Appendix M

Northeast Lakeshore TMDL

Total Maximum Daily Loads for Total Phosphorus and Total Suspended Solids

Water Quality Trading

SnapPlus Analysis

Edge of Field Targets

CONTENTS

LIST OF TABLES

1 INTRODUCTION AND NEED

TMDL load allocations (LAs) for agricultural sources can be challenging to incorporate into TMDL implementation planning efforts due to 1) the dependence of nonpoint source pollutant loading on weather, soil, and land management practices that vary widely in space and time; and 2) conceptual differences between watershed models used for TMDL development and field-scale models used by agricultural producers to estimate nutrient and sediment losses under alternative management practices.

WDNR has developed a framework for communicating agricultural LAs to translate results of the watershed model used for TMDL development to field-scale model outputs that are better understood by the agricultural community, referred to here as "targets". The framework serves as a tool for agricultural producers to evaluate BMPs to implement on their own fields in order to meet TMDL targets. This section describes target phosphorus and sediment yields for agricultural sources that are comparable to outputs from SnapPlus (Soil Nutrient Application Planner), the standard nutrient management planning software used by Wisconsin agricultural producers.

SnapPlus allows evaluation of BMPs and can differentiate between total phosphorus (TP) and dissolved reactive phosphorus (DRP). TP is a measurement of both the amount phosphate that is attached to soil particles (sediment) as well as the amount of DRP. Over time the phosphate that is bound to the sediment can dissolve and become more available for aquatic plant and algae growth. In this form, it is called DRP. BMPs should target reductions in both TP and DRP. Some BMPs that reduce edge-of-field TP loss can result in an increase in DRP loss so considerations should be made to factor in TP and DRP when selecting BMPs. For example, many studies have shown a decrease in TP but an increase in DRP under no-till. This points to the importance of whole field management and utilization of complementary BMPs. For example, nutrient management (Wisconsin NRCS Conservation Practice Standard 590) should serve as the foundation for supporting practices such as no-till, conservation tillage, cover crops, and filter strips.

2 HOW TO USE THIS APPENDIX

SnapPlus is Wisconsin's nutrient management planning software. The program helps farmers make the best use of their on-farm nutrients, as well as make informed and justified commercial fertilizer purchases. By calculating potential soil and phosphorus runoff losses on a field-by-field basis while assisting in the economic planning of manure and fertilizer applications, SnapPlus provides Wisconsin farmers with a tool for protecting soil and water quality.

Producers can use SnapPlus software to verify whether their management plans are meeting TMDL targets for phosphorus and sediment yields. First, producers need to determine the appropriate target phosphorus and sediment yields defined by the TMDL for their location. To allow for flexibility in planning, this appendix provides target phosphorus and sediment yields for two watershed scales: TMDL subbasins and HUC12s. Each watershed scale divides the study area into discreet subunits, but the scales differ in their exact drainage boundaries.

Producers can determine which TMDL subbasin or HUC12 their fields are located within using maps provided in Section 4. If these figures are too coarse for locating farm fields, the NEL

TMDL theme of the interactive Watershed Restoration Viewer can be used instead (type "watershed restoration viewer" into the search bar at http://dnr.wi.gov) by clicking the "Layer" tab on the left-hand panel, then locate the layer called "TMDL Subbasins" under "Specific TMDLS, Northeast Lakeshore". Similarly, users can identify which HUC12 their field is located within by using the interactive Water Condition Viewer (type "water condition viewer" into the search bar at http://dnr.wi.gov) by clicking the "Layer" tab on the left-hand panel, then locate the layer called "12-digit HUCs" under "Water Resources, Hydrologic Delineations, Federal Hydrologic Unit Codes (HUC)". After locating their TMDL subbasin or HUC12, producers can refer to the tables in this appendix to determine the appropriate target SnapPlus phosphorus and sediment yields for their location that correspond to the TMDL agricultural LAs.

Producers can then use SnapPlus to create or modify a database for each field within their farm to: (a) reflect actual (not planned) cropland practices (e.g., tillage, crop rotation, nutrient applications) they have implemented; and (b) ensure all fields within the SnapPlus "Fields" menu use the predominant soil as the critical soil type (within SnapPlus, the critical soil type is used to generate soil and P loss estimates). Once SnapPlus reflects (a) and (b), producers can use SnapPlus reports to compare each crop rotation they manage to the phosphorus and sediment targets. If annual average phosphorus and sediment losses for a given crop rotation exceed the targets in the tables in this appendix, then that crop rotation exceeds the TMDL agricultural LA, and additional reductions are needed.

2.1 Water Quality Trading and TMDLs

Water Quality Trading (WQT) may be used by Wisconsin Pollutant Discharge Elimination System (WPDES) permit holders to demonstrate compliance with water quality-based effluent limitations (WQBELs). Generally, WQT occurs when a point source facing relatively high pollutant reduction costs compensates another party to achieve less costly pollutant reduction that yields the same or greater water quality benefit. In other words, WQT provides point sources with the flexibility to offset their pollutant load reductions by providing financial resources to reduce pollutants from other sources in the watershed. Point sources can receive credit for reducing phosphorus and sediment loss on agricultural fields (WDNR, 2020).

2.1.1 Credit Threshold

The credit threshold denotes the level of pollutant loading below which reductions need to be made to generate credits; however, there is an exception for interim credits. When trading in a watershed with U.S. EPA approved TMDLs, the credit threshold ensures that the assumptions and modeling supporting the allocations contained in the TMDL are maintained.

For nonpoint sources, the credit threshold generally corresponds with the assigned load allocation or corresponding percent reduction for that watershed, agricultural field, or nonpoint source. Section 5.0 of this appendix includes the edge-of-field targets (Target TP Load and Target TSS Load) which serve as the basis for calculation of the credit threshold. Actual credit thresholds will be inserted into the WQT Guidance once the TMDL is approved by U.S. EPA.

For permitted MS4s, the credit threshold corresponds to the wasteload allocations and the corresponding percent reduction assigned in a U.S. EPA approved TMDL as well as requirements contained in s. NR 151.13 (2)(b)1.b, Wis. Adm. Code..

2.1.2 Delivery Factor

After the load reduction has been estimated, a trade ratio must be applied to calculate credits available for WQT (WDNR, 2020). All WQT have some margin of uncertainty associated with them and therefore require applying a trade ratio to all phosphorus and TSS reductions generated. The trade ratio adjusts the number of WQT credits needed to account for uncertainties or potential inaccuracies associated with the quantification and implementation of BMPs associated with the trade as well as delivery of pollutants through the hydrologic system.

The delivery factor is a component of the overall trade ratio and accounts for the distance between trading partners and the impact that the various processes, that occur over this distance, has on the fate and transport of the traded pollutant in surface waters. For the NEL TMDL, delivery factors do not need to be applied because the TMDL implicitly accounts for the fate and transport mechanisms through the modeling and analysis that was performed as part of the TMDL analysis.

3 MODELING METHODS

3.1 TMDL Baseline Loads, Allocations, and Reductions

Pollutant LAs for nonpoint sources are expressed as average daily and annual loads (pounds) of TP and TSS that result in attainment of surface water quality standards in each TMDL subbasin. The agricultural LAs are derived from baseline loads estimated using the SWAT watershed model. Percent reductions are also calculated for agricultural sources in each TMDL Subbasin using LAs and baseline loads derived from the SWAT model as:

$$\%\ Reduction = \left(1 - \frac{Load\ Allocation}{SWAT\ Baseline\ Load}\right) * 100$$

Within the SWAT model, data on land cover, soils, topographic slopes, and agricultural management practices throughout the basin are used to estimate baseline pollutant loads at the outlet of each TMDL subbasin. Baseline loads and TMDL allocations, therefore, reflect loading magnitudes within stream and river channels at watershed outlets. Because there is typically a gradual loss of phosphorus and sediment as the load travels downstream from uplands sources such as farm fields to a watershed outlet, the baseline loads and LAs derived from the SWAT model are not directly comparable to field-scale loading estimates for upland sources (i.e., phosphorus and sediment losses estimated at a field edge). To facilitate TMDL implementation planning, WDNR has translated baseline agricultural loads and LAs to field-scale baseline and target TP and TSS yields that are comparable to results from the SnapPlus model (SnapPlus version 17 was used for this study).

Note that other BMPs not related to cropping practices can also be implemented to comply with the TMDL, for example water and sediment control basins, or barnyard improvement. In these cases, modeling tools specific to these BMPs must be used for assessing whether load reductions comply fully with the TMDL.

3.2 SnapPlus Translation of Baseline Loads

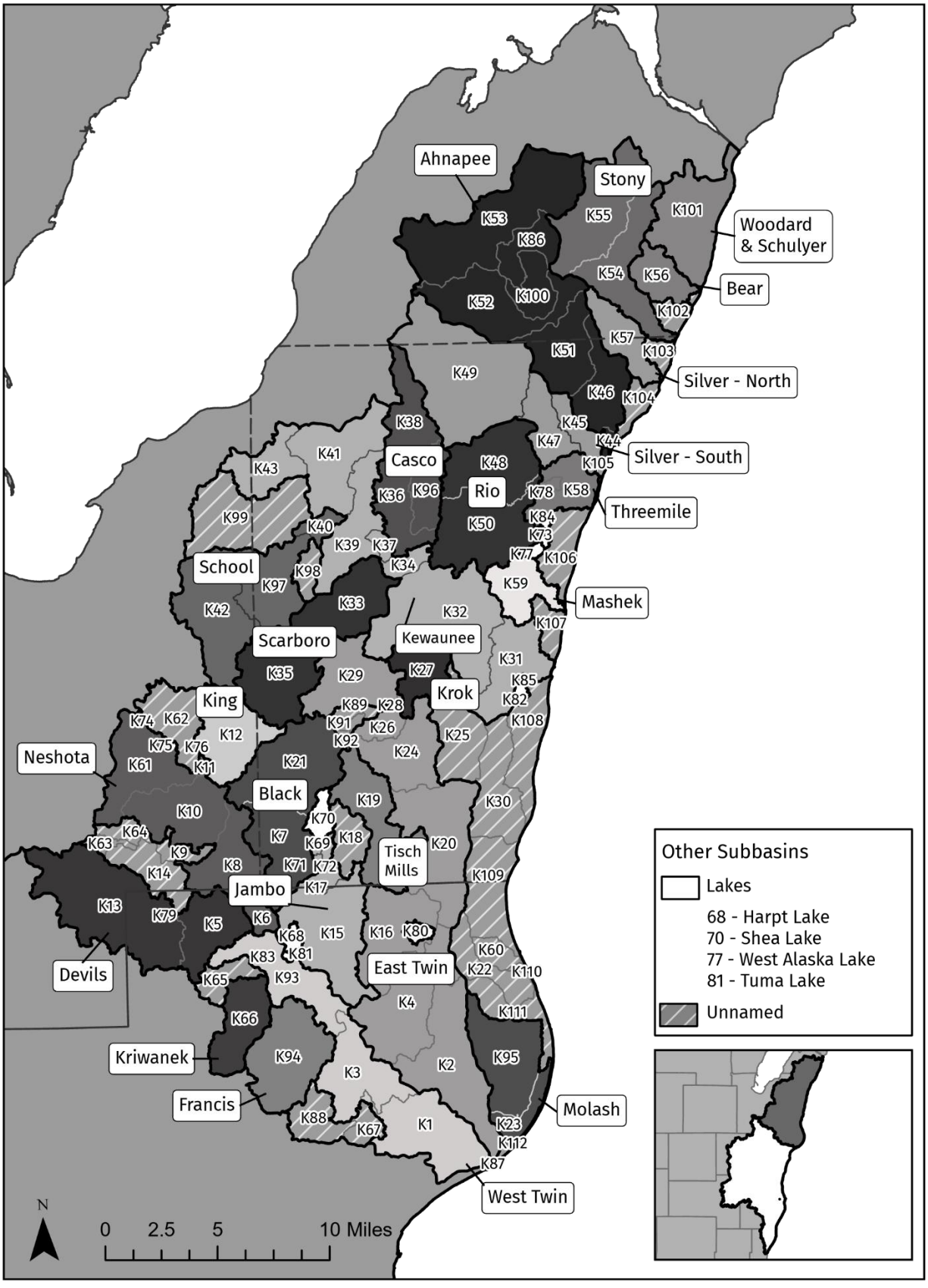
To convert baseline agricultural loads derived from SWAT to field-scale baseline yields, we first translated inputs used for the SWAT model into corresponding inputs to the SnapPlus model. The SnapPlus model simulates phosphorus and sediment loss from several agricultural cover types, with different management operations (cropping, tillage, fertilizer, etc.) applied to each type. The agricultural cover types represented in the SWAT model were selected based on land cover imagery and feedback from county land and water conservation departments (see Appendix D for a detailed description of the NEL SWAT model).

SWAT agricultural cover types were initially translated into SnapPlus "fields" in a template SnapPlus database. Settings for these SnapPlus fields reflected the same crop rotations, tillage, fertilizer, and manure application rates as SWAT agricultural types. Using these template fields as a starting point, additional SnapPlus fields were defined, each with a unique combination of agriculture type, soil type, soil phosphorus, manure application rate, topographic slope, and watershed location. The following steps were applied to define the additional SnapPlus fields:

a) A geographic overlay of soil types in the Web Soil Survey (SSURGO) database and Model Subwatershed boundaries was completed to identify and map unique soil types within each Model Subwatershed, including slopes and slope lengths.
b) A geographic overlay of soil types in the SSURGO database and HUC12 boundaries was completed to identify and map unique soil types within each HUC12.
c) The average soil phosphorus content of each unique soil type-watershed combination identified in steps (a) and (b) was calculated as the average of a combination of CAFO-reported soil phosphorus samples and county-level averages of soil phosphorus samples (see Appendix F for more information);
d) The soil type-watershed combinations identified in steps a) and b) were further overlaid with a map of SWAT agricultural cover types to identify 57,213 unique combinations of soils, watersheds, and agricultural cover types.

The 57,213 combinations of soils, watersheds, and agricultural cover types were modeled as individual SnapPlus fields, each with specific settings for land management, dominant soil type, soil phosphorus, manure application rate, and slope. The resulting phosphorus and sediment yields from SnapPlus were averaged for each TMDL subbasin and HUC12 to calculate baseline TP and TSS yields (Appendix H).

4 TMDL SUBBASIN MAPS


Ahnapee
Stony
Woodard & Schulyer
Bear
Silver - North
Silver - South
Threemile
Mashek
Casco
Rio
School
Scarboro
Kewaunee
Krok
King
Neshota
Black
Jambo
Tisch Mills
East Twin
Devils
Kriwanek
Francis
Molash
West Twin
K53
K55
K101
K86
K54
K56
K52
K100
K102
K57
K51
K103
K49
K46
K104
K45
K38
K47
K44
K41
K48
K105
K43
K36
K96
K78
K58
K99
K84
K40
K50
K73
K39
K37
K77
K106
K34
K98
K59
K97
K33
K42
K32
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K27
K85
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K24
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K21
K30
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K19
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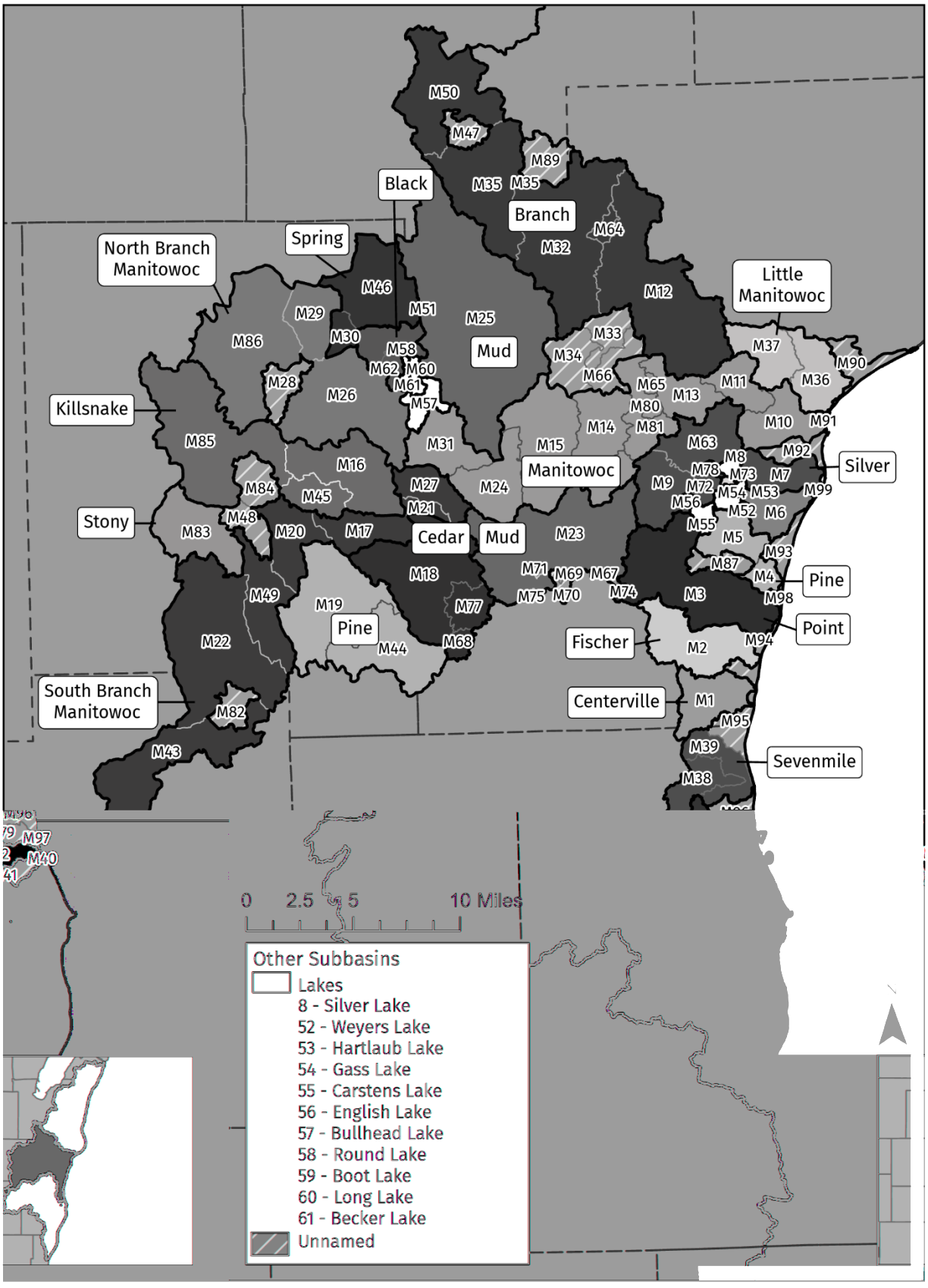
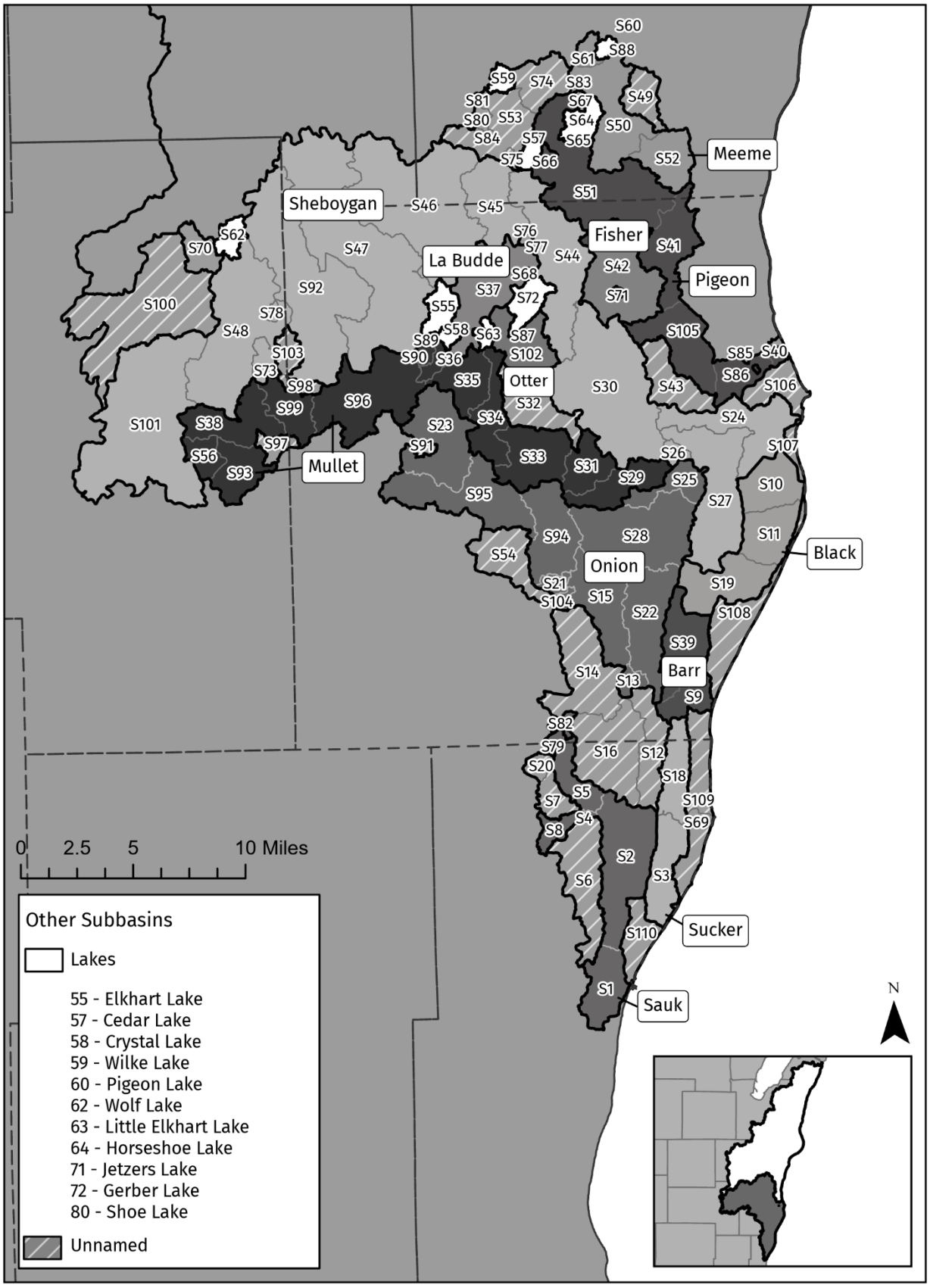
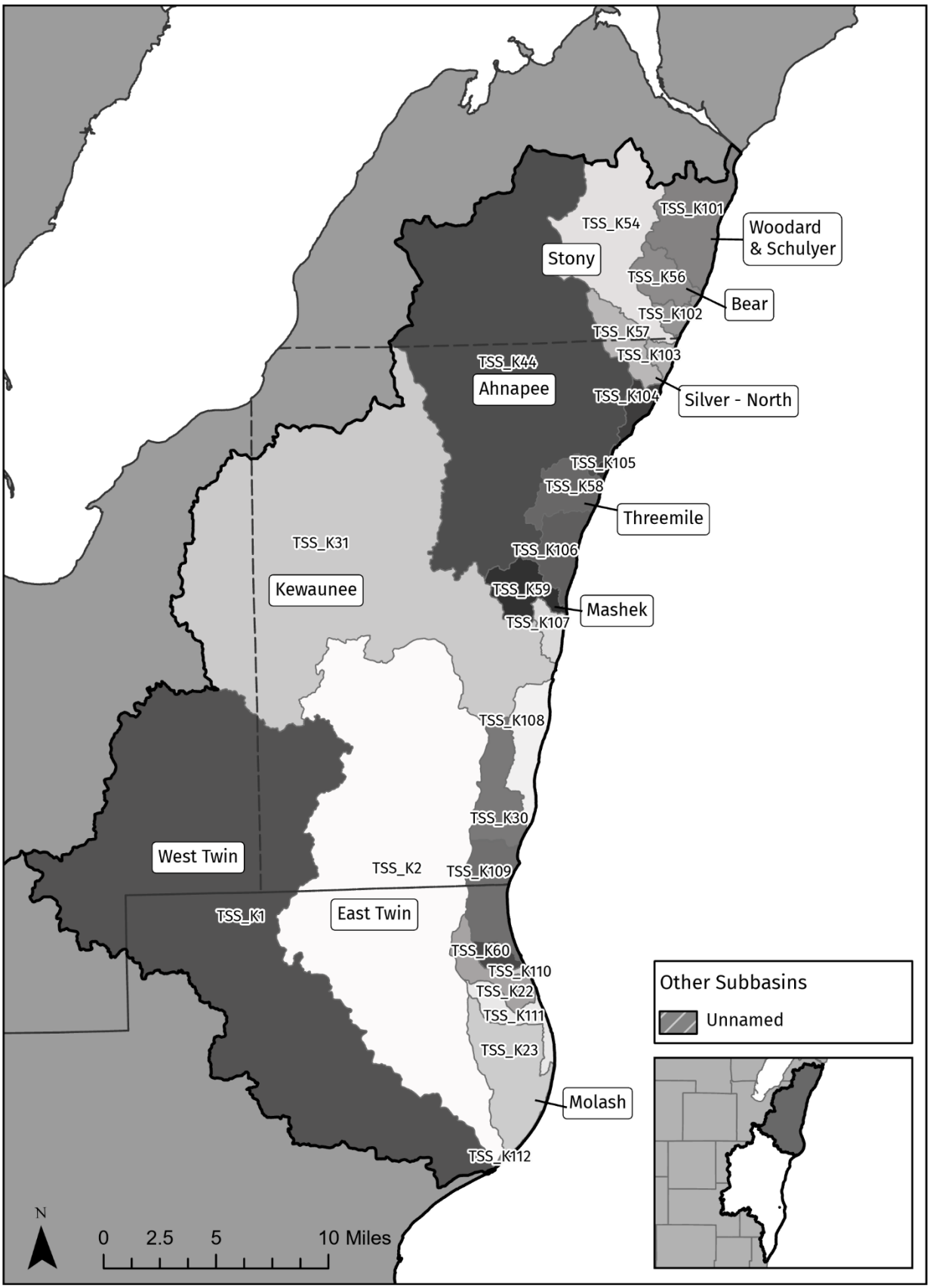
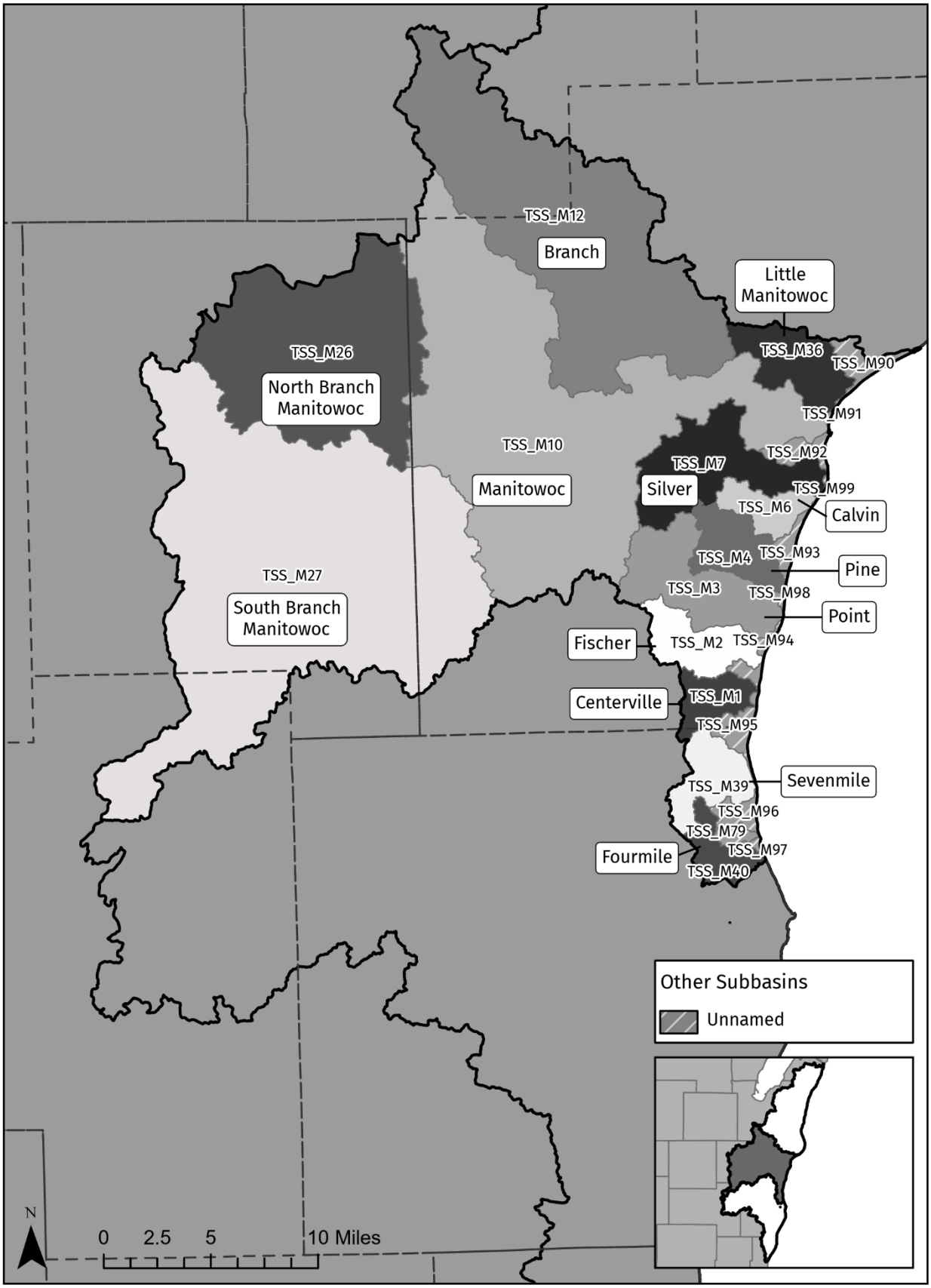
K64
K7
K69
K18
K20
K63
K9
K71
K72
K109
K8
K14
K17
K13
K79
K6
K5
K68
K15
K16
K80
K60
K83
K81
K22
K110
K65
K93
K4
K111
K66
K94
K95
K3
K2
K88
K67
K1
K23
K112
K87
N
0
2.5
5
10 Miles
Other Subbasins
Lakes
68 - Harpt Lake
70 - Shea Lake
77 - West Alaska Lake
81 - Tuma Lake
Unnamed


Black
Spring
North Branch Manitowoc
Branch
Little Manitowoc
Killsnake
Mud
Manitowoc
Silver
Stony
Cedar
Mud
Pine
Pine
Point
Fischer
South Branch Manitowoc
Centerville
Sevenmile
M50
M47
M89
M35
M35
M64
M32
M12
M46
M51
M25
M29
M30
M58
M62
M60
M61
M57
M86
M28
M26
M33
M34
M66
M37
M90
M36
M11
M65
M13
M80
M81
M14
M10
M91
M63
M92
M8
M78
M73
M7
M9
M72
M54
M53
M99
M56
M52
M6
M55
M5
M93
M87
M4
M98
M3
M74
M71
M69
M67
M75
M70
M85
M31
M15
M16
M84
M45
M27
M24
M21
M48
M83
M20
M17
M23
M18
M49
M19
M77
M22
M44
M68
M2
M94
M82
M1
M95
M39
M43
M38
M97
M40
0 2.5 5 10 Miles
Other Subbasins
Lakes
8 - Silver Lake
52 - Weyers Lake
53 - Hartlaub Lake
54 - Gass Lake
55 - Carstens Lake
56 - English Lake
57 - Bullhead Lake
58 - Round Lake
59 - Boot Lake
60 - Long Lake
61 - Becker Lake
Unnamed


S60
S88
S61
S59
S74
S83
S81
S67
S49
S80
S53
S64
S50
S84
S57
S65
S75
S66
S52
Meeme
S51
Sheboygan
S46
S45
S76
Fisher
S41
S62
S70
S47
S77
S44
La Budde
S42
S68
Pigeon
S92
S37
S72
S100
S55
S71
S78
S48
S58
S63
S87
S105
S89
S85
S40
S103
S90
S36
S102
S73
S86
S106
S98
S35
Otter
S30
S43
S99
S96
S32
S24
S101
S38
S34
S23
S97
S91
S26
S107
S56
S33
S31
S29
S25
Mullet
S93
S10
S95
S27
S94
S28
S11
S54
Onion
Black
S21
S19
S104
S15
S22
S108
S39
S14
S13
Barr
S9
S82
S79
S16
S12
S20
S18
S5
S109
S7
S4
S69
S8
S2
S3
S6
S110
Sucker
S1
Sauk
0
2.5
5
10 Miles
N
Other Subbasins
Lakes
55 - Elkhart Lake
57 - Cedar Lake
58 - Crystal Lake
59 - Wilke Lake
60 - Pigeon Lake
62 - Wolf Lake
63 - Little Elkhart Lake
64 - Horseshoe Lake
71 - Jetzers Lake
72 - Gerber Lake
80 - Shoe Lake
Unnamed


TSS_K101
TSS_K54
Woodard & Schulyer
Stony
TSS_K56
Bear
TSS_K102
TSS_K57
TSS_K103
TSS_K44
Ahnapee
TSS_K104
Silver - North
TSS_K105
TSS_K58
Threemile
TSS_K31
TSS_K106
Kewaunee
TSS_K59
Mashek
TSS_K107
TSS_K108
TSS_K30
West Twin
TSS_K2
TSS_K109
TSS_K1
East Twin
TSS_K60
TSS_K110
TSS_K22
TSS_K111
TSS_K23
Molash
TSS_K112
Other Subbasins
Unnamed
N
0 2.5 5 10 Miles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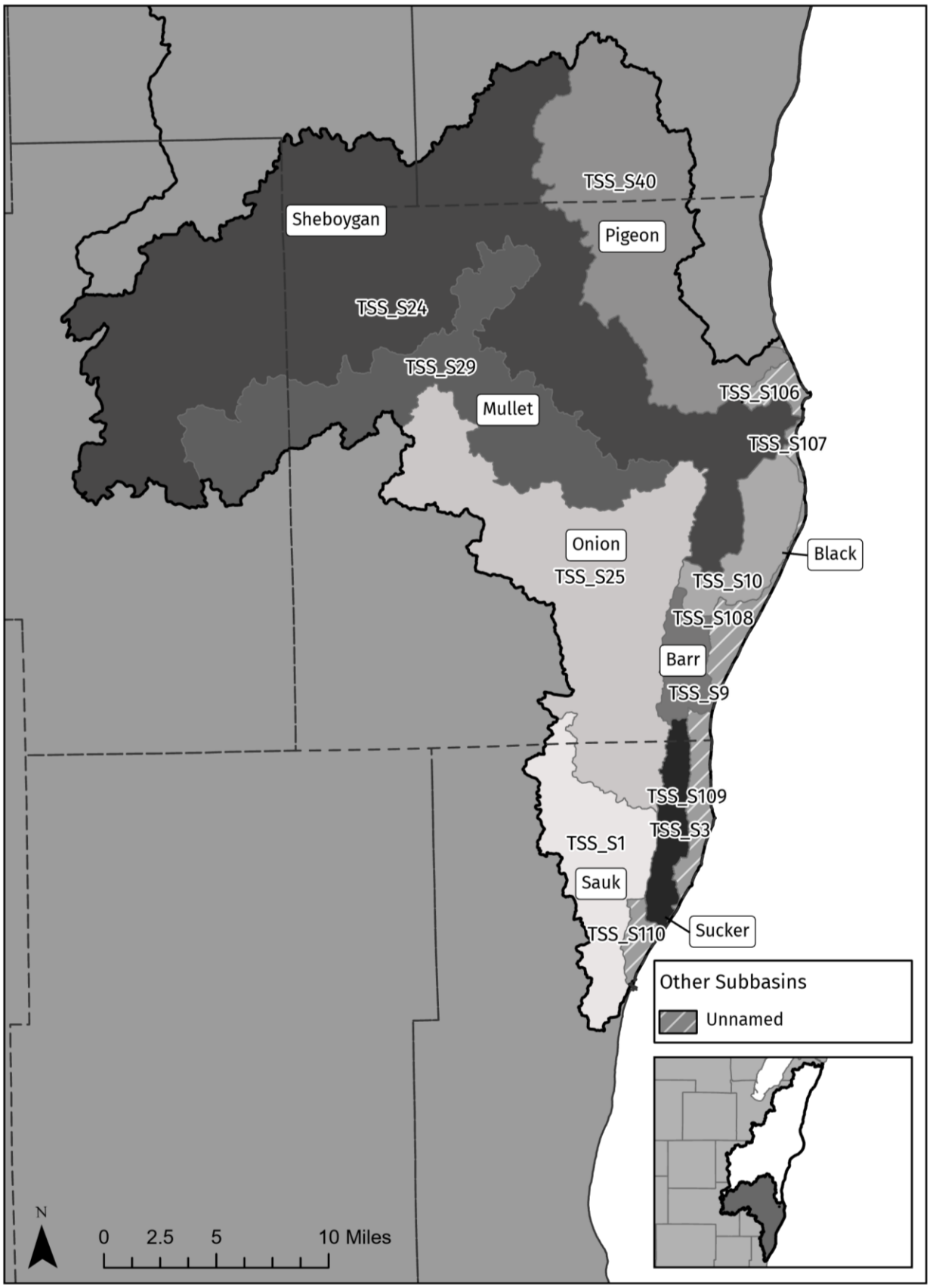
Branch
Little Manitowoc
TSS_M26
North Branch Manitowoc
TSS_M36
TSS_M90
TSS_M91
TSS_M10
TSS_M7
TSS_M92
Manitowoc
Silver
TSS_M99
TSS_M6
Calvin
TSS_M4
TSS_M93
Pine
TSS_M27
South Branch Manitowoc
TSS_M3
TSS_M98
Point
Fischer
TSS_M2
TSS_M94
Centerville
TSS_M1
TSS_M95
TSS_M39
Sevenmile
TSS_M96
TSS_M79
TSS_M97
Fourmile
TSS_M40
Other Subbasins
Unnamed
N
0 2.5 5 10 Miles


TSS_S40
Sheboygan
Pigeon
TSS_S24
TSS_S29
TSS_S106
Mullet
TSS_S107
Onion
TSS_S25
Black
TSS_S10
TSS_S108
Barr
TSS_S9
TSS_S109
TSS_S3
TSS_S1
Sauk
TSS_S110
Sucker
Other Subbasins
Unnamed
N
0
2.5
5
10 Miles

5 AGRICULTURAL EDGE-OF-FIELD TARGET TABLES

5.1 Total Phosphorus Tables

5.1.1 Kewaunee Region

Table 1 Kewaunee region total phosphorus edge-of-field targets summary table (blue)

TMDL Subbasin	Baseline TP Loss (lb/ac/yr)	TMDL % Reduction (TP)	Target TP Load (lb/ac/yr)
K1	2.4	0.0%	2.4
K2	2.1	15.5%	1.8
K3	2.1	27.8%	1.5
K4	2.3	41.8%	1.3
K5	3.4	51.5%	1.6
K6	2.9	56.1%	1.3
K7	2.8	53.7%	1.3
K8	3.5	66.1%	1.2
K9	3.3	80.3%	0.6
K10	3.2	66.3%	1.1
K11	6.0	46.2%	3.2
K12	3.6	75.5%	0.9
K13	3.3	40.7%	2.0
K14	3.5	54.0%	1.6
K15	3.0	0.0%	3.0
K16	2.3	0.0%	2.3
K17	3.0	58.9%	1.3
K18	2.7	19.6%	2.2
K19	3.0	15.7%	2.5
K20	3.1	55.3%	1.4
K21	3.8	61.9%	1.4
K22	2.3	89.2%	0.3
K23	2.2	0.0%	2.2
K24	2.3	0.0%	2.3
K25	3.2	27.2%	2.4
K26	2.8	19.1%	2.3
K27	2.6	0.0%	2.6
K28	2.8	0.0%	2.8
K29	3.6	65.6%	1.2
K30	3.4	86.6%	0.5
K31	4.9	22.6%	3.8
K32	3.8	20.2%	3.0
K33	3.4	61.6%	1.3
K34	3.0	0.0%	3.0
K35	4.1	58.8%	1.7

TMDL Subbasin	Baseline TP Loss (lb/ac/yr)	TMDL % Reduction (TP)	Target TP Load (lb/ac/yr)
K36	3.2	0.0%	3.2
K37	4.5	9.1%	4.1
K38	3.1	0.0%	3.1
K39	3.2	75.7%	0.8
K40	3.1	78.9%	0.7
K41	3.0	67.2%	1.0
K42	2.8	70.2%	0.8
K43	3.2	69.6%	1.0
K44	2.0	0.0%	2.0
K45	2.7	0.0%	2.7
K46	2.7	0.0%	2.7
K47	3.1	27.7%	2.3
K48	3.1	49.5%	1.6
K49	2.6	34.8%	1.7
K50	3.3	45.8%	1.8
K51	2.3	0.0%	2.3
K52	2.0	0.0%	2.0
K53	2.3	0.0%	2.3
K54	2.2	11.8%	1.9
K55	2.1	0.0%	2.1
K56	2.5	53.7%	1.1
K57	2.0	0.0%	2.0
K58	3.9	46.2%	2.1
K59	3.6	56.5%	1.6
K60	2.0	84.5%	0.3
K61	3.4	62.1%	1.3
K62	2.7	50.0%	1.3
K63	3.0	85.6%	0.4
K64	2.8	30.9%	1.9
K65	3.3	51.3%	1.6
K66	3.1	35.8%	2.0
K67	2.0	14.7%	1.7
K68	2.5	56.8%	1.1
K69	4.1	0.0%	4.1
K70	3.1	55.5%	1.4
K71	4.2	0.0%	4.2
K72	5.4	0.0%	5.4
K73	3.6	0.0%	3.6
K76	6.1	0.0%	6.1
K77	6.6	6.0%	6.2
K78	6.4	17.8%	5.3
K80	2.7	0.0%	2.7

TMDL Subbasin	Baseline TP Loss (lb/ac/yr)	TMDL % Reduction (TP)	Target TP Load (lb/ac/yr)
K81	2.0	0.0%	2.0
K82	3.6	79.8%	0.7
K83	1.4	0.0%	1.4
K84	4.1	63.1%	1.5
K85	3.4	57.4%	1.5
K86	2.3	0.0%	2.3
K88	2.4	54.9%	1.1
K89	4.0	56.3%	1.8
K90	4.1	47.7%	2.2
K91	3.4	89.8%	0.3
K92	3.8	17.8%	3.1
K93	3.1	0.0%	3.1
K94	2.6	12.7%	2.3
K95	2.1	68.9%	0.7
K96	4.5	0.0%	4.5
K97	3.2	77.5%	0.7
K98	3.0	61.4%	1.1
K99	2.9	74.4%	0.7
K100	2.9	0.0%	2.9
K101	2.2	62.4%	0.8
K102	2.9	44.2%	1.6
K103	2.6	42.6%	1.5
K104	2.4	0.0%	2.4
K105	1.7	0.0%	1.7
K106	2.9	75.6%	0.7
K107	4.0	74.1%	1.0
K108	3.4	88.2%	0.4
K109	2.6	89.7%	0.3
K110	2.9	93.7%	0.2
K111	2.2	78.1%	0.5

Table 2 Kewaunee region total phosphorus edge-of-field targets summary table by HUC12 (orange)

HUC12	Baseline TP Loss (lb/ac/yr)	TMDL % Reduction (TP)	Target TP Load (lb/ac/yr)
040301010101	2.3	83.2%	0.4
040301010102	2.8	29.6%	2.0
040301010103	2.4	17.6%	2.0
040301010104	2.7	31.1%	1.8
040301010105	1.7	28.5%	1.2
040301010201	3.2	58.2%	1.3
040301010202	3.1	45.8%	1.7
040301010203	3.2	66.1%	1.1
040301010204	2.7	20.7%	2.2
040301010205	1.9	26.4%	1.4
040301020201	2.2	22.8%	1.7
040301020202	2.7	47.4%	1.4
040301020203	2.3	31.0%	1.6
040301020204	2.1	0.0%	2.1
040301020205	3.0	62.6%	1.1
040301020301	2.6	73.3%	0.7
040301020302	2.5	72.5%	0.7
040301020303	3.5	60.1%	1.4
040301020304	3.0	38.3%	1.9
040301020305	3.9	20.9%	3.0
040301020407	2.7	69.6%	0.8
040302040303	2.4	50.0%	1.2
041900000200	3.0	81.0%	0.6

5.1.2 Manitowoc Region

Table 3 Manitowoc region total phosphorus edge-of-field targets summary table (blue)

TMDL Subbasin	Baseline TP Loss (lb/ac/yr)	TMDL % Reduction (TP)	Target TP Load (lb/ac/yr)
M1	2.9	56.6%	1.3
M2	3.0	61.7%	1.1
M3	3.2	61.6%	1.2
M4	3.1	65.0%	1.1
M5	2.8	70.4%	0.8
M6	2.6	52.5%	1.2
M7	2.2	35.7%	1.4
M8	3.7	59.1%	1.5
M9	3.0	66.1%	1.0
M10	2.4	49.9%	1.2
M11	2.5	0.0%	2.5
M12	3.5	0.0%	3.5
M13	3.5	74.0%	0.9
M14	3.3	82.1%	0.6
M15	2.5	80.2%	0.5
M16	2.5	51.8%	1.2
M17	2.4	44.5%	1.3
M18	2.6	75.5%	0.6
M19	3.1	85.5%	0.5
M20	2.8	85.7%	0.4
M21	2.1	0.0%	2.1
M22	3.7	77.9%	0.8
M23	2.8	57.7%	1.2
M24	2.0	0.0%	2.0
M25	2.6	80.7%	0.5
M26	2.4	51.1%	1.2
M27	2.3	25.8%	1.7
M28	2.3	78.0%	0.5
M29	1.9	7.3%	1.8
M30	1.9	0.0%	1.9
M31	2.4	0.0%	2.4
M32	2.7	8.2%	2.5
M33	2.8	39.7%	1.7
M34	2.4	68.2%	0.8
M35	3.7	60.9%	1.4
M36	2.3	76.6%	0.5
M37	1.9	89.0%	0.2
M38	3.6	67.7%	1.2
M39	3.4	69.6%	1.0

TMDL Subbasin	Baseline TP Loss (lb/ac/yr)	TMDL % Reduction (TP)	Target TP Load (lb/ac/yr)
M41	3.0	0.0%	3.0
M42	3.6	54.1%	1.7
M43	3.6	81.1%	0.7
M44	2.7	75.3%	0.7
M45	2.5	64.0%	0.9
M46	2.6	57.3%	1.1
M47	3.0	53.3%	1.4
M48	3.1	85.0%	0.5
M49	3.3	77.4%	0.7
M50	3.0	36.8%	1.9
M51	2.5	46.2%	1.3
M52	3.7	0.0%	3.7
M53	3.0	0.0%	3.0
M54	4.2	77.1%	1.0
M55	3.1	89.3%	0.3
M56	2.9	35.2%	1.9
M57	2.8	95.1%	0.1
M58	3.2	0.0%	3.2
M59	3.3	63.0%	1.2
M60	3.1	95.2%	0.1
M61	3.5	82.8%	0.6
M62	3.0	44.9%	1.6
M63	2.6	69.6%	0.8
M64	4.8	0.0%	4.8
M65	5.7	89.7%	0.6
M66	3.0	61.0%	1.2
M67	4.0	87.8%	0.5
M68	3.4	83.2%	0.6
M69	2.1	0.0%	2.1
M70	2.8	0.0%	2.8
M71	4.0	0.0%	4.0
M72	2.4	64.9%	0.8
M73	2.8	0.0%	2.8
M74	4.9	66.5%	1.6
M75	3.7	0.0%	3.7
M76	2.6	33.3%	1.7
M77	3.7	86.7%	0.5
M78	2.7	50.1%	1.3
M79	2.7	44.2%	1.5
M80	4.6	91.5%	0.4
M81	4.1	68.1%	1.3
M82	4.4	85.3%	0.6

TMDL Subbasin	Baseline TP Loss (lb/ac/yr)	TMDL % Reduction (TP)	Target TP Load (lb/ac/yr)
M83	3.3	80.9%	0.6
M84	2.6	74.0%	0.7
M85	2.5	74.9%	0.6
M86	2.3	67.5%	0.7
M87	2.8	66.4%	1.0
M89	3.7	0.0%	3.7
M90	2.2	41.3%	1.3
M92	3.0	0.0%	3.0
M93	2.0	64.0%	0.7
M94	2.8	0.0%	2.8
M95	2.7	23.4%	2.1
M96	3.2	46.6%	1.7
M97	1.3	0.0%	1.3
M98	3.1	63.1%	1.1

Table 4 Manitowoc region total phosphorus edge-of-field targets summary table by HUC12 (orange)

HUC12	Baseline TP Loss (lb/ac/yr)	TMDL % Reduction (TP)	Target TP Load (lb/ac/yr)
040301010204	3.1	0.0%	3.1
040301010301	1.8	67.5%	0.6
040301010302	2.3	54.6%	1.0
040301010303	1.8	46.0%	1.0
040301010401	3.1	81.7%	0.6
040301010402	2.8	78.8%	0.6
040301010403	2.3	81.8%	0.4
040301010404	2.5	81.6%	0.5
040301010405	2.5	77.9%	0.5
040301010406	2.1	74.8%	0.5
040301010407	2.0	55.4%	0.9
040301010408	2.0	36.2%	1.2
040301010501	2.9	43.7%	1.6
040301010502	2.2	26.5%	1.6
040301010503	3.1	0.0%	3.1
040301010601	2.0	80.7%	0.4
040301010602	2.5	58.7%	1.0
040301010603	2.4	59.9%	1.0
040301010604	1.4	77.9%	0.3
040301010605	2.7	44.0%	1.5
040301010701	2.2	64.5%	0.8
040301010702	2.0	45.2%	1.1
040301010703	2.6	61.6%	1.0
040301010704	2.2	53.4%	1.0
040301010705	2.7	59.5%	1.1
040302040203	1.8	67.5%	0.6
040302040204	1.0	7.3%	0.9

5.1.3 Sheboygan Region

Table 5 Sheboygan region total phosphorus edge-of-field targets summary table (blue)

TMDL Subbasin	Baseline TP Loss (lb/ac/yr)	TMDL % Reduction (TP)	Target TP Load (lb/ac/yr)
S1	4.6	68.6%	1.4
S2	3.9	89.9%	0.4
S3	3.6	86.1%	0.5
S4	5.0	94.6%	0.3
S5	4.6	91.7%	0.4
S6	3.6	86.0%	0.5
S7	4.1	75.1%	1.0
S8	4.0	86.2%	0.6
S9	3.8	87.1%	0.5
S10	3.0	57.0%	1.3
S11	3.3	73.1%	0.9
S12	3.2	60.8%	1.2
S13	4.0	74.8%	1.0
S14	4.6	91.3%	0.4
S15	3.3	74.3%	0.9
S16	4.1	86.2%	0.6
S18	4.0	89.9%	0.4
S19	3.5	85.2%	0.5
S20	4.3	93.2%	0.3
S21	4.9	83.7%	0.8
S22	3.2	69.0%	1.0
S23	4.8	0.0%	4.8
S24	3.9	0.0%	3.9
S25	3.2	69.6%	1.0
S26	8.0	0.0%	8.0
S27	3.4	0.0%	3.4
S28	3.1	79.3%	0.7
S29	3.6	50.2%	1.8
S30	3.8	94.2%	0.2
S31	3.4	71.0%	1.0
S32	3.6	68.7%	1.1
S33	4.6	70.1%	1.4
S34	4.8	77.5%	1.1
S35	6.4	38.2%	4.0
S36	6.7	0.0%	6.7
S37	5.1	0.0%	5.1
S38	4.0	0.0%	4.0
S39	3.1	80.8%	0.6
S40	1.9	0.0%	1.9

TMDL Subbasin	Baseline TP Loss (lb/ac/yr)	TMDL % Reduction (TP)	Target TP Load (lb/ac/yr)
S41	3.6	77.4%	0.8
S42	4.4	85.0%	0.7
S43	3.6	74.9%	0.9
S44	6.0	84.0%	1.0
S45	4.7	0.0%	4.7
S46	4.5	0.0%	4.5
S47	4.8	43.8%	2.7
S48	3.8	0.0%	3.8
S49	3.3	70.7%	1.0
S50	3.2	83.7%	0.5
S51	3.6	76.7%	0.8
S52	3.5	78.2%	0.8
S53	2.7	0.0%	2.7
S54	4.6	77.6%	1.0
S55	5.3	6.0%	5.0
S56	4.9	63.4%	1.8
S57	2.1	0.0%	2.1
S58	12.2	0.0%	12.2
S59	4.1	0.0%	4.1
S60	5.5	6.7%	5.2
S61	3.0	24.5%	2.3
S62	3.8	64.7%	1.4
S63	4.9	7.2%	4.5
S64	3.5	29.6%	2.5
S65	2.7	0.0%	2.7
S66	5.2	71.3%	1.5
S67	4.0	68.3%	1.3
S68	4.4	0.0%	4.4
S69	3.7	0.0%	3.7
S70	3.2	0.0%	3.2
S71	5.0	82.4%	0.9
S72	5.8	87.7%	0.7
S73	5.7	83.3%	1.0
S74	2.5	12.8%	2.1
S75	2.3	0.0%	2.3
S76	5.9	0.0%	5.9
S77	2.2	0.0%	2.2
S78	4.6	0.0%	4.6
S79	7.7	92.7%	0.6
S80	3.1	0.0%	3.1
S81	2.8	0.0%	2.8
S82	8.7	89.0%	1.0

TMDL Subbasin	Baseline TP Loss (lb/ac/yr)	TMDL % Reduction (TP)	Target TP Load (lb/ac/yr)
S83	3.9	0.0%	3.9
S84	1.2	0.0%	1.2
S86	2.8	0.0%	2.8
S87	4.7	0.0%	4.7
S88	6.4	92.8%	0.5
S89	6.4	0.0%	6.4
S90	1.9	0.0%	1.9
S91	11.1	0.0%	11.1
S92	5.0	90.5%	0.5
S93	4.0	0.0%	4.0
S94	4.1	84.3%	0.6
S95	5.5	29.8%	3.9
S96	5.3	0.0%	5.3
S97	4.8	61.1%	1.9
S98	4.2	0.0%	4.2
S99	4.5	0.0%	4.5
S100	4.5	84.4%	0.7
S101	5.3	53.1%	2.5
S102	4.8	0.0%	4.8
S103	4.5	78.2%	1.0
S104	8.5	91.3%	0.7
S105	3.7	62.8%	1.4
S106	1.6	0.0%	1.6
S108	4.0	0.0%	4.0
S109	3.7	86.0%	0.5
S110	3.1	61.5%	1.2

Table 6 Sheboygan region total phosphorus edge-of-field targets summary table by HUC12 (orange)

HUC12	Baseline TP Loss (lb/ac/yr)	TMDL % Reduction (TP)	Target TP Load (lb/ac/yr)
040301010401	3.2	64.7%	1.1
040301010705	1.3	0.0%	1.3
040301010801	2.8	76.7%	0.6
040301010802	2.9	72.2%	0.8
040301010803	3.5	82.0%	0.6
040301010804	3.1	65.2%	1.1
040301010901	3.8	12.9%	3.3
040301010902	4.8	0.0%	4.8
040301010903	3.6	64.5%	1.3
040301011001	4.0	52.3%	1.9
040301011002	2.9	79.4%	0.6
040301011003	3.1	83.5%	0.5
040301011004	2.7	75.0%	0.7
040301011101	3.6	84.4%	0.6
040301011102	4.5	53.1%	2.1
040301011103	3.5	13.5%	3.0
040301011104	3.9	63.1%	1.4
040301011105	2.3	5.5%	2.2
040301011106	3.6	0.0%	3.6
040301011107	5.1	48.3%	2.6
040301011108	3.3	94.2%	0.2
040301011109	2.9	0.0%	2.9
040301011201	2.8	78.2%	0.6
040301011202	2.8	62.9%	1.0
040301011203	3.3	83.8%	0.5
040301011204	3.1	86.9%	0.4

5.2 Total Suspended Solids Tables

5.2.1 Kewaunee Region

Table 7 Kewaunee region total suspended solids edge-of-field targets summary table (green)

TMDL Subbasin	Baseline TSS Loss (ton/ac/yr)	TMDL % Reduction (TSS)	Target TSS Load (ton/ac/yr)
TSS_K1	3.1	19.5%	2.5
TSS_K2	2.8	0.0%	2.8
TSS_K22	2.3	0.0%	2.3
TSS_K23	2.1	0.0%	2.1
TSS_K30	3.4	0.0%	3.4
TSS_K31	3.4	0.0%	3.4
TSS_K44	2.7	0.0%	2.7
TSS_K54	2.1	0.0%	2.1
TSS_K56	2.5	0.0%	2.5
TSS_K57	2.0	0.0%	2.0
TSS_K58	4.1	0.0%	4.1
TSS_K59	3.6	0.0%	3.6
TSS_K60	2.0	0.0%	2.0
TSS_K101	2.2	0.0%	2.2
TSS_K102	2.9	0.0%	2.9
TSS_K103	2.6	0.0%	2.6
TSS_K104	2.4	0.0%	2.4
TSS_K105	1.7	0.0%	1.7
TSS_K106	3.1	0.0%	3.1
TSS_K107	4.0	0.0%	4.0
TSS_K108	3.4	0.0%	3.4
TSS_K109	2.6	28.2%	1.8
TSS_K110	2.9	0.0%	2.9
TSS_K111	2.2	0.0%	2.2

Table 8 Kewaunee region total suspended solids edge-of-field targets summary table by HUC12 (yellow)

HUC12	Baseline TSS Loss (tons/ac/yr)	TMDL % Reduction (TSS)	Target TSS Load (tons/ac/yr)
040301010101	2.8	5.4%	2.6
040301010102	3.1	0.0%	3.1
040301010103	2.9	0.0%	2.9
040301010104	2.9	0.0%	2.9
040301010105	2.2	0.0%	2.2
040301010201	3.3	19.5%	2.7
040301010202	3.3	19.5%	2.7
040301010203	3.4	19.5%	2.7
040301010204	2.9	19.5%	2.4
040301010205	2.2	19.5%	1.8
040301020201	2.2	0.0%	2.2
040301020202	3.2	0.0%	3.2
040301020203	2.7	0.0%	2.7
040301020204	2.3	0.0%	2.3
040301020205	3.5	0.0%	3.5
040301020301	2.9	0.0%	2.9
040301020302	2.9	0.0%	2.9
040301020303	3.8	0.0%	3.8
040301020304	3.2	0.0%	3.2
040301020305	4.1	0.0%	4.1
040301020407	3.2	0.0%	3.2
040302040303	2.7	19.5%	2.2
041900000200	3.5	0.0%	3.5

5.2.2 Manitowoc Region

Table 9 Manitowoc region total suspended solids edge-of-field targets summary table (green)

TMDL Subbasin	Baseline TSS Loss (ton/ac/yr)	TMDL % Reduction (TSS)	Target TSS Load (ton/ac/yr)
TSS_M1	2.9	72.4%	0.8
TSS_M2	3.0	70.5%	0.9
TSS_M3	3.2	77.9%	0.7
TSS_M4	2.9	77.2%	0.7
TSS_M6	2.7	68.6%	0.8
TSS_M7	2.7	74.1%	0.7
TSS_M10	2.7	70.4%	0.8
TSS_M12	3.1	72.4%	0.9
TSS_M26	2.4	58.3%	1.0
TSS_M27	3.0	71.1%	0.9
TSS_M36	2.1	58.2%	0.9
TSS_M39	3.5	76.0%	0.8
TSS_M79	2.7	42.7%	1.6
TSS_M90	2.2	0.0%	2.2
TSS_M92	3.0	0.0%	3.0
TSS_M93	2.0	45.8%	1.1
TSS_M94	2.8	0.0%	2.8
TSS_M95	2.7	34.2%	1.8
TSS_M96	3.2	62.8%	1.2
TSS_M97	1.3	0.0%	1.3
TSS_M98	3.1	52.0%	1.5

Table 10 Manitowoc region total suspended solids edge-of-field targets summary table by HUC12 (yellow)

HUC12	Baseline TSS Loss (tons/ac/yr)	TMDL % Reduction (TSS)	Target TSS Load (tons/ac/yr)
040301010204	3.5	72.4%	1.0
040301010301	2.3	58.3%	0.9
040301010302	2.6	58.3%	1.1
040301010303	2.3	58.3%	1.0
040301010401	3.7	71.1%	1.1
040301010402	3.6	71.1%	1.0
040301010403	3.0	71.1%	0.9
040301010404	3.1	71.1%	0.9
040301010405	2.8	71.1%	0.8
040301010406	2.5	71.1%	0.7
040301010407	2.5	71.1%	0.7
040301010408	2.3	71.1%	0.7
040301010501	3.3	72.4%	0.9
040301010502	2.7	72.4%	0.8
040301010503	3.5	72.4%	1.0
040301010601	2.6	70.4%	0.8
040301010602	2.8	70.4%	0.8
040301010603	2.8	70.4%	0.8
040301010604	2.1	49.8%	1.1
040301010605	3.0	70.4%	0.9
040301010701	2.7	74.1%	0.7
040301010702	2.8	71.3%	0.8
040301010703	3.2	77.9%	0.7
040301010704	2.9	64.0%	1.1
040301010705	3.4	71.4%	1.0
040302040203	2.3	58.3%	0.9
040302040204	1.9	58.3%	0.8

5.2.3 Sheboygan Region

Table 11 Sheboygan region total suspended solids edge-of-field targets summary table (green)

TMDL Subbasin	Baseline TSS Loss (ton/ac/yr)	TMDL % Reduction (TSS)	Target TSS Load (ton/ac/yr)
TSS_S1	4.0	57.2%	1.7
TSS_S3	3.8	67.7%	1.2
TSS_S9	3.2	42.7%	1.9
TSS_S10	3.4	0.0%	3.4
TSS_S24	4.5	6.8%	4.2
TSS_S25	3.9	57.4%	1.7
TSS_S29	4.4	27.7%	3.2
TSS_S40	3.7	55.9%	1.6
TSS_S106	1.6	0.0%	1.6
TSS_S108	4.0	7.5%	3.7
TSS_S109	3.7	53.5%	1.7
TSS_S110	3.1	49.2%	1.6

Table 12 Sheboygan region total suspended solids edge-of-field targets summary table by HUC12 (yellow)

HUC12	Baseline TSS Loss (tons/ac/yr)	TMDL % Reduction (TSS)	Target TSS Load (tons/ac/yr)
040301010401	3.8	6.8%	3.6
040301010705	1.6	0.0%	1.6
040301010801	3.4	55.9%	1.5
040301010802	3.6	55.9%	1.6
040301010803	4.1	55.9%	1.8
040301010804	3.6	55.9%	1.6
040301010901	4.3	27.7%	3.1
040301010902	5.3	27.7%	3.8
040301010903	4.1	27.7%	3.0
040301011001	4.7	57.4%	2.0
040301011002	3.8	57.4%	1.6
040301011003	4.1	57.4%	1.7
040301011004	3.2	57.4%	1.3
040301011101	4.5	6.8%	4.2
040301011102	5.3	6.8%	4.9
040301011103	3.9	6.8%	3.6
040301011104	4.9	6.8%	4.6
040301011105	2.6	6.8%	2.5
040301011106	4.5	6.8%	4.2
040301011107	5.4	6.8%	5.1
040301011108	3.8	6.8%	3.5
040301011109	3.5	6.8%	3.2
040301011201	3.4	0.0%	3.4
040301011202	3.4	34.4%	2.2
040301011203	3.7	61.5%	1.4
040301011204	4.1	57.2%	1.7

6 REFERENCES

Wisconsin Department of Natural Resources (2020). Guidance for Implementing Water Quality Trading in WPDES Permits (No. 3200-3400-3800-2020-03). Retrieved from: https://dnr.wisconsin.gov/topic/Wastewater/WaterQualityTrading.html