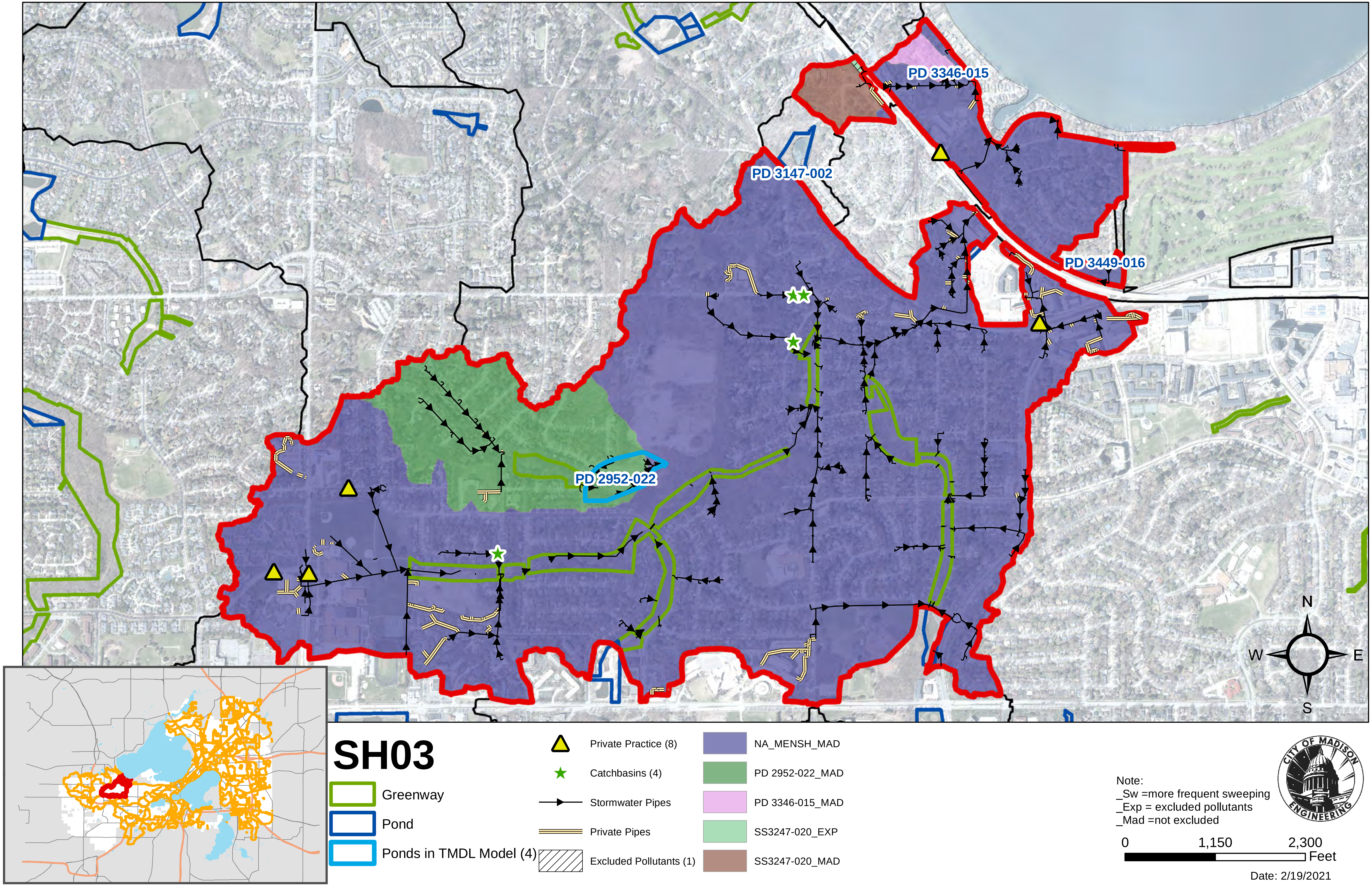


Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

Date: 2/19/2021

Document Path: M:\MS4_WaterQualityModel\2019_2020 Modeling Effort\GIS\Working\MXDs\ModelAreas_DD.mxd

User Name: enles



SH03

🟩 Greenway

🟦 Pond

🟦 Ponds in TMDL Model (4)

△ Private Practice (8)

★ Catchbasins (4)

Stormwater Pipes

Private Pipes

▨ Excluded Pollutants (1)

🟪 NA_MENSH_MAD

🟩 PD 2952-022_MAD

🟪 PD 3346-015_MAD

🟩 SS3247-020_EXP

🟫 SS3247-020_MAD

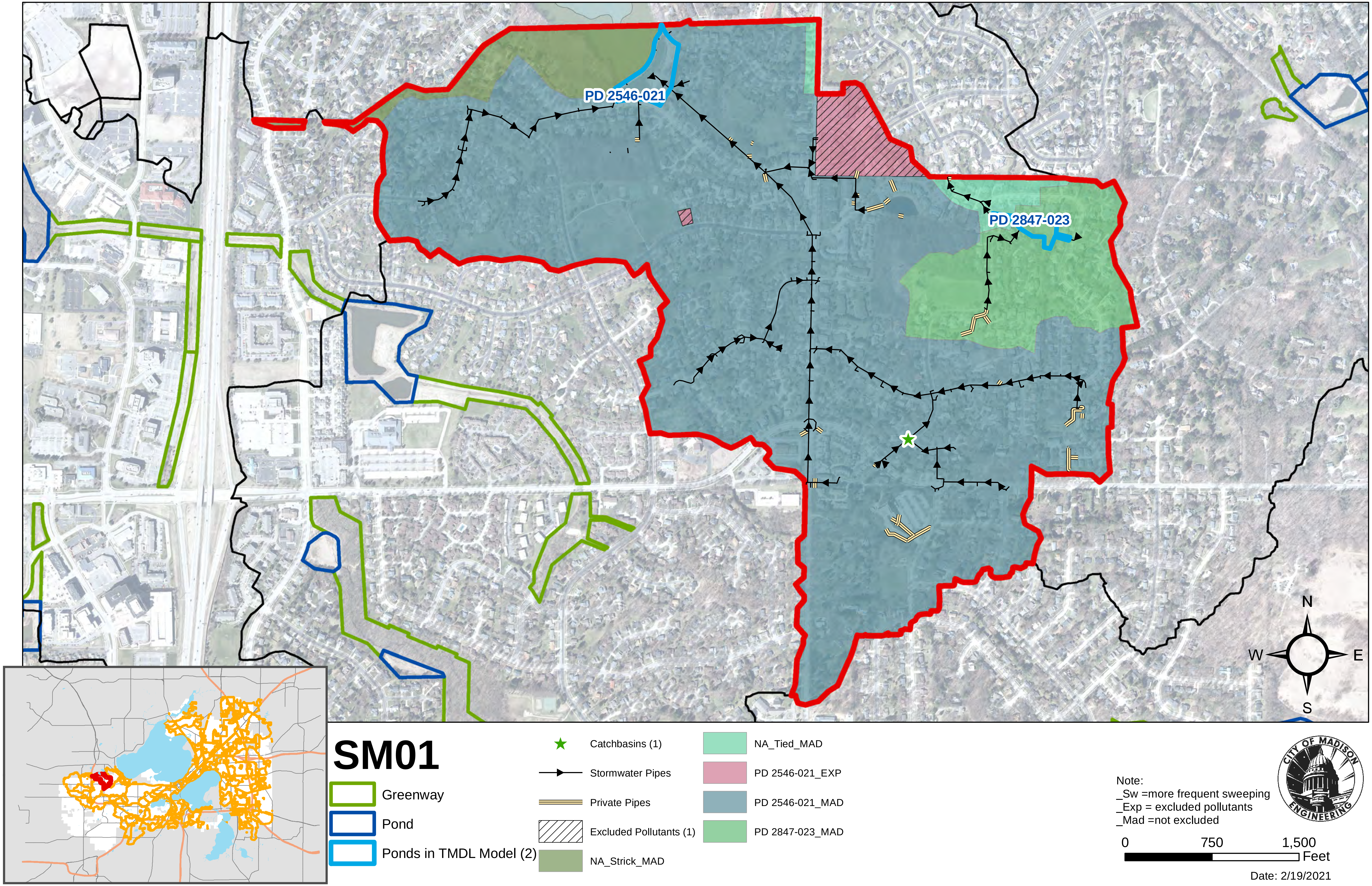
Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

Date: 2/19/2021

Document Path: M:\MS4_WaterQualityModel\2019_2020 Modeling Effort\GIS\Working\MXDs\ModelAreas_DD.mxd

User Name: enles

SM01



★ Catchbasins (1)

—▶— Stormwater Pipes

═ Private Pipes

▨ Excluded Pollutants (1)

🟩 NA_Strick_MAD

🟩 NA_Tied_MAD

🟥 PD 2546-021_EXP

🟦 PD 2546-021_MAD

🟩 PD 2847-023_MAD

🟩 Greenway

🟦 Pond

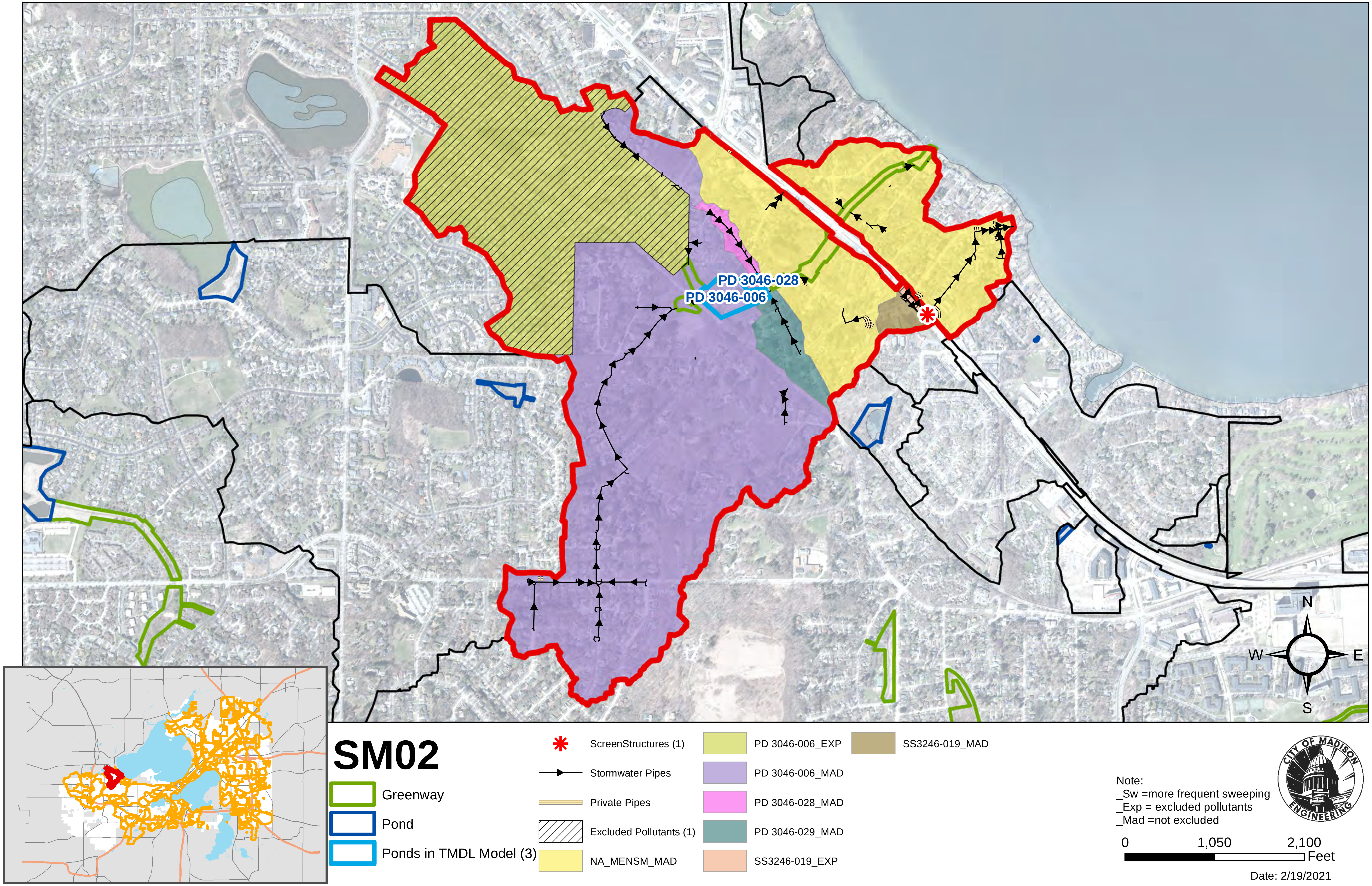
🟦 Ponds in TMDL Model (2)

Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

Date: 2/19/2021

Document Path: M:\MS4_WaterQualityModel\2019_2020 Modeling Effort\GIS\Working\MXDs\ModelAreas_DD.mxd

User Name: enles



SM02

🟩 Greenway

🟦 Pond

🟦 Ponds in TMDL Model (3)

✱ ScreenStructures (1)

→ Stormwater Pipes

═ Private Pipes

▨ Excluded Pollutants (1)

🟨 NA_MENSM_MAD

🟨 PD 3046-006_EXP

🟪 PD 3046-006_MAD

🟪 PD 3046-028_MAD

🟩 PD 3046-029_MAD

🟧 SS3246-019_EXP

🟫 SS3246-019_MAD

Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

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Date: 2/19/2021

Document Path: M:\MS4_WaterQualityModel\2019_2020 Modeling Effort\GIS\Working\MXDs\ModelAreas_DD.mxd

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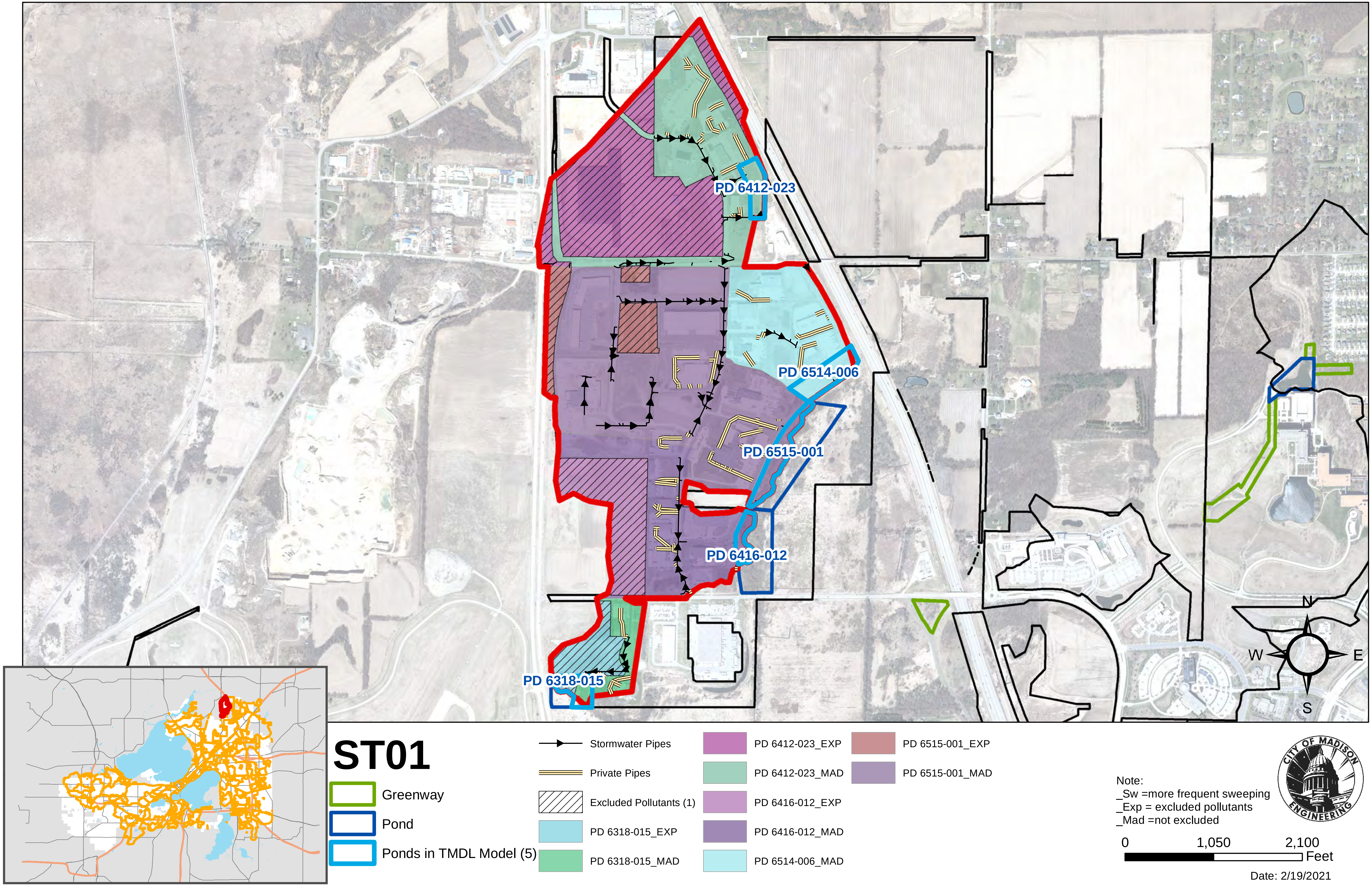

ST01

Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

Date: 2/19/2021

Document Path: M:\MS4_WaterQualityModel\2019_2020 Modeling Effort\GIS\Working\MXDs\ModelAreas_DD.mxd

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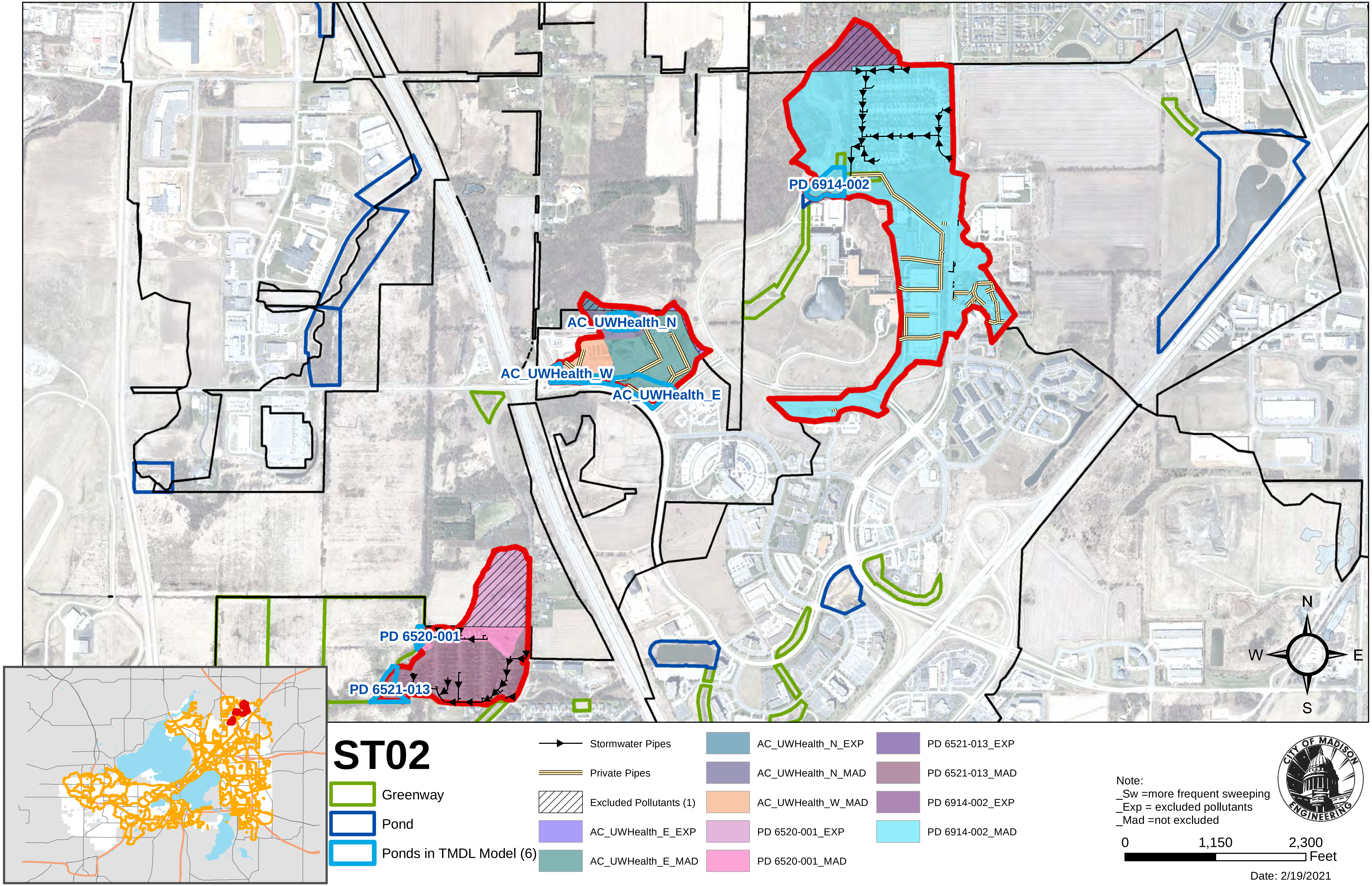


ST02

- 🟩 Greenway
- 🟦 Pond
- 🟦 Ponds in TMDL Model (6)
- → Stormwater Pipes
- ═ Private Pipes
- ▨ Excluded Pollutants (1)
- ■ AC_UWHealth_E_EXP
- ■ AC_UWHealth_E_MAD
- ■ AC_UWHealth_N_EXP
- ■ AC_UWHealth_N_MAD
- ■ AC_UWHealth_W_MAD
- ■ PD 6520-001_EXP
- ■ PD 6520-001_MAD
- ■ PD 6521-013_EXP
- ■ PD 6521-013_MAD
- ■ PD 6914-002_EXP
- ■ PD 6914-002_MAD

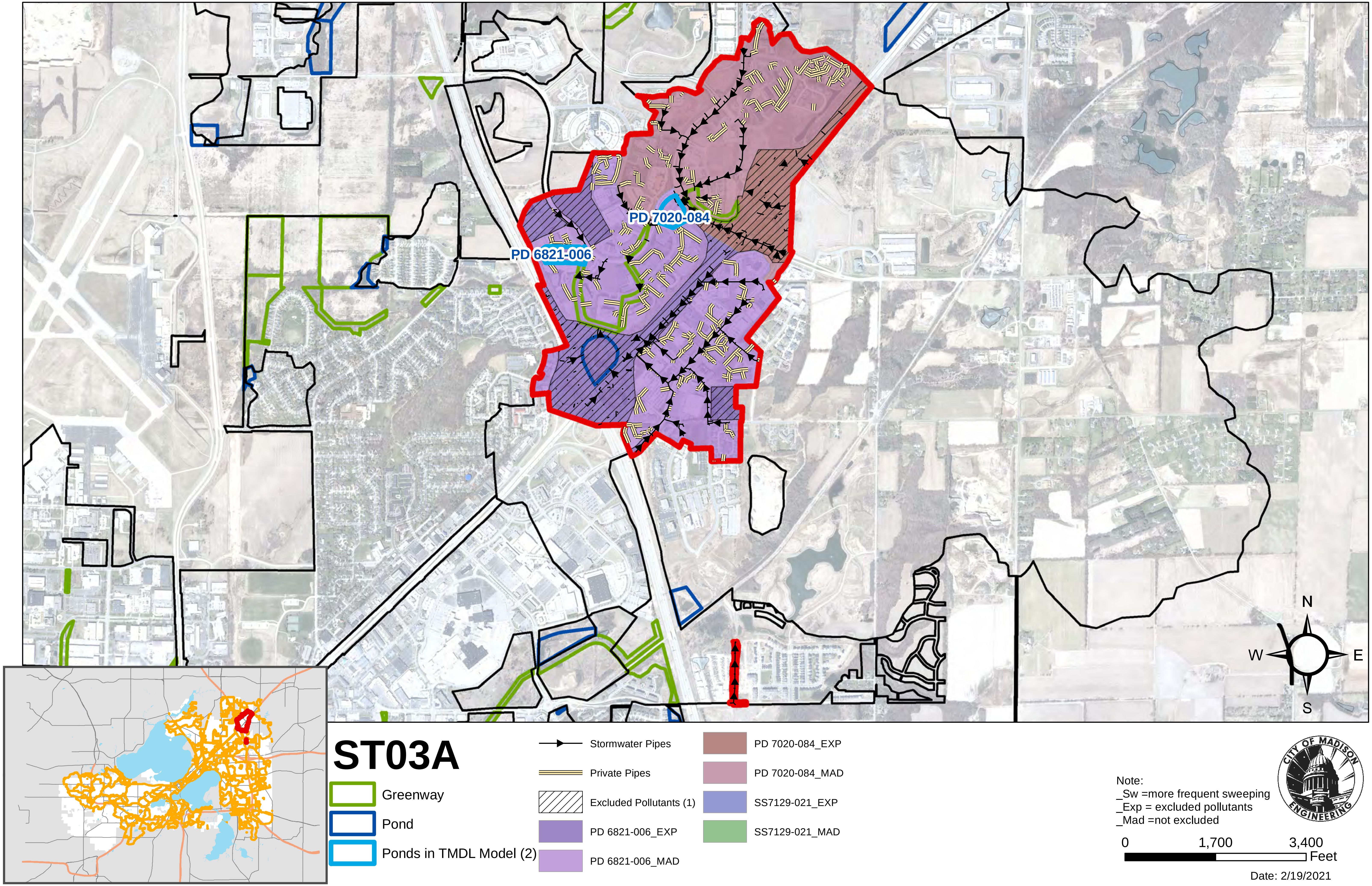
Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

0 1,150 2,300 Feet

Date: 2/19/2021

Document Path: M:\MS4_WaterQualityModel\2019_2020 Modeling Effort\GIS\Working\MXDs\ModelAreas_DD.mxd

User Name: enles



ST03A

Greenway

Pond

Ponds in TMDL Model (2)

Stormwater Pipes

Private Pipes

Excluded Pollutants (1)

PD 6821-006_EXP

PD 6821-006_MAD

PD 7020-084_EXP

PD 7020-084_MAD

SS7129-021_EXP

SS7129-021_MAD

Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

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Date: 2/19/2021

Document Path: M:\MS4_WaterQualityModel\2019_2020 Modeling Effort\GIS\Working\MXDs\ModelAreas_DD.mxd

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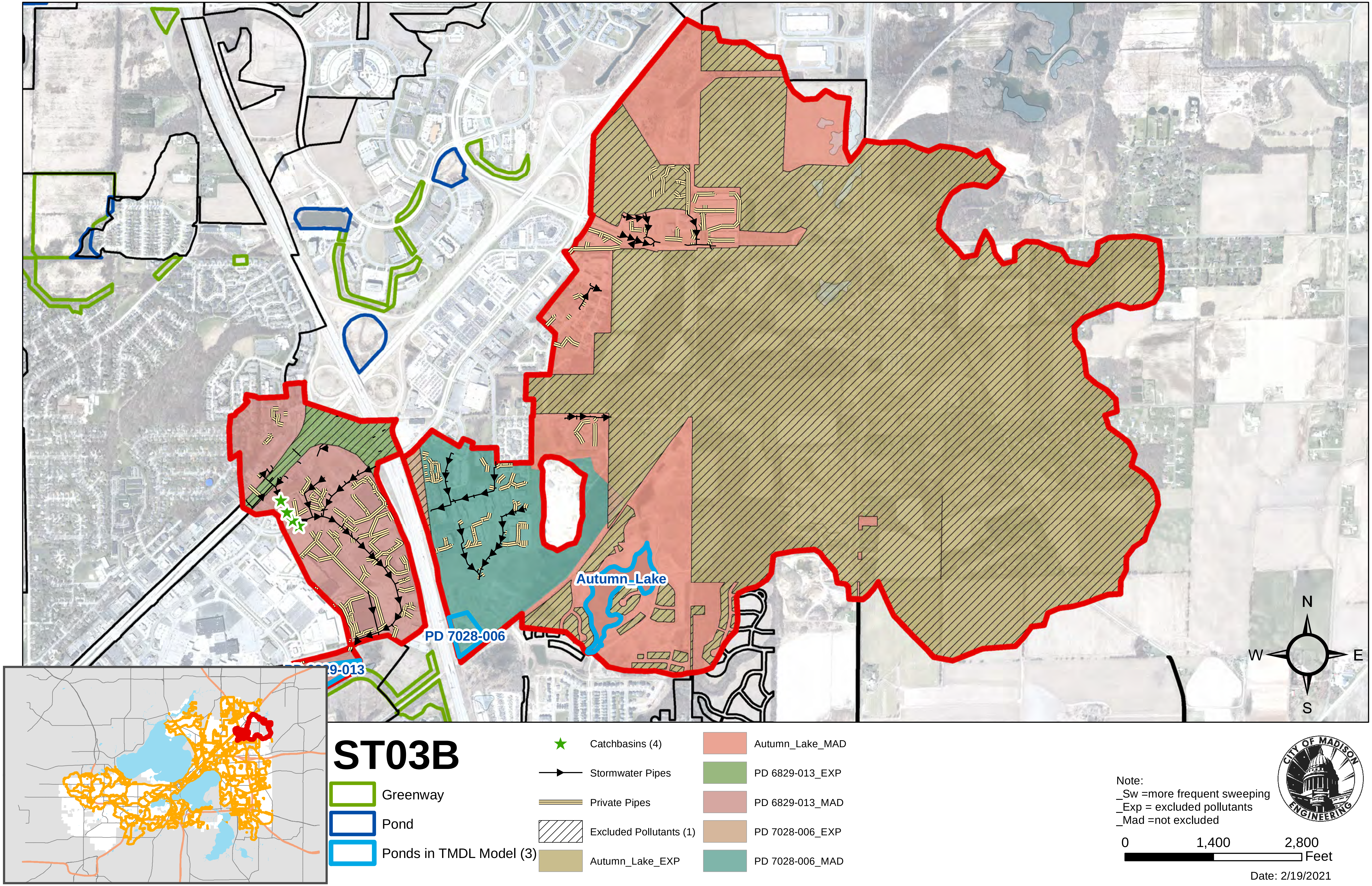


ST03B

- 🟩 Greenway
- 🟦 Pond
- 🟦 Ponds in TMDL Model (3)

- ★ Catchbasins (4)
- → Stormwater Pipes
- ═ Private Pipes
- ▨ Excluded Pollutants (1)
- 🟫 Autumn_Lake_EXP
- 🟥 Autumn_Lake_MAD
- 🟩 PD 6829-013_EXP
- 🟥 PD 6829-013_MAD
- 🟫 PD 7028-006_EXP
- 🟦 PD 7028-006_MAD

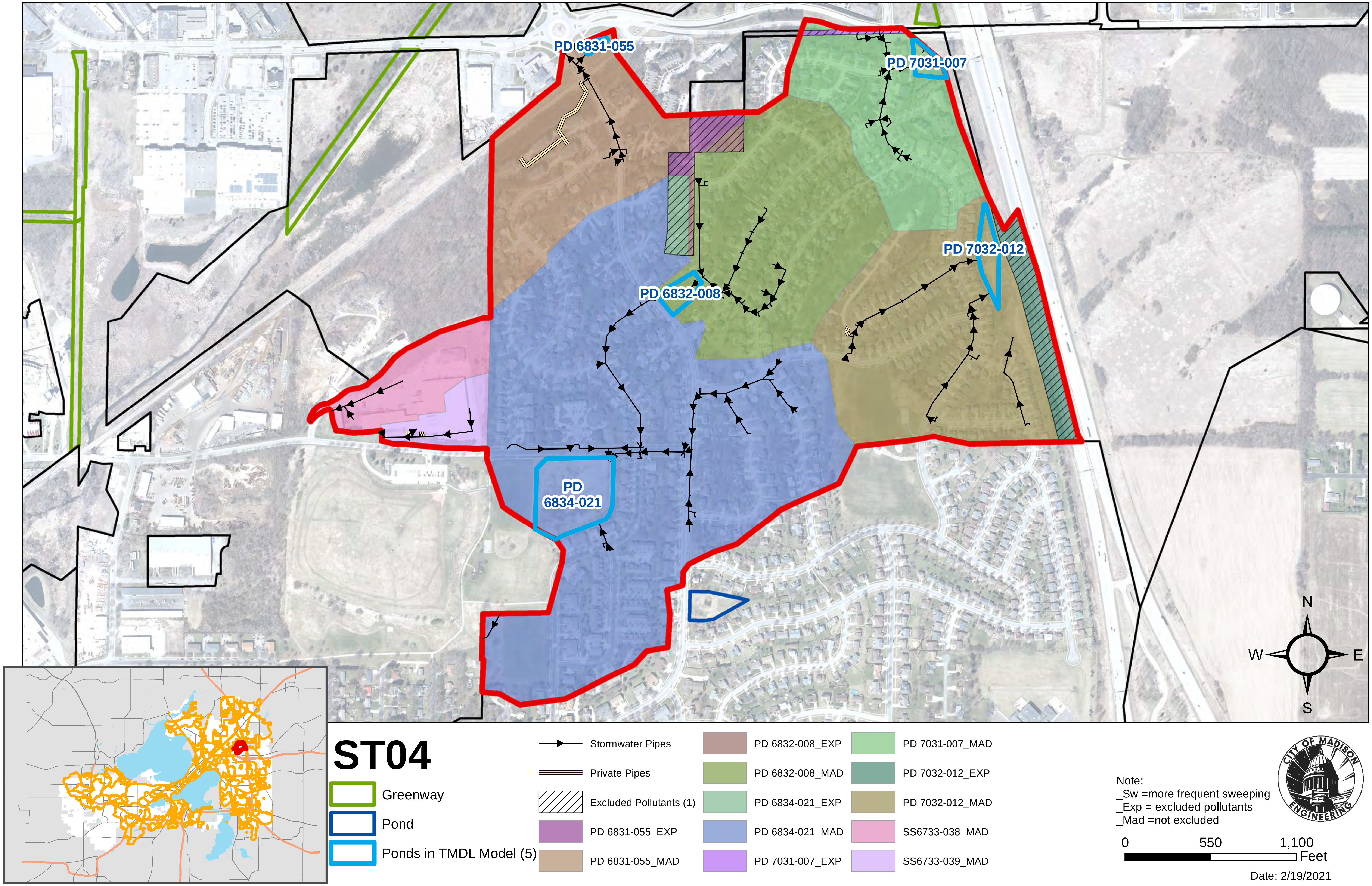
Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

0 1,400 2,800 Feet

Date: 2/19/2021

Document Path: M:\MS4_WaterQualityModel\2019_2020 Modeling Effort\GIS\Working\MXDs\ModelAreas_DD.mxd

User Name: enles



ST04

Greenway

Pond

Ponds in TMDL Model (5)

Stormwater Pipes

Private Pipes

Excluded Pollutants (1)

PD 6831-055_EXP

PD 6831-055_MAD

PD 6832-008_EXP

PD 6832-008_MAD

PD 6834-021_EXP

PD 6834-021_MAD

PD 7031-007_EXP

PD 7031-007_MAD

PD 7032-012_EXP

PD 7032-012_MAD

SS6733-038_MAD

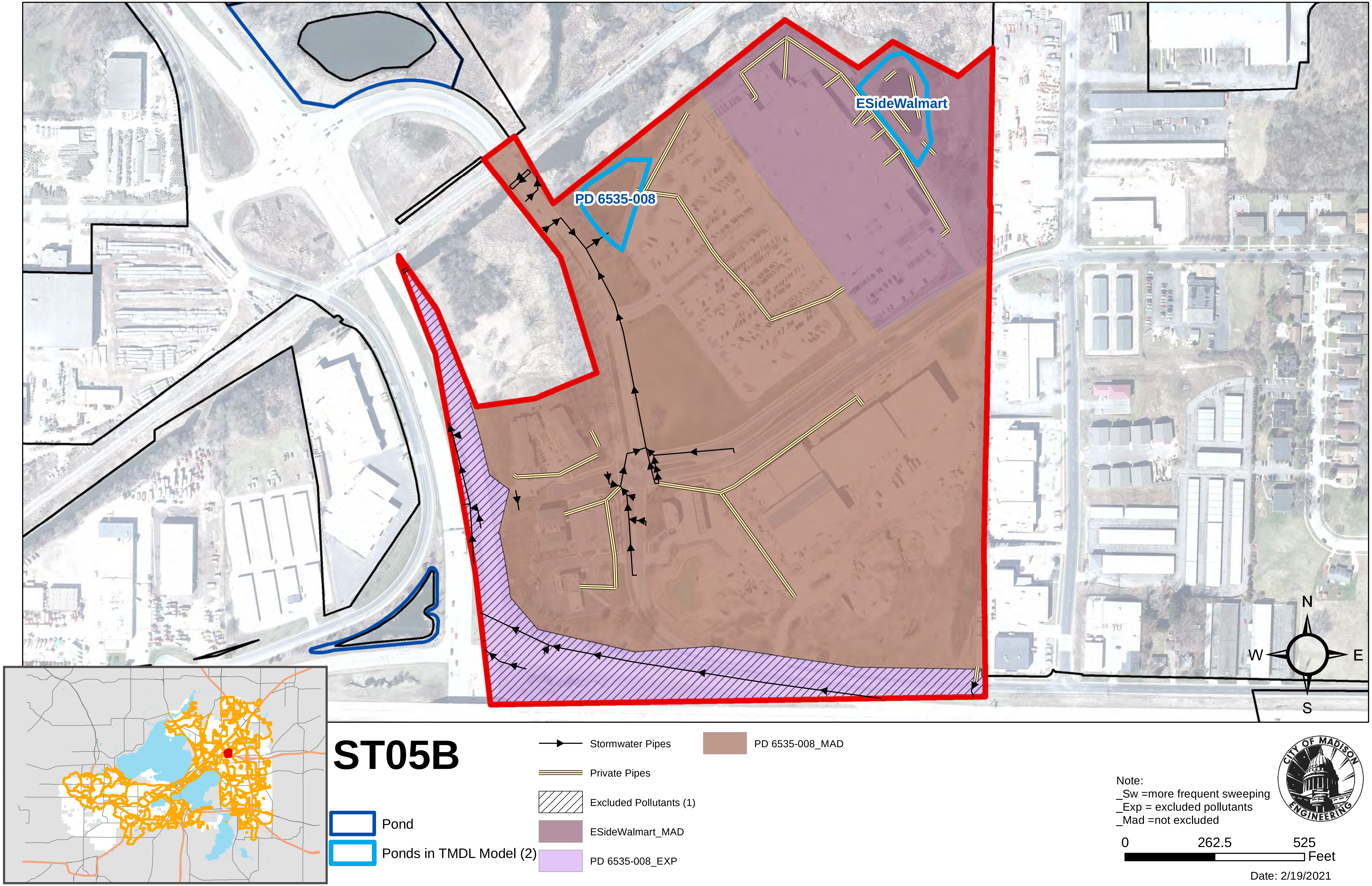
SS6733-039_MAD

Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

Date: 2/19/2021

Document Path: M:\MS4_WaterQualityModel\2019_2020 Modeling Effort\GIS\Working\MXDs\ModelAreas_DD.mxd

User Name: enles



ST05B

- Pond
- Ponds in TMDL Model (2)
- Stormwater Pipes
- Private Pipes
- ▨ Excluded Pollutants (1)
- ESideWalmart_MAD
- PD 6535-008_EXP
- PD 6535-008_MAD

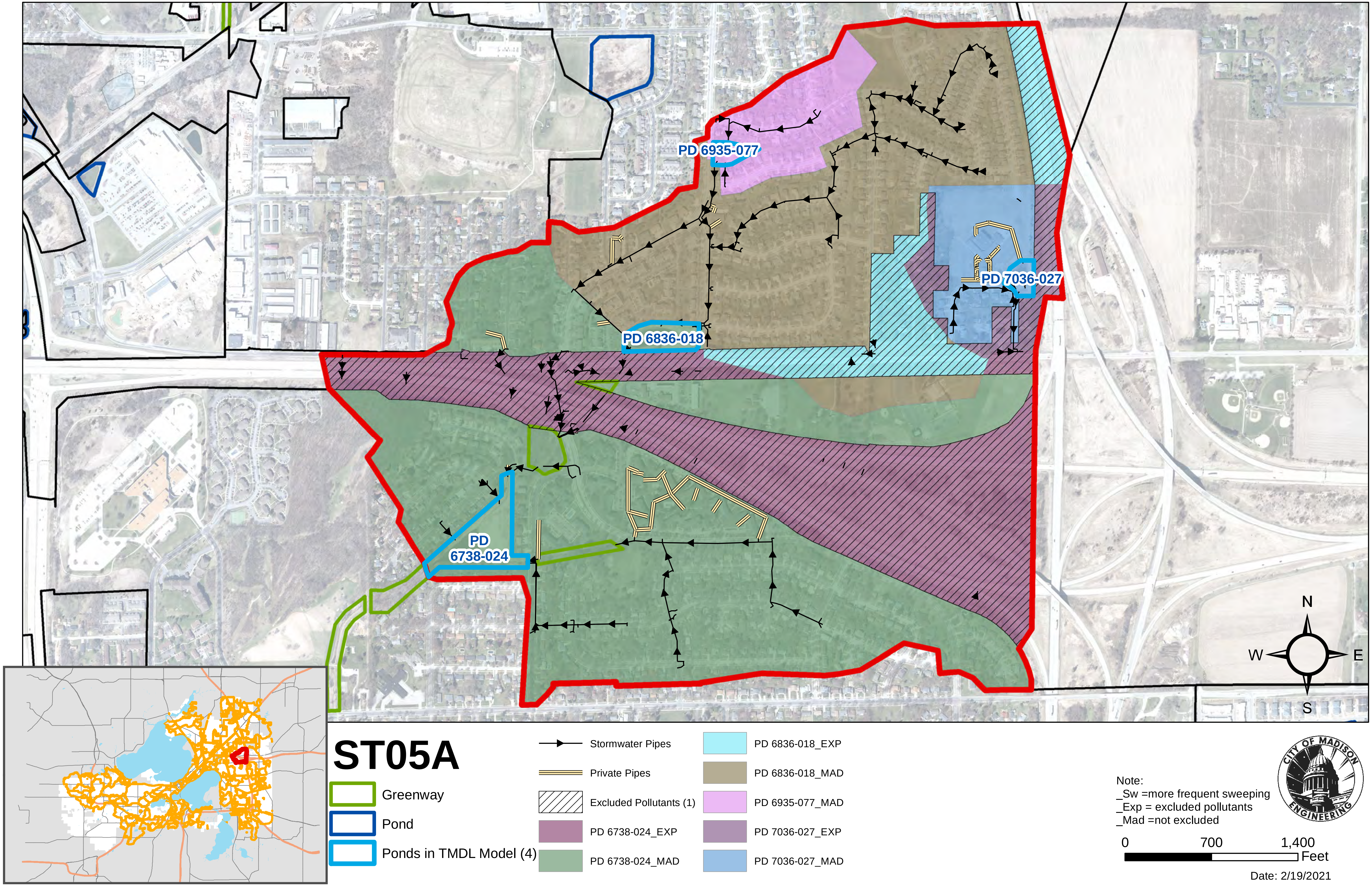
Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

0 262.5 525 Feet

Date: 2/19/2021

Document Path: M:\MS4_WaterQualityModel\2019_2020 Modeling Effort\GIS\Working\MXDs\ModelAreas_DD.mxd

User Name: enles



ST05A

- Greenway
- Pond
- Ponds in TMDL Model (4)
- Stormwater Pipes
- Private Pipes
- ▨ Excluded Pollutants (1)
- PD 6738-024_EXP
- PD 6738-024_MAD
- PD 6836-018_EXP
- PD 6836-018_MAD
- PD 6935-077_MAD
- PD 7036-027_EXP
- PD 7036-027_MAD

Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

Date: 2/19/2021

Document Path: M:\MS4_WaterQualityModel\2019_2020 Modeling Effort\GIS\Working\MXDs\ModelAreas_DD.mxd

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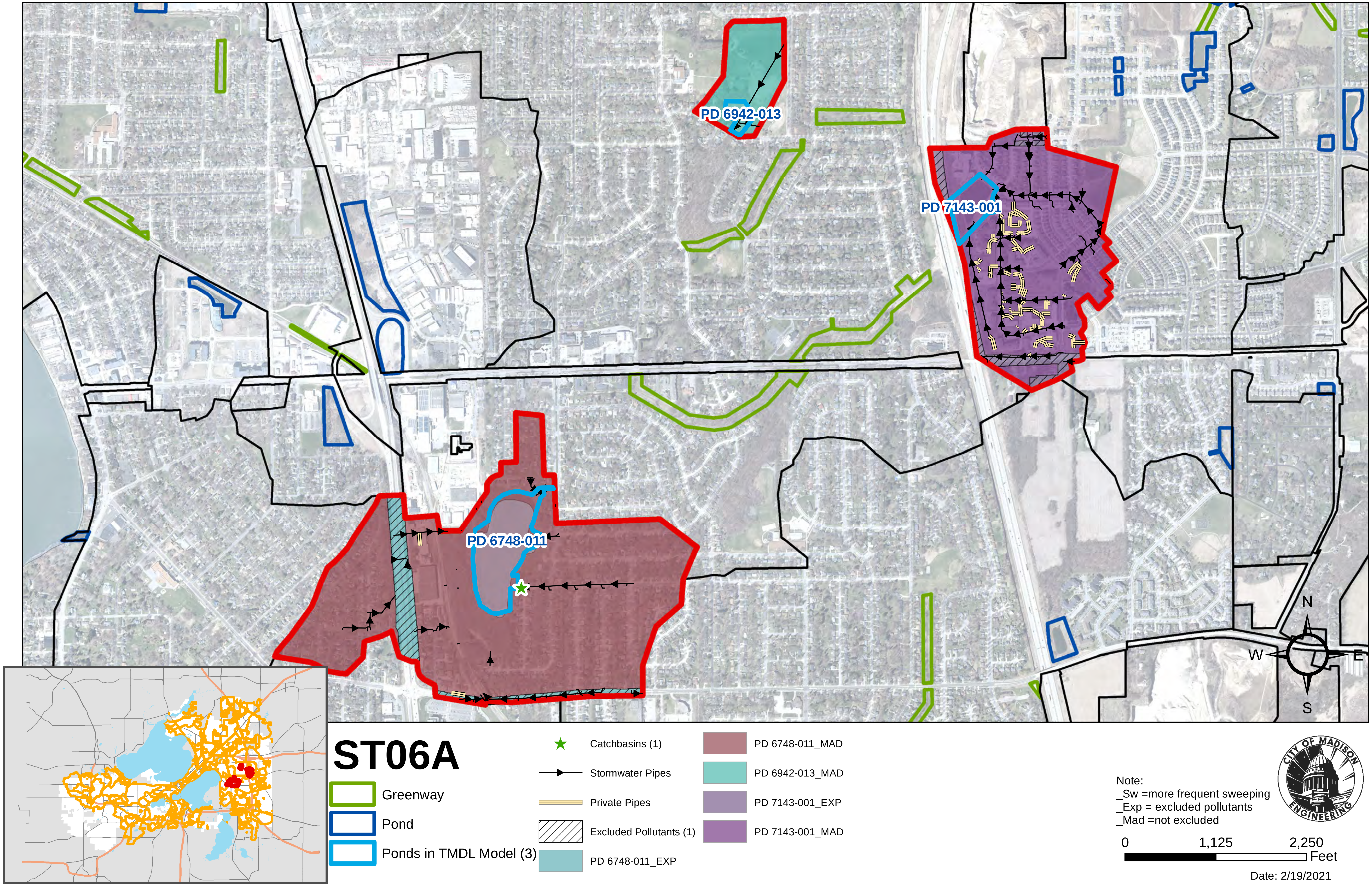

ST06A

- 🟩 Greenway
- 🟦 Pond
- 🟦 Ponds in TMDL Model (3)
- ★ Catchbasins (1)
- ➤ Stormwater Pipes
- ═ Private Pipes
- ▨ Excluded Pollutants (1)
- ■ PD 6748-011_EXP
- ■ PD 6748-011_MAD
- ■ PD 6942-013_MAD
- ■ PD 7143-001_EXP
- ■ PD 7143-001_MAD

Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

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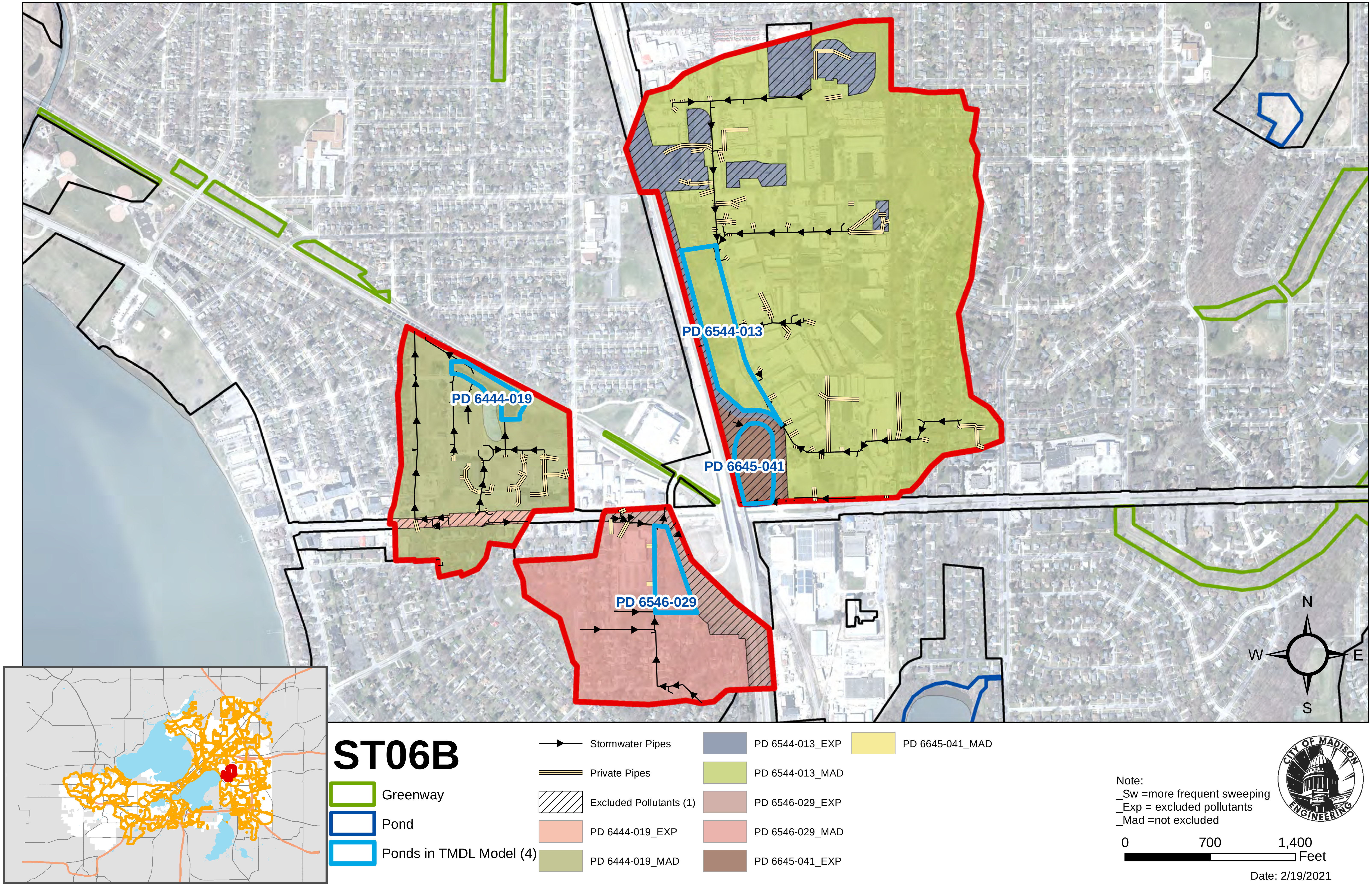
User Name: enles

ST06B



Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

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Date: 2/19/2021

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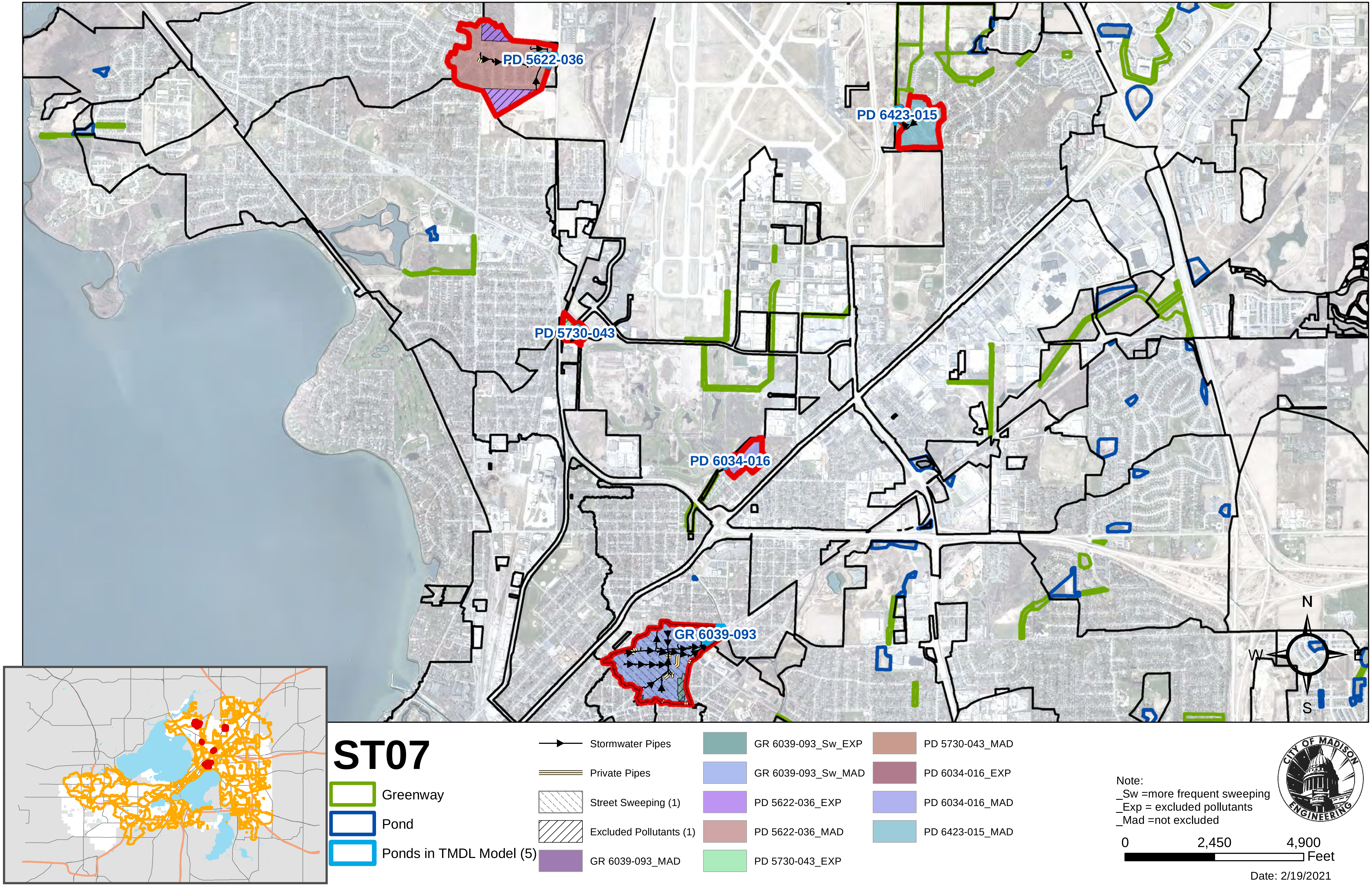

ST07

Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

Date: 2/19/2021

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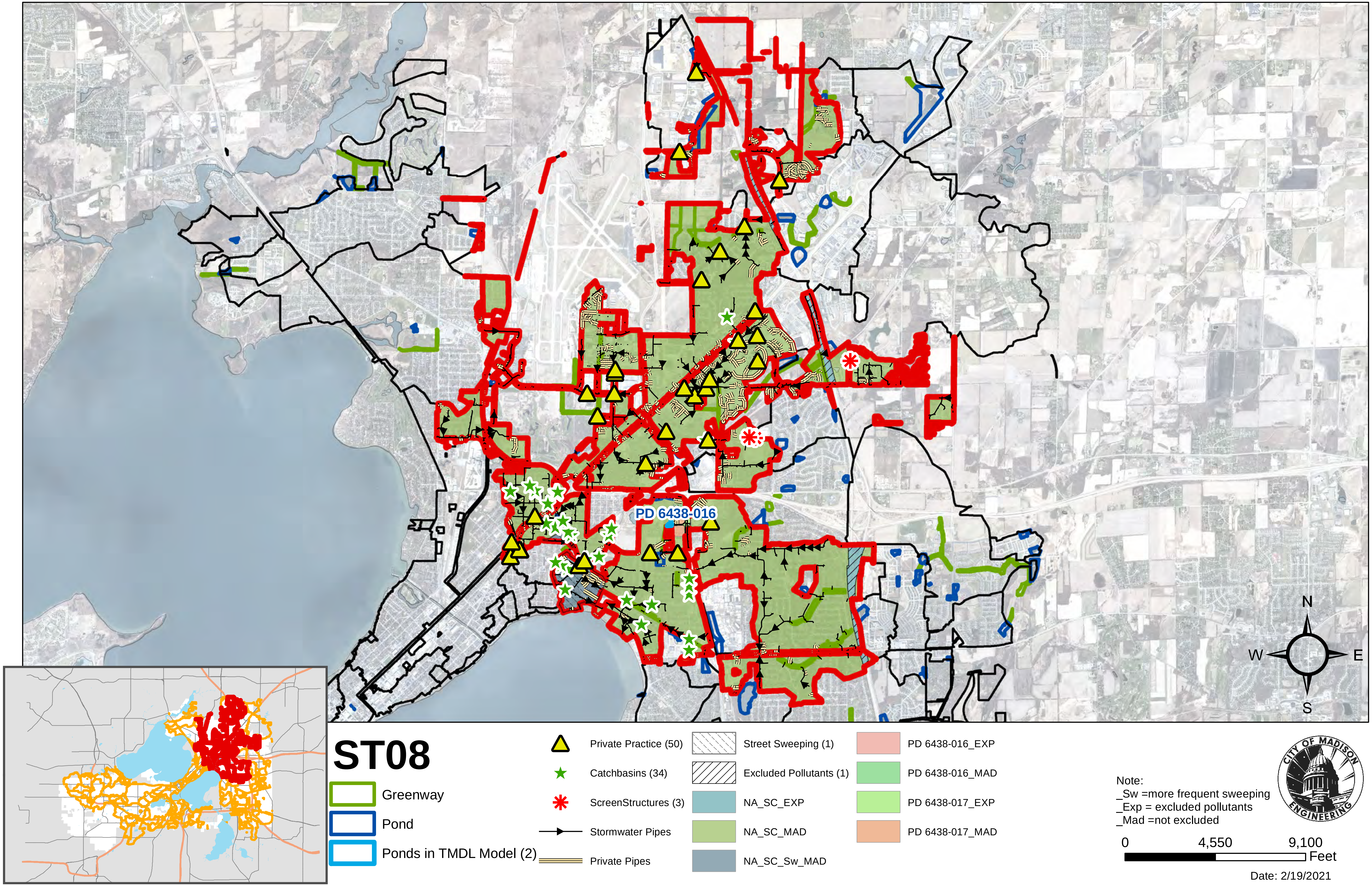

ST08

Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

Date: 2/19/2021

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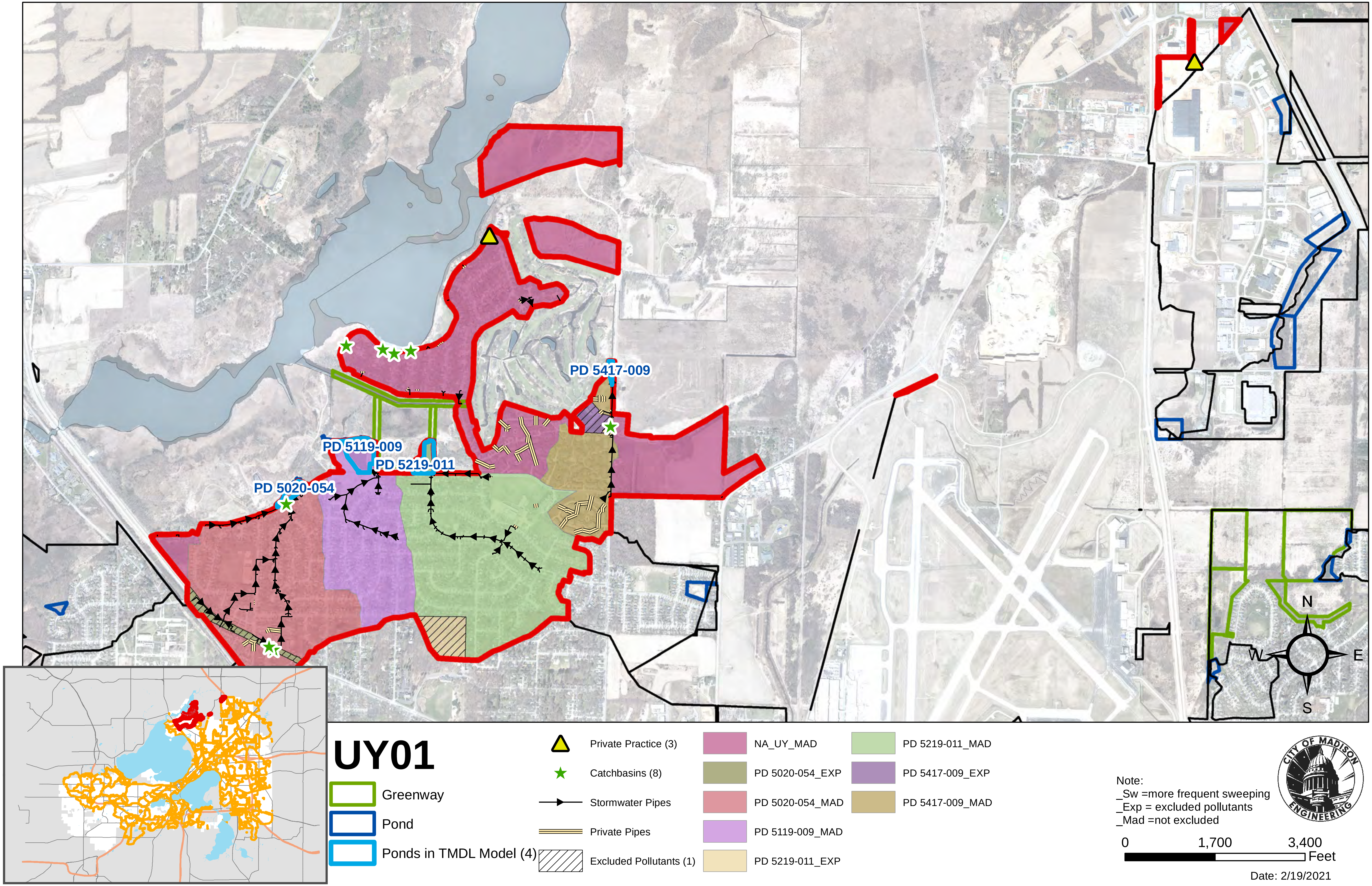
User Name: enles

UY01



Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

Date: 2/19/2021

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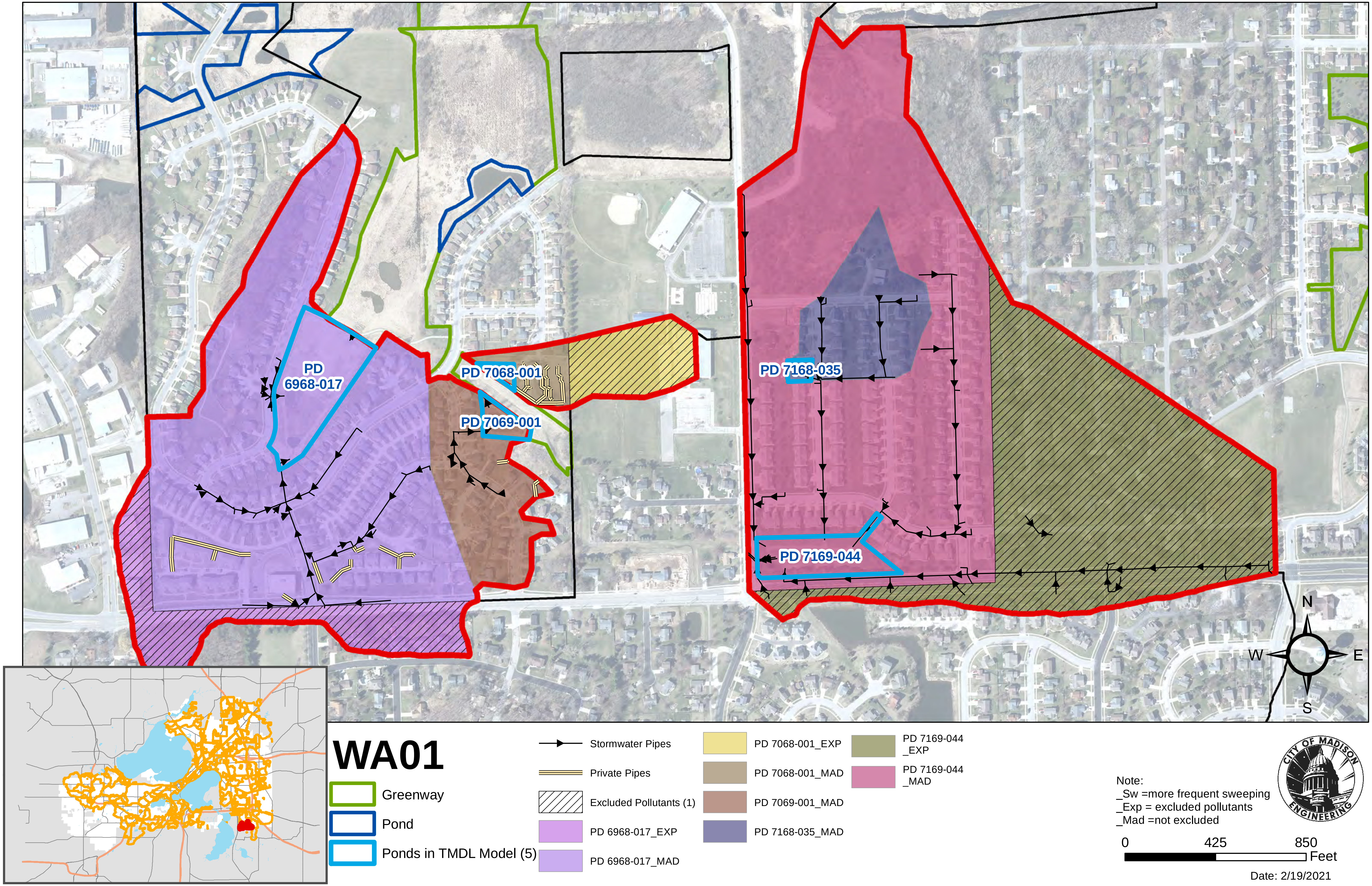
User Name: enles



WA01

🟩 Greenway
🟦 Pond
🟦 Ponds in TMDL Model (5)

→ Stormwater Pipes
═ Private Pipes
▨ Excluded Pollutants (1)
■ PD 6968-017_EXP
■ PD 6968-017_MAD
■ PD 7068-001_EXP
■ PD 7068-001_MAD
■ PD 7069-001_MAD
■ PD 7168-035_MAD
■ PD 7169-044_EXP
■ PD 7169-044_MAD

Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

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0 425 850 Feet

Date: 2/19/2021

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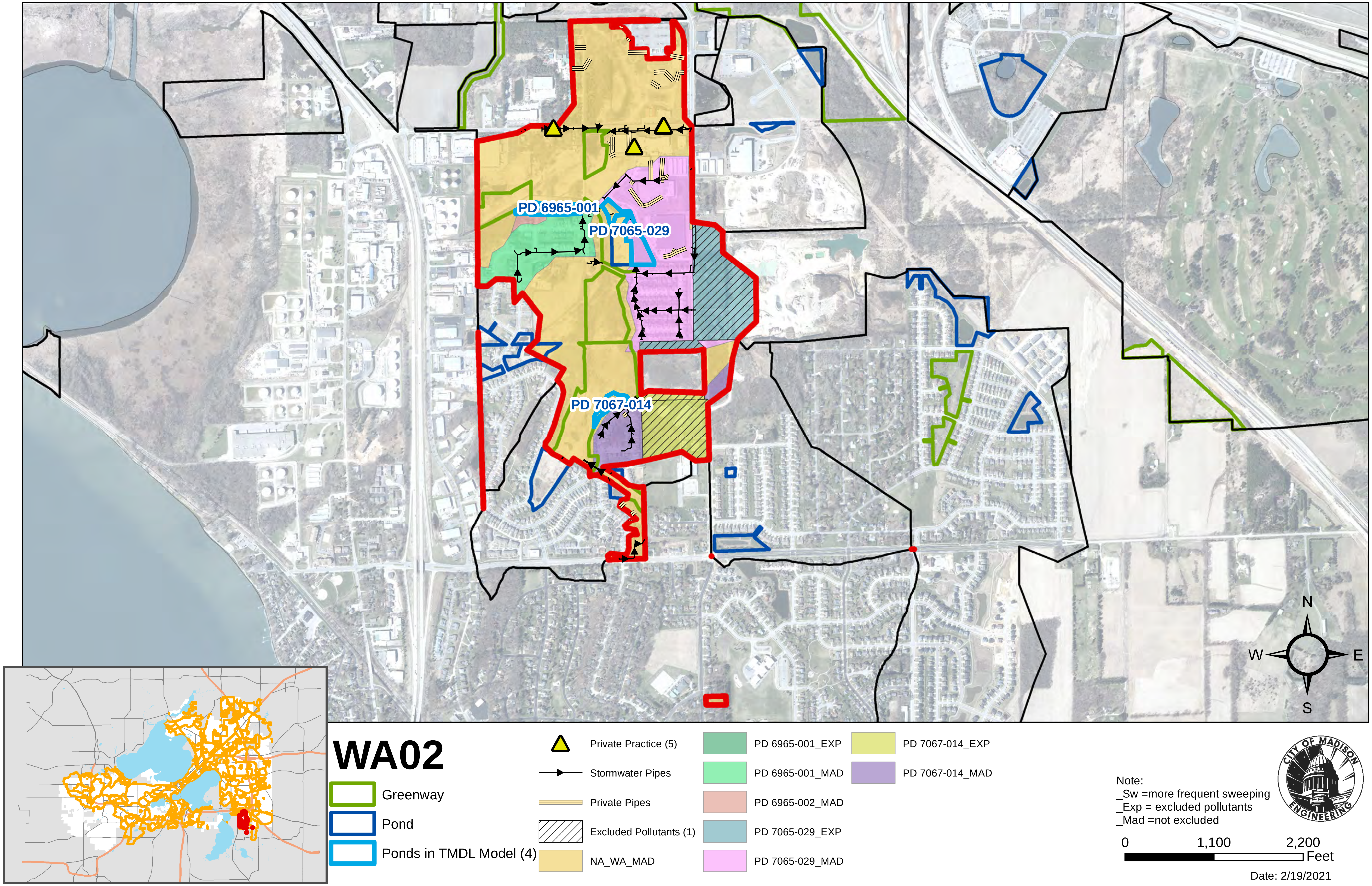
WA02



Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

Date: 2/19/2021

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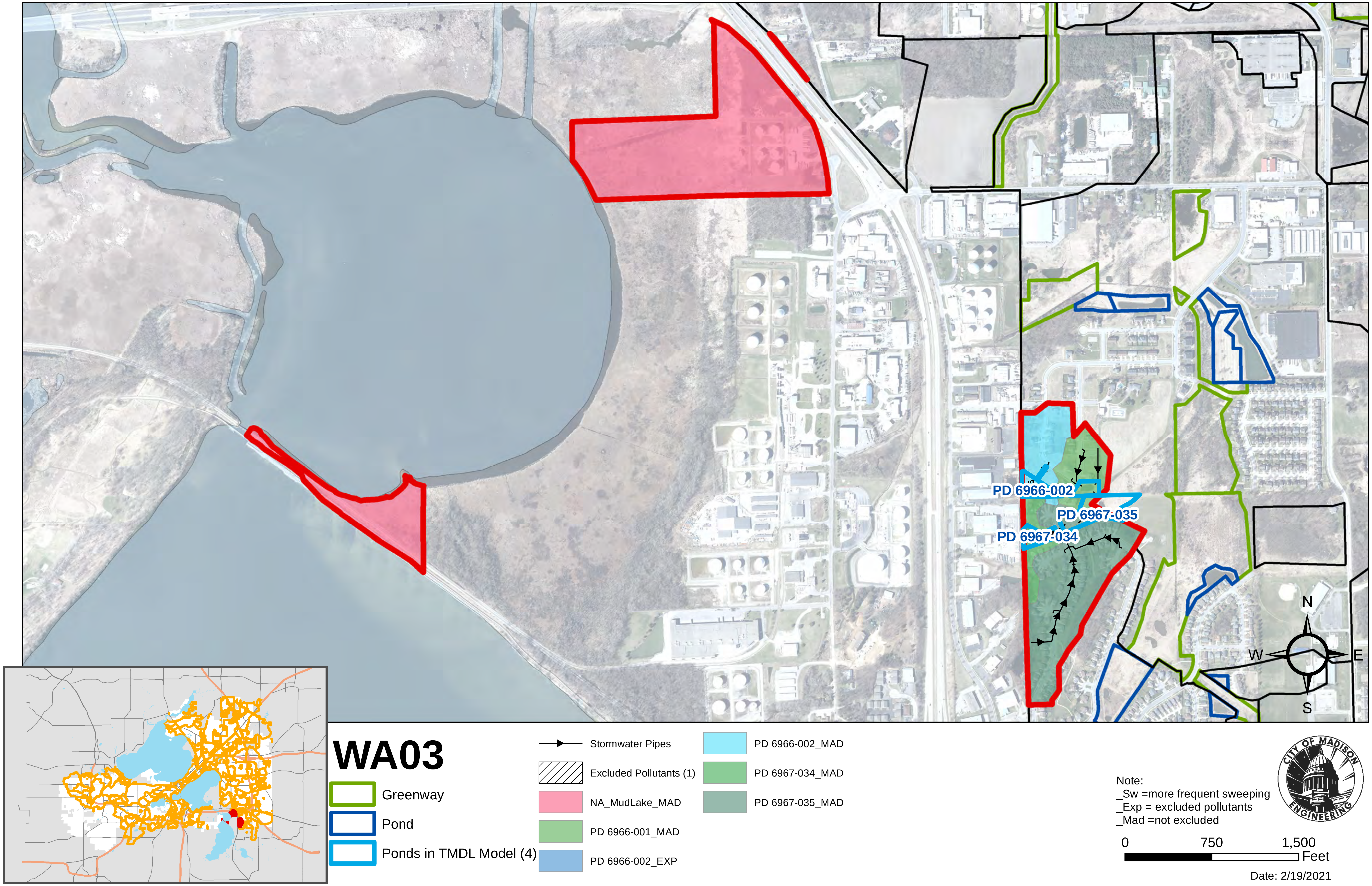

WA03

- 🟩 Greenway
- 🟦 Pond
- 🟦 Ponds in TMDL Model (4)
- → Stormwater Pipes
- ▨ Excluded Pollutants (1)
- 🟥 NA_MudLake_MAD
- 🟩 PD 6966-001_MAD
- 🟦 PD 6966-002_EXP
- 🟦 PD 6966-002_MAD
- 🟩 PD 6967-034_MAD
- 🟩 PD 6967-035_MAD

Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

Date: 2/19/2021

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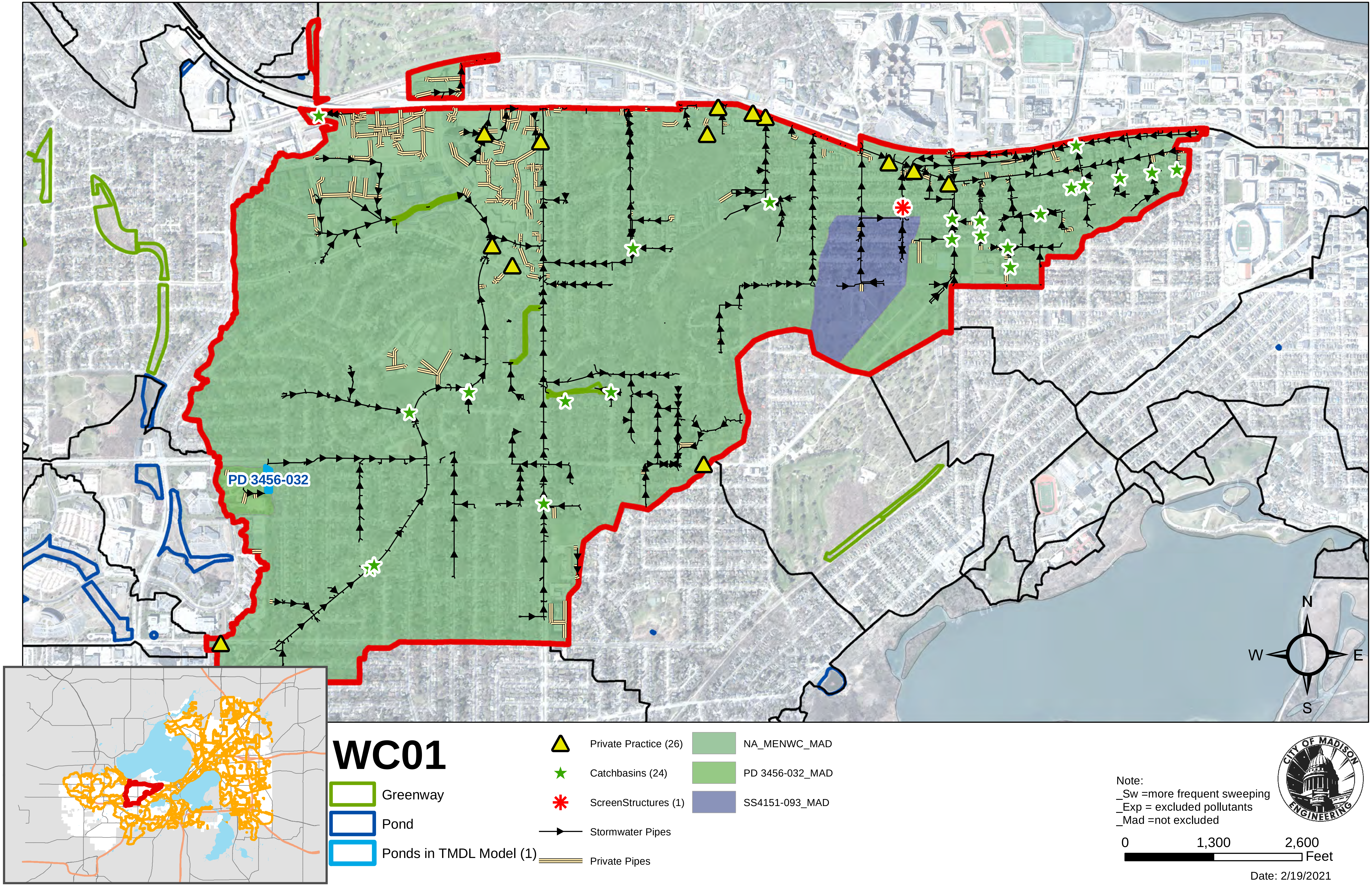
WC01



Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

Date: 2/19/2021

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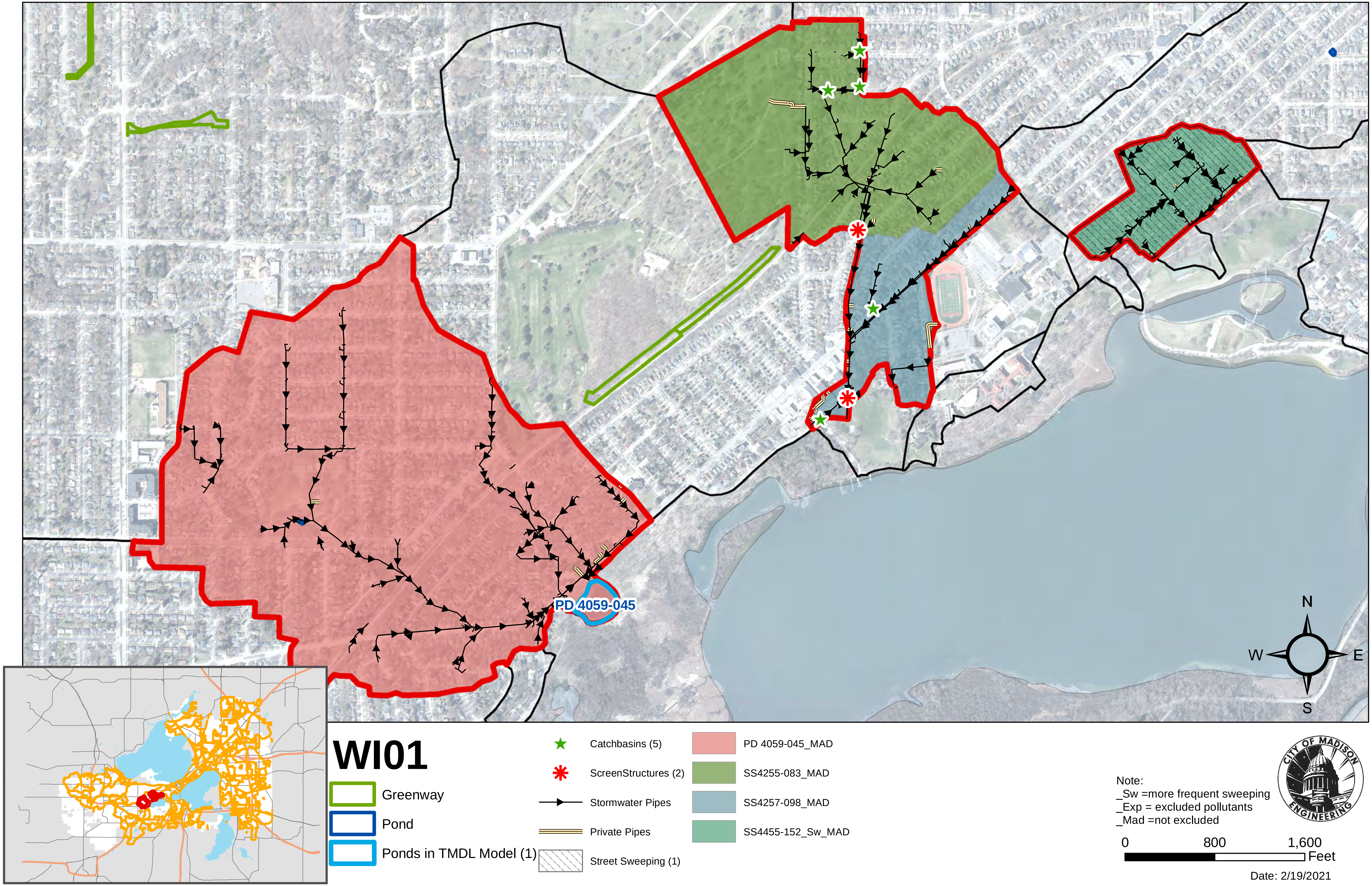


WI01

- ▭ Greenway
- ▭ Pond
- ▭ Ponds in TMDL Model (1)
- ★ Catchbasins (5)
- ✳ ScreenStructures (2)
- → Stormwater Pipes
- ═ Private Pipes
- ▨ Street Sweeping (1)
- 🟥 PD 4059-045_MAD
- 🟩 SS4255-083_MAD
- 🟦 SS4257-098_MAD
- 🟩 SS4455-152_Sw_MAD

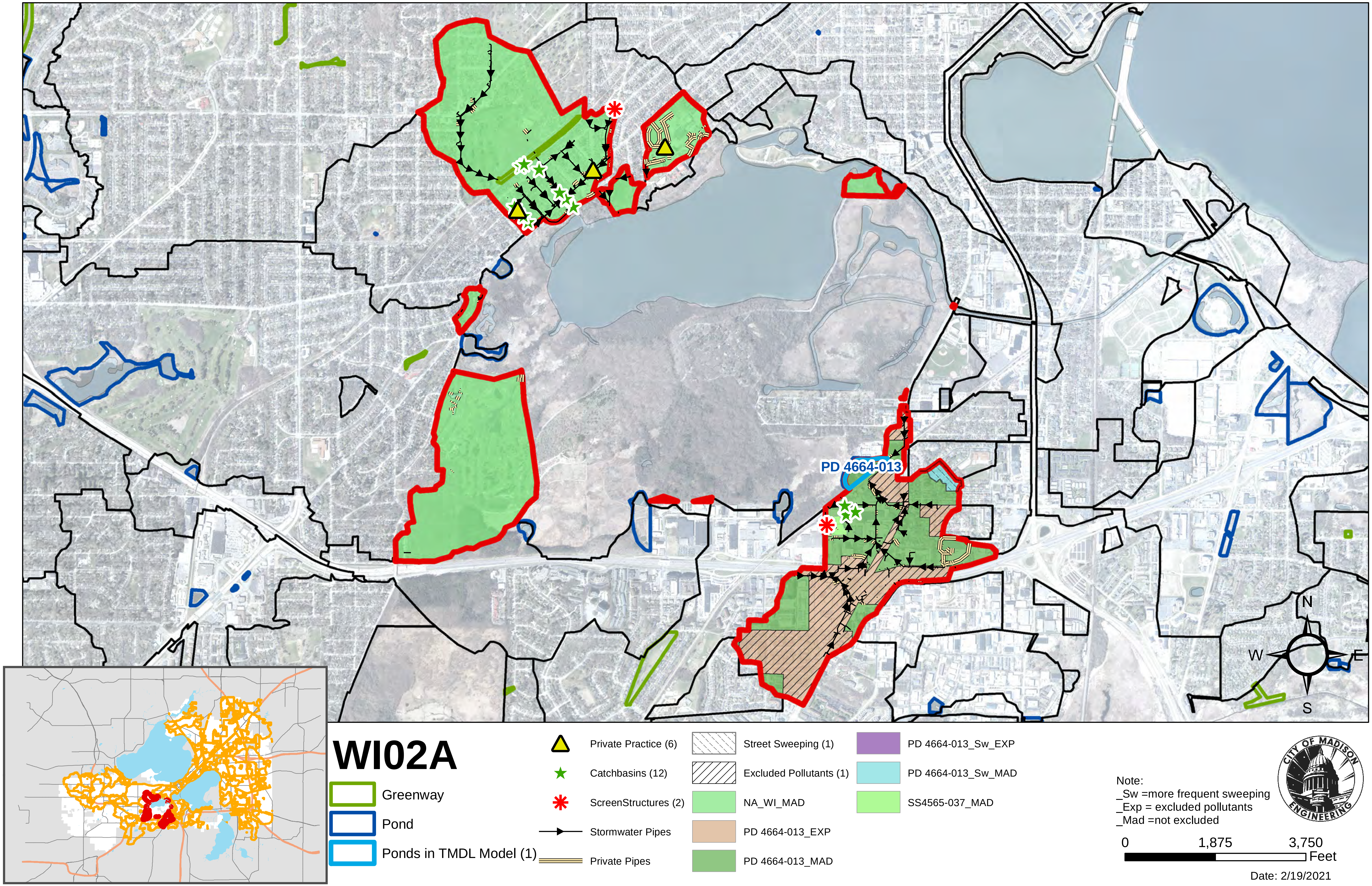
Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

Date: 2/19/2021

User Name: enles

Document Path: M:\MS4_WaterQualityModel\2019_2020 Modeling Effort\GIS\Working\MXDs\ModelAreas_DD.mxd

WI02A



Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

Date: 2/19/2021

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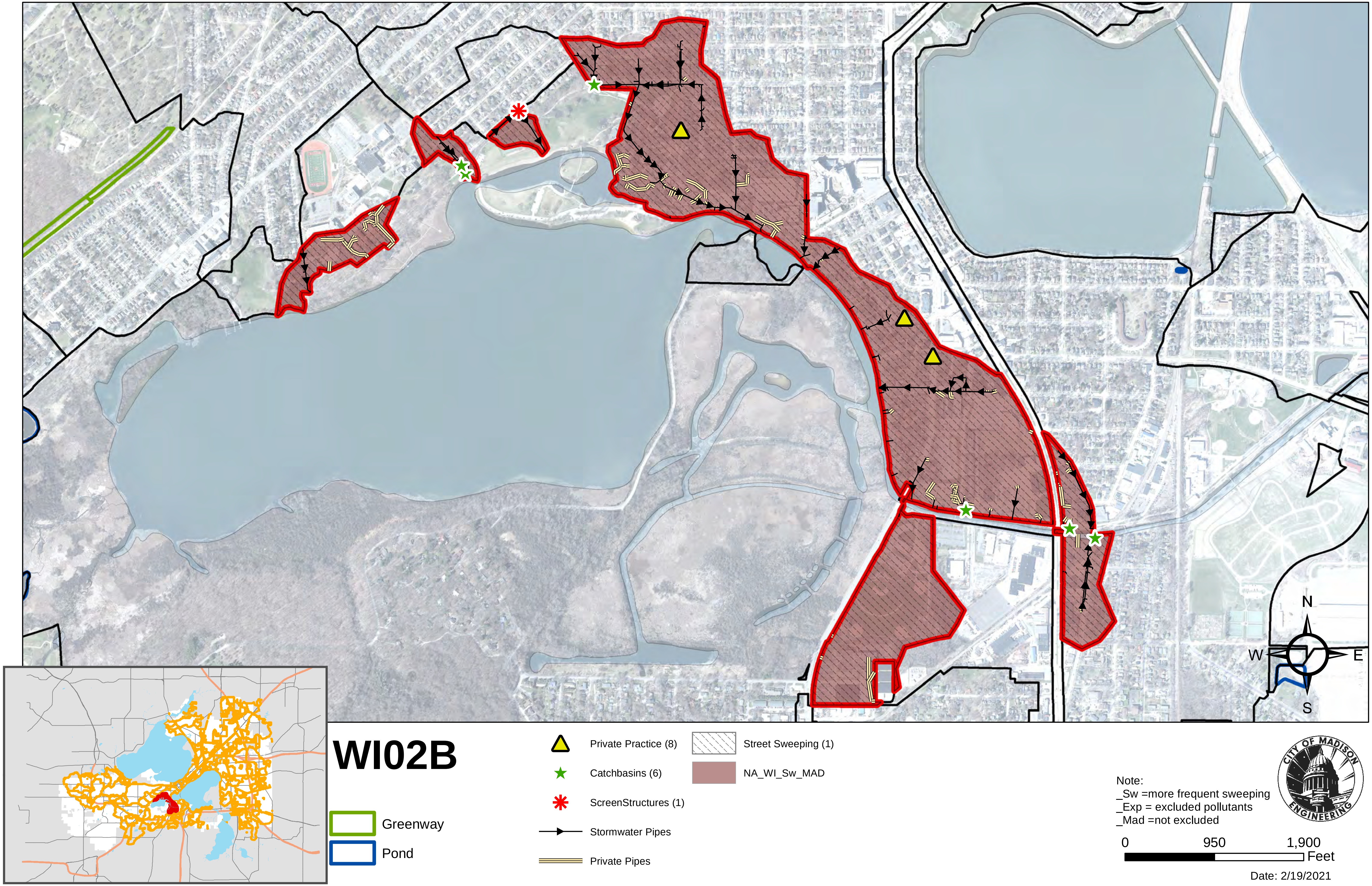

WI02B

Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

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Date: 2/19/2021

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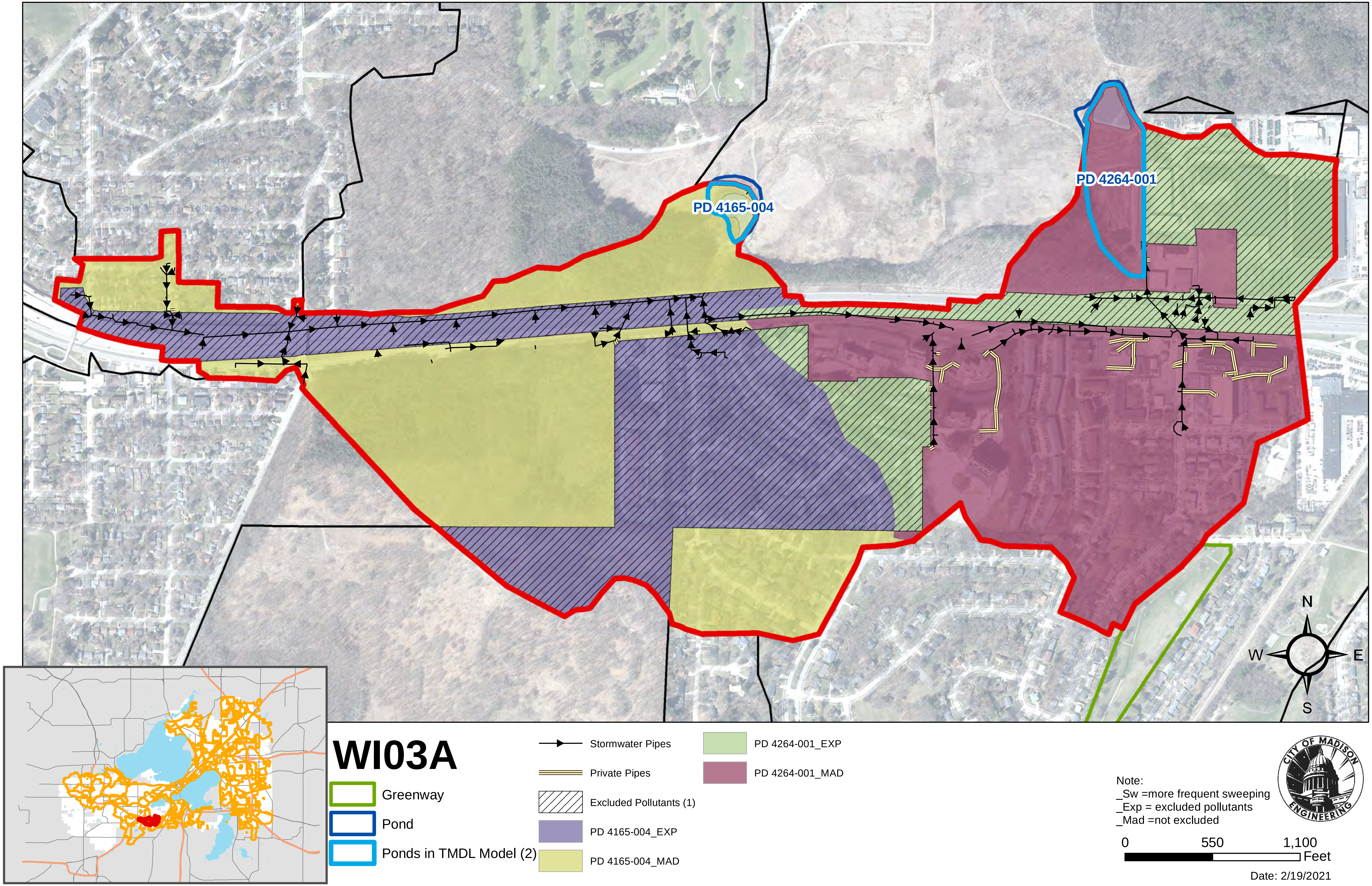

WI03A

- ▢ Greenway
- ▢ Pond
- ▢ Ponds in TMDL Model (2)
- → Stormwater Pipes
- ═ Private Pipes
- ▨ Excluded Pollutants (1)
- 🟪 PD 4165-004_EXP
- 🟨 PD 4165-004_MAD
- 🟩 PD 4264-001_EXP
- 🟥 PD 4264-001_MAD

Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

Date: 2/19/2021

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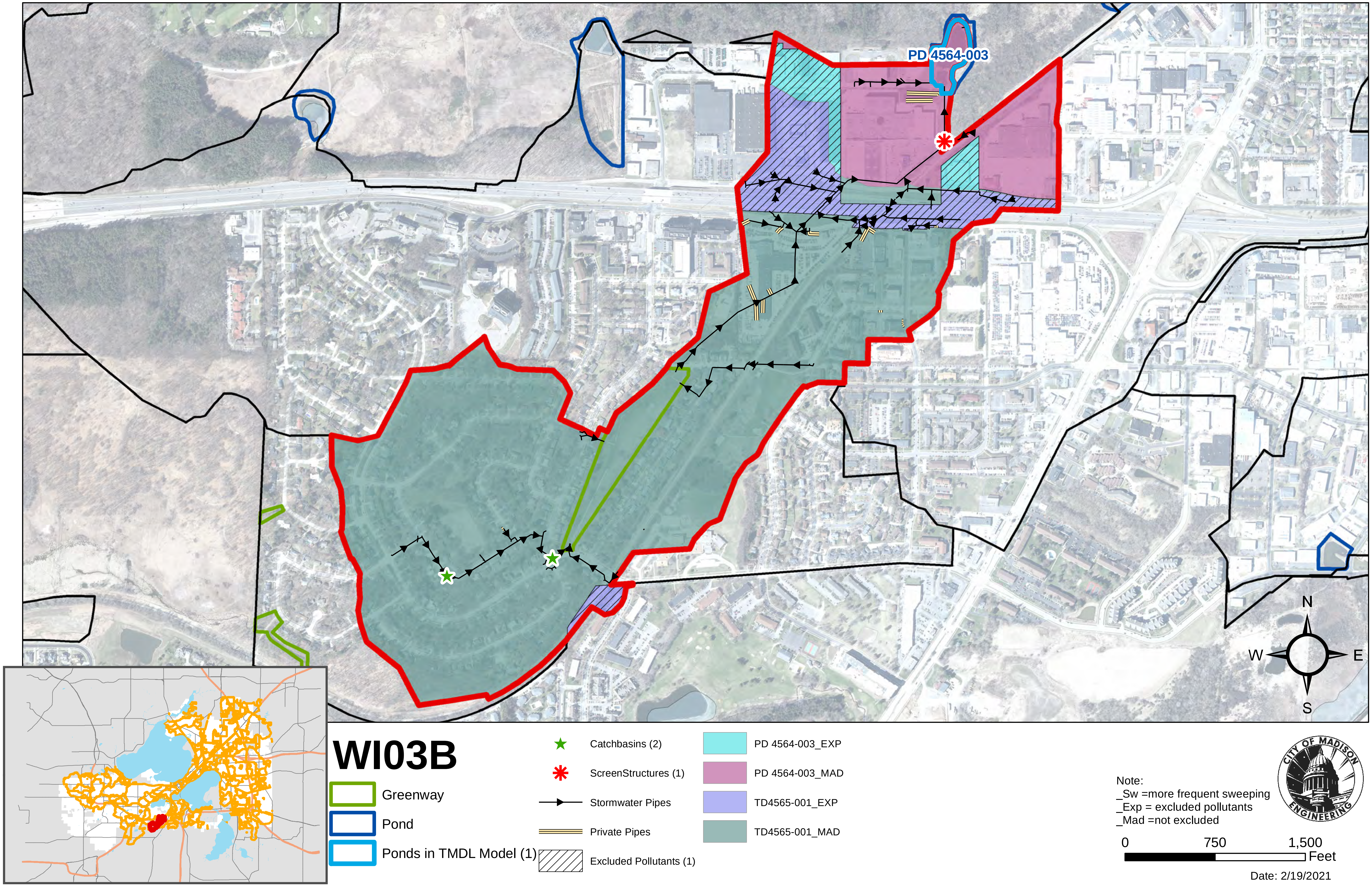

WI03B

- 🟩 Greenway
- 🟦 Pond
- 🟦 Ponds in TMDL Model (1)
- ★ Catchbasins (2)
- ✱ ScreenStructures (1)
- → Stormwater Pipes
- ═ Private Pipes
- ▨ Excluded Pollutants (1)
- 🟦 PD 4564-003_EXP
- 🟪 PD 4564-003_MAD
- 🟪 TD4565-001_EXP
- 🟩 TD4565-001_MAD

Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

Date: 2/19/2021

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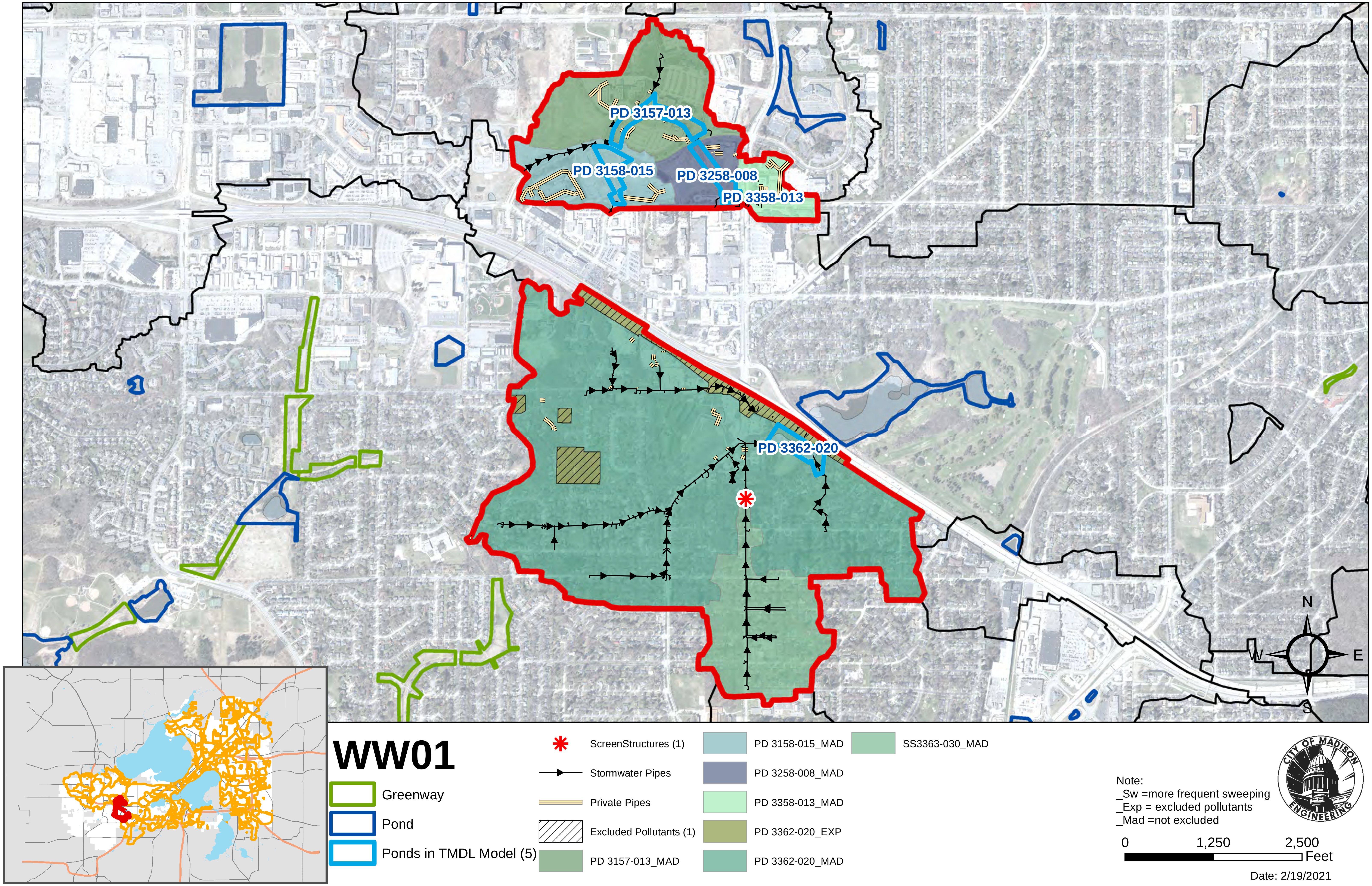
User Name: enles

WW01



Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

Date: 2/19/2021

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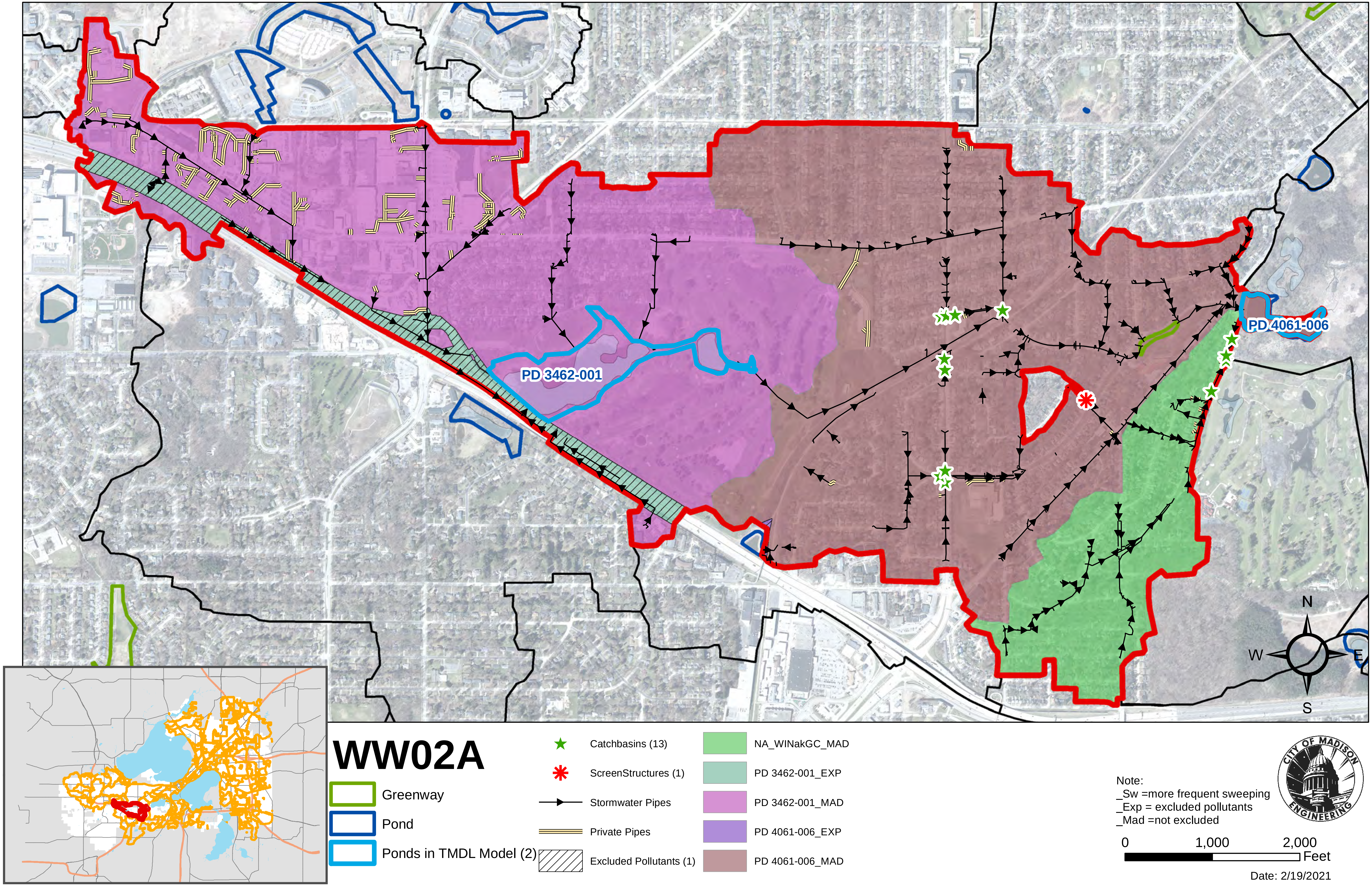

WW02A

Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

Date: 2/19/2021

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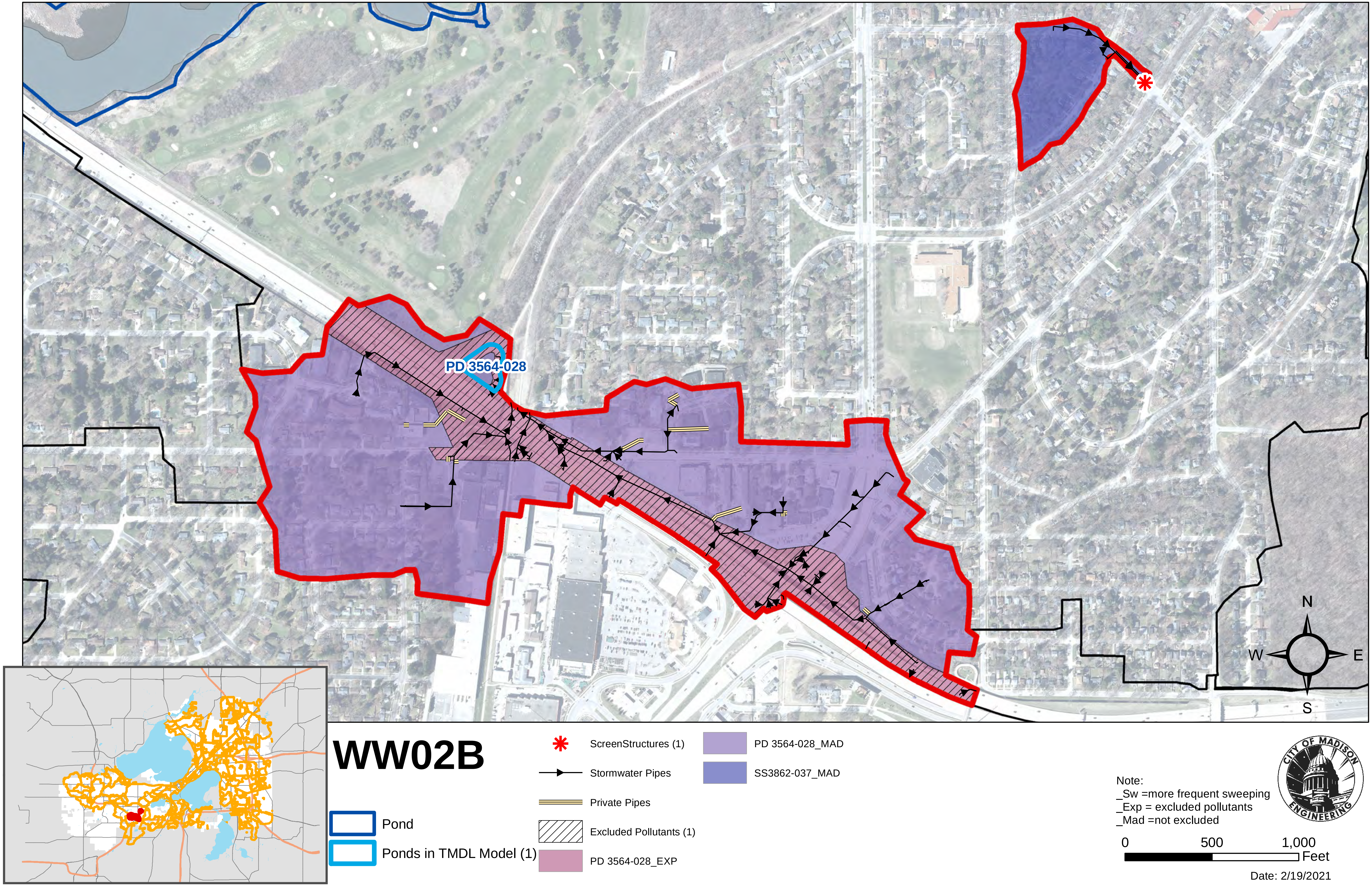

WW02B

- ✱ ScreenStructures (1)
- → Stormwater Pipes
- ═ Private Pipes
- ▨ Excluded Pollutants (1)
- ■ PD 3564-028_EXP
- ■ PD 3564-028_MAD
- ■ SS3862-037_MAD
- □ Pond
- □ Ponds in TMDL Model (1)

Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

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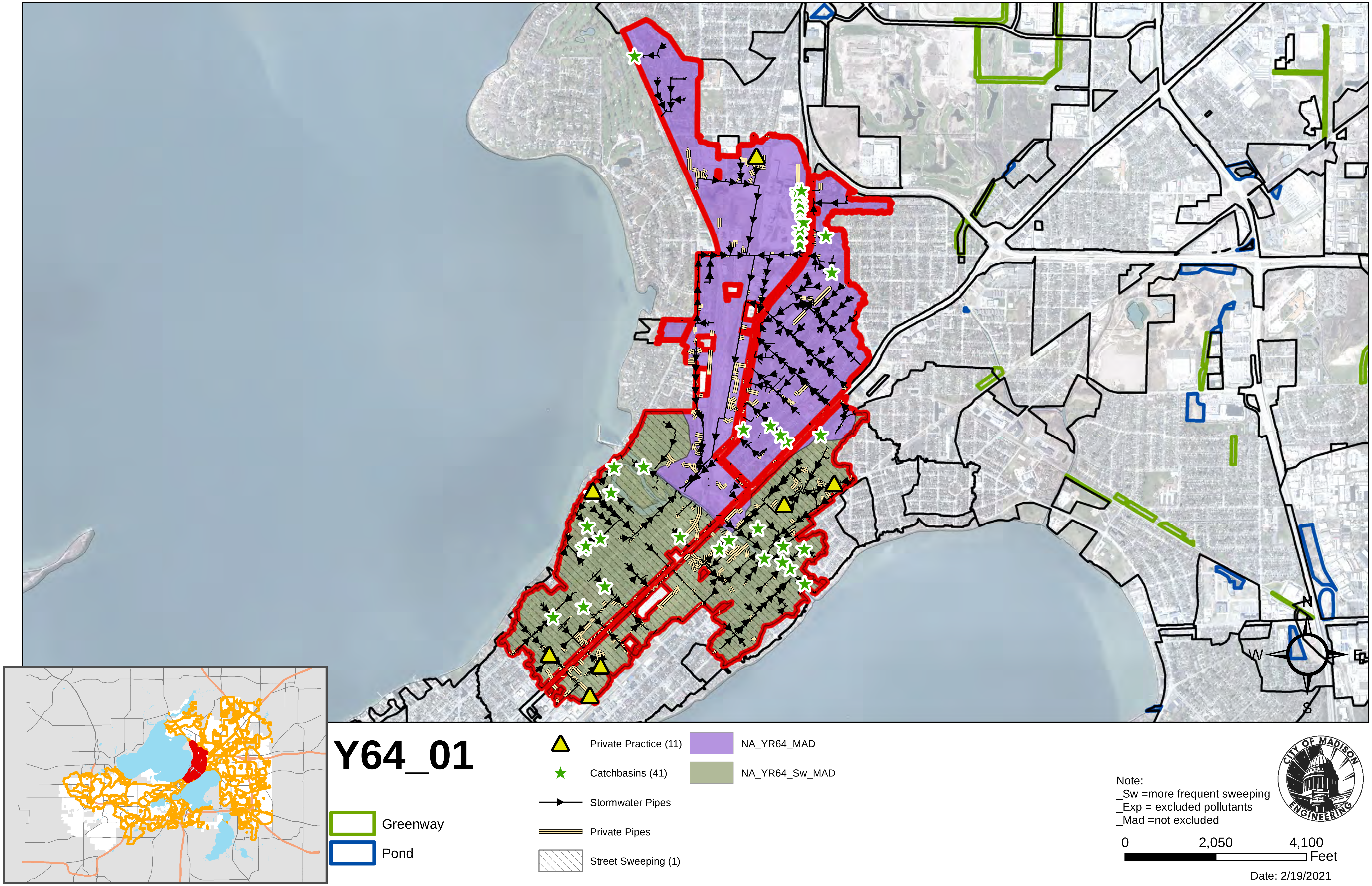

Y64_01

- ▲ Private Practice (11)
- ★ Catchbasins (41)
- → Stormwater Pipes
- ═ Private Pipes
- ▨ Street Sweeping (1)
- 🟪 NA_YR64_MAD
- 🟩 NA_YR64_Sw_MAD
- ☐ Greenway
- ☐ Pond

Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

Date: 2/19/2021

User Name: enles

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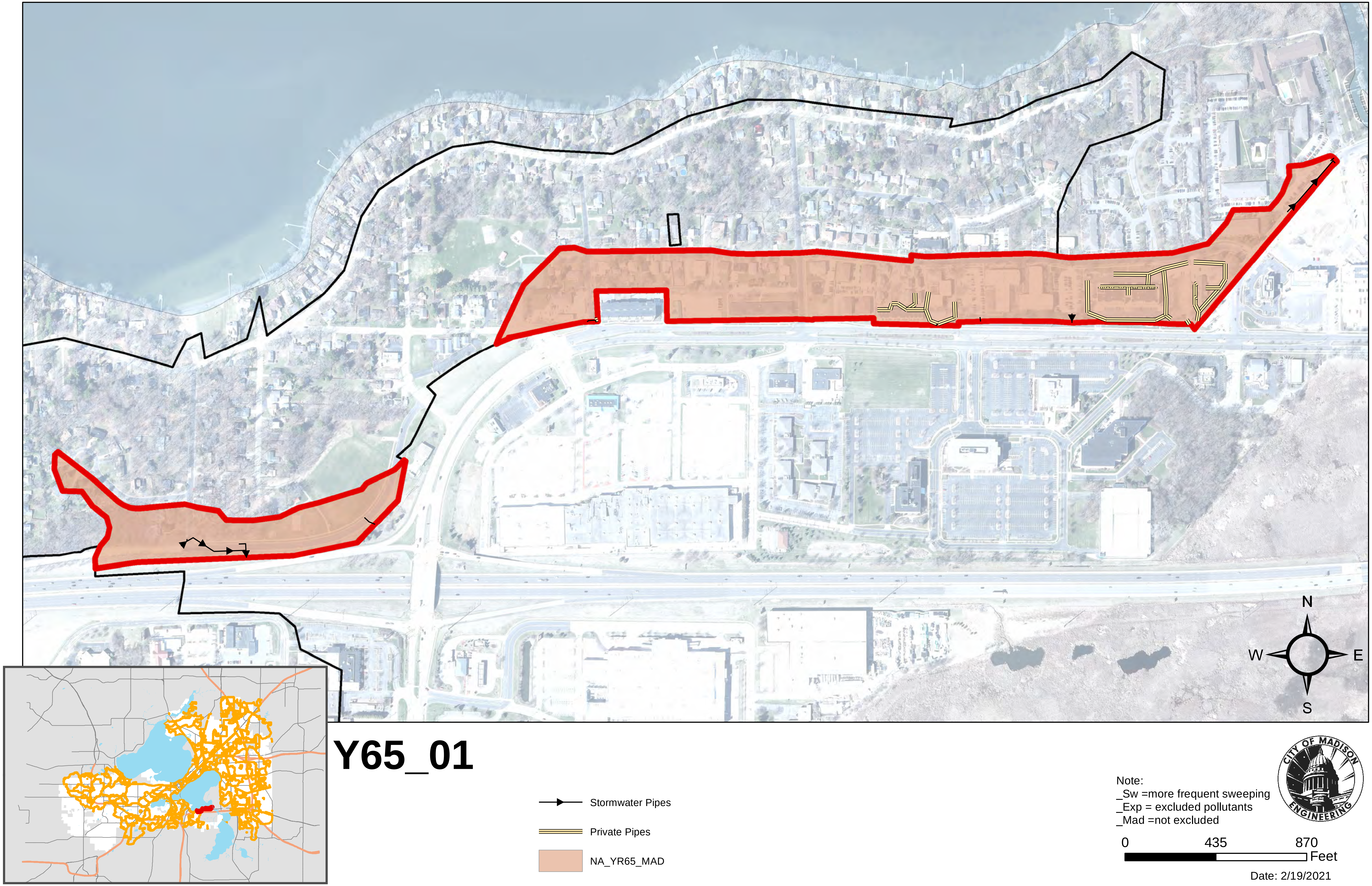

Y65_01

Note:
_Sw =more frequent sweeping
_Exp = excluded pollutants
_Mad =not excluded

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Date: 2/19/2021

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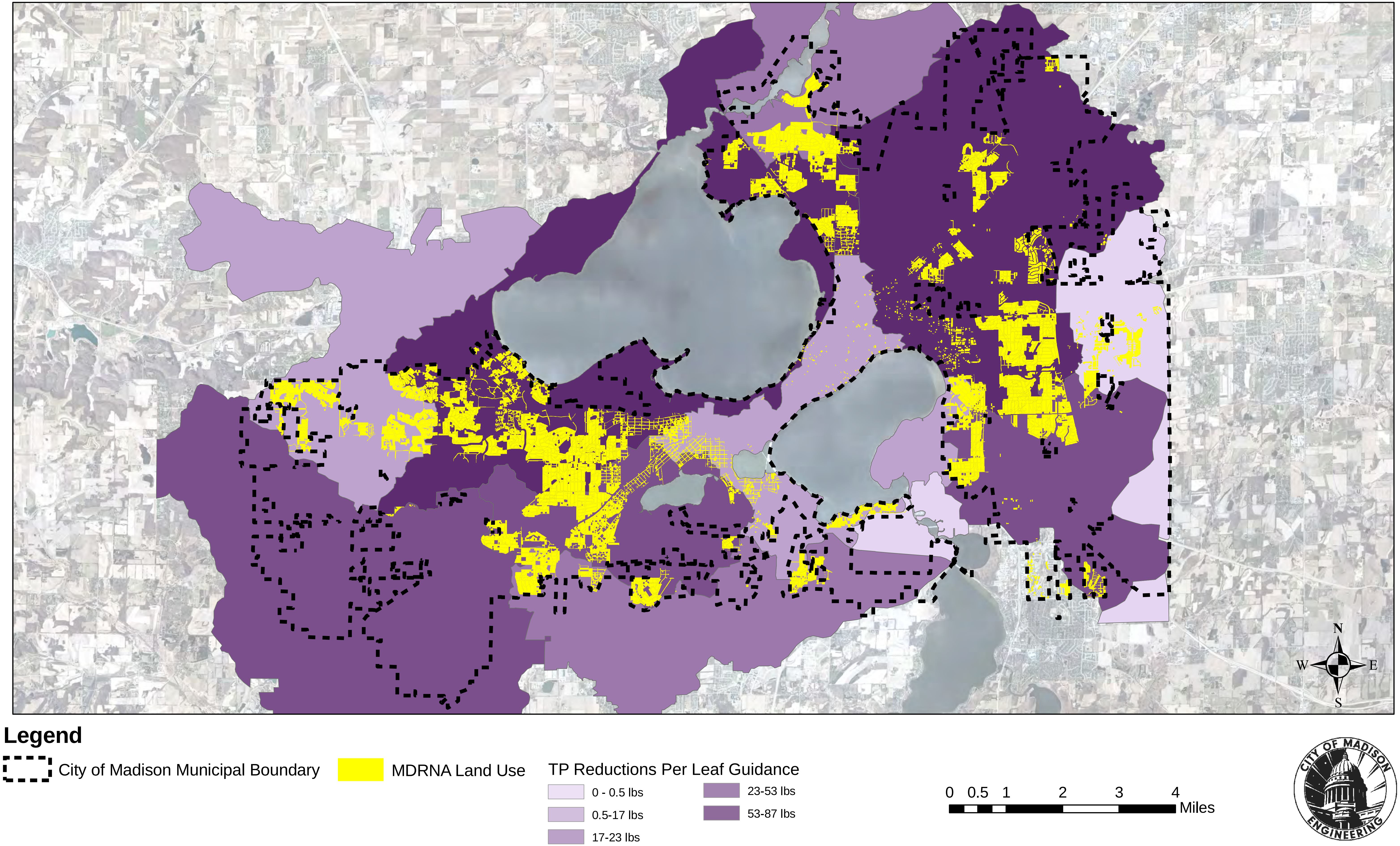
Figure 6: Annual TP Reductions per Leaf Management Guidance By Reachshed



Appendix B: Models and Input Files

See the files included with the report: No Controls Models (v10.5.037), With Controls 5 Year Models (v10.5.037), and MS4Input2020Creater_ReducedSize.mdb.

Appendix C: Limitations

This document is governed by the specific scope of work authorized by the City; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work.

The main purpose of this document is to help the City meet the federal and state regulatory program requirements for stormwater pollution reduction. Flooding issues related to stormwater conveyance system capacity, or flood elevations, were not the focus of this document and are not addressed in this report.

This document is a planning level study. Information used to develop the results and recommendations were based on available data sources and limited field investigation. The plan provides City decision makers a sound basis for proceeding with a stormwater management program to meet federal and state stormwater pollution regulations. It is important to note however, that the recommended structural stormwater pollution management measures will require significant additional engineering and design and possible federal/state permitting, before implementation. Factors or site conditions discovered during the engineering and design phase of a project may result in modifications in the scale, scope, costs, or ultimate feasibility of the project.

It is important to note that no Waters of the State were included in this modeling effort. Some water bodies eligible for inclusion under the terms of the TMDL, including Tenney Lagoons and Warner Lagoons, were omitted from this project due to lack of necessary data.

Appendix D: References

City of Madison (2017) Modeling Post-Construction Stormwater Management and Treatment NR 151, Wis. Adm. Code. 26 December 2017.

Selbig W.R. (2016) Evaluation of leaf removal as a means to reduce nutrient concentrations and loads in urban stormwater. Science of the Total Environment, 571, pp. 124-133.

WDNR (2012) Total Maximum Daily Load and Watershed Management Plan for Total Phosphorus and Total Suspended Solids in the Lower Fox River Basin and Lower Green Bay. March 2012.

WDNR (2020) Explore Wisconsin's Waters. Accessed online at: http://dnr.wi.gov/water/default.aspx

Appendix E: WDNR Documents

Modeling guidance

City of Madison/WDNR MS4 Meeting Minutes

WDNR Correspondence

State of Wisconsin

CORRESPONDENCE/MEMORANDUM

DATE: November 24, 2010

TO: Regional Water Leaders, Basin Leader & Experts
Stormwater Permit Staff (via Email)

FROM: Russ Rasmussen, Director Russell Rasmussen
Bureau of Watershed Management

SUBJECT: Developed Urban Areas and the 20% and 40% TSS Reductions
Sections NR 151.13(2) and NR 216.07(6), Wis. Adm. Code

This document is intended solely as guidance, and does not contain any mandatory requirements except where requirements found in statute or administrative rule are referenced. This guidance does not establish or affect legal rights or obligations, and is not finally determinative of any of the issues addressed. This guidance does not create any rights enforceable by any party in litigation with the State of Wisconsin or the Department of Natural Resources. Any regulatory decisions made by the Department of Natural Resources in any matter addressed by this guidance will be made by applying the governing statutes and administrative rules to the relevant facts. ***This document supersedes the guidance memo dated June 6, 2005, subsequent errata dated 8/15/05 and April, 2009 and the guidance memo dated May 14, 2010.***

Issue

Under s. NR 151.13 (2), Wis. Adm. Code, a municipality subject to the municipal stormwater permit requirements of subch. I of ch. NR 216, Wis. Adm. Code, must, to the maximum extent practicable, implement a 20% and a 40% reduction in total suspended solids in runoff that enters waters of the state as compared to no controls, by March 10, 2008 and March 10, 2013, respectively. Staff who work with affected municipalities need guidance on what areas under the municipalities' jurisdictions will be included in this requirement. They also need to know what is meant by "no controls" and "with controls", and what methods are acceptable for making these calculations.

Discussion

Chapter NR 216, Wis. Adm. Code, is the implementation code for the developed urban area performance standard. Applicability for permit coverage purposes is dictated by s. NR 216.02, Wis. Adm. Code. Under this provision, owners or operators of the following municipal separate storm sewer systems (MS4s) are required to obtain coverage under a WPDES municipal stormwater permit:

- MS4s serving populations of 100,000 or more.
- Previously notified owners or operators of municipal separate storm sewer systems.
- MS4s within urbanized areas as identified by EPA.
- MS4s serving populations over 10,000 unless exempted by DNR.

"MS4" is defined under s. NR 216.002 (17), Wis. Adm. Code, as a conveyance or system of conveyances, including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, constructed channels or storm drains, which meets all the following criteria:

- Owned or operated by a municipality.
- Designed or used for collecting or conveying stormwater.
- Not a combined sewer conveying both sanitary and stormwater.

- Not part of a publicly owned wastewater treatment works that provides secondary or more stringent treatment.

"Waters of the state" is defined under s. 283.01 (20), Stats., and it includes surface water, wetlands and groundwater. Waters of the state may overlap with the definition of MS4. For this purpose, if a waterway meets the definition of an MS4, it will be regulated as an MS4. The significant language in that definition is whether or not the municipality owns or operates the drainage way (i.e., maintains, has easement access for work, dredges, etc.). For example, when a "stream" is designed or used for collecting or conveying stormwater such as flowing through a municipally owned or operated culvert or bridge restriction, that "stream" is part of the MS4.

Under s. NR 216.07 (6)(a), Wis. Adm. Code, a municipality must develop a stormwater management program to achieve compliance with the developed urban area performance standard (s. NR 151.13 (2), Wis. Adm. Code). Developed areas are generally those that were not subject to the post-construction performance standards (s. NR 151.12 or NR 151.24, Wis. Adm. Code). The total suspended solids control requirements of s. NR 151.13 (2)(b)1.b. and 2., Wis. Adm. Code, may be achieved on an individual municipal basis. Control does not have to apply uniformly across the municipality. The control may also be applied on a watershed or regional basis by involving several municipalities. However, note that the Department is proposing to revise s. NR 151.12, Wis. Adm. Code, to limit the geographic extent of the watershed or regional area that municipalities may collectively meet the developed urban area standard.

A municipality is required under s. NR 216.07 (6)(b), Wis. Adm. Code, to provide an assessment of the actions taken to comply with the performance standards. This assessment may take the form of an annual progress report. The initial assessment must include a pollutant-loading analysis using a model such as SLAMM, P8 or equivalent methodology that is approved by the department. At a minimum, a pollutant-loading analysis must be conducted for total suspended solids and phosphorus. A model would not be run again after the initial assessment unless significant management changes occurred that should be accounted for, or the progress report indicates a re-run is necessary.

DNR Guidance

To comply with the code, the developed urban area must be modeled under a "no control" condition and a "with controls" condition. The 20% and 40% TSS reductions are assessed against the "no control" condition for the entire area served by the MS4 as defined below. They are not applied uniformly across the municipality, nor are they applied drainage area by drainage area within the municipal boundary. In most cases however, a calculation drainage basin by drainage basin will be used to determine the total loading and the achieved reductions.

Areas Required to be Included in the Calculations

A municipality must include the following areas when calculating compliance with the developed urban area standard (s. NR 151.13, Wis. Adm. Code):

1. Any developed area that was not subject to the post-construction performance standards of s. NR 151.12 or 151.24, Wis. Adm. Code, for new development only, that drains to the MS4 owned or operated by the municipality. The baseline developed urban area does not change due to future redevelopment of existing urban areas.
2. Any area covered by an NOI submitted prior to October 1, 2004 where development is still underway. The pollutant load shall be based on full build out. If it is known that the future development of some parcels may require compliance with s. NR 151.12 or NR 151.24, Wis. Adm. Code, then these areas may be excluded from the calculation.
3. Any undeveloped (in-fill) areas under 5 acres. These areas must be modeled as fully developed, with a land use similar to the properties around them.
4. For municipalities with large areas of agricultural lands separating areas of development, only the developed areas within the urbanized area as defined by the U.S. Census Bureau.

5. Non-manufacturing areas of industrial facilities such as customer or employee parking lots. (The manufacturing, outside storage and vehicle maintenance areas of these industrial facilities are covered under subch. II of ch. NR 216, Wis. Adm. Code, industrial permit.)
6. Any industry that has certified a condition of "no exposure" in accordance with s. NR 216.21(3), Wis. Adm. Code.
7. Any connecting highways as identified and listed in the Official Highway State Truck Highway System Maps at: http://www.dot.wisconsin.gov/localgov/highways/connecting.htm

Areas Prohibited from Inclusion in the Calculations

Areas and loadings that shall not be included:

1. Lands zoned for agricultural use and operating as such.
2. Pollutant loadings from an upstream MS4 (independent of whether it is regulated under a ch. NR 216, Wis. Adm. Code, permit) unless the municipality has an agreement to share the pollutant control credit with the upstream municipality.
3. Undeveloped land parcels over 5 acres within the municipality. These areas will be subject to the new development post-construction performance standards of s. NR 151.12 or 151.24, Wis. Adm. Code, when developed.
4. Any internally drained area with natural infiltration. (This does not include engineered or constructed infiltration areas.) However, a separate guidance memo dated April 6, 2009 (Subject: Developed Urban Areas and the 20% and 40% Reductions - Internally Drained Areas) provides conditions under which an internally drained area may be included in the calculation.
5. Any active or inactive mining site unless it has been reclaimed into another land use. The pollutant load associated with a mining site is not included in the calculation. However, runoff which drains into a mining site would be eligible for treatment credit in accordance with the April 6, 2009 guidance memo.
6. Areas subject to the new development performance standards of s. NR 151.12, Wis. Adm. Code.

Optional Areas to Include in the Calculations

Areas a municipality may, but is not required to, include in the developed urban area load calculation:

1. Property that drains to *waters of the state* without passing through the permittee's MS4.
2. Any area that discharges to an adjacent municipality's MS4 (Municipality B) without passing through the jurisdictional municipality's MS4 (Municipality A). Municipality B that receives the discharge into their MS4 may choose to be responsible for this area from Municipality A. If Municipality B has a stormwater treatment practice that serves a portion of A as well as a portion of B, then the practice must be modeled as receiving loads from both areas, independent of who carries the responsibility for the area. However, if runoff from an area within Municipality A's jurisdiction drains into Municipality B's MS4 but then drains back into Municipality A's MS4 farther downgradient, then Municipality B does not have the option of including the load from Municipality A in their analysis and the load from that area is Municipality A's responsibility.
3. Industrial facilities subject to a permit under subch. II of ch. NR 216, Wis. Adm. Code, except the pollutant load associated with an active or inactive mining site. This exclusion covers the facilities that are required to have permit coverage. Contact the regional stormwater specialist or central office to get a list of permitted facilities within a municipality.
    - The industrial NR 216 permit covers areas with industrial materials and activities, specifically areas with manufacturing, vehicle maintenance, storage of materials, etc.

A municipality may include any of the areas identified above in their developed urban area as part of their load calculation provided the areas are not prohibited from inclusion in the calculation. If they choose to include an area, it must be included in both the "no controls" and "with controls" condition. Inclusion of areas they choose to be responsible for will allow them to take credit for any of those areas that may have controls in place. For example, if an industrial park would have been excluded because all the industries in the industrial park have an NR 216 industrial permit, but the municipality chooses to keep this area in their "no controls" area, then any best management practices existing or built to serve the industrial park can be included in the "with controls" scenario.

Model Inputs

Model Version:
To model the TSS load in the area served by the MS4, the municipality must select a model such as SLAMM, P8 or an equivalent method deemed acceptable by the Department. For the analysis to show compliance with the 40% developed urban area performance standard, SLAMM version 9.2 or P8 version 3.4 or a subsequent version of these models may be used. As part of the reporting process, the municipality must identify which model version is being used. The analysis must use the same version for both the "no controls" scenario and the "with controls" scenario unless it is verified that the "no controls" pollutant discharge load does not change between the model versions. If there is a change in the no controls pollutant discharge load then the new pollutant discharge load corresponding with the version of the model selected for the analysis needs to be utilized. An entire city-wide municipal "no controls" scenario does not need to be remodeled, only those areas being updated with the new version of the model.

"No control"
In SLAMM, the "no controls" condition generally will be based on the standard land use files for different land uses. This assumes certain default parameter files, an assumed level of disconnection and an assumed distribution of road smoothness. The "no controls" condition for each land use is based on this assumed percent of disconnected imperviousness. All land uses as modeled must be equal to the connected imperviousness values in the standard land use files unless site specific data is available. However under the "with controls" condition, land use that has a greater level of disconnection than the values in the standard land use files may take credit for volume and pollutant reduction. In P8, the help menu provides standard land use values that can be used for the percent directly connected versus indirectly connected impervious surfaces.

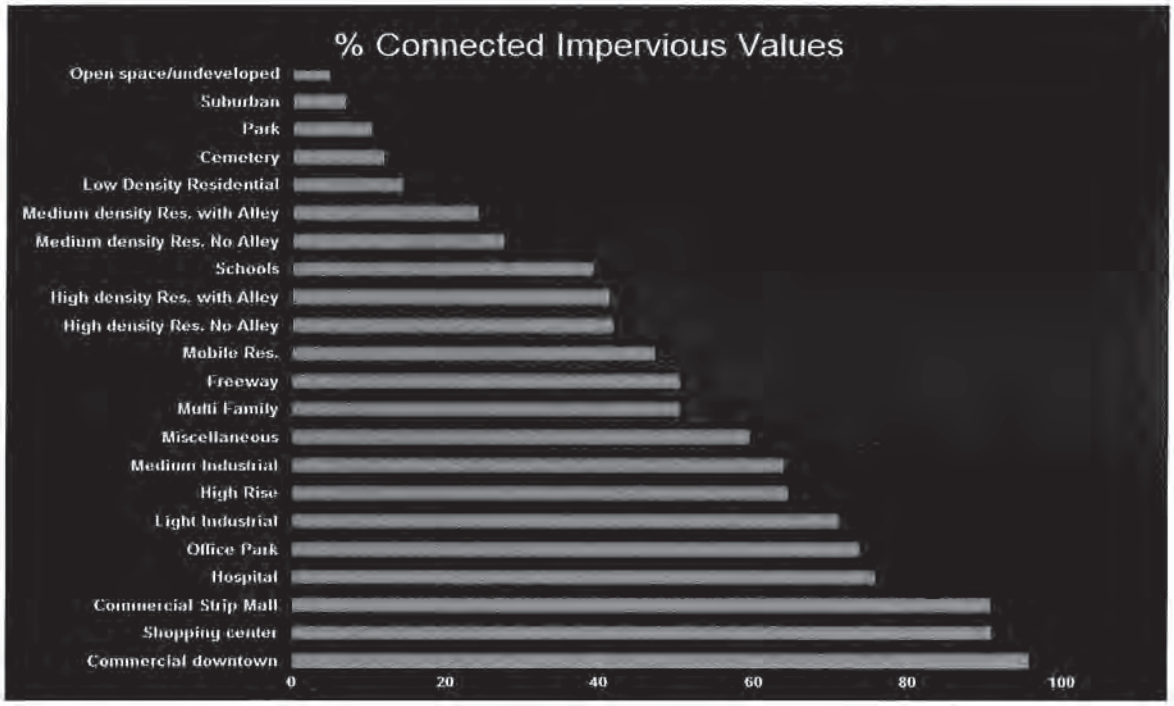
All roads within the urbanized area that are part of a county or town's MS4 are the responsibility of the county or town. To generate a load under "no controls", model the road based on the nearest urban land use, even if agricultural land use is on one or both sides of the road. Select the urban land use that will most likely typify the traffic that will be on that road (for example commercial or residential) and include that area in the corresponding standard land use file.

For the drainage system, the default will be curb and gutter (even if the drainage system is currently swale drainage), in fair condition. For "no controls" there will be no recognition of street sweeping, catch basin cleaning, swale drainage, or the existence of any engineered best management practices. These practices and facilities will be accounted for under the "with controls" condition.

A municipality is not required to use the standard land use files if it has surveyed the land uses in its developed urban area and has "real" source area data on which to base the input files. The percent connected imperviousness must be verified in the field. Disconnection may be assumed for residential rooftops where runoff has a flow path of 20 feet or greater over a pervious area in good condition. Disconnection for impervious surfaces other than residential rooftops may be assumed provided all of the following are met:

- The source area flow length does not exceed 75 feet,
- The pervious area is covered with a self-sustaining vegetation in "good" condition and at a slope not exceeding 8%,
- The pervious area flow length is at least as long as the contributing impervious area and there can be no additional runoff flowing into the pervious area other than that from the source area.
- The pervious area must receive runoff in a sheet flow manner across an impervious area with a pervious width at least as wide as the contributing impervious source area.

The table below shows the overall percent connected imperviousness that is associated with SLAMM standard land use files. The overall percent disconnection shown in this table is not input into SLAMM as the percent disconnection, rather the individual road, roof top, sidewalk, etc. areas have their own individual connectedness included in the standard land use files.



"With controls"

The "with controls" condition is applied to the developed urban area with the inclusion of the practices and facilities (existing and proposed). Modeling is a means to confirm a practice's efficiency for the conditions found in Wisconsin. If the model cannot predict efficiencies for certain practices that the municipality identifies as water quality practices, then a literature review must be conducted to estimate the reduction value. Proprietary stormwater practices that utilize settling as their means of solids reduction should be modeled in accordance with DNR Technical Standard 1006 (Method for Predicting the Efficiency of Proprietary Storm Water Sedimentation Devices).

When designing treatment practices, runoff draining to the practice from off-site must be taken into account in determining the treatment efficiency of the practice. Any impact on the efficiency must be compensated for by increasing the size of the practice accordingly.

Practices on private property that drain to an MS4 can be included in the "with controls" scenario for a municipality, provided the municipality enters into an agreement or equivalent enforceable mechanism with the stormwater treatment facility owner that will ensure the practice is properly maintained. An operation and maintenance plan, including a maintenance schedule, must be developed for the stormwater treatment facility in accordance with relevant DNR technical standards. The agreement or equivalent mechanism between the municipality and the private owner should include the following:

- A description of the stormwater treatment facility including dimensions and location.
- Identify the owner of the property on which the stormwater treatment facility is located.
- Identify who is responsible for implementing the operation and maintenance plan.
- Outline a means of terminating the agreement that includes notifying DNR.

The efficiency of the practice on private property must be modeled using the best information the municipality can obtain on the design of the practice. For example, permanent pool area is not sufficient information to know the pollutant reduction efficiency of a wet detention basin even if it matches the area requirements identified in Technical Standard 1001 Wet Detention Basin for an 80% reduction. Information on the depth of the wet pool and the outlet design are critical features that determine whether a detention pond is providing 80% TSS reduction.

Further clarifications

- If a portion of a municipality's MS4 drains to a stormwater treatment facility in an adjacent municipality, the municipality generating the load will not receive any treatment credit due to the downstream municipality's treatment facility unless there is an inter-municipal agreement where the downstream municipality agrees to allow the upstream municipality to take credit for such treatment. DNR anticipates that such an agreement would have the upstream municipality assist with the construction and/or maintenance of the treatment facility. This contract must be in writing with signatures from both municipalities specifying how the treatment credit will be shared.

- The model results will be the basis for determining compliance with the permit for "no controls" and "with controls" TSS load.
- For reporting purposes, the pollutant load must be summarized as the cumulative total for the developed urban area served by the MS4. Additionally pollutant loads for grouped drainage areas as modeled shall also be reported. Drainage areas may be grouped at the discretion of the modeler for such reasons as to emphasize higher priority areas, balance model development with targeting or for cost-effectiveness.
- No credit should be taken for sweeping of non-curbed streets.
- The additional runoff volume from areas that are exempt or outside of the developed urban area to which the TSS standard applies needs to be accounted for when it drains into the treatment device. The pollutant load can be "turned off" but the runoff hydrology needs to be accounted for to properly calculate the treatment efficiency of the device.
- Due to concerns of sediment resuspension, basins with an outlet on the bottom are generally not eligible for pollutant removal based solely on settling. However, credit may be taken for treatment due to infiltration or filtration. Features to prevent scour should always be included for any practice where appropriate.
- When street cleaning is applied across a watershed with devices that serve only certain areas within the watershed, it is acceptable to first take credit for street cleaning across the entire watershed but then the treatment efficiency for devices must be reduced by the efficiency of the street cleaning to prevent double counting.
- To model a combination of mechanical broom and vacuum assisted street cleaning, it may require an analysis of several model runs depending on the timing of the mechanical and vacuum cleaning. If mechanical broom and vacuum cleaning occur at generally the same time (e.g. within two weeks of each other) then only the removal efficiency of the vacuum cleaning should be taken. If the municipality performs broom sweeping in the spring or fall and vacuum clean the remained of the year, calculate the combined cleaning efficiency using the following method:
  (A) Model the entire street cleaning program as if entire period is done by a mechanical broom cleaner.
  (B) Model just the period of time for vacuum cleaning (do not include the mechanical broom cleaning).
  (C) Model the same period as B) but with a mechanical broom.
  (D) The overall combined efficiency would be A + B – C.

WinSLAMM clarification:

- WinSLAMM 9.3.4 and earlier versions of WinSLAMM result in double counting of pollutant removal for most treatment practices modeled in series. WinSLAMM 9.2 and subsequent versions contain warnings to help alert modelers of this issue. The modeler will need to make adjustments to ensure that the results do not include double credit for removal of the same particle size. PV & Associates has created a document titled 'Modeling Practices in Series Using WinSLAMM' which helps to guide a user as to whether and or how certain practices can be modeled in series and this document is available at: http://winslamm.com/Select_documentation.html

P8 clarifications

- P8 does not account for scour and sediment resuspension. DNR requires that a wet basin with less than a 3-foot permanent pool have its treatment efficiency reduced. A basin with zero permanent pool depth should be considered to get zero credit for pollutant removal due to settling and a basin with 3 or more feet of permanent pool depth can be given the full pollutant removal efficiency credited by settling. The pollutant removal efficiency may be given straight-line depreciation such that a basin with a 1.5 foot-deep permanent pool would be eligible for 1/2 the pollutant removal efficiency that would be credited due to settling.
- A device that DNR gives no credit for pollutant removal may still be modeled if it is in series with other practices because of its benefit on runoff storage capacity that may enhance the treatment efficiency of downgradient treatment devices. To do so, turn the treatment efficiency off in P-8.

- P8 starts its model runs with no water in the basins. P8 should be started an extra year before the "keep dates", in order to allow the model to fill up ponds to the lowest outlet elevation.

Approved By:

Gordon Stevenson

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BUREAU OF WATERSHED MANAGEMANT
PROGRAM GUIDANCE

Storm Water Management Program

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

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

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

APPROVED:

Pam Biersach

Pam Biersach, Director
Bureau of Watershed Management

10/28/14
Date

A. Statement of Problem

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

B. Background

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

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

C. Discussion

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

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

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

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

D. Guidance

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

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

PART 1 – Expressing WLAs and Reduction Targets

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

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

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

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

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

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

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

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

Percent Reduction (from baseline) = 100 * (1 – (WLA Loading Condition / Baseline Loading Condition))

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

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

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

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

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

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

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

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

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

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

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

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

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

PART 2 – Implementation and Compliance Benchmarks

Storm Water Management Planning (SWMP)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Compliance Schedule and Benchmarks

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

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

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

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

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

Runoff Treatment Outside of the MS4's Jurisdiction

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

Tracking

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

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

PART 3 – Modeling

<u>Discussion</u>

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

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

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

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

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

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

Guidance

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

TMDL Analysis Area

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

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

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

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

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

Optional: The pollutant loads associated with the following areas are optional for an MS4 to include:

1. Area that never passes through a permittee's MS4 such as a riparian area.
2. Land zoned for agricultural use and operating as such.
3. Manufacturing, outside storage and vehicle maintenance areas of industrial facilities permitted under subch. II of ch. NR 216, Wis. Adm. Code, are optional to include. This does not include any industrial facilities that have certified a condition of "no exposure" pursuant to s. NR 216.21(3), Wis. Adm. Code. *Note: DNR recommends that municipalities include all industrial facility areas within their WLA analysis area instead of creating 'holes' within its area of analysis.*
4. Any area that discharges to an adjacent municipality's MS4 (Municipality B) without passing through the jurisdictional municipality's MS4 (Municipality A). Municipality B that receives the discharge into their MS4 may choose to be responsible for this area from Municipality A. If Municipality B has a stormwater treatment practice that serves a portion of A as well as a portion of B, then the practice must be modeled as receiving loads from both areas, independent of who carries the responsibility for the area. However, if runoff from an area within Municipality A's jurisdiction drains into Municipality B's MS4 but then drains back into Municipality A's MS4 farther downgradient, then Municipality B does not have the option of including the load from Municipality A in their analysis and the load from that area is Municipality A's responsibility.
5. For county and towns, the area outside of the most recent urbanized area as defined by the US Census Bureau. This area is classified as non-permitted urban and part of the non-point source load allocation (NPS LA).

MS4 Water Quality Models and Related Information

To model pollutants such as TSS and total phosphorus in the area served by the MS4, the municipality must select a model such as SLAMM, P8 or an equivalent method deemed acceptable by the Department. For the analysis to show compliance, SLAMM version 9.2 or P8 version 3.4 or a subsequent version of these models may be used.

All roadway right-of-ways within the urbanized area that are part of a county or town's MS4 are the responsibility of the county or town. Model the road based on the urban land use that will most typify the traffic, even if agricultural land use is on one or both sides of the road (for example commercial or residential) and include that area in the corresponding standard land use file.

A municipality is not required to use the standard land use files if it has surveyed the land uses in its developed urban area and has "real" source area data on which to base the input files. The percent connected imperviousness beyond the standard land use files must be verified in the field. Disconnection may be assumed for residential rooftops where runoff has a flow path of 20 feet or greater over a pervious area in good condition. Disconnection for impervious surfaces other than residential rooftops may be assumed provided all of the following are met:

- The source area flow length does not exceed 75 feet,

- The pervious area is covered with a self-sustaining vegetation in “good” condition and at a slope not exceeding 8%,
- The pervious area flow length is at least as long as the contributing impervious area and there can be no additional runoff flowing into the pervious area other than that from the source area.
- The pervious area must receive runoff in a sheet flow manner across an impervious area with a pervious width at least as wide as the contributing impervious source area.

Water quality modeling is a means to determine a storm water management control practice’s treatment efficiency. If the model cannot predict efficiencies for certain storm water management control measures that a municipality identifies as a water quality management practice, then a literature review should be conducted to estimate the reduction value. Proprietary stormwater management control measures that utilize settling as their means of TSS reduction should be modeled in accordance with DNR Technical Standard 1006 (Method for Predicting the Efficiency of Proprietary Storm Water Sedimentation Devices).

When designing storm water management practices, runoff draining to a management practice from off-site must be taken into account in determining the treatment efficiency of the measure. Any impact on the efficiency must be compensated for by increasing the size of the measure accordingly.

Storm water management practices on private property that drain to an MS4 can be given treatment credit, provided the municipality enters into an agreement or has an equivalent enforceable mechanism with the facility/land owner that will ensure the management practice is properly maintained. The municipality will need a tracking system that includes maintenance of treatment practices. An operation and maintenance plan, including a maintenance schedule, must be developed for the stormwater management practice in accordance with relevant DNR technical standards. The agreement or equivalent mechanism between the municipality and the private owner should include the following:

- A description of the stormwater management practice including dimensions and location.
- Identify the owner of the property on which the stormwater management practice is located.
- Identify who is responsible for implementing the operation and maintenance plan.
- Outline a means of terminating the agreement that includes notifying DNR.

The efficiency of a storm water management practice on both public and private property must be modeled using the best information the municipality can obtain on the design of the practice. For example, permanent pool area is not sufficient information to know the pollutant reduction efficiency of a wet detention basin even if it matches the area requirements identified in Technical Standard 1001 Wet Detention Basin for an 80% reduction. Information on the depth of the wet pool and the outlet design are critical features that determine the level of control a detention pond is providing.

Modeling Clarifications

- A TMDL might remove certain internally drained areas from its analysis. If an internally drained area is removed from the TMDL analysis, the MS4 permittee shall not include such area in its MS4 analysis to show compliance with its TMDL requirements. Under this scenario if stormwater is pumped from inside the internally drained area to an external drainage area, then this additional pollutant discharge needs to be accounted for in the MS4 analysis to show compliance with its TMDL requirements.
- Where an internally drained area is included in the TMDL analysis, an MS4 permittee has the option of including this area in its TMDL analysis to show compliance with its TMDL requirements. However, credit for pollutant removal in internally drained areas may only be taken provided the April 6, 2009 DNR Internally Drained Area guidance memo is met with respect to taking pollutant reduction credit within internally drained areas.

- When water is pumped rather than gravity drained from an internally drained area of many acres in area, the MS4 will be expected to use monitoring data to determine the annual average mass of pollutants discharged to the surface water to which the TMDL applies. This does not apply to dewatering covered under a DNR storm water construction site general permit.
- If a portion of a municipality's MS4 drains to a stormwater treatment facility in an adjacent municipality, the municipality generating the load will not receive any treatment credit due to the downstream municipality's treatment facility unless there is an inter-municipal agreement where the downstream municipality agrees to allow the upstream municipality to take credit for such treatment. DNR anticipates that such an agreement would have the upstream municipality assist with the construction and/or maintenance of the treatment facility. This contract must be in writing with signatures from both municipalities specifying how the treatment credit will be shared.
- For reporting purposes, the pollutant reductions must be summarized by TMDL reachshed. Additionally, pollutant loads for grouped drainage areas as modeled shall also be reported. Drainage areas may be grouped at the discretion of the modeler for such reasons as to emphasize higher priority areas, balance model development with targeting or for cost-effectiveness.
- The additional runoff volume from areas that are outside of the analysis area needs to be accounted for when it drains into treatment devices. The pollutant load can be "turned off" but the runoff hydrology needs to be accounted for to properly calculate the treatment efficiency of the device.
- Due to concerns of sediment resuspension, basins with an outlet on the bottom are generally not eligible for pollutant removal based solely on settling. However, credit may be taken for treatment due to infiltration or filtration. Filtration might occur through engineered soil or proprietary filters. Features to prevent scour should always be included for any practice where appropriate.
- Credit should not be taken for street cleaning unless a curb or equivalent barrier is present which leads to sediment buildup on the street.
- To model a combination of mechanical broom and vacuum assisted street cleaning, it may require an analysis of several model runs depending on the timing of the mechanical and vacuum cleaning. If mechanical broom and vacuum cleaning occur at generally the same time (e.g. within two weeks of each other) then only the removal efficiency of the vacuum cleaning should be taken. If the municipality performs broom sweeping in the spring or fall and vacuum clean the remained of the year, calculate the combined cleaning efficiency using the following method:
  (A) Model the entire street cleaning program as if entire period is done by a mechanical broom cleaner.
  (B) Model just the period of time for vacuum cleaning (do not include the mechanical broom cleaning).
  (C) Model the same period as B) but with a mechanical broom.
  (D) The overall combined efficiency would be A + B – C.

WinSLAMM clarification

- WinSLAMM 9.4 and earlier versions of WinSLAMM result in double counting of pollutant removal for most treatment practices modeled in series. WinSLAMM 9.2 and subsequent versions contain warnings to help alert modelers of this issue. The modeler will need to make adjustments to ensure that the results do not include double credit for removal of the same particle size. PV & Associates has created a document titled 'Modeling Practices in Series Using WinSLAMM' which helps to guide a user as to whether and or how certain practices can be modeled in series and this document is available at: http://winslamm.com/Select_documentation.html
- In WinSLAMM 9.4 and earlier versions, when street cleaning is applied across a larger modeled area with devices that serve only a certain area within the larger modeled area, it is acceptable to first take credit for street cleaning across the entire larger area but then the treatment efficiency for other devices must be reduced by the efficiency of the street cleaning to prevent double counting.

P8 clarifications

- P8 does not account for scour and sediment resuspension. DNR requires that a wet basin with less than a 3-foot permanent pool have its treatment efficiency reduced. A basin with zero permanent pool depth should be considered to get zero credit for pollutant removal due to settling and a basin with 3 or more feet of permanent pool depth can be given the full pollutant removal efficiency credited by settling. The pollutant removal efficiency may be given straight-line depreciation such that a basin with a 1.5 foot-deep permanent pool would be eligible for 1/2 the pollutant removal efficiency that would be credited due to settling.
- A device that DNR gives no credit for pollutant removal may still be modeled if it is in series with other practices because of its benefit on runoff storage capacity that may enhance the treatment efficiency of downgradient treatment devices. To do so, turn the treatment efficiency off in P-8.
- P8 should be started an extra year or at least several months before the "keep dates", in order to allow the model to build up representative pollutant concentrations in wet basins.

CREATED:

10/20/14

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On behalf of the Storm Water Liaison Team

Date

10/20/14

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Date

APPROVED:

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10/21/14

Mary Anne Lowndes, Chief
Runoff Management Section

Date

Runoff Management Policy Management Team approved on 9/30/14 (date).

Attachment A: Technical Notes

Establishing relationships between multiple point and nonpoint pollutant sources and their influences on stream flow and water quality is complex. This process is often further complicated by the spatial scale under which TMDLs are developed. In order to help make TMDL development manageable, TMDLs are often developed using large scale modeling approaches that can be difficult to translate to the smaller scale often needed for implementation. For instance, loadings from “non-traditional” permitted MS4s (WDOT and county highways and UW campus systems) are often aggregated with the loadings of traditional MS4s (cities, villages and towns). This loss in resolution can result in inconsistencies in the WLA assignment necessitating a more thorough examination and possible reallocation of a portion of the WLA to non-traditional MS4 permittees.

In many cases where there is an existing TMDL that aggregated WLAs, the Wisconsin Department of Natural Resources (DNR) will need to review, and may need to reallocate WLAs to MS4 permittees. MS4 permittees will then need to conduct storm water management planning to evaluate their current pollutant loads relative to the TMDL reduction goals and create and implement a plan to meet the TMDL reductions.

Whether or not a municipality changes in size or land use, the allowable pollutant load that the receiving water can handle does not change. In the TMDL, the total allowable permitted MS4 load was determined by reach and typically was distributed uniformly across permitted MS4s on a unit area load basis. Since the permitted MS4 allowable unit area load is the same across a reachshed, MS4 WLAs can be reallocated between each other based on area. However, this reallocation must occur at the same time step that was used in the TMDL development process.

> Example: the Rock River TMDL generated allocations on a monthly basis so any reallocation of the WLA between sources must also proceed on a monthly basis. Simply adding the monthly allocations into an annual load and reallocating using an average annual unit load approach will result in a misrepresentation of the TMDL allocations. Analysis must be conducted on a monthly basis.

It is expected that the extent area that will need to be modeled for the MS4 WLA will be larger than that modeled under the s. NR 151.13 (developed urbanized area modeling analysis). This is because the s. NR 151.13 modeling area has many optional and excluded areas, whereas, the TMDL WLA analysis generally lumps all of these areas into the WLA. Also, s. NR 151.13 modeling was based on year 2004 developed area condition versus a TMDL which generally considers most recent development information.

In municipalities that have recently experienced significant growth, there may be a significant increase in urban area. In addition, in some instances the total actual permitted MS4 area within a reachshed is different than that used in the TMDL development process. Initially DNR believed that it would be easy to reallocate a portion of the non-point source LA to the permitted MS4s based on a unit load approach; however, the task can be more difficult than it initially appears. As explained above, the reallocation needs to be conducted using the same time step used in the development of the TMDL and at the same critical flow period used to develop the TMDL. In many cases, this critical flow period used in the development of the TMDL may not correspond with an average annual unit load.

<u>Reallocation Option</u>: In some cases, where TMDL analysis was conducted on an average annual basis it may be appropriate to adjust WLAs based on the acreage associated with each MS4 by reachshed. If reallocating WLAs and LAs within the same reach will still not be adequate to address significant area differences between actual and TMDL modeled reachsheds, DNR will consider on a case-by-case basis as to whether a reallocation between reaches is warranted. For example, an MS4 may collect runoff from a substantial amount of area from one reachshed and discharge it directly into another reachshed.

DNR would include reallocated WLAs in the next reissued permit of affected MS4s. MS4s would have the opportunity to comment and/or adjudicate reallocated WLAs when the permit is public noticed.

Attachment B: TMDL Compliance Summary

TMDL Reach Number & Name: 64 (Yahara River, Lake Mendota & Lake Monona)
MS4 TMDL Percent Reductions needed (no controls): 73% (TSS) & 68% (TP)*
MS4 Existing Controls Percent Reduction (year 2014): 32% (TSS) & 24% (TP)
Modeled MS4 Annual Average Pollutant Load (no controls): 433 tons/yr (TSS) & 124 lb/yr
Modeled MS4 Annual Average Pollutant Load (existing controls): 294 tons/yr (TSS) & 94 lb/yr

Benchmark (BM)	Description of BM Measure	Outfalls Affected by BM control	Affected Drainage Areas (as modeled)	Implementation Date	Measure Treatment Performance	BM % Reduction toward TMDL Reduction	MS4 Cumulative % Control (from no controls)
N/A	Existing control measures	All	All	Ongoing	TSS: 32% TP: 24%	TSS: 32% TP: 24%	TSS: 32% TP: 24%
1	Increased SWM control for Roadway Reconstruction	All	All	1/1/2020	TSS: 60% TP: 40% to MEP	TSS: 0.6% (annually) TP: 0.4% (annually) (30% TSS reduction over 50 years)	TSS: 35% TP: 26% (Accounts for 5 years of reduction)
2	Implement Enhanced Street Cleaning Program	001 003 004 008	1A - 1D 3A – 3K 4C – 4F 8D	1/1/2020	TSS: 12% TP: 8% (no redundant controls)	TSS: 9% TP: 6% (eff. reduced for redundant measures)	TSS: 44% TP: 32%
3	Implement Enhanced Yard Waste Collection Program	All	All	1/1/2021	TSS: 2% TP: 6% (no redundant controls)	TSS: 1.6% TP: 5% (eff. reduced for redundant measures)	TSS: 46% TP: 37%
4	Ordinance Revised – Higher Redevelopment Standard	All	All	1/1/2022	TSS: 60% TP: 40% to MEP	TSS: 0.6% (annually) TP: 0.4% (annually) (30% of TSS reduction over 50 years)	TSS: 49% TP: 39% (Accounts for 5 years of reduction)
5	Retrofit 2nd St. Basin into wet basin	002	B4	1/1/2023	TSS: 60% TP: 40%	TSS: 2% TP: 1% (only serves part of MS4)	TSS: 51% TP: 40%
6	New Wet Basin B15	005	5B - 5H	1/1/2023	TSS: 60% TP: 40% to MEP	TSS: 3% TP: 2% (only serves part of MS4)	TSS: 54% TP: 42%
7	Stabilize MS4 Drainage Ways between X and Y streets	003	3D and 3E	1/1/2024	20 tons/year sediment reduction	N/A Streambank & MS4 stabilization does not count against TMDL reduction requirement	TSS: 54% TP: 42%

* The TSS and TP percent reductions were taken from the Rock River Report's Appendix H and I. All other mass and percent reductions listed are fictitious and shown for example purposes only.

Attachment C: Rock River TMDL MS4 Annual Average Percent Reductions

Reach	Appendix H TP reduction from baseline of 27%	Appendix I TSS reduction from baseline of 40%	Calculated TP reduction from no-controls	Calculated TSS reduction from no-controls
2	29%	1%	48%	41%
3	82%	26%	87%	56%
20	14%	0%	37%	40%
21	10%	0%	34%	40%
23	12%	11%	36%	47%
24	11%	12%	35%	47%
25	64%	32%	74%	59%
26	35%	29%	53%	57%
27	0%	0%	27%	40%
28	1%	0%	28%	40%
29	51%	7%	64%	44%
30	0%	0%	27%	40%
33	29%	9%	48%	45%
34	81%	31%	86%	59%
37	66%	54%	75%	72%
39	0%	0%	27%	40%
45	13%	8%	36%	45%
51	14%	0%	37%	40%
54	61%	6%	72%	44%
55	68%	43%	77%	66%
56	19%	0%	41%	40%
59	54%	15%	66%	49%
60	29%	1%	48%	41%
61	6%	2%	31%	41%
62	70%	70%	78%	82%
63	14%	11%	37%	47%
64	47%	55%	61%	73%
65	49%	46%	63%	68%
66	37%	37%	54%	62%
67	0%	0%	27%	40%
68	52%	18%	65%	51%
69	72%	21%	80%	53%
70	1%	1%	28%	41%
71	29%	31%	48%	59%
72	0%	0%	27%	40%
73	51%	49%	64%	69%
74	17%	20%	39%	52%
75	15%	19%	38%	51%
76	75%	29%	82%	57%
78	4%	0%	30%	40%
79	54%	37%	66%	62%
81	20%	7%	42%	44%
83	37%	25%	54%	55%

Baseline reductions of TP = 27% & TSS = 40% were identified in the RR TMDL report on pages 25 & 27.
% TP reduction from no-controls = 27 + [0.73 x (% TP control in Appendix H)]
% TSS reduction from no-controls = 40 + [0.60 x (% TSS control in Appendix I)]
Reaches that are not listed above did not have a permitted MS4 within the reach.

Table developed by: Eric Rortvedt, DNR Stormwater Engineer
Dated: 9/16/2014

Attachment D: Lower Fox River Basin TMDL MS4 Annual Average Percent Reductions

Sub-Basin	TMDL Report TP reduction from baseline of 15%	TMDL Report TSS reduction from baseline of 20%	Calculated TP reduction from no-controls	Calculated TSS reduction from no-controls
East River	30.0%	40.0%	41%	52%
Baird Creek	30.0%	40.0%	41%	52%
Bower Creek	30.0%	40.0%	41%	52%
Apple Creek	30.0%	40.0%	41%	52%
Ashwaubenon Creek	30.0%	40.0%	41%	52%
Dutchman Creek	30.0%	40.0%	41%	52%
Plum Creek	30.0%	40.0%	41%	52%
Kankapot Creek	30.0%	40.0%	41%	52%
Garners Creek	63.1%	49.9%	69%	60%
Mud Creek	39.0%	28.5%	48%	43%
Duck Creek	30.0%	40.0%	41%	52%
Trout Creek	30.0%	40.0%	41%	52%
Neenah Slough	30.0%	40.0%	41%	52%
Lower Fox River Main Stem	30.0%	65.2%	41%	72%
Lower Green Bay	30.0%	40.0%	41%	52%

Baseline reductions of TP = 15% & TSS = 20%.
% TP reduction from no-controls = 15 + [0.85 x (% TP control in Lower Fox TMDL Report)]
% TSS reduction from no-controls = 20 + [0.80 x (% TSS control Lower Fox TMDL Report)]

Table checked by : Eric Rortvedt and Amy Minser, DNR Stormwater Engineers
Dated: 9/16/2014

BUREAU OF WATERSHED MANAGEMENT
PROGRAM GUIDANCE

RUNOFF MANAGEMENT POLICY AND MANAGEMENT TEAM
Storm Water Management Program

Wisconsin Department of Natural Resources
101 S. Webster Street, P.O. Box 7921
Madison, WI 53707-7921

Interim Municipal Phosphorus Reduction Credit for Leaf Management Programs

03-08-18
EGAD Number: 3800-2018-01

APPROVED:

Pam Biersach, Director
Bureau of Watershed Management

March 8, 2018
Date

A. Introduction/Statement of Problem Being Addressed

Permitted Municipal Separate Storm Sewer Systems (MS4s) will be subject to an annual average reduction for the discharge of a pollutant of concern to a surface water that has an approved TMDL. Recent studies indicate that phosphorus loads in stormwater in the fall of the year may be reduced by frequent leaf collection followed by street cleaning. Many municipalities are currently developing plans to meet TMDL limits and wish to include fall leaf management efforts in their plans.

While additional research is needed on a broader range of conditions and management methods, sufficient data is available to determine a preliminary phosphorus reduction credit for the most common municipal land use type. This credit is limited to the specific conditions and methods for which data is available. No credit has been quantified for other land uses, tree canopies, or collection programs but it is the Department's intent to expand the applicability of the guidance to more conditions and programs as additional studies are completed. This expansion is dependent on availability of funding for further data collection and evaluation.

B. Objectives

This guidance identifies a percent phosphorus reduction credit which may be taken by municipalities as part of TMDL planning and the conditions required to take that credit.

C. Background and Definitions

Urban trees provide a host of benefits to the residents and workers within a community, such as energy savings, aesthetics, airborne pollutant reduction, noise reduction, and providing bird habitat. Trees are also an important part of the hydrologic cycle. However, without adequate management of leaf litter, they also contribute to the nutrient loading in urban stormwater. Each tree species contributes a different amount of phosphorus to the stormwater, but since a diverse set of tree species is beneficial to long-term maintenance of a healthy canopy this effect is not being addressed at this time.

While there are many sources of phosphorus in urban stormwater, a primary contributor is organic detritus, especially in areas with dense overhead tree canopy (Duan et al, 2014; Hobbie et al, 2014; and Kalinosky et al, 2014). Measurement of end-of-pipe phosphorus concentrations has demonstrated that phosphorus loads in urban stormwater vary seasonally in certain medium density residential areas, with higher concentrations coinciding with leaf accumulation on streets (Selbig, 2016). As phosphorus discharges in stormwater can vary from year to year depending on timing of rainfall events, seasonal phosphorus loads were modeled over a twenty-year period with WinSLAMM to determine the average proportion that is discharged in the fall. From this information, it is estimated that on average 43% of the annual phosphorus load is discharged in the fall.

A variety of public works programs are already in place to collect leaves from the streets and properties in the fall, but until recently, little was known about the phosphorus reduction potential of different leaf collection programs. Over the last four years, the United States Geological Survey (USGS) conducted a study to characterize reductions of total and dissolved forms of phosphorus in stormwater through a municipal leaf collection and street cleaning programs in Madison, Wisconsin, USA. Some credit for phosphorus reduction is warranted based on the information.

To estimate the efficiency of leaf collection, leaves were collected three to four times at the test site and collected only once at the end of the fall at the control site. A small vehicle was used to push the leaves from the terrace into the street and then the leaves were pushed into garbage trucks. Within 24 hours of leaf collection, remaining leaf litter in the street was collected using mechanical street cleaners. Eight end-of-pipe phosphorus concentration measurements were compared at the test and control sites during the fall of 2016. Water quality data collected indicate that the collection and transfer method resulted in a 40% reduction of total phosphorus discharge in the fall at the test site versus the control site.

D. Guidance Content

A municipality may assume the specified reduction from no controls phosphorus loads provided all of the conditions are met. Further evaluation is required to determine how leaf collection methods may reduce loading to structural best management practices (BMPs) such as ponds. Therefore, this credit may not be taken in addition to phosphorus reductions from other BMPs in the drainage area at this time.

Transfer Plus Street Cleaning Method of Leaf Collection

Municipalities may assume 17% (40% reduction due to collection efforts x 43% of annual phosphorus load occurring in fall) Total Phosphorus annual load reduction for the leaf collection effort in the Medium Density Residential No Alleys (MDRNA) land use for this option. If the credit is desired for an area containing MDRNA and other land uses, the annual load reduction must be modified by the percent of the total phosphorus load from the area that is from the MDRNA. For example, the phosphorus load from a MDRNA might represent 60% of the load from the entire area. The new annual percent reduction for the area would be 10% (17% X 60%). Municipalities may apply the leaf credit to a subset of their MDRNA area if other BMPs are providing more phosphorus reduction for the remaining area. At this time credit for leaf collection is not available for other land uses or lower-density tree canopies. The Total Phosphorus annual load reduction for this option may be assumed if the following conditions are met:

1. Medium Density (2-6 units/acre) Residential (Single-family) land use without alleys. Medium Density Residential with alleys land use may be included if the alleys receive the same level of leaf collection and street cleaning as the streets.

2. Curb and gutter with storm sewer drainage systems and light parking densities during street cleaning activities.
3. An average of one or more mature trees located between the sidewalk and the curb for every 80 linear feet of curb. Where sidewalk is not present, trees within 15 feet of the curb may be counted toward tree cover. Generally, this equates to a tree canopy over the street (pavement only) of 17% or greater. Field investigations or aerial photography may be used to document the tree cover.
4. The municipality has an ordinance prohibiting residents from placement of leaves in the street and a policy stating that residents may place leaves on the terrace in bags or piles for collection.
5. Municipal leaf collection provided at least 4 times spaced throughout the months of October and November. Leaves may be pushed, vacuumed, or manually loaded into a fully enclosed vehicle, such as a garbage truck or covered dump truck. No leaf piles are left in the street overnight.
6. Within 24 hours of leaf collection, remaining leaf litter in the street must be collected using street cleaning machines, such as a mechanical broom or vacuum assisted street cleaner. A brush attachment on a skid steer is not an acceptable equivalent.

It is anticipated that additional scenarios will be added as research is completed.

E. References

Duan, S., Delaney-Newcomb, K., Kaushal, S.S., Findlay, S.E.G., Belt, K.T., 2014. Potential effects of leaf litter on water quality in urban watersheds. Biogeochemistry 121, 61–80. http://dx.doi.org/10.1007/s10533-014-0016-9.

Hobbie, S.E., Baker, L.A., Buyarski, C., Nidzgorski, D., Finlay, J.C., 2014. Decomposition of tree leaf litter on pavement: implications for urban water quality. Urban Ecosyst. 17 (2), 369–385. http://dx.doi.org/10.1007/s11252-013-0329-9.

Kalinosky, P., Baker, L.A., Hobbie, S., Bintner, R., Buyarksi, C., 2014. User support manual: estimating nutrient removal by enhanced street sweeping. Report to the Minnesota Pollution Control Agency (available at: http://larrybakerlab.cfans.umn.edu/files/2011/07/Kalinosky-et-al.-2014.-Street-Sweeping-Guidance-Manual-final-9-24-2014.docx, (accessed April 11th, 2016)).

Selbig, W.R., 2016, Evaluation of leaf removal as a means to reduce nutrient concentrations and loads in urban stormwater, Science of the Total Environment, 571, pp. 124 – 133. http://dx.doi.org/10.1016/j.scitotenv.2016.07.003

CREATED:

Amy Minser 3/8/18

Amy Minser, Stormwater Engineer
On behalf of the Storm Water Liaison Team

Date

APPROVED:

Mary Anne Lowndes 3/9/18

Mary Anne Lowndes, Chief
Runoff Management Section

Date

Runoff Management Policy Management Team approved on February 1, 2018.
Division Administrator approved March 6, 2018.

Department of Public Works
Engineering Division
Robert F. Phillips, P.E., City Engineer

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Kathleen M. Cryan

Principal Engineer 2
Christopher J. Petykowski, P.E.
John S. Fahrney, P.E.

Principal Engineer 1
Christina M. Bachmann, P.E.
Mark D. Moder, P.E.
Janet Schmidt, P.E.
James M. Wolfe, P.E.

Facilities & Sustainability
Bryan Cooper, Principal Architect

Mapping Section Manager
Eric T. Pederson, P.S.

Financial Manager
Steven B. Danner-Rivers

December 19, 2019
1:00 PM

City Engineering Offices
210 Martin Luther King Jr Blvd
Room 115
Madison, WI 53575

MEETING MINUTES – CITY OF MADISON/WDNR MS4 MEETING

Topics

1. Delineating riparian areas

The currently identified streams are acceptable; the streams that were identified are considered perennial, navigable streams.

The City may choose to add non-perennial, navigable streams. However, these streams cannot be identified upstream of an existing, online, stormwater control measure.

The City may also choose to identify internal drained areas with no discharge below the 10-year TMDL record of rain utilized for the TMDL.

The City will review the non-perennial, navigable streams and the internally drained areas within the City. Based on the results of the review, the City may revise the figure. The finalized figure will be provided to the WDNR for concurrence.

2. City of Madison custom Standard Land Use files – for MS4/TMDL modeling

The City provided an overview of the calculations to create standard land uses where streets are their own standard land use and the non-street areas are in a separate standard land use. A sensitivity analysis was conducted to determine the difference in results between the custom files and the original standard land uses that come with the WinSLAMM program. The differences in runoff volume are essentially negligible. The differences in pollutant loading are expected based on the way the street standard land uses were created.

The discussion resulted in Eric being comfortable with the approach. The City will draft a document describing the approach and results and send to the WDNR for concurrence.

3. City of Madison private practices maintenance ordinance

The City of Madison is updating its stormwater ordinance. The City asked for review of the section regarding maintenance of private practices for purposes of adding needed revisions to the current ordinance update.

Eric did a cursory review of the current language and thought it was acceptable.

Following the meeting, Eric provided potential revisions to the ordinance. The City will review the revisions and incorporate where appropriate.

4. MS4 vs. TMDL modeling

A discussion was held regarding where the City could put its efforts for purposes of the stormwater modeling update due March 2021. The City's current model for MS4 permit compliance with the Developed Urban Area Standard indicates the City is above 20% reduction of TSS on a city-wide basis (the documented results indicate the City is achieving 35.9% TSS reduction as of December 2017).

Current legislation requires permitted municipalities achieve 20% reduction; the provision for achieving 40% TSS reduction is not currently enforceable by the WDNR and is not expected to become enforceable in the foreseeable future.

The conclusion of the discussion is that because the City is above 20% TSS reduction, and very close to 40% TSS reduction, the City should keep the current modeling showing the results of the Developed Urban Area Standard, but not spend its effort to update it. Effort should be focused on updating the modeling for compliance with the TMDL.

Greg asked a question regarding if credits can be purchased for the portion of the loading reduction deficit below 40% TSS reduction. Eric confirmed, via email after that meeting, that the City may not purchase its required TSS control credit for the amount short of the 40% goal via adaptive management. Only the credit for pollution reduction above the 40% required by the TMDL may be purchased via adaptive management. Adaptive management is managed by pounds of TP, not TSS, and the TMDL for both criteria is "accepted" as being met provided the targeted pounds of TP are purchased.

From: Fries, Gregory
Sent: Friday, February 29, 2008 2:47 PM
To: Eric Rortvedt
Cc: Nelson, Larry; Dailey, Mike; Peterson, Cami L - DNR; Lowndes, MaryAnne - DNR
Subject: RE: DNR Comments on City of Madison MS4 Treatment Analysis

Eric,

See my notes below (CAPS FOR CLAIRITY ONLY):

Thanks for taking the time to discuss this with me.

Greg

-----Original Message-----
From: Rortvedt, Eric - DNR [mailto:Eric.Rortvedt@Wisconsin.gov]
Sent: Friday, February 29, 2008 1:57 PM
To: Fries, Greg
Cc: Nelson, Larry; Dailey, Mike; Peterson, Cami L - DNR; Lowndes, MaryAnne - DNR
Subject: DNR Comments on City of Madison MS4 Treatment Analysis

Hello Greg,

I have reviewed the City of Madison MS4 treatment analysis to demonstrate that the MS4 provides a 20% reduction in TSS discharged to surface waters of the state as compared to no controls. Based on my review of the September 19, 2007 letter, supporting information and my discussions with you, I have the following comments:

1. Treatment Basin Efficiency - I agree that the submitted analysis is adequate to demonstrate that greater than 20% TSS control is being achieved by the City of Madison's MS4. However, a refined modeling analysis to determine wet pond TSS control will be needed to demonstrate compliance with the existing urban area TSS standard of 40% control (year 2013). The simplified methodology that was used to credit wet pond performance for ponds that existed prior to about year 2000 is not acceptable for the 40% control analysis. It is my understanding that the City will be compiling existing data and gathering additional survey information in order to appropriately model each wet basin where credit will be taken.

AS I DISCUSSED WITH YOU YESTERDAY - THIS IS NOT A PROBLEM WE ANTICIPATED COMPLETING SLAMM ANALYSIS FOR EACH OF OUR 550+ WATERSHEDS AND THIS SHOULD ADDRESS THIS ISSUE.

2. Credit for stormwater treatment within waters of the state - The City has identified the need to establish whether credit for stormwater treatment may be taken within certain waters of the state. In particular, it was indicated that the City has documentation that the Vilas Lagoons, Acewood Pond and Odana Pond were excavated and/or modified to provide stormwater management. Section NR 151.003, Wis. Adm. Code, acknowledges that storm water practices that serve existing developed areas may be located within navigable surface waters and wetlands, provided that construction of such practices is (or was at the time) allowed under all applicable federal, state and local regulations, such as ch NR 103, Wis. Adm. Code and ch. 30, Stats. Please provide me with documentation that shows when these ponds were constructed and or modified to provide stormwater management benefits. Also, please explain and or provide documentation as to whether any maintenance of these ponds as stormwater treatment practices has occurred in the past or is anticipated in the future.

I WILL RESEARCH AND PROVIDED YOU THE DOCUMENTATION I HAVE AVAILABLE.

3. Minor correction - I happen to notice that the street texture
between the existing and proposed model runs for the Apts_07_***.dat files changed. Since the other files kept the same texture between conditions, I assume that this was a typo. You do not need to send me any correction for this. Please adjust accordingly for future modeling.

NO PROBLEM - THIS WILL BE ADDRESSSED

4. Suggestion - The spreadsheet summarizing the results is very
well organized and already displays a lot of information. However, I would find it helpful to also have a column for percent TSS control for the treatment system used as part of the overall summary. Please consider adding this for future submittals.

NO PROBLEM - THIS WILL BE ADDRESSED

Please send me the information requested under item 2 in order to determine whether any of these ponds can be credited as a stormwater treatment practice.

Thank you for your cooperation. If you have any questions, feel free to contact me.

P Eric S. Rortvedt, P.E.
Water Resources Engineer
South Central Region
Wisconsin Department of Natural Resources
(*) phone: (608) 273-5612
(*) fax: (608) 275-3338
(*) e-mail: Eric.Rortvedt@wisconsin.gov

Burger, Caroline

From: Rortvedt, Eric - DNR <Eric.Rortvedt@wisconsin.gov>
Sent: Friday, January 10, 2020 2:59 PM
To: Burger, Caroline
Cc: Striegl, Lauren; Schmidt, Janet; Fries, Gregory; OBrien, Joanna; Breidenbach, Richie; Bannerman, Roger T - DNR
Subject: RE: December 19, 2019 City of Madison MS4 Modeling Discussion - Meeting Minutes

Caroline,

I read through the meeting minutes and they look fine to me.

Thanks

Eric Rortvedt, P.E.
Phone: (608) 273-5612
Eric.Rortvedt@Wisconsin.gov

From: Burger, Caroline <CBurger@cityofmadison.com>
Sent: Tuesday, January 07, 2020 3:15 PM
To: Rortvedt, Eric - DNR <Eric.Rortvedt@wisconsin.gov>
Cc: Striegl, Lauren <LStriegl@cityofmadison.com>; Schmidt, Janet <jschmidt@cityofmadison.com>; Fries, Greg <gfries@cityofmadison.com>; OBrien, Joanna <jobrien@cityofmadison.com>; Breidenbach, Richie <RBreidenbach@cityofmadison.com>; Bannerman, Roger T - DNR <Roger.Bannerman@wisconsin.gov>
Subject: December 19, 2019 City of Madison MS4 Modeling Discussion - Meeting Minutes

Hi Eric,

Attached are the meeting minutes from our meeting on December 19, 2019.

Please review and let me know if there are needed revisions.

Thank you,

Caroline Burger, PE, ENV SP
Engineer 3
Engineering Division
City-County Building, Room 115
210 Martin Luther King, Jr. Blvd.
Madison, WI 53703
☎ Desk: 608-266-4913
✉ cburger@cityofmadison.com

-----Original Appointment-----
From: Striegl, Lauren <LStriegl@cityofmadison.com>
Sent: Tuesday, December 3, 2019 8:50 AM
To: Striegl, Lauren; Eric Rortvedt - WDNR (eric.rortvedt@wisconsin.gov); Fries, Gregory; Schmidt, Janet; OBrien, Joanna; Breidenbach, Richie; Burger, Caroline; 'Bannerman, Roger T - DNR'
Subject: City of Madison MS4 Modeling Discussion
When: Thursday, December 19, 2019 1:00 PM-3:00 PM (UTC-06:00) Central Time (US & Canada).
Where: Conf Rm CCB 115 - Engineering Staff Only

Please see the attached agenda for tomorrow's meeting. I will more than likely be home with a sick kid, so Caroline has awesomely volunteered to MC tomorrow!

This meeting is scheduled to occur at City of Madison Engineering offices (210 MLK Jr Blvd), although it can be changed if desired ☺. We will cover Madison SLU modifications, as well as Madison's streams and rivers network. Our team is working on a map of lakes, rivers and streams within the City's MS4. **We will provide this map to Eric prior to the meeting for his review.**

From:	Eric Rortvedt
Sent:	Tuesday, August 4, 2020 1:24 PM
To:	Burger, Caroline
Cc:	Striegl, Lauren; Fries, Gregory; Schmidt, Janet; Gaebler, Phil
Subject:	RE: City of Madison - TMDL Modeling - Citywide Land Use Approach - Asking for Concurrence

Caroline,

I have reviewed the proposed strategy and justification you have outlined below and I agree that it seems to be an appropriate strategy. You have may concurrence.

Sorry my review took as long as it did. It's been a busy year.

Eric Rortvedt, P.E.
Phone: (608) 273-5612 (voice mail only)
Eric.Rortvedt@Wisconsin.gov

From: Burger, Caroline <CBurger@cityofmadison.com>
Sent: Tuesday, July 07, 2020 1:15 PM
To: Rortvedt, Eric - DNR <Eric.Rortvedt@wisconsin.gov>
Cc: Striegl, Lauren <LStriegl@cityofmadison.com>; Fries, Greg <gfries@cityofmadison.com>; Schmidt, Janet <jschmidt@cityofmadison.com>; Gaebler, Phil <PGaebler@cityofmadison.com>
Subject: City of Madison - TMDL Modeling - Citywide Land Use Approach - Asking for Concurrence

Hi Eric,

How are you?

As you are aware, the City of Madison is currently updating its TMDL modeling using WinSLAMM. We met in December to discuss a few items. One of those items was how the City is going to approach delineating the WinsLAMM standard land use City-wide. At the meeting, we discussed creating some Madison-specific standard land uses – ones that are only streets and ones that exclude streets. The purpose was to take advantage of our parcel-based standard land use designations and also appropriately account for the streets. The attached is a summary of that discussion and your response.

As we started creating the final set of Madison-specific standard land use files, we found we had to make numerous assumptions. The parcel land use is only for the parcel – the remainder is the right-of-way. The right-of-way includes more than just streets; it also includes sidewalks, terraces, and driveways. The assumptions we needed to create seemed to compound themselves in such a manner that we were not confident the resulting Madison-specific standard land uses would be reasonable for the right-of-way.

Therefore, we tried a second approach. This is the approach we'd like to use for this round of TMDL modeling.

The City has attributed all the parcels in the City with the WinSLAMM specific standard land use. The City has also categorized all right-of-way as Commercial, Residential, Industrial, Institutional, and Other Urban – the WinSLAMM major land uses. To categorize the streets in this manner, they were split down the centerline and, if necessary, split along parcel lines and categorized based on the land use of the adjacent parcel(s). This resulted in a full coverage of polygons in a GIS feature class for the entire City.

This next step is the one we'd like your thoughts on. The final step we took was to then assign the right-of-way the standard land use category for the adjacent parcel. So, for example, if the right-of-way is categorized as Commercial, and the parcel adjacent to the right-of-way is Strip Mall Commercial, then that right-of-way was categorized Strip Mall commercial.

Where there were numerous types of standard land uses adjacent to a right-of-way polygon with the same WinSLAMM major land use, that right-of-way polygon was assigned the parcel standard land use with the largest coverage. For example, in a residential neighborhood, you may have parcels categorized as Low Density Residential, Medium Density Residential No Alleys, and High Density Residential No Alleys all adjacent to the same Residential right-of-way polygon. If the Medium Density Residential No Alleys parcels had the largest percentage of coverage adjacent to that Residential right-of-way polygon, the Residential right-of-way polygon was assigned as Medium Density Residential No Alleys.

We feel comfortable with this assignment for three reasons:

1) We did a check to compare the standard land use breakdown of the area of only the parcels against the standard land use breakdown of the area of the entire City with the newly-assigned right-of-way. For all land uses, except MDRNA, Park, and Open Space, the breakdown was essentially the same. MDRNA, Park, and Open Space were off by a couple percentages. Given the accuracy of the model, we thought this deviation was acceptable.
2) In talking with Dr. Pitt, right-of-way loading doesn't distinguish between individual standard land uses; it takes on the predominant standard land use loading as traffic and people move through it.
3) The City is currently under contract with the University of Northern Iowa to delineate the impervious area within the City and then categorize all areas of the City with its WinSLAMM source area – ie roof, sidewalk, landscaped, etc. That work will not be finished until this fall/winter – not in time for this round of TMDL modeling. BUT, we will be using it for the next TMDL modeling update.

Please let us know your thoughts on this and if it is an acceptable way to proceed.

Thank you,

Caroline Burger, PE, ENV SP
Engineer 3
Engineering Division
City-County Building, Room 115
210 Martin Luther King, Jr. Blvd.
Madison, WI 53703
☎ Desk: 608-266-4913
✉ cburger@cityofmadison.com

Please note some City offices currently closed to the public due to COVID-19, but most staff is still working. See our website (link below) for the most up to date information on how to best continue working with each department.
https://www.cityofmadison.com/health-safety/coronavirus/service-updates

Striegl, Lauren

From: Eric Rortvedt
Sent: Sunday, August 9, 2020 7:20 PM
To: Striegl, Lauren
Subject: RE: City of Madison TMDL/MS4 - Navigable Water Riparian Areas
Attachments: CityofMadison_LakesRiversStreams.pdf

Lauren,

I have reviewed the attached map and I agree that all the blue stream sections are navigable waters and that any runoff draining directly to them without passing through a City of Madison storm sewer may be removed from the MS4 TMDL analysis. If there was a City of Madison owned or operated storm water treatment facility within a blue stream section, then the drainage area above that treatment facility should be included in the City of Madison MS4 TMDL analysis.

Note: The Starkweather Creek section that is along the western side of the Dane County airport appears to have been relocated between 2005 and 2010 based on aerials. The current stream location is somewhat to the west of the blue line which was the prior location of the stream.

If you have any other questions, please let me know. I promise, I will be much quicker to respond to follow up questions. I also can be reached at home via cell at [redacted].

Eric Rortvedt, P.E.
Phone: (608) 273-5612 (voice mail only)
Eric.Rortvedt@Wisconsin.gov

From: Striegl, Lauren <LStriegl@cityofmadison.com>
Sent: Thursday, July 02, 2020 9:44 AM
To: Rortvedt, Eric - DNR <Eric.Rortvedt@wisconsin.gov>
Subject: City of Madison TMDL/MS4 - Navigable Water Riparian Areas

Hi Eric,

I hope that you're navigating (and surviving!) this pandemic well, or at least as well as possible. I wanted to follow-up on a remaining item from Madison's TMDL/MS4 modeling meeting with you from last December. If you recall, we had left it that Madison would develop and provide a figure showing the navigable waters associated with riparian areas that we intended to remove from the TMDL modeling area within City boundaries. Attached please find the figure that we created – we hoped that you would be willing to look it over and confirm that this looks acceptable to you.

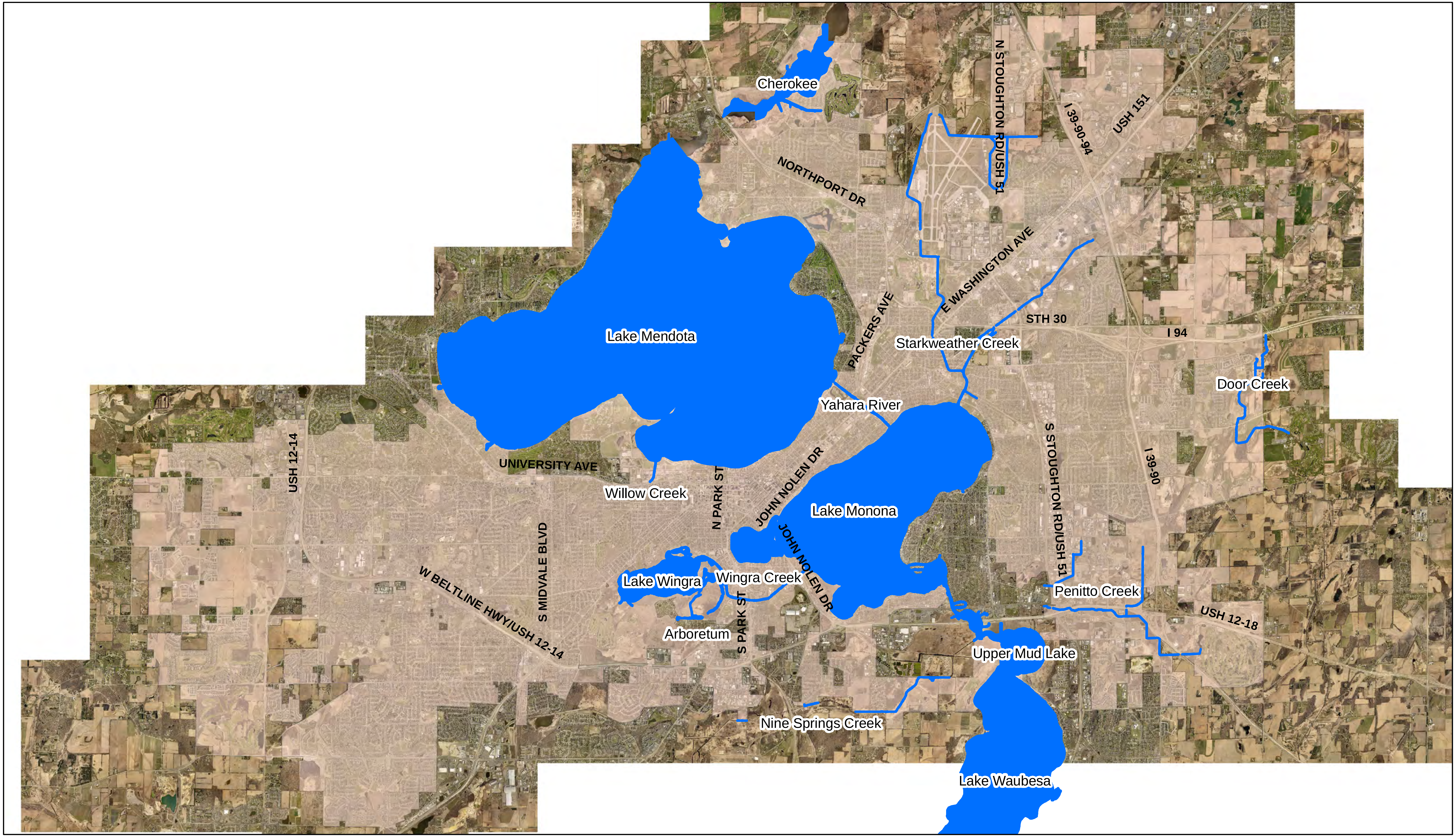
Thanks much, and stay healthy! Also, because I'm curious – I've been semi-following the drama encompassing the MLB season this year. Is your son still in the minors? If so, I'm guessing he won't be playing this year ☹. I'm sure he's disappointed, but it certainly seems better to err on the side of safety this year. What a mess 2020 has been ☹.

Lauren

Lauren Striegl, PE
(she/her/hers)
Engineer
City of Madison Engineering Division

210 Martin Luther King Jr. Blvd, Room 115
Madison, WI 53703

Navigable Waters Associated with Riparian Areas to Be Removed from TMDL Area
City of Madison, WI
May 13, 2020



From:	Eric Rortvedt
Sent:	Thursday, September 3, 2020 12:19 PM
To:	Fries, Gregory; Burger, Caroline
Cc:	Schmidt, Janet; Striegl, Lauren
Subject:	RE: Confirmation to use SCMs in Waters of the State for credit towards the TMDL?
Attachments:	RE: DNR Comments on City of Madison MS4 Treatment Analysis

Hi all,

Item 2 in the attached email is somewhat related to this issue.

Section NR 151.003(2)(d), Wis. Adm. Code, specifies that storm water treatment credit may be taken for existing development, infill and redevelopment areas provided *"The BMP was constructed, contracts were signed or bids advertised and all applicable permits were received prior to January 1, 2011."*
Any BMP placed within a navigable water of the state that do not meet one of the conditions under s. NR 151.003(2)(d), are not allowed to be used for generating storm water treatment credit under NR 151. However, this section pertains to treatment credit under NR 151 and not necessarily for storm water TMDL compliance. NR 151:
http://docs.legis.wisconsin.gov/code/admin_code/nr/100/151.pdf

Storm water treatment credit may be taken for a storm water facility under NR 151 and for TMDL compliance that meets either of the following:

a) In a wetland where proper wetland permits have been obtained.
b) In an artificial waterbody, whether navigable or non-navigable, where all proper permits have been obtained. See s. 281.16(2)(c) stats.,

I need to get internally DNR concurrence on taking TMDL credit for a legally permitted storm water facility, such as the Willow Creek facility, that was installed after 2011 in a non-artificial water of the state. I will get back to you on this issue.

Eric Rortvedt, P.E.
Phone: (608) 273-5612 (voice mail only)
Eric.Rortvedt@Wisconsin.gov

From: Fries, Gregory <GFries@cityofmadison.com>
Sent: Friday, August 28, 2020 8:29 AM
To: Burger, Caroline <CBurger@cityofmadison.com>; Rortvedt, Eric - DNR <Eric.Rortvedt@wisconsin.gov>
Cc: Schmidt, Janet <jschmidt@cityofmadison.com>; Striegl, Lauren <LStriegl@cityofmadison.com>
Subject: RE: Confirmation to use SCMs in Waters of the State for credit towards the TMDL?

Thanks Caroline.

Eric – the context of our discussion was for the Willow Creek Project and that because it was in a water of the state as an online system we could not take credit under NR-151 but could take credit for the TMDL (at least that is how I remember it ☺).

Thanks

Greg

From: Burger, Caroline <CBurger@cityofmadison.com>
Sent: Friday, August 28, 2020 8:25 AM
To: Eric Rortvedt <eric.rortvedt@wisconsin.gov>
Cc: Fries, Gregory <GFries@cityofmadison.com>; Schmidt, Janet <jschmidt@cityofmadison.com>; Striegl, Lauren <LStriegl@cityofmadison.com>
Subject: Confirmation to use SCMs in Waters of the State for credit towards the TMDL?

Hi Eric,

The City of Madison is looking for confirmation on an approach. Greg indicates that in one of your many conversations, you wrote in an email that water bodies that are considered Waters of the State – such as Odana Golf Course Ponds – could be used towards credit for the TMDL, but not for NR151. He searched for the famous email and could not find it. Therefore, I am reaching out to you to confirm that.

We are finalizing the water bodies/ponds we are using for our TMDL analysis.

Can you please confirm?

Thank you,

Caroline Burger, PE, ENV SP
Engineer 4
Engineering Division
City-County Building, Room 115
210 Martin Luther King, Jr. Blvd.
Madison, WI 53703
☎ Desk: 608-266-4913
✉ cburger@cityofmadison.com

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https://www.cityofmadison.com/health-safety/coronavirus/service-updates

From: Eric Rortvedt
Sent: Monday, December 14, 2020 4:38 PM
To: Burger, Caroline
Cc: Striegl, Lauren; Gaebler, Phil; Fries, Gregory; Schmidt, Janet; Breidenbach, Richie; Jorgensen, Emily
Subject: RE: Street Cleaning

Caroline,

Your summary does correctly capture the approach we discussed. I look forward to reviewing the results of the 1- and 5-year model runs to help determine a relationship to apply to the other watersheds with out-of-memory errors.

Warm regards,

Eric Rortvedt, P.E.
Cell: (608) 438-9087
Phone: (608) 273-5612 (voice mail only)
Eric.Rortvedt@Wisconsin.gov

From: Burger, Caroline <CBurger@cityofmadison.com>
Sent: Monday, December 14, 2020 2:56 PM
To: Rortvedt, Eric - DNR <Eric.Rortvedt@wisconsin.gov>
Cc: Striegl, Lauren <LStriegl@cityofmadison.com>; Gaebler, Phil <PGaebler@cityofmadison.com>; Fries, Greg <gfries@cityofmadison.com>; Schmidt, Janet <jschmidt@cityofmadison.com>; Breidenbach, Richie <RBreidenbach@cityofmadison.com>; Jorgensen, Emily <EJorgensen@cityofmadison.com>
Subject: Street Cleaning

Hi Eric,

Thank you for taking the time to talk today. This email summarizes our discussion. Please let me know if you agree that it reflects what we spoke about, or, if you have modifications.

The City is building WinSLAMM models to calculate its existing pollution reduction for purposes of compliance with its MS4 permit. The City is broken up into approximately 50 sub-watersheds with a WinSLAMM model being created for each sub-watershed.

Due to the size of some of the models (the combination of land uses, control practices, rainfall, and pollutants), we are getting out-of-memory errors. This occurs when the processing required for the models is overwhelmed by the amount of data in the model. PVA is working on addressing this issue separately, but will not be done with the solution until after the modeling is due.

To help alleviate this error, the City also contracted with PVA to create a component in the model that would allow linking the output of one model to the input of another. This new component will help with most of the errors.

However, we believe we may have a couple sub-watersheds where the model is still too large. We have found that when we remove street cleaning, the model errors no longer exist. Therefore, we would like to develop an approach that accounts for street cleaning for the large areas while keeping the models small enough that we do not get out of memory errors. The following is the approach we discussed:

1. Run all the models that do not get the out-of-memory error for both the 1-year rainfall file and the 5-year rainfall file, with and without street cleaning.
2. Plot the relationship between the 1-year and 5-year pollution reduction.
3. Develop a relationship between the 1-year and 5-year pollution reduction, with and without street cleaning.
4. For the models where the out-of-memory error occurs for the 5-year rainfall file, apply the developed relationship.

Once we have developed the relationship, we will provide it to you for your review before we apply it to the models in question.

Thank you,

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Striegl, Lauren

From: Rortvedt, Eric - DNR <Eric.Rortvedt@wisconsin.gov>
Sent: Wednesday, January 3, 2018 11:01 AM
To: Striegl, Lauren
Cc: Fries, Gregory; Gaebler, Phil; OBrien, Joanna
Subject: RE: City of Madison MS4 Modeling - Private Practice Guidance

Lauren,

Your proposed approach described below to take an additional TSS reduction credit as the difference is acceptable. I believe that this approach should work for TP as well.

Note: If one of the treatment practices were a device that is modeled to infiltrate then we should evaluate whether this approach is still valid/reasonable.

Eric S. Rortvedt, P.E.
Phone: (608) 273-5612

From: Striegl, Lauren [mailto:LStriegl@cityofmadison.com]
Sent: Wednesday, January 03, 2018 10:49 AM
To: Rortvedt, Eric - DNR
Cc: Fries, Gregory ; Gaebler, Phil ; OBrien, Joanna
Subject: City of Madison MS4 Modeling - Private Practice Guidance

Hi Eric,

Thanks again for looking over my drawing yesterday and talking this morning with me about how to deal with private practices. As discussed, I wanted to follow up with a synopsis email so that everyone is on the same page (and so I don't forget).

To recap, the City of Madison is hoping to avoid putting private stormwater treatment practices into our WinSLAMM models due to their relatively small size as well as WinSLAMM's instability with large models. To that end, the City is looking for guidance on how to account for these practices "on the back end," preferably in a spreadsheet, after modeling the larger treatment practices and overall watersheds in WinSLAMM.

The primary concern that we discussed in our phone call was the tracking of particle sizes – we don't want to "double-count" larger particles. Therefore, we agreed on a fairly straightforward approach. Let's say a particular private practice (PP) obtains 80% TSS removal, but the parcel (Shopping Mall) that it treats is located in a watershed that drains to a large pond (MegaPond). MegaPond provides 40% TSS control to the whole contributing watershed. Instead of the City of Madison taking credit for 80% of PP's incoming TSS load, we would take 80% - 40% = **40%** credit of the load from Shopping Mall in addition to the reductions calculated by WinSLAMM for MegaPond.

In the rare event that a private practice has calculated TP load reductions, the City would use the same approach to calculate TP load reductions in PP. If PP reduces the TP load from Shopping Mall by 67%, and MegaPond provides 27% TP reduction, then in addition to the reductions from MegaPond, the City of Madison would claim credit for 67% - 27% = **40%** TP. I understand that the TP situation is more complex than the TSS situation, so I'm certainly open to revisiting this particular calc.

If you could confirm the methodology proposed for TSS, and offer your thoughts on the methodology proposed for TP, that would be awesome. Thanks so much for your time on this!

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