APPENDIX E. INTERFLUVE MENOMONEE AND KINNICKINNIC RIVERS FINAL CONCEPT DESIGN REPORT

Upper Menomonee and Kinnickinnic Rivers

Final Concept Design Report

Submitted to
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EXECUTIVE SUMMARY

This report outlines the data analysis and design approach in the creation of concept plans for river restoration in select reaches of the Menomonee and Kinnickinnic Rivers in the Milwaukee metropolitan area. The project was funded by a grant from the Fund for Lake Michigan. The overall goal for the project is to develop concept designs and cost estimates for targeted projects in the Menomonee River and Kinnickinnic River basins. Sweetwater (Southeast Wisconsin Watershed Trust) intends to advance select projects toward final design and construction.

The Project Partner science team included representatives from Milwaukee Riverkeeper, Sweetwater, Clean Wisconsin, the Milwaukee Metropolitan Sewerage District (MMSD), the Wisconsin Department of Natural Resources (WIDNR), the Southeast Wisconsin Regional Planning Commission (SEWRPC), local consulting firms, Milwaukee County, and Inter-Fluve.

A geomorphic assessment was completed previously in 2003, which included examination of all rivers and tributaries in Milwaukee County (Inter-Fluve 2004). Review of previous data for this project showed nearly 200 potential restoration projects, including bank erosion repair, fish passage restoration, dam removal, meander restoration of channelized segments, floodplain restoration and riparian buffer establishment. The 2004 tabulated ranking spreadsheet and the associated scoring metrics were used as the basis for the 2015 Sweetwater project, with the project partners reviewing the list and adding several projects not included. Municipalities and counties within the watershed were asked to provide any information for unlisted projects they deemed relevant, and these were also added to the spreadsheet. The project list encompassed all of the known potential projects that best suited the needs of the stakeholders and the overall watershed restoration goals as stated in the *Implementation Plan* and *Watershed Restoration Plan* for each watershed. Project Partners met to discuss the projects, and all of the projects were scored using a draft set of metrics. The prioritization metrics were revised in response to comments by the Project Partners to better achieve the Sweetwater goals (Table 1.)

The project partners reviewed the matrix and rankings. Although bank stabilization was initially viewed as the primary goal, it became clear that the need for projects that exclusively addressed bank erosion in the watersheds of interest was limited. A more common problem was the extensive floodplain encroachment and channelization of streams throughout the watersheds. The initial project goal was for 10 smaller projects, but the Project Partners modified the strategy to include 9

larger scale meander and floodplain restoration projects, each including elements of bank stabilization. The finalized list of projects advanced to concept design includes:

- *Rotary Park* (Menomonee Falls) - Meander restoration of a 4,500 feet reach of the Menomonee River at Pilgrim Road and Menomonee Parkway. The project would result in 7,000 feet of restored, meandering river channel, constructed riffle and pool features, restored streambanks, trails and park amenities.
- *Frontier Park* (Butler) - Channel restoration and riparian area restoration. This 500 foot segment of the Menomonee River was channelized historically, and a large amount of floodplain material was excavated to create the parking lot and adjacent Frontier Park surface. Reclamation here includes filling in the ponded area to restore the river channel, bank stabilization, and restoration of the floodplain to include parking lot relocation away from the channel, and relocation of the baseball field to minimize disturbance and expand the riparian buffer.
- *Lyons Park Creek* (Milwaukee) – This project involves creating a floodplain bench and restored riparian corridor over 450 feet of Lyons Park Creek downstream of South 55th Street to the park footbridge. For an additional 500 feet downstream of the footbridge, the project would include removal of concrete debris, riffle and pool construction, minor bank stabilization and storm sewer outfall integration.
- *Elm Grove Village Park* (Elm Grove) – The focus in this reach is meander restoration of a 2,500 foot section of a channelized Underwood Creek downstream of Marcella Avenue to Elmhurst Parkway. This project would include 4,000 feet of new channel construction, removal of invasive vegetation and restoration of a native vegetation riparian corridor.
- *Underwood Creek* (Brookfield) – This project involves meander restoration of Underwood Creek from Clearwater Drive to North Avenue. This would transform a 4,000 foot section of a channelized ditch into roughly 7,000 feet of new stream channel. The project would also include restoration of a native vegetation riparian corridor.
- *Butler Creek Reach 1* (Brookfield) – The focus in this reach is meander restoration of Butler Creek from Hampton Road to W Lisbon Road. This project involves meander restoration of a 1,700 foot section of the channelized ditch, resulting in roughly 2,500 feet of new stream channel. The project would also include restoration of a native vegetation riparian corridor.
- *Butler Creek Reach 2* (Brookfield) – This project involves meander restoration of a 5,700 foot section of a channelized Butler Creek from Shamrock Lane to Lilly Road (Lilly Heights Park). This project would include 8,000 feet of new channel construction and restoration of a native vegetation riparian corridor.
- *Kinnickinnic River – Jackson Park East and West* (Milwaukee) – This effort is separated into two projects. The West project encompasses 4,600 feet of the upper Kinnickinnic River from South 60th Street to the footbridge in line with South 51st Street. The West project involves bank stabilization and floodplain bench creation, incised channel restoration, and riparian zone restoration. The East project segment covers the river from the footbridge downstream to South 43rd Street and involves the same restoration elements. A major goal here will be to restore the channel while minimizing the impact to valuable monument trees.

Field reconnaissance was completed on the priority sites selected. GIS information such as aerial photos and roads were incorporated into the concept drawings, which depict both existing and proposed corridor elements. Concept plans are included here as Appendix A. The following paragraphs describe the general restoration approaches shown in the concept plans:

MEANDER RESTORATION

Historically, the Menomonee River was a more sinuous stream and was also much smaller, likely less than two thirds of its current width. Agricultural and urban impacts increased the rate and volume of runoff to the river, and the river responded by deepening and widening. Farming and urban development included the channelization or straightening of the river system, which resulted in a steepening of the river slope, further contributing to channel instability. Much of this channelization came with hard armoring of channel banks.

Ditching, also called straightening or channelization of streams and rivers, homogenizes the aquatic habitat, resulting in channels with no variability in bedform. The riffles, runs and pools normally present in meandering alluvial channels are important areas of habitat diversity. In a ditched system, these features are no longer present, and are replaced by flat bottom, wide and shallow channels with marginal habitat. Channelization also reduces the amount of available habitat due to the significant shortening of the river. This shortening also increases the slope of the stream, which can cause channel downcutting, subsequent bank instability and sediment pollution.

Meandering encourages undercutting, deposition of lateral bars and the creation of pools, riffles and runs, all important aspects of stream habitat. In every concept presented, with the exception of Frontier Park, the central design element is restoration of channel meanders. Design of natural meandering channels in urban areas requires not only a solid understanding of natural channel form, but also of the many constraints and disturbance pressures on the normal geomorphic processes of erosion and deposition. The Menomonee River system is subject to extremes such as low base flow discharge in winter or during drought, and large and increasingly frequent flood flows. The channel size is a function of this hydrologic regime. Returning the stream to a pre-settlement condition is not possible given the changes to the floodplain and the hydrologic regime, but we can restore the channel to an equilibrium natural condition given the modern constraints. In the concept plan, we have used the existing channel width as an analog for design, but during final design these dimensions may change slightly.

Table 1. Sweetwater Scoring Metrics

Infrastructure risk	No risk to infrastructure with no action, or no infrastructure present	Low to moderate infrastructure risk and minimal risk to public safety with no action, or inf. value <$100,000	Infrastructure at moderate but not immediate risk, moderate public safety risk, or infrastructure value <$200,000	Infrastructure at high or imminent risk of failure with no action. Public safety at risk or infr. value >$200,000
Erosion/channel stability	Minimal improvement to overall stream stability and function, <250 ft	Low to moderate improvement 250-1000 ft	Moderate improvement 1000-2500 ft	Significant improvement to overall stream stability and function or >2500 ft
Design complexity	Complex plans >20 sheets, specification and project manual, 2-D or other complex modeling	Plans under 20 sheets, moderate complexity, 1-D hydraulic modeling	Plans 10-20 sheets, simple modeling or analog based design	Plans <10 sheets or no plans, fit in field, analog design (eg. simple plantings)
Permitting complexity	Complex permitting, EAW/EIS, CLOMR and LOMR issues, wetlands, mitigation, contaminants	Moderately complex permitting, state and USACE Chap 30/31, no contamination, simple wetland and cultural resource submittals	Simple permitting, no wetland or cultural resources issues, limited submittal	No permits required
Other complexity factors	Major groundwater and surfacewater issues, potential site contamination, or other complexities.	Moderate groundwater and surfacewater issues, potential site contamination, or other complexities.	Minor groundwater and surfacewater issues, potential site contamination, or other complexities.	No groundwater and surfacewater issues, potential site contamination, or other complexities.
Hydrologic benefit (incl. flood storage benefit)	No hydrologic benefit	Low impact, minimal reduction in rate and volume of runoff, flows <2 yr or channel forming flow	Moderate impact , some reduction in rate and volume of runoff, flows <5 yr or channel forming flow	Significant reduction in rate and volume of runoff for flows <10 yr or channel forming flow
Sediment/nutrient loading	No load reduction resulting	Some minor reduction in sediment pollution, increased filtration of nutrients	Moderate reduction in bank erosion and surface runoff entering stream. Buffer or other BMP establishment > 30 ft	Significant BMP installation, stormwater detention, infiltration or buffer filter. Major bank stabilization or erosion control.
Project cost	> $1M	$501 - $999K	$100 - 500K	$0 - $99K
Aesthetic, Recreation and Access impact	No impact	Low impact	Moderate positive impact	High positive impact
Public Education	No public education value	Low value - Poor site access, difficult to see, small project	Moderate value - Good access, moderate demonstration value	High value - Easy access, cooperating landowner, good demonstration and visual impact
In-stream Ecological Benefit	No in-stream ecological benefit	Low benefit - Spot location, small size	Moderate benefit - subreach based, moderate sized project	High benefit - Reach based, >1000 ft of stream
Riparian Ecological Benefit	No riparian ecological benefit	Low benefit - Spot location, small size	Moderate benefit - subreach based, moderate sized project	High benefit - Reach based, large riparian areas, floodplain scale
Project proximity/synergy	Independent project	Borders one additional project, moderate impacts to adjacent project	Near two additional projects, positive impact to all projects	Ties in well, has positive impact on other planned or existing projects

FLOODPLAIN RESTORATION

In addition to, and often in conjunction with, ditching and channelization, floodplain encroachment has caused further degradation. Under natural conditions, flood energy is dissipated over wide areas of the Menomonee River floodplain. However, in many of the tributary channels and in main stem reaches through urban settings, humans have filled in these floodplains and built roads and structures on them. This filling causes flood flows to concentrate in a narrower area, increasing the erosive power of the river channel and speeding the conveyance of water to downstream reaches that then flood more often and more severely.

It is well known that floodplain hydraulic connectivity correlates well with biological diversity in streams, due to the fact that energy coming into and leaving the stream environment must traverse both the channel and the floodplain. Flood waters hydrate dried floodplain areas, maintain vernal pools, allow for spawning of wetland dependent fish and macroinvertebrates, and provide important water for floodplain vegetation. Floods also transport nutrients and organic matter (e.g. leaves, migrating fish) back and forth in the riparian corridor. Native floodplain vegetation provides critical migratory habitat for birds and other animals.

Restoration of floodplains involves excavating small floodplain benches or can also include large scale floodplain excavation. Alternatively, incised channels can be raised back up to reconnect floodplains. This involves excavation of unwanted material, removal off site, stabilization of floodplain soils and banks, and planting of native vegetation. Floodplain restoration in park areas such as Rotary Park or Jackson Park, can also involve extensive trail development, relocation of park amenities, and reconstruction of infrastructure (bridges, outfalls).

CONSTRUCTION LOGISTICS AND PHASING

For most floodplain and meander restoration projects, the existing channel is used as a dewatering channel or the stream is put into a pipe and pumped around the project area, so the new channel and floodplain are constructed in a dry state. Once all of the channel and bank features are constructed, the water is "turned on" and then the floodplain features can be finalized. Long meandering projects can be completed in phases, depending on the amount of funding that is available. Phasing projects can be a good way of generating additional funding. Once a seed project is completed, funders are more likely to build on the successful initial effort.

DESIGN DEVELOPMENT

Concept designs offer a look into the spatial possibilities, but do not generate the topography and detailed design material quantities needed for accurate construction planning and cost estimating. The next step in the design process is to generate a design progress submittal, generally expressed as a percentage of a complete, construction ready planset. For large urban projects with park amenities and infrastructure, it is beneficial to all parties to generate a 30% or even a 60% planset. Sometimes, both submittals are warranted. In order to generate the topographic detail necessary for such plans, and to develop a hydraulic model of flows, a survey of the existing channel needs to be completed. This information is combined with either ground survey and/or LiDAR data often available to municipalities.

Topographic survey data is input into AutoCAD or another drafting program, and existing and preliminary proposed surfaces are constructed. Channel and floodplain design analysis includes modeling flood flows, sediment movement and erosive energy for a variety of flood flows. Material types and quantities are determined. Once the preliminary submittals are reviewed, comments are incorporated into 90% and 100% complete plans and specifications.

At one of the submittal junctures, plans are submitted for state, federal and local permitting. Once permits are issued, then the plans can be let out for public bid and a construction contractor hired to complete the installation under the supervision of the project Owner and the project design engineer.

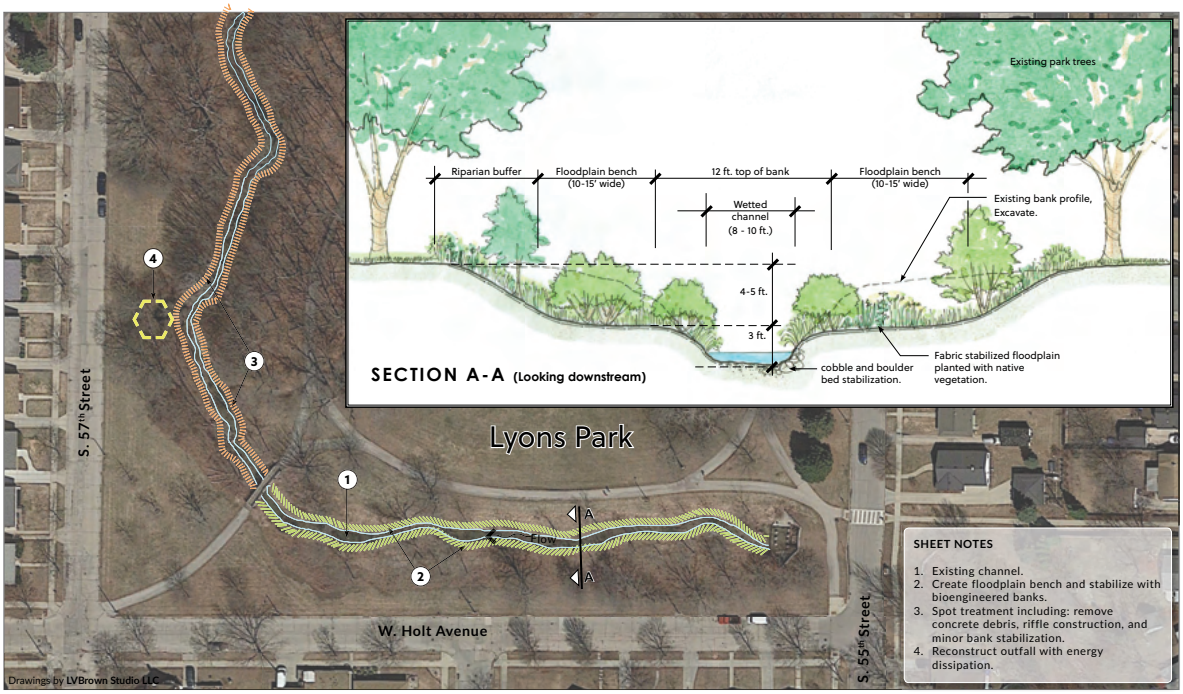
CONCEPT LEVEL COST ESTIMATES

The cost information provided in Appendix B comes with the understanding that these are preliminary estimates based on concept designs only. These estimates can be used for planning purposes, but 30%, 60% and 90% design submittals will need to be generated before more refined construction estimates can be given to improve accuracy in the bid process. Cost estimates for concept level projects are typically given with an accuracy of +/- 50 to 100%. We have included a 50% caveat, but it should be noted that true costs for projects are refined at each progressive submittal. It is likely that the plan will change significantly between concept and the next submittal, and estimated costs will need to be modified accordingly.

APPENDIX A - CONCEPT PLANS

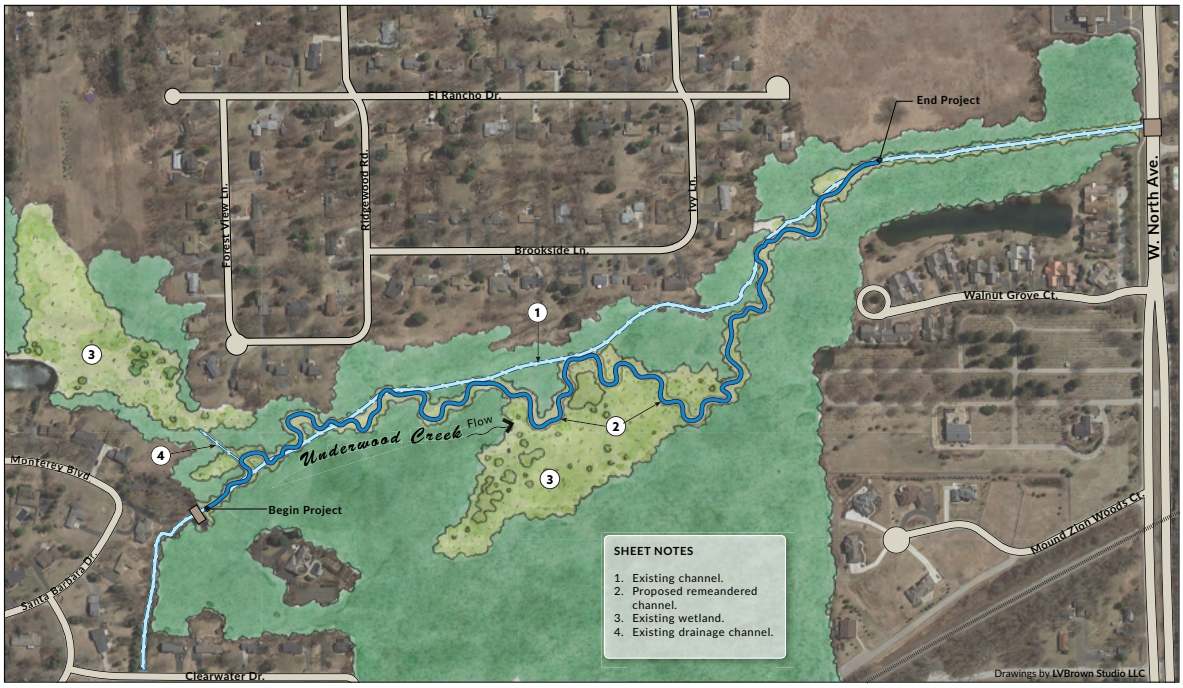
Rotary Park
Sweetwater Concept Design (August 26, 2015)
0 150 300 600 ft.
N
SHEET 1

Frontier Park - Butler, WI
Sweetwater Concept Design (June 19, 2015)
0 100 200 400 ft.
N
SHEET 2

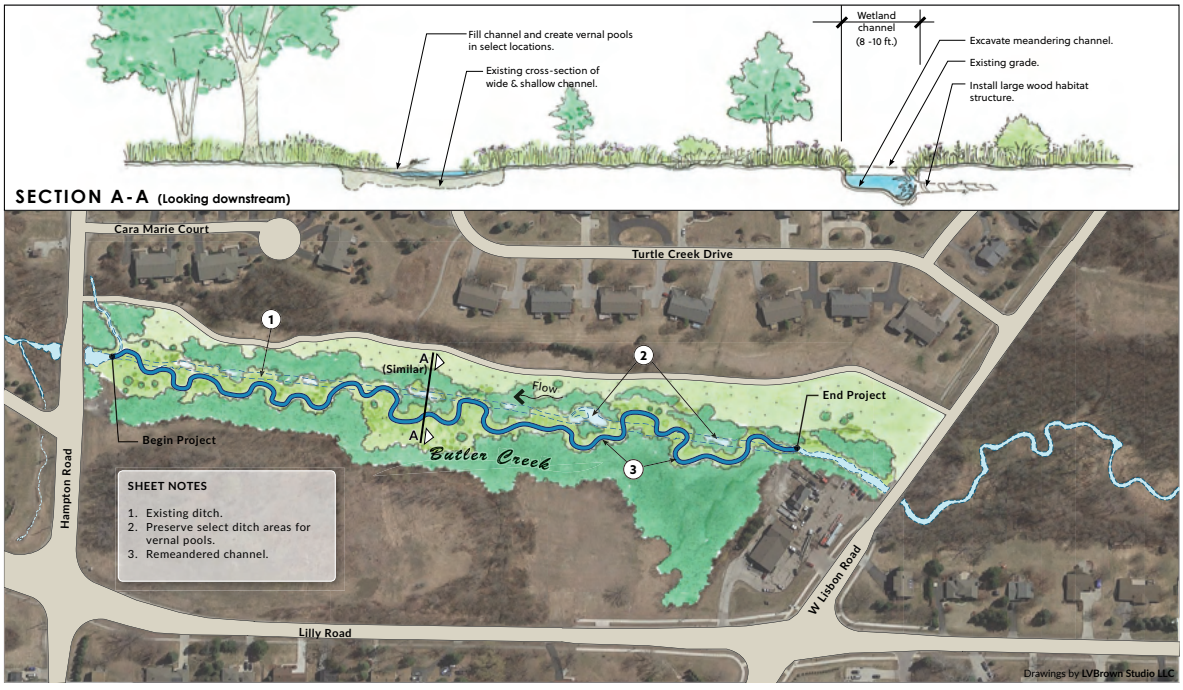


Lyons Park Creek
Sweetwater Concept Design (June 19, 2015)
0 40 80 120 ft.
N
SHEET 3

Underwood Creek - Elm Grove
Sweetwater Concept Design (June 19, 2015)
0 150 300 450 ft.
N
SHEET 4



Underwood Creek - Juneau to Pomona
Sweetwater Concept Design (June 19, 2015)
0 150 300 450 ft. N
SHEET 5



Butler Creek - Reach 1
Sweetwater Concept Design (August 26, 2015)
0 100 200 300 ft. N
SHEET 6

Butler Creek - Reach 2
Sweetwater Concept Design (June 19, 2015)
0 200 400 600 ft.
N
SHEET 7

Kinnickinnic River - Jackson Park West
Sweetwater Concept Design (August 26, 2015)
0 100 200 400 ft.
N
SHEET 8

inter·fluve Sweet Water

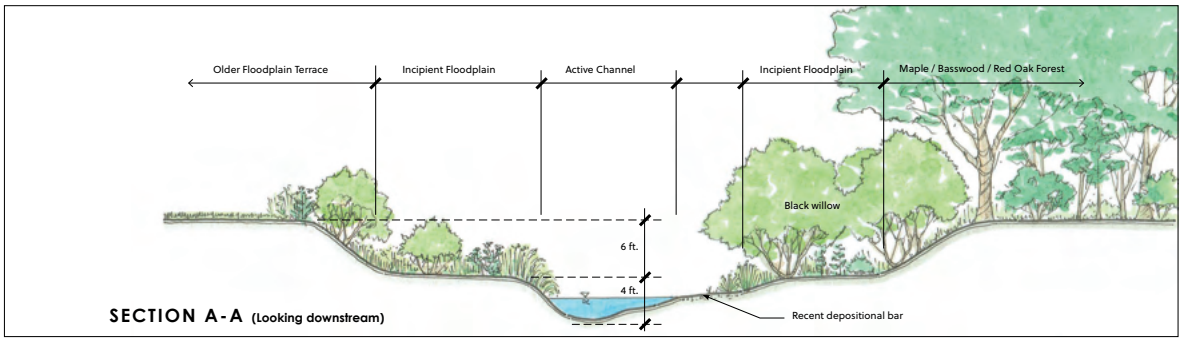
Kinnickinnic River - Jackson Park East

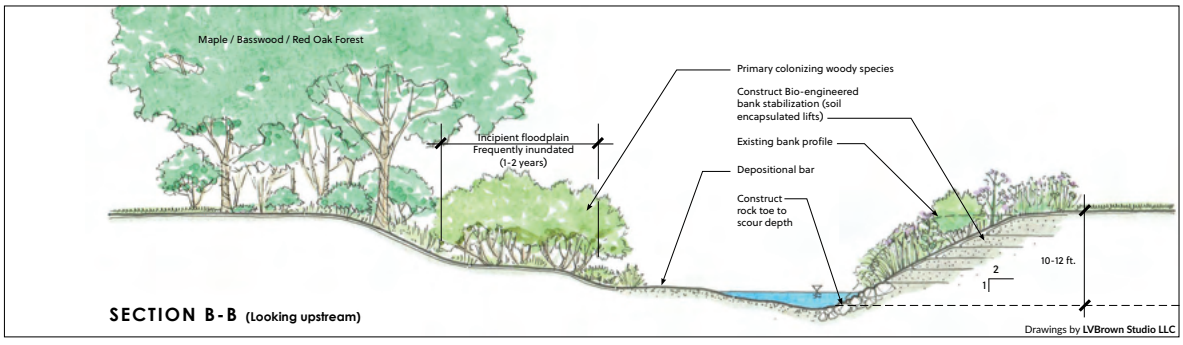
Sweetwater Concept Design (August 26, 2015)

0 100 200 400 ft.

N

SHEET 9





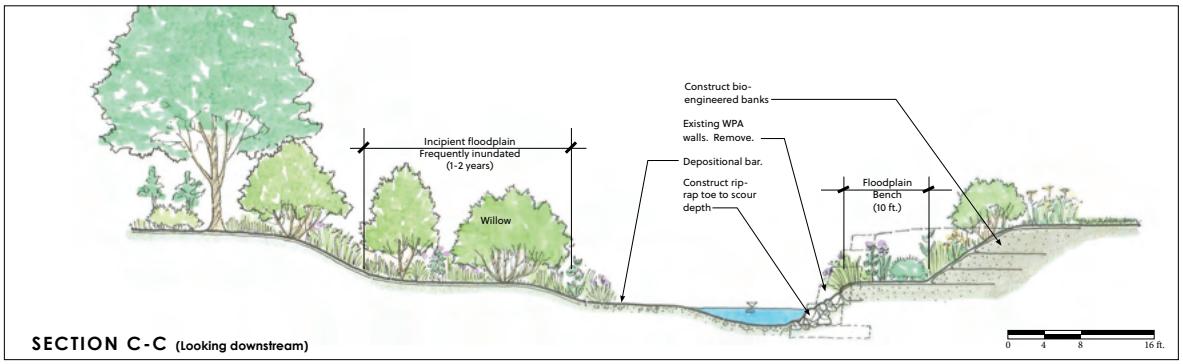
inter·fluve Sweet Water

Kinnickinnic River - Jackson Park - Sections

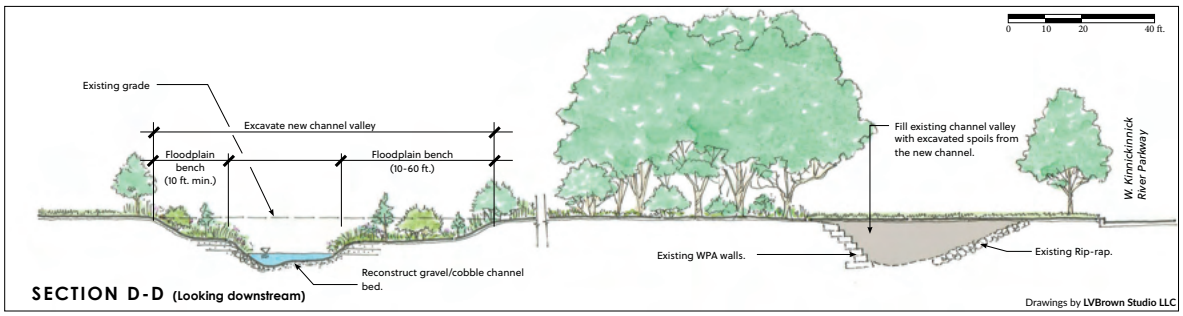
Sweetwater Concept Design (June 19, 2015)

0 4 8 16 ft.

SHEET 10



SECTION C-C (Looking downstream)



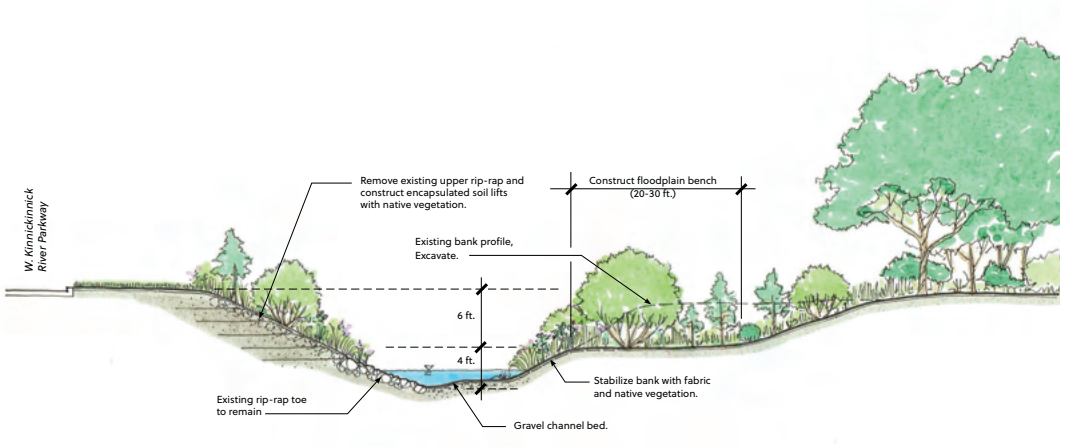
SECTION D-D (Looking downstream)

Drawings by **LVBrown Studio LLC**

Kinnickinnic River - Jackson Park - Sections
Sweetwater Concept Design (June 19, 2015)

0 4 8 16 ft.

SHEET 11



SECTION E-E (Looking downstream)

Drawings by **LVBrown Studio LLC**

Kinnickinnic River - Jackson Park - Sections
Sweetwater Concept Design (June 19, 2015)

0 4 8 16 ft.

SHEET 12

APPENDIX B – CONCEPT COST ESTIMATES

COST ESTIMATE WORKSHEET

PROJECT NAME: **Rotary Park, Menomonee Falls - Menomonee River** Milwaukee, WI

* Costs are ballpark (+/- 50%) Comprehensive project 8/24/2015

Phase I - Engineering and Permitting

Item	Description	Cost per	Unit	Number	Cost
Engineering Design	Includes survey, analysis, modeling, 30, 60, 90 and 100% submittals, plans specs. Concepts are complete. Stream only, no LA	$180,000	LS	1	$180,000
Permitting	All permits and related work	$25,000	LS	1	$25,000
				Total Design and Engineering	**$205,000**

Phase 2 - Construction

Item	Description	Cost per	Unit	Number	Cost
Staging and mobilization	includes clearing, equipment mobilization, general erosion control, haul road, staging area setup (10%)	$135,673.84	lump	1.0	$135,674
Clear, grub and process wood/slash	Clear trees - Remove whole trees, save slash and rootwads, logs on site. Slash and wood to be stored in strategic piles.	$3,500.00	acre	2.0	$7,000
Dewatering	Assumes combination of work off-line and dam/pump and/or diversion, limited in-situ dewatering necessary	$25,000	lump	1	$25,000
Excavation	Channel excavation, fill of old channel - assumes $3.50 per yd to move each time, 3 times. Visual compaction.	$15.00	CY	36,296	$544,444
Grade control riffles	Assumes some riffle construction (imported fill), and also simple bank shaping and erosion control, dig and pitch for bar formation	$100.00	CY	622	$62,222
Fabric treatments	Encapsulated lifts at old channel crossings only	$42.00	face ft	2,700	$113,400
Bank construction	1 side, surface fabric (2 layer) treatment, includes fabric, stakes and staples	$4.00	SY	20,000	$80,000
Large wood/logs	Assumes rootwads and logs, at least 50% on site. (15-25 ft long), includes materials and installation. Used at channel connections	$350.00	each	30	$10,500
Seeding	Single pass corridor 40ft wide + disturbed areas , staging and access repair (avg 60ft width); 30 lb/ac	$100.00	lb	289	$28,926
Planting	Trees and shrubs, includes materials (plants, vispore mats, deer protection, mulch) and labor	$100.00	each	400	$40,000
Construction oversight	Construction manual, pre bid, pre con, staking, oversight, punch list, and final inspection	$60,000	LS	1	$60,000
				Estimated Construction Cost	**$1,107,166** +/-50%

Estimate does not include pedestrian bridges, ball fields or other park amenities
Additional considerations include long term invasive species management of riparian vegetation

COST ESTIMATE WORKSHEET

PROJECT NAME: **Rotary Park, Menomonee Falls - Menomonee River** Milwaukee, WI

* Costs are ballpark (+/- 50%) Upstream and Downstream Reaches Separated 8/24/2015

Phase I - Engineering and Permitting (Assumes design of upstream reach only)

Item	Description	Cost per	Unit	Number	Cost
Engineering Design	Includes survey, analysis, modeling, 30, 60, 90 and 100% submittals, plans specs. Concepts are complete. Stream only, no LA	$150,000	LS	1	$150,000
Permitting	All permits and related work	$20,000	LS	1	$20,000
				Total Design and Engineering (Upstream reach)	**$170,000**

Phase 2 - Construction(Upstream from Pilgrim Rd to first footbridge)

Item	Description	Cost per	Unit	Number	Cost
Staging and mobilization	includes clearing, equipment mobilization, general erosion control, haul road, staging area setup (10%)	$33,743.20	lump	1.0	$33,743
Clear, grub and process wood/slash	Clear trees - Remove whole trees, save slash and rootwads, logs on site. Slash and wood to be stored in strategic piles.	$3,500.00	acre	1.0	$3,500
Dewatering	Assumes combination of work off-line and dam/pump and/or diversion, limited in-situ dewatering necessary	$15,000	lump	1	$15,000
Excavation	Channel excavation, fill of old channel - assumes $3.00 per yd to move each time, 3 times. Visual compaction.	$9.00	CY	9,333	$84,000
Grade control riffles	Assumes some riffle construction (imported fill), and also simple bank shaping and erosion control, dig and pitch for bar formation	$100.00	CY	100	$10,000
Fabric treatments	Encapsulated lifts at old channel crossings only	$42.00	face ft	1,800	$75,600
Bank construction	1 side, surface fabric (2 layer) treatment, includes fabric, stakes and staples	$4.00	SY	5,667	$22,667
Large wood/logs	Assumes rootwads and logs, at least 50% on site. (15-25 ft long), includes materials and installation. Used at channel connections	$350.00	each	15	$5,250
Seeding	Single pass corridor 40ft wide + disturbed areas , staging and access repair (avg 60ft width); 30 lb/ac	$100.00	lb	74	$7,438
Planting	Trees and shrubs, includes materials (plants, vispore mats, deer protection, mulch) and labor	$100.00	each	50	$5,000
Construction oversight	Construction manual, pre bid, pre con, staking, oversight, punch list, and final inspection	$30,000	LS	1	$30,000
				Estimated Construction Cost (Upstream Reach)	**$292,198** +/-50%

Estimate does not include pedestrian bridges, ball fields or other park amenities
Additional considerations include long term invasive species management of riparian vegetation

Phase 3 - Engineering and Permitting (Assumes design of downstream reach)

Item	Description	Cost per	Unit	Number	Cost
Engineering Design	Includes survey, analysis, modeling, 30, 60, 90 and 100% submittals, plans specs. Concepts are complete. Stream only, no LA	$180,000	LS	1	$180,000
Permitting	All permits and related work	$20,000	LS	1	$20,000
				Total Design and Engineering (Downstream reach)	**$200,000**

Phase 4 - Construction(From first footbridge to downstream end of project)

Item	Description	Cost per	Unit	Number	Cost
Staging and mobilization	includes clearing, equipment mobilization, general erosion control, haul road, staging area setup (10%)	$76,688.66	lump	1.0	$76,689
Clear, grub and process wood/slash	Clear trees - Remove whole trees, save slash and rootwads, logs on site. Slash and wood to be stored in strategic piles.	$3,500.00	acre	1.0	$3,500
Dewatering	Assumes combination of work off-line and dam/pump and/or diversion, limited in-situ dewatering necessary	$15,000	lump	1	$15,000
Excavation	Channel excavation, fill of old channel - assumes $3.00 per yd to move each time, 3 times. Visual compaction.	$9.00	CY	26,444	$238,000
Grade control riffles	Assumes some riffle construction (imported fill), and also simple bank shaping and erosion control, dig and pitch for bar formation	$100.00	CY	533	$53,333
Fabric treatments	Encapsulated lifts at old channel crossings only	$42.00	face ft	1,800	$75,600
Bank construction	1 side, surface fabric (2 layer) treatment, includes fabric, stakes and staples	$4.00	SY	17,000	$68,000
Large wood/logs	Assumes rootwads and logs, at least 50% on site. (15-25 ft long), includes materials and installation. Used at channel connections	$350.00	each	15	$5,250
Seeding	Single pass corridor 40ft wide + disturbed areas , staging and access repair (avg 60ft width); 30 lb/ac	$100.00	lb	211	$21,074
Planting	Trees and shrubs, includes materials (plants, vispore mats, deer protection, mulch) and labor	$100.00	each	350	$35,000
Construction oversight	Construction manual, pre bid, pre con, staking, oversight, punch list, and final inspection	$40,000	LS	1	$40,000
				Estimated Construction Cost (Downstream reach)	**$631,446** +/-50%

Estimate does not include pedestrian bridges, ball fields or other park amenities
Additional considerations include long term invasive species management of riparian vegetation

COST ESTIMATE WORKSHEET

PROJECT NAME: **Frontier Park, Butler, WI - Menomonee River**

Milwaukee, WI

* Costs are ballpark (+/- 50%)

8/24/2015

Phase I - Engineering and Permitting

Item	Description	Cost per	Unit	Number	Cost
Engineering Design	Includes survey, analysis, modeling, 30, 60, 90 and 100% submittals, plans specs. Concepts are complete. Stream only, no LA	$75,000	LS	1	$75,000
Permitting	All permits and related work	$15,000	LS	1	$15,000
				Total Design and Engineering	**$90,000**

Phase 2 - Construction

Item	Description	Cost per	Unit	Number	Cost
Staging and mobilization	includes clearing, equipment mobilization, general erosion control, haul road, staging area setup (10%)	$31,702.11	lump	1.0	$31,702
Clear, grub and process wood/slash	Clear trees - Remove whole trees, save slash and rootwads, logs on site. Slash and wood to be stored in strategic piles.	$3,500.00	acre	1.0	$3,500
Dewatering	Assumes combination of work off-line and dam/pump and/or diversion, limited in-situ dewatering necessary	$15,000	lump	1	$15,000
Excavation	Channel excavation, fill of old channel - assumes $3.50 per yd to move each time, 3 times. Visual compaction.	$15.00	CY	7,407	$111,111
Grade control riffles	Assumes riffle construction (imported fill) at one location, and also simple bank shaping and erosion control, dig and pitch	$100.00	CY	148	$14,815
Fabric treatments	Encapsulated lifts at old channel crossings only	$42.00	face ft	500	$21,000
Bank construction	1 side, surface fabric (2 layer) treatment, includes fabric, stakes and staples	$4.00	SY	1,667	$6,667
Large wood/logs	Assumes rootwads and logs, at least 50% on site. (15-25 ft long), includes materials and installation. Used at channel connections	$350.00	each	100	$35,000
Seeding	Disturbed areas, staging and access repair	$100.00	lb	28	$2,755
Planting	Trees and shrubs, includes materials (plants, vispore mats, deer protection, mulch) and labor	$100.00	each	50	$5,000
Construction oversight	Construction manual, pre bid, pre con, staking, oversight, punch list, and final inspection	$20,000	LS	1	$20,000
		.		**d Construction Cost**	**$266,550** +/-50%

Estimate does not include pedestrian bridges and other park amenities
Additional considerations include long term invasive species management of riparian vegetation

Baseball Field

Landscape architecture design	Includes baseball field relocation design	$50,000	LS	1	$50,000
Ball field relocation	New infield, grade, seeding, backstop, fencing and demolition and site repair of old facility	$50,000	LS	1	$50,000

COST ESTIMATE WORKSHEET

PROJECT NAME: **Lyons Park, Lyons Park Creek, Milwaukee**

Milwaukee, WI

* Costs are ballpark (+/- 50%)

8/24/2015

Phase I - Engineering and Permitting

Item	Description	Cost per	Unit	Number	Cost
Engineering Design	Includes survey, analysis, modeling, 30, 60, 90 and 100% submittals, plans specs. Concepts are complete. Stream only, no LA	$55,000	LS	1	$55,000
Permitting	All permits and related work	$15,000	LS	1	$15,000
				Total Design and Engineering	**$70,000**

Phase 2 - Construction

Item	Description	Cost per	Unit	Number	Cost
Staging and mobilization	includes clearing, equipment mobilization, general erosion control, haul road, staging area setup (10%)	$24,374.57	lump	1.0	$24,375
Clear, grub and process wood/slash	Clear trees - Remove whole trees, save slash and rootwads, logs on site. Slash and wood to be stored in strategic piles.	$3,500.00	acre	0.5	$1,750
Dewatering	Assumes combination of work off-line and dam/pump and/or diversion, limited in-situ dewatering necessary	$15,000	lump	1	$15,000
Excavation	Channel excavation, fill of old channel - assumes $3.50 per yd to move each time, 3 times. Visual compaction.	$15.00	CY	1,600	$24,000
Grade control riffles	Assumes 3 constructed riffles (imported materials), rearrange existing in-channel material below ped crossing	$100.00	CY	33	$3,333
Fabric treatments	FES lifts in lower bank floodplain area	$42.00	face ft	900	$37,800
Bank construction	1 side, surface fabric (2 layer) treatment, includes fabric, stakes and staples	$4.00	SY	3,000	$12,000
Riprap/boulders	Assumes 5ft deep, 2ft thick, 450 x 2 sides, Cobble sized rock, installed	$100.00	CY	333	$33,333
Outfall energy dissipator	Concrete or riprap solution	$30,000.00	LS	1	$30,000
Seeding	Disturbed areas, staging and access repair	$100.00	lb	20.3	$2,030
Planting	Trees and shrubs, includes materials (plants, vispore mats, deer protection, mulch) and labor	$100.00	each	50	$5,000
Construction oversight	Construction manual, pre bid, pre con, staking, oversight, punch list, and final inspection	$20,000	LS	1	$20,000
				d Construction Cost	**$208,622** +/-50%

Estimate does not include pedestrian bridges and other park amenities
Additional considerations include long term invasive species management of riparian vegetation

COST ESTIMATE WORKSHEET

PROJECT NAME: **Underwood Creek - Elm Grove, WI (Marcella to Elmhurst Pkwy)** Milwaukee, WI

* Costs are ballpark (+/- 50%) Elm Grove Village Park 8/24/2015

Phase I - Engineering and Permitting

Item	Description	Cost per	Unit	Number	Cost
Engineering Design	Includes survey, analysis, modeling, 30, 60, 90 and 100% submittals, plans specs. Concepts are complete. Stream only, no LA	$98,000	LS	1	$98,000
Permitting	All permits and related work	$20,000	LS	1	$20,000
				Total Design and Engineering	**$118,000**

Phase 2 - Construction

Item	Description	Cost per	Unit	Number	Cost
Staging and mobilization	includes clearing, equipment mobilization, general erosion control, haul road, staging area setup (10%)	$36,916.25	lump	1.0	$36,916
Clear, grub and process wood/slash	Clear trees - Remove whole trees, save slash and rootwads, logs on site. Slash and wood to be stored in strategic piles.	$3,500.00	acre	6.2	$21,694
Dewatering	Assumes combination of work off-line and dam/pump and/or diversion, limited in-situ dewatering necessary	$10,000	lump	1	$10,000
Excavation	Channel excavation, fill of old channel - assumes $3.50 per yd to move each time, 3 times. Visual compaction. Assumes 4500 ft of new channel.	$15.00	CY	5,000	$75,000
Grade control riffles	Assumes riffle construction (imported fill)	$100.00	CY	133	$13,333
Fabric treatments	Encapsulated lifts at old channel crossings only	$42.00	face ft	1,000	$42,000
Bank construction	1 side, surface fabric (2 layer) treatment, includes fabric, stakes and staples	$4.00	SY	10,111	$40,444
Large wood/logs	Assumes rootwads and logs, at least 50% on site. (15-25 ft long), includes materials and installation. Used at channel connections	$350.00	each	100	$35,000
Seeding	Disturbed areas, staging and access repair	$100.00	lb	103	$10,331
Planting	Trees and shrubs, includes materials (plants, vispore mats, deer protection, mulch) and labor	$100.00	each	200	$20,000
Construction oversight	Construction manual, pre bid, pre con, staking, oversight, punch list, and final inspection	$30,000	LS	1	$30,000
				d Construction Cost	**$334,719** +/-50%

Estimate does not include pedestrian bridges and other park amenities
Additional considerations include long term invasive species management of riparian vegetation

COST ESTIMATE WORKSHEET

PROJECT NAME: **Underwood Creek - Brookfield, WI (Clearwater to North Ave.)**

Milwaukee, WI

* Costs are ballpark (+/- 50%)

8/24/2015

Phase I - Engineering and Permitting

Item	Description	Cost per	Unit	Number	Cost
Engineering Design	Includes survey, analysis, modeling, 30, 60, 90 and 100% submittals, plans specs. Concepts are complete. Stream only, no LA	$98,000	LS	1	$98,000
Permitting	All permits and related work	$20,000	LS	1	$20,000
				Total Design and Engineering	**$118,000**

Phase 2 - Construction

Item	Description	Cost per	Unit	Number	Cost
Staging and mobilization	includes clearing, equipment mobilization, general erosion control, haul road, staging area setup (10%)	$36,616.25	lump	1.0	$36,616
Clear, grub and process wood/slash	Clear trees - Remove whole trees, save slash and rootwads, logs on site. Slash and wood to be stored in strategic piles.	$3,500.00	acre	5.5	$19,284
Dewatering	Assumes combination of work off-line and dam/pump and/or diversion, limited in-situ dewatering necessary	$10,000	lump	1	$10,000
Excavation	Channel excavation, fill of old channel - assumes $3.50 per yd to move each time, 3 times. Visual compaction. Assumes 4500 ft of new channel.	$15.00	CY	5,000	$75,000
Grade control riffles	Assumes riffle construction (imported fill)	$100.00	CY	133	$13,333
Fabric treatments	Encapsulated lifts at old channel crossings only	$42.00	face ft	1,000	$42,000
Bank construction	1 side, surface fabric (2 layer) treatment, includes fabric, stakes and staples	$4.00	SY	10,111	$40,444
Large wood/logs	Assumes rootwads and logs, at least 50% on site. (15-25 ft long), includes materials and installation. Used at channel connections	$350.00	each	100	$35,000
Seeding	Disturbed areas, staging and access repair	$100.00	lb	103	$10,331
Planting	Trees and shrubs, includes materials (plants, vispore mats, deer protection, mulch) and labor	$100.00	each	180	$18,000
Construction oversight	Construction manual, pre bid, pre con, staking, oversight, punch list, and final inspection	$30,000	LS	1	$30,000
				d Construction Cost	**$330,008** +/-50%

Estimate does not include pedestrian bridges and other park amenities
Additional considerations include long term invasive species management of riparian vegetation

COST ESTIMATE WORKSHEET

PROJECT NAME: **Butler Creek, Brookfield WI**

Milwaukee, WI

* Costs are ballpark (+/- 50%)

8/24/2015

Phase I - Engineering and Permitting

Item	Description	Cost per	Unit	Number	Cost
Engineering Design	Includes survey, analysis, modeling, 30, 60, 90 and 100% submittals, plans specs. Concepts are complete. Stream only, no LA	$98,000	LS	1	$98,000
Permitting	All permits and related work	$20,000	LS	1	$20,000
				Total Design and Engineering	**$118,000**

Phase 2 - Construction

Item	Description	Cost per	Unit	Number	Cost
Staging and mobilization	includes clearing, equipment mobilization, general erosion control, haul road, staging area setup (10%)	$17,879.75	lump	1.0	$17,880
Clear, grub and process wood/slash	Clear trees - Remove whole trees, save slash and rootwads, logs on site. Slash and wood to be stored in strategic piles.	$3,500.00	acre	1.7	$6,026
Dewatering	Assumes combination of work off-line and dam/pump and/or diversion, limited in-situ dewatering necessary	$10,000	lump	1	$10,000
Excavation	Channel excavation, fill of old channel - assumes $3.50 per yd to move each time, 3 times. Visual compaction. Assumes 1500 ft of new channel.	$15.00	CY	1,667	$25,000
Grade control riffles	Assumes riffle construction (imported fill)	$100.00	CY	44	$4,444
Fabric treatments	Encapsulated lifts at old channel crossings only	$42.00	face ft	500	$21,000
Bank construction	1 side, surface fabric (2 layer) treatment, includes fabric, stakes and staples	$4.00	SY	2,889	$11,556
Large wood/logs	Assumes rootwads and logs, at least 50% on site. (15-25 ft long), includes materials and installation. Used at channel connections	$350.00	each	60	$21,000
Seeding	Disturbed areas, staging and access repair	$100.00	lb	62	$6,198
Planting	Trees and shrubs, includes materials (plants, vispore mats, deer protection, mulch) and labor	$100.00	each	200	$20,000
Construction oversight	Construction manual, pre bid, pre con, staking, oversight, punch list, and final inspection	$40,000	LS	1	$40,000
				d Construction Cost	**$183,104** +/-50%

Estimate does not include pedestrian bridges and other park amenities
Additional considerations include long term invasive species management of riparian vegetation

COST ESTIMATE WORKSHEET

PROJECT NAME: **Butler Creek, Brookfield, WI**

Milwaukee, WI

8/24/2015

* Costs are ballpark (+/- 50%)

Phase I - Engineering and Permitting

Item	Description	Cost per	Unit	Number	Cost
Engineering Design	Includes survey, analysis, modeling, 30, 60, 90 and 100% submittals, plans specs. Concepts are complete. Stream only, no LA	$108,000	LS	1	$108,000
Permitting	All permits and related work	$20,000	LS	1	$20,000
				Total Design and Engineering	**$128,000**

Phase 2 - Construction

Item	Description	Cost per	Unit	Number	Cost
Staging and mobilization	includes clearing, equipment mobilization, general erosion control, haul road, staging area setup (10%)	$40,892.42	lump	1.0	$40,892
Clear, grub and process wood/slash	Clear trees - Remove whole trees, save slash and rootwads, logs on site. Slash and wood to be stored in strategic piles.	$3,500.00	acre	1.1	$4,017
Dewatering	Assumes combination of work off-line and dam/pump and/or diversion, limited in-situ dewatering necessary	$15,000	lump	1	$15,000
Excavation	Channel excavation, fill of old channel - assumes $3.50 per yd to move each time, 3 times. Visual compaction. Assumes 4500 ft of new channel.	$15.00	CY	6,444	$96,667
Grade control riffles	Assumes riffle construction (imported fill)	$100.00	CY	44	$4,444
Fabric treatments	Encapsulated lifts at old channel crossings only	$42.00	face ft	500	$21,000
Bank construction	1 side, surface fabric (2 layer) treatment, includes fabric, stakes and staples	$4.00	SY	14,444	$57,778
Large wood/logs	Assumes rootwads and logs, at least 50% on site. (15-25 ft long), includes materials and installation. Used at channel connections	$350.00	each	100	$35,000
Seeding	Disturbed areas, staging and access repair	$100.00	lb	227	$22,727
Planting	Trees and shrubs, includes materials (plants, vispore mats, deer protection, mulch) and labor	$100.00	each	200	$20,000
Construction oversight	Construction manual, pre bid, pre con, staking, oversight, punch list, and final inspection	$40,000	LS	1	$40,000
				d Construction Cost	**$357,526** +/-50%

Estimate does not include pedestrian bridges and other park amenities
Additional considerations include long term invasive species management of riparian vegetation

COST ESTIMATE WORKSHEET

PROJECT NAME: **Kinnickinnic River, Milwaukee, WI**

Milwaukee, WI
8/18/2015

* Costs are ballpark (+/- 50%)

Phase I - Engineering and Permitting

Item	Description	Cost per	Unit	Number	Cost
Engineering Design	Includes survey, analysis, modeling, 30, 60, 90 and 100% submittals, plans specs. Concepts are complete. Stream only, no LA	$300,000	LS	1	$300,000
Permitting	All permits and related work	$40,000	LS	1	$40,000
				Total Design and Engineering	**$340,000**

Phase 2 - Construction

Item	Description	Cost per	Unit	Number	Cost
Staging and mobilization	includes clearing, equipment mobilization, general erosion control, haul road, staging area setup (10%)	$164,444.40	lump	1.0	$164,444
Clear, grub and process wood/slash	Clear trees - Remove whole trees, save slash and rootwads, logs on site. Slash and wood to be stored in strategic piles.	$3,500.00	acre	4.0	$14,000
Dewatering	Assumes combination of work off-line and dam/pump and/or diversion, limited in-situ dewatering necessary	$35,000	lump	1	$35,000
Excavation	Channel excavation, fill of old channel - assumes $3.50 per yd to move each time, 3 times. Visual compaction. 1,100 feet of new channel and 4,000 ft of bench widening.	$15.00	CY	37,037	$555,556
Grade control riffles	Assumes riffle construction (imported fill)	$100.00	CY	593	$59,259
Fabric treatments	Encapsulated lifts	$42.00	face ft	6,000	$252,000
Bank construction	1 side, surface fabric (2 layer) treatment, includes fabric, stakes and staples	$4.00	SY	28,889	$115,556
Seeding	Disturbed areas, staging and access repair	$100.00	lb	289	$28,926
Planting	Trees and shrubs, includes materials (plants, vispore mats, deer protection, mulch) and labor	$100.00	each	500	$50,000
Construction oversight	Construction manual, pre bid, pre con, staking, oversight, punch list, and final inspection	$100,000	LS	1	$100,000
				d Construction Cost	**$1,374,740** +/-50%

Estimate does not include pedestrian bridges and other park amenities
Additional considerations include long term invasive species management of riparian vegetation

APPENDIX F. MENOMONEE RIVER MUNICIPAL GROUP STORMWATER PERMIT 2020

WISCONSIN
DEPT. OF NATURAL RESOURCES

STATE OF WISCONSIN
DEPARTMENT OF NATURAL RESOURCES

GENERAL PERMIT TO DISCHARGE UNDER THE WISCONSIN POLLUTANT DISCHARGE ELIMINATION SYSTEM
WPDES PERMIT NO. WI-S065404-2

In compliance with the provisions of Ch. 283 Wis. Stats., and Chs. NR 151 and 216, Wis. Adm. Code, the **Menomonee River Watershed Permittees**:

City of Brookfield
Village of Butler
Village of Elm Grove
Village of Germantown
City of Greenfield
Village of Menomonee Falls
City of Milwaukee
Milwaukee County
City of West Allis
Village of West Milwaukee
City of Wauwatosa

are permitted to discharge storm water from all portions of the

MUNICIPAL SEPARATE STORM SEWER SYSTEM

owned or operated by the Menomonee River Watershed Permittees to waters of the state in watersheds of the Menomonee River, Fox River, Kinnickinnic River, Root River, and Cedar Creek in accordance with the conditions set forth in this permit.

This permit takes effect on the date of signature. This permit to discharge expires at midnight, March 31, 2025. The Department is required to charge an annual permit fee to owners and operators authorized to discharge under this permit in accordance with s. 283.33(9), Wis. Stats., and s. NR 216.08, Wis. Adm. Code.

State of Wisconsin Department of Natural Resources
For the Secretary

By _____ 3/31/2020
Jacob Zimmerman, PE — Date Permit Signed
Water Resources Engineer

PERMIT EFFECTIVE DATE: April 1, 2020 **EXPIRATION DATE:** March 31, 2025

Table of Contents

I. APPLICABILITY

A. PERMITTED AREA

This Wisconsin Pollution Discharge Elimination System (WPDES) permit regulates municipal separate storm sewer system (MS4) discharges from the following municipalities located fully or partially within the Menomonee River Watershed:

- City of Brookfield
- Village of Butler
- Village of Elm Grove
- Village of Germantown
- City of Greenfield
- Village of Menomonee Falls
- City of Milwaukee
- Milwaukee County
- City of West Allis
- Village of West Milwaukee
- City of Wauwatosa

In this permit these municipalities are referred to as the Menomonee River Watershed Permittees. This permit covers all areas within the jurisdiction of the Menomonee River Watershed Permittees, including areas of the communities which do not drain into the Menomonee River watershed. This permit is issued in accordance with chapter 283, Wis. Stats. and chs. NR 151 and NR 216, Wis. Adm. Code.

B. AUTHORIZED DISCHARGES

This permit authorizes storm water point source discharges from the MS4 to waters of the state in the permitted area. This permit also authorizes the discharge of storm water co-mingled with flows contributed by process wastewater, non-process wastewater, and storm water associated with industrial activity, provided the discharges are regulated by other WPDES permits or are discharges which are not considered illicit discharges pursuant to Section II. D. 1 of this permit.

C. INDIVIDUAL RESPONSIBILITY

Each Menomonee River Watershed Permittee is responsible for:

1. Effectively prohibiting non-storm water discharges into the MS4 unless otherwise permitted by Section I. B.

2. Reducing pollutants to the maximum extent practicable (MEP). Compliance with this permit, completion of individual benchmarks, and implementation of the storm water management program establishes this MEP requirement.

3. Completing the Total Maximum Daily Load (TMDL) requirements in Section III. A. and the applicable municipality specific special requirements in Section III. B.

D. SHARED RESPONSIBILITY

1. The Menomonee River Watershed Permittees may work together to comply with the provisions of Section II. A. of this permit.

2. The Menomonee River Watershed Permittees' implementation of one or more of the conditions of this permit may incorporate cooperative efforts with other MS4 regulated

permittees or efforts by other groups or organizations if the shared responsibility is approved by the Department. The permittee may rely on another municipality or contract with another entity to satisfy a condition of this permit if all of the following are met:

a) The other municipality or entity implements the required control measure or permit requirements.
b) A particular control measure, or component thereof, is at least as stringent as the corresponding permit requirements.
c) The other municipality or entity agrees to implement a control measure or permit requirement on the permittee's behalf. This shall be shown by formal written agreement, signed by both parties' authorized representatives. The agreement shall be explicit as to which specific permit conditions are being covered by which municipality or other entity. Copies of current agreements shall be submitted with the annual report or to the Department upon request.

E. WATER QUALITY STANDARDS

1. This permit specifies the conditions under which storm water may be discharged to waters of the state for the purpose of achieving water quality standards contained in chs. NR 102 through 105, NR 140, and NR 207, Wis. Adm. Code. During the permit term, compliance with water quality standards will be addressed by adherence to the requirements of this permit, implementation of storm water management programs and practices, and modifications to practices when practices are determined not effective to achieve the aforementioned goals and standards.

2. This permit does not authorize water discharges that the Department, prior to authorization of coverage under this permit, determines will cause or have reasonable potential to cause or contribute to an excursion above any applicable water quality standards. Where such determinations have been made prior to authorization, the Department may authorize coverage under this permit where the storm water management programs required under this permit will include appropriate controls and implementation procedures designed to bring the storm water discharge into compliance with water quality standards.

F. WETLANDS

The permittee's MS4 discharge shall comply with the applicable wetland water quality standards provisions in ch. NR 103, Wis. Adm. Code.

G. ENDANGERED AND THREATENED SPECIES

The permittee's MS4 discharge shall comply with the endangered and threatened resource protection requirements of s. 29.604, Wis. Stats., and ch. NR 27, Wis. Adm. Code.

H. HISTORIC PROPERTY

The permittee's MS4 discharge may not affect any historic property that is listed property, or on the inventory or on the list of locally designated historic places under s. 44.45, Wis. Stats., unless the Department determines that the MS4 discharge will not have an adverse effect on any historic property pursuant to s. 44.40(3), Wis. Stats.

I. IMPAIRED WATERBODIES

The requirements of this section apply to receiving waters listed as impaired on the 303(d) list without established TMDL wasteload allocations to which the permittee discharges. The permittee shall:

1. Review the applicable pollutants of concern on the 2018 303(d) list, or the most recent United States Environmental Protection Agency (EPA) approved list that are relevant to the permittee's MS4 discharge and determine whether any part of its MS4 discharges to a listed impaired waterbody. Review shall occur within 12 months each time the 303(d) list is revised.

2. Include a written section in their storm water management program that discusses the management practices and control measures it will implement as part of its program to reduce, with the goal of eliminating, the discharge of each pollutant of concern that contributes to the impairment of the waterbody. This section of the permittee's program shall specifically identify control measures and practices that will collectively be used to eliminate the MS4's discharge of pollutant(s) of concern that contribute to the impairment of the waterbody and explain why these control measures and practices were chosen as opposed to other alternatives. Pollutant(s) of concern means a pollutant that is causing impairment of a waterbody.

   Note: The Department maintains a searchable database of impaired waterways. This publicly accessible database is available at http://dnr.wi.gov/water/impairedSearch.aspx.

3. After a permittee's start date of coverage under this permit, the permittee may not establish a new MS4 discharge of a pollutant of concern to an impaired waterbody or increase the discharge of a pollutant of concern to an impaired waterbody unless the new or increased discharge causes the receiving water to meet applicable water quality standards, or the new discharge is consistent with an EPA approved TMDL.

J. GENERAL STORM WATER DISCHARGE LIMITATIONS

In accordance with s. NR 102.04, Wis. Adm. Code, the Menomonee River Watershed Permittees shall control storm water discharges so that all surface waters including the mixing zone meet the following conditions at all times and under all flow and water level conditions:

1. Substances that will cause objectionable deposits on the shore or in the bed of a body of water, shall not be present in such amounts as to interfere with public rights in waters of the state.

2. Floating or submerged debris, oil, scum or other material shall not be present in such amounts as to interfere with public rights in waters of the state.

3. Materials producing color, odor, taste or unsightliness shall not be present in such amounts as to interfere with public rights in waters of the state.

4. Substances in concentrations or combinations which are toxic or harmful to humans shall not be present in amounts found to be of public health significance, nor shall substances be present in amounts which are acutely harmful to animal, plant or aquatic life.

K. EXCLUSIONS

The following are excluded from coverage under this permit:

1. Combined Sewer and Sanitary Sewer Systems:
   Discharges of water from a wastewater treatment facility, sanitary sewer or a combined sewer system conveying both sanitary and storm water. These discharges are regulated under s. 283.31, Wis. Stats, and require a separate individual permit.

2. Agricultural Facilities and Practices:
   Discharges from "agricultural facilities" and "agricultural practices". "Agricultural facility" means a structure associated with an agricultural practice. "Agricultural practice" means beekeeping; commercial feedlots; dairying; egg production; floriculture; fish or fur farming; grazing; livestock raising; orchards; poultry raising; raising of grain, grass, mint and seed crops; raising of fruits, nuts and berries; sod farming; placing land in federal programs in return for payments in kind; owning land, at least 35 acres of which is enrolled in the conservation reserve program under 16 USC 3831 to 3836; and vegetable raising.

3. Other Excluded Discharges:
   Storm water discharges from industrial operations or land disturbing construction activities that require separate coverage under a WPDES permit pursuant to subchs. II or III of ch. NR 216, Wis. Adm. Code. For example, while storm water from industrial or construction activity may discharge from an MS4, this permit does not satisfy the need to obtain any other permits for those discharges. This exclusion does not apply to each permittee's responsibility to regulate construction sites within its jurisdiction in accordance with Sections II. E. and F. of this permit.

4. Indian Country:
   Storm water discharges within Indian Country. The federal Clean Water Act requires that owners and operators of storm water discharges within Indian Country to obtain permit coverage directly from the EPA.

II. STORM WATER MANAGEMENT PROGRAM

The permittee shall have a written storm water management program (SWMP) that describes in detail how the permittee intends to comply with the permit requirements for each minimum control measure. Unless otherwise specified, the permittee shall submit written program documents no later than March 31, 2022 and shall begin implementing any updates to its storm water management programs no later than March 31, 2022.

A. GROUP PUBLIC EDUCATION AND OUTREACH CONDITIONS

The Menomonee River Watershed Permittees shall implement a written public education and outreach program to increase the awareness of how the combined actions of human behavior influence storm water pollution and its effects on the environment. The public education and outreach program may incorporate cooperative efforts with other entities not regulated by this permit provided a mechanism is developed and implemented to track the results of these cooperative efforts and reported annually.

The Menomonee River Watershed Permittees intend to collaborate and satisfy these conditions collectively. This does not prohibit the Menomonee River Watershed Permittees from continuing to develop and implement unique programs within their respective jurisdictional municipal boundaries.

The program shall:

1. For each topic in Table 1, identify targeted pollutants of concern, the targeted audience, delivery mechanism and the entity responsible for implementation.

2. Address all topics at least once during the permit term with a minimum of 3 topics being addressed, either collectively or individually, each year. Topics may be repeated as necessary.

3. Address the topics in Table 1 below:

Table 1: Public Education and Outreach Topics

#	Topic Area	Description
1	Illicit Discharge Detection and Elimination	Promote detection and elimination of illicit discharges and water quality impacts associated with such discharges from municipal separate storm sewer systems.
2	Household Hazardous Waste Disposal/Pet Waste Management/Vehicle Washing	Inform and educate the public about the proper management of materials that may cause storm water pollution from sources including automobiles, pet waste, household hazardous waste and household practices.
3	Yard Waste Management/Pesticide and Fertilizer Application	Promote beneficial onsite reuse of leaves and grass clippings and proper use of lawn and garden fertilizers and pesticides.
4	Stream and Shoreline Management	Promote the management of streambanks and shorelines by riparian landowners to minimize erosion and restore and enhance the ecological value of waterways.

5	Residential Infiltration	Promote infiltration of residential storm water runoff from rooftop downspouts, driveways and sidewalks through implementation of green infrastructure best management practices (BMPs) such as rain barrels, rain gardens, and permeable pavements.
6	Construction Sites and Post-Construction Storm Water Management	Inform and educate those responsible for the design, installation, and maintenance of construction site erosion control practices and storm water management facilities on how to design, install and maintain the practices.
7	Pollution Prevention	Storm water runoff from commercial properties and, where appropriate, educate specific businesses such as lawn care companies, golf courses, carwashes, and restaurants on storm water pollution prevention planning to reduce pollutant sources.
8	Green Infrastructure/Low Impact Development	Promote environmentally sensitive land development designs by developers and designers, including green infrastructure and low impact development.
9	Snow and Ice Control	Promote BMPs for snow and ice removal and inform specific audiences such as snow removal/deicing companies, private residences, industrial and commercial facilities, and residents about resources that provide further information on methods of reducing application of chemical deicers while maintaining public safety.

B. INDIVIDUAL EDUCATION AND OUTREACH CONDITIONS

Each MS4, excluding Milwaukee County, must implement an education and outreach program designed to achieve measurable goals based upon target audiences, specific storm water quality issues in the community, or identified pollutants of concern. The permittee must:

1. Evaluate the Storm Water Education Needs of their individual community by September 30, 2021. The permittee shall:

   a) Conduct a survey or use other appropriate methods to identify their education needs.

   b) Submit a list of prioritized storm water education needs for their community including the methods and rationale used for prioritization.

2. Complete Targeted Education. The permittee shall:

   a) By September 30, 2023, provide education and outreach within the MS4 boundary for at least one prioritized education topic identified in Section II. B. 1.

   b) Develop metrics that will be used for measuring progress after the education event has been held.

c) Submit as part of the permit application (due September 30, 2024), a summary of the results of the education efforts and planned targeted education for the next permit term.

C. PUBLIC INVOLVEMENT AND PARTICIPATION

The permittee shall implement a public involvement and participation program that provides opportunities for the public to effectively participate in the development, implementation, and modification of the permittee's storm water management program. The approach must include provisions for receiving and considering public comments on the following permit activities: annual reports, SWMP revisions, adoption of storm water related ordinances, and TMDL pollutant load reduction benchmark development. The permittee shall also identify delivery mechanism and target participants associated with each permit activity. Delivery mechanisms may include public workshop, presentation of storm water information, government event (public hearing, council meeting, etc.), citizen committee meeting, or website.

D. ILLICIT DISCHARGE DETECTION AND ELIMINATION

Each municipality shall continue to implement a program to detect, remove, and eliminate illicit connections and discharges to the municipal separate storm sewer system. The program must include:

1. **Ordinance:** An ordinance or other regulatory mechanism, at a minimum, to:
   a) Prohibit illicit discharge, spilling or dumping of non-storm water substances or material into the permittee's MS4 or waters of the state.

   b) Identify non-storm water discharges or flows that are not considered illicit discharges. Non- storm water discharges that are not considered illicit discharges including water line flushing, landscape irrigation, diverted stream flows, uncontaminated groundwater infiltration, uncontaminated pumped groundwater, discharges from potable water sources, foundation drains, air conditioning condensation, irrigation water, lawn watering, individual residential car washing, flows from riparian habitats and wetlands, firefighting, and discharges authorized under a WPDES permit unless identified by the permittee as significant source of pollutants to waters of the state.

   c) Establish inspection and enforcement authority.

   Note: Chapter NR 815, Wis. Adm. Code, regulates injection wells including storm water injection wells. Construction or use of a well to dispose of storm water directly into groundwater is prohibited under s. NR 815.11(5), Wis. Adm. Code.

2. **Dry Weather Outfall Screening:** A written IDDE field screening procedure. At a minimum, the procedure must include:
   a) The name, title, and phone number of the individual(s) responsible for field screening activities.

   b) Field screening during dry weather periods (72 hours after measurable rainfall) at the MS4 outfalls.

(1) Location. Screening locations shall be selected by the following criteria:

(a) All major outfalls which showed no indication of illicit discharges during the previous permit term. Annually, at least 20 percent of such major outfalls shall be screened, on a rolling basis, such that at the end of the permit term all major outfalls which showed no indication of illicit discharges during the previous permit term have been screened.

(b) All major outfalls which showed evidence of illicit discharges or exceeded a parameter action level during the last two samplings under the preceding permit term shall be evaluated at a minimum one time per year.

(c) All other outfalls regardless of size, which have been identified as a priority screening location based upon the Human Illicit Discharge Potential methodology. At least 20 percent of such priority outfalls shall be screened annually, on a rolling basis such that at the end of the permit term all major outfalls which showed no indication of illicit discharges during the previous permit term have been screened.

Note: The Human Illicit Discharge Potential methodology was developed during the previous permit term. The prioritization of non-major outfalls should be periodically updated based upon the results of field screening.

(2) Visual Observation. A narrative description of visual observations including color, odor, turbidity, oil sheen or surface scum, trash, flow rate, condition of conveyance system or outfall, and any other relevant observations regarding the potential presence of non-storm water discharges or illicit dumping shall be completed for each outfall visited.

(3) Field Analysis. If flow is observed, a field analysis must be conducted to determine the cause of the dry weather flow. The field analysis shall include sampling for pH, total chlorine, total copper, total phenol, and detergents unless the permittee elects to use alternative indicator parameters such as ammonia, potassium, and fluoride. Other alternative indicator parameters may be authorized by the Department in writing. Where appropriate, pollutant parameter action levels identified by the permittee must be considered. Field analysis procedures shall describe when other investigation methods such as dye testing or televising will be used.

(4) Pollutant parameter action levels that will be used as part of the field screening and analysis under Section II. D. 2. b) (3). The action levels will identify concentrations for identified pollutants that, if exceeded, will require further investigation, which may include laboratory analysis, to identify the source the illicit discharge.

(5) Laboratory Analysis. If general observations and field screening indicate the presence of a suspected illicit discharge and the source or cause of the illicit discharge cannot be determined through other investigatory methods, the permittee

shall collect a water quality sample for laboratory analysis for ongoing discharges. The water quality sample must be analyzed for pollutant parameters or identifiers which will aide in the determination of the sources of the illicit discharge.

c) Documentation. Visual observation and field screening results shall be recorded for each outfall and kept for 5 years. A summary of results shall be included with the annual report.

3. **Investigation and Elimination Procedures.** The permittee shall have written procedures for investigating and responding to known or suspected illicit discharges. Procedures must be developed for all of the following:

a) The name, title, and phone number of the individual(s) responsible for responding to reports of illicit discharges and spills.

b) Immediately investigating portions of the municipal separate storm sewer system that, based on the results of visual observation, field screening, laboratory analysis, or other relevant information, such as a complaint or referral, indicates a reasonable potential for containing illicit discharges.

c) Responding to spills that discharge into and/or from the MS4 including tracking the source of the spill if unknown.

d) Preventing and containing spills that may discharge into or are already within the MS4.

e) Immediately notifying the Department in accordance with ch. NR 706, Wis. Adm. Code, if the permittee identifies a spill or release of a hazardous substance, which results in the discharge of pollutants into waters of the state. The Department shall be notified via the 24-hour toll free spill hotline at 1-800-943-0003. The permittee shall cooperate with Department in efforts to investigate and prevent such discharges from polluting waters of the state.

f) Elimination of the illicit discharge as soon as practicable.
(1)Once the source of an illicit discharge is determined, the permittee must take appropriate action to seek to eliminate the illicit discharges within 30 days. This includes an initial evaluation of the feasibility to eliminate the discharge within 30 days. The permittee shall contact the Department if the illicit discharge cannot be eliminated in the 30-day time period.

(2)If the permittee determines that the elimination of the illicit discharge will take more than 30 days due to technical, logistical or other reasonable issues, the permittee must develop and implement an illicit discharge elimination plan to remove the illicit discharge in an expeditious manner. The elimination plan must be submitted to the Department within 45 days of determining the source of an illicit discharge. In lieu of developing and implementing an individual elimination plan for common types of illicit discharges, the permittee may document and

implement response procedures, a response plan, or similar document. The action plan, response procedures, response plan or similar document must include a timeframe for elimination of the illicit discharge as soon as practicable.

g) Elimination of any leakage or discharge from sanitary conveyance systems into the MS4 as required in s. NR 216.07 (3) (h), Wis. Adm. Code.

h) Providing the Department with advance notice of the time and location of dye testing within a MS4.

i) Notification of adjacent municipality. In the case of an illicit discharge that originates from the municipality's permitted area and that discharges directly to a storm sewer system or property under the jurisdiction the adjacent municipality, the first municipality shall notify the affected municipality within one working day.

j) Documentation. The permittee shall maintain a system for documenting complaints, referrals, and any actions taken to investigate or eliminate an illicit discharge. A summary of illicit discharge activities for each year shall be included in the annual report.

4. **Enforcement Response.** Include documentation in an enforcement response plan or similar document, by March 31, 2022 a description of the enforcement response procedures the permittee implements when an illicit discharge investigation identifies a responsible party.

5. **Training:** All staff responsible for implementation of the IDDE program shall receive training at least once per permit term. This includes office staff, field staff, and emergency response staff (police and fire departments).

E. CONSTRUCTION SITE POLLUTION CONTROL

The permittee shall continue to implement and enforce a written program that establishes measurable goals and reduces the discharge of sediment and construction materials from construction sites. The permittee through implementation of this program shall:

1. Maintain and enforce the municipal ordinance regarding construction site storm water discharges on all sites, including municipal projects. The municipal ordinance must include the following items:

a) Performance standards equivalent to, or more restrictive than, those under ss. NR 151.11 and 151.23, Wis. Adm Code.

b) Sanctions to ensure compliance to the extent authorized by law.

c) Requirements for construction site operators to manage waste such as discarded building materials, concrete truck washout, chemicals, litter, and sanitary waste at the construction site so to reduce adverse impacts to waters of the state.

Note: The County has identified in their permit application that in lieu of a County ordinance, the County defers to the applicable municipal construction erosion control ordinance for all county projects. Construction activities undertaken by Milwaukee County, as well as all other construction activities occurring on Milwaukee County owned lands, are required to follow the construction erosion control ordinance of the applicable municipality that the project is within.

2. Implement procedures for conducting plan reviews to ensure site planning considers potential water quality impacts. Erosion and sediment control best management practices must comply with design, installation, and maintenance standards that meet or exceed the Department's technical standards or permittee's ordinance.

3. Conduct erosion control inspections at sites one acre or more in size within the permittee's jurisdiction. Beginning April 1, 2021, conduct erosion control inspections following the frequency and actions outlined in Table 2.

Table 2: Construction Site Inspection Frequency

Site	Inspection Frequency
(1) All sites one acre or more in size	• New projects shall be inspected within the first two weeks of commencement of land disturbing activity • All active sites shall be inspected at least once every 45 days • All inactive sites shall be inspected at least once every 60 days
(2) Follow up inspection	• Follow up inspections are required within 7 days of any sediment discharge or inadequate control measure, unless corrections were made and observed by the inspector during initial inspection or corrections were verified via photographs submitted to the inspector
(3) Final inspection	• Confirm that all graded areas have reached final stabilization and that all temporary control measures are removed, and permanent storm water management BMPs are installed as designed

4. Maintain records of site inspections, including any follow up necessary on sites out of compliance with their site-specific erosion control plans, as identified in the permittee's program.

5. Enforce erosion and sediment control plan requirements for landowners of construction sites equivalent to those contained in s. NR 216.46, Wis. Adm. Code, including municipal projects applicable under the permittee's ordinance.

6. Enforce permit coverage termination requirements for landowners of construction sites equivalent to those contained in s. NR 216.55, Wis. Adm. Code, including removal of all temporary erosion and sediment control best management practices and complete site restoration with perennial vegetative cover.

7. Maintain an enforcement response plan or similar document describing the enforcement procedures the permittee will follow when addressing issues at construction sites. The enforcement procedures must ensure construction activities are in compliance with the ordinances.

8. Implement procedures for responding to information submitted by the public, including complaints.

F. POST-CONSTRUCTION STORM WATER MANAGEMENT

Each municipality shall continue to implement and enforce a written program that establishes measurable goals and to control the quantity and quality of discharges from areas of new development and redevelopment, after construction is completed. The program shall include:

1. An ordinance or other regulatory mechanism to regulate post-construction storm water discharges from new development and redevelopment. At a minimum, the ordinance or other regulatory mechanism shall establish or include:

   Note: Milwaukee County has identified in their permit application that in lieu of a County ordinance, the County defers to the applicable municipal post-construction storm water discharge ordinance for all county projects. Construction activities undertaken by Milwaukee County, as well as all other construction activities occurring on Milwaukee County owned lands, are required to follow the post-construction storm water discharge ordinance of the applicable municipality that the project is within. To fulfill this permit requirement, the County can submit to the Department a declaration or other written policy that identifies this procedure.

   a) Applicability and jurisdiction that shall apply to new development and redevelopment projects with one acre or more of land disturbance, and sites of less than one acre if they are part of a larger common plan of development or sale within the jurisdiction of the permittee. The jurisdiction shall include any adjacent developing areas that are planned to have a minimum density of 500 people per square mile, the urbanized area, and developing areas whose runoff will connect to the MS4.

   b) Design criteria, standards and specifications equivalent to the technical standards approved by the Department. The Department approved technical standards are available at http://dnr.wi.gov/topic/stormwater/standards/index.html.

   c) Post-construction performance standards equivalent to, or more restrictive than, those in ss. NR 151.121 through 151.125, Wis. Adm. Code.

   d) Storm water management plan requirements for landowners of construction sites equivalent to those contained in s. NR 216.47, Wis. Adm. Code.

   e) Permitting requirements, procedures and fees.

f) Long-term maintenance requirements for landowners and other persons responsible for long- term maintenance of post-construction storm water control measures, including requirement for routine inspection and maintenance of privately-owned post-construction storm water control measures that discharge into the MS4 to maintain their pollutant removal operating efficiency.

g) Inspection and enforcement authority.

2. Written procedures for post-construction site plan review which incorporate consideration of potential water quality impacts, including source water protection areas where applicable. Post-construction reviews must be conducted for all construction sites with one or more acres of land disturbance.

3. A system for tracking and completing long-term maintenance, inspections, and enforcement of all post-construction BMPs, public and private. This system shall include:

a) An inventory of all municipally owned or operated BMPs which includes:

(1) BMP, name, location, BMP type, and year constructed.
(2) Record drawing.
(3) An operation and maintenance plan with inspection procedures and schedule.
(4) Written documentation of the municipalities' ability to use a privately-owned BMP to meet a water quality requirement of this permit.

b) Written procedures that will be used by the permittee through its ordinance jurisdiction, approval process, and authority, to track and enforce the long-term maintenance of storm water management facilities implemented to meet the post-construction performance standards in Section II F. 1. c).

c) Long-term maintenance inspections at least once per permit term

d) Inspection documentation

e) A description of the inspection and enforcement response procedures the permittee will follow when addressing project compliance issues with the enforceable post-construction storm water management performance standards.

4. Green Infrastructure Barrier Removal. Each permittee shall review design, construction, landscaping and other related ordinances to identify and remove barriers to implementation of green infrastructure projects within the MS4. Barriers shall be removed through adopted ordinance revisions by March 31, 2022. If barriers are identified after March 31, 2022, the barriers shall be removed within 18 months of barrier identification.

G. POLLUTION PREVENTION

Each municipality shall develop and implement a written pollution prevention program that establishes measurable goals for pollution prevention. The program shall include:

1. Winter Road Management:
   a) Road salt or other deicer shall not be applied in quantities larger than required to maintain public safety. The permittee shall develop and implement a written salt application or salt reduction strategy to minimize over application of deicers. The strategy shall include a description of the temperature, precipitation event, and road conditions, and other factors which warrant different management techniques. The plan will also include a description of the equipment and products used for road management.

   b) All salt application equipment shall be calibrated annually beginning November 2020. Calibration methods shall be documented in the salt application strategy or similar document and calibration records kept for 5 years.

   c) Training on the Permittee's salt strategy shall be provided at a frequency no less than every other year.

   d) The quantity of salt and other deicing products shall be tracked on a monthly basis and reported on the annual report.

2. Nutrient Management:
   The application of turf and garden fertilizers on five acres or more of municipally controlled properties shall be done in accordance with a site-specific nutrient application schedule based on appropriate soil tests. The nutrient application schedule shall be designed to maintain the optimal health of the turf or garden vegetation. All properties subject to this section shall be identified on the MS4 map.

3. Street Sweeping and Catch Basin Cleaning:
   a) If street sweeping or catch basin cleaning is utilized to meet a water quality requirement under this permit, sweeping and catch basin shall continue at the frequency specified in the SWMP. The number of lane miles swept, number of catch basins cleaned, and the weight in tons of the material collected shall be tracked and included in the Annual Report.

   b) Material collected through street sweeping and catch basin cleaning shall be handled and stored in a manner that prevents contamination of storm water runoff and shall be disposed of or beneficially reused in accordance with applicable solid and hazardous waste statutes and administrative codes. Non-storm water discharges to waters of the state associated with dewatering and drying material collected under section a) of this section are not authorized by this permit.

      Note: Information on managing waste and materials is available on the Department's Internet site at: https://dnr.wi.gov/topic/Waste/. Information on WPDES permits for non-storm water discharges is available on the Department's Internet site at: https://dnr.wi.gov/topic/wastewater/

4. Management of Leaves and Grass Clippings:
   If the permittee provides leaf and grass clipping collection, the program shall include the following:

   a) A description of the leaf collection program, including pick-up methodology and equipment used, timing of associated street cleaning, standard operating procedures, schedule and frequency, and instructions for residents and property owners.

   b) Identification of leaf disposal locations.

   c) An estimate of the weight in tons of material collected annually and a description of how the weight is estimated.

   d) By March 31, 2023, A description of the BMPs which the permittee employs or will employ to its leaf collection program that reduce nutrient loading to the receiving waters. The permittee shall consider source, transport and discharge location when considering BMPs for the leaf collection program.

5. Storm Water Pollution Prevention Planning:
   All municipal garages, municipal storage areas, and other public works related municipal facilities shall have a Storm Water Pollution Prevention Plan (SWPPP). The SWPPPs shall:

   a) Be developed and implemented by December 31, 2020 for sites without a SWPPP.

   b) Include the information under s. NR 216.27 (3), Wis. Adm. Code, minus the monitoring requirements under s. NR 216.27 (3) (l), Wis. Adm. Code.
   Note: The SWPPP requirements can be located here: https://docs.legis.wisconsin.gov/code/admin_code/nr/200/216/II/27.

   c) Conduct and document quarterly visual inspections of the property and annual facility compliance inspections.

   d) Discuss spill prevention and response for each facility.

   e) Contain procedures for annual training of municipal staff on implementation of the SWPPP.

6. Internal Training and Education:
   The permittee shall provide education for appropriate municipal and other personnel involved in implementing the pollution prevention programs. Documentation shall be maintained of the date, the names of each person attending, and the content of the training.

H. STORM WATER QUALITY MANAGEMENT

Each municipality shall develop and implement a municipal storm water management program that controls the discharge of total suspended solids from the MS4 system to waters of the state.

1. The storm water management program shall achieve compliance with the developed urban area performance standards of s. NR 151.13(2), Wis. Adm. Code, for those areas of the municipality that were not subject to the post-construction performance standards of s. NR 151.12 or 151.24, Wis. Adm. Code. (Note: projects prior to Oct. 1, 2004).

2. The permittee shall ensure continued operation and maintenance of all best management practices implemented on or before July 1, 2011 to achieve a total suspended solids reduction of more than 20 percent as compared to no controls.

I. STORM SEWER SYSTEM MAP

Each municipality shall maintain a municipal separate storm sewer system map. The municipal storm sewer system map shall include:

1. Identification of waters of the state, watershed boundaries, name and classification of receiving waters, and identification of whether the receiving water is listed as an impaired water under s. 303 (d) of the Clean Water Act.

2. Identification of all known municipal storm sewer system outfalls discharging to waters of the state or other municipal separate storm sewer systems, stormwater drainage basin boundaries for each MS4 outfall, and municipal separate storm sewer conveyance systems with flow direction. Major outfalls shall be categorized and priority outfalls for illicit discharge detection and elimination shall be identified. Other major municipal, government, or privately-owned storm water conveyance systems lying within, but not owned by the permittee, shall also be identified.

3. A boundary defining the municipal border and the storm water planning area.

4. The location of any known discharge to the municipal separate storm sewer system that has been issued a WPDES permit by the Department.

5. Location of municipally owned or operated structural storm water controls including detention basins, infiltration basins, and manufactured treatment devices. If the permittee will be taking credit for pollutant removal from privately-owned facilities, they must be identified.

6. Identification of publicly owned parks, recreational areas and other open lands.

7. Location of municipal garages and other public works facilities.

8. Identification of streets.

9. Identification of other potential sources of pollution.

J. AMENDMENTS

The permittee shall amend a program required under this permit as soon as possible if the permittee becomes aware that it does not meet a requirement of this permit. The permittee shall

amend its program if notified by the Department that a program or procedure is insufficient or ineffective in meeting a requirement of this permit. The Department notice to the permittee may include a deadline for amending and implementing the amendment.

K. ANNUAL REPORT

The Permittee shall submit an annual report by **March 31st of the following year** for each calendar year unless the Department authorizes biannual reporting to be submitted the 2nd and 4th year of the permit term pursuant to s. NR 216.07(8) Wis. Adm. Code. The municipal governing body, interest groups and the general public shall be provided opportunity to review and comment on the annual report. The annual report shall include:

1. An evaluation of program compliance, the appropriateness of identified BMPs, and progress towards achieving identified measurable goals. Any program changes made as a result of this evaluation shall be identified and described in the annual report. For any identified deficiencies towards achieving the requirements under Section II of this permit or lack of progress towards meeting a measurable goal, the permittee shall initiate program changes to improve their effectiveness.

2. Updated storm sewer system maps, where necessary, to identify any new outfalls, structural controls, or other noteworthy changes.

3. An IDDE report that includes:

   a) A summary of screening results from outfalls evaluated under Section II D.2.

   b) Identified Illicit Discharges: A summary of each identified illicit discharge and follow up actions.

   c) Spills: A summary of all spills including location, material, quantity, and follow up actions.

4. A summary describing:

   a) The number and nature of construction and post-construction inspections and enforcement actions conducted to ensure compliance with the required ordinances.

   b) Street sweeping frequency and the amount collected.

   c) Catch basin cleaning frequency and the amount collected.

   d) All SWPPP inspections.

   e) Pollutant loading removal rates and status of meeting performance standards.

2. A fiscal analysis which includes the annual expenditures and budget for the reporting year, and the proposed budget for the next year.

3. Identification of any known water quality improvements or degradation in the receiving water to which the permittee's MS4 discharges as required in Section I I. 2. Where degradation is identified, identify why and what actions are being taken to improve the water quality of the receiving water.

4. A duly authorized representative of the permittee shall sign and certify the annual report and include a statement or resolution that the permittee's governing body or delegated representatives have reviewed or been apprised of the content of the annual report.

5. The annual report and other required reports, and permit compliance documents shall be submitted electronically through the Department's electronic reporting system.

   Note: The Department's electronic reporting system is Internet-based and available at: https://dnr.wi.gov/permits/water/. Municipal storm water permit eReporting information and user support tools can be found at: https://dnr.wi.gov/topic/stormwater/municipal/eReporting.html

L. REAPPLICATION FOR PERMIT COVERAGE

To remain covered after the expiration date of this permit, pursuant to s. NR 216.09, Wis. Adm. Code, the permittee shall submit an application package to the Department by September 30, 2024 for continued coverage under a reissued version of this permit. The application package shall include:

1. For each storm water management program, the proposed program modifications and measurable goals for the next permit term. This includes specific actions and activities or structural BMPs and expected dates of implementation.

2. An assessment of the proposed storm water management program's adequacy to reduce pollutants to the MEP. The assessment must include:

   a) Explanation and rationale on how implementation of the programs provides the highest level of performance that is achievable during the next permit term considering other environmental problems, technical capability, current technology, and available resources.

   b) Estimate the additional pollution reduction and water quality benefits from the proposed action. This includes proposed BMPs for pollutants causing impairments not included in a TMDL.

3. A fiscal evaluation summarizing program expenditures for the current permit cycle and projected program allocations for the next permit cycle.

4. An updated estimate of annual storm water pollutant loads for TSS and TP. A description of how the pollutant loads were calculated shall be provided.

5. The established TMDL pollutant load reduction benchmarks, as required by Section III. A. 3.

6. The proposed fecal coliform reduction benchmarks for the next permit term, as discussed in Section III. A. 4.

7. Updated MS4 maps showing service boundary of the MS4, projected changes in land use and future growth, and industrial WPDES permittees which discharge to the MS4.

8. A summary of the results from the individual education efforts in Permit Section II. B. 2 and the planned education efforts for the next permit term.

III. SPECIAL CONDITIONS

A. TOTAL MAXIMUM DAILY LOADS (TMDLs):

The Requirements of this section apply to discharges covered under the "Total Maximum Daily Loads for Total Phosphorus, Total Suspended Solids, and Fecal Coliform Milwaukee River Basin, Wisconsin" as approved by USEPA on March 9, 2018. The Permittee shall complete the following:

1. TMDL POLLUTANT LOAD REDUCTION EVALUATION FOR TSS AND TP:

The progress towards reducing TMDL pollutant loads shall be evaluated by the Permittee through modeling analysis, or through substantially similar or equivalent methods as approved by the Department. The results of the pollutant reduction evaluation shall be described in a report and submitted to the Department by March 31, 2023. The report must contain the following items:

a) A map that identifies:

(1) The TMDL reachshed boundaries within the municipal boundary
(2) The MS4 drainage boundaries associated with each TMDL reachshed
(3) Identification of areas within the municipal boundary the permittee believes should be excluded from its analysis to show progress towards reducing TMDL pollutant loads
(4) Structural BMPs and associated drainage area for each BMP used for pollutant reduction.

b) The associated area, in acres, for the lands identified in Section III. A.1.a (1) through (4).

c) An explanation for why the the area identified in Section III. A.1.a (3) are to be excluded from analysis

d) The methodology and rationale used to evaluate progress towards reducing TMDL pollutant loads

e) For each reachshed, an estimate of the current pollutant loading without considering implementation of BMPs and an estimate of the current pollutant loadings considering BMP implementation. The difference between these two estimates is the existing load reduction. For privately owned BMPs, the permittee must have a maintenance agreement to count the load reduction.

f) A comparison of the applicable TMDL WLA for each reachshed to the estimated pollutant loading with and without BMPs. The applicable TMDL reachshed reductions from the no controls condition are identified in Section VII.

g) For each structural BMP, a tabular summary which identifies the type of BMP, area treated in acres, pollutant loading reduction efficiency, and documentation of the maintenance agreement for any private BMP.

h) A description of the effectiveness of non-structural BMPs, if applicable, and the rationale for the selected approach.

i) A narrative summarizing progress towards the applicable TMDL WLAs, and if applicable, existing TMDL benchmarks.

j) If the permittee estimates that the TMDL WLAs are achieved with existing BMP implementation, the permittee must provide a statement supporting this conclusion.

2. WLA ATTAINMENT ANALYSIS:

The permittee shall complete an assessment of TSS and TP WLA attainment, including identifying information related to the type and extent of BMPs necessary to achieve the pollutant load reductions in the Milwaukee River Basin TMDL and the financial costs and other resources that may be associated with the implementation, operation and maintenance of BMPs. The results of the assessment must be submitted to the Department by September 30, 2023. The attainment analysis shall also include:

a) A review of local development and redevelopment standards. This review shall evaluate historical development and redevelopment rates and the potential pollutant load reduction achieved in future years if more stringent pollutant reductions standards are adopted.

3. ESTABLISHMENT OF WLA BENCHMARKS FOR TSS AND TP

A TMDL pollutant reduction benchmark must be developed for TSS and TP where existing BMP implementation is not achieving the WLA. Updated pollutant benchmarks must be submitted by September 30, 2024. The submittal must include:

a) The pollutant load reduction benchmark proposed to achieve additional progress towards the TMDL WLA during the next permit term.

b) An explanation of the relationship between the TMDL WLA and the TMDL benchmark for each TMDL pollutant.

c) A description of how SWMP implementation contributes to the overall reduction of the TMDL pollutants during the next permit term.

d) Identification of additional BMPs or modified BMPs that will result in further reductions in the discharge of the applicable TMDL pollutants, including the rationale for proposing the BMPs.

e) An estimate of current pollutant loading that reflect implementation of the current BMPs and the BMPs proposed to be implemented during the next permit term.

4. FECAL COLIFORM REDUCTION EFFORTS:

a) Each permittee shall develop an action benchmark for bacteria for their Illicit Discharge Screening program as described in Section II. D. 6. By June 30, 2021.

b) Fecal Coliform Inventory: By March 31, 2023, the permittee shall develop and submit to the Department an inventory of fecal coliform sources and a map indicating the locations of the potential sources of fecal coliform entering the MS4. The inventory shall be in tabular format and include a label code, location, description, and ownership of the source. The map shall identify the location of the sources by label code. The

inventory shall consider flow variation in its identification of sources. The inventory and map shall include the following sources:

(1) Known or suspected leaking or failing septic systems
(2) Sanitary sewer overflow locations
(3) Livestock and domesticated animals housed or raised within the MS4 permitted area and discharging into the MS4, but not including household pets.
(4) Zoos, kennels, animal breeders, pet stores, and dog training facilities
(5) Waste hauling, storage, and transfer facilities
(6) Areas that attract congregations of nuisance urban birds and wildlife
(7) Known or suspected properties with inadequate food or organic waste handling or storage
(8) Composting sites or facilities
(9) Known or suspected areas with improper human sanitation use
(10) Any other source that the permittee identifies as discharging to the MS4.

c) By September 30, 2023, the permittee shall develop and submit to the Department a fecal coliform source elimination plan. The plan shall include:

(1) Prioritization of source removal with and explanation of the prioritization criteria. Prioritization criteria shall include, at a minimum, fecal coliform source, exposure risk, ease of removal, and cost.
(2) A description of the type and extent BMPs to be employed to address each source
(3) A cost estimate of BMP implementation, operation, and maintenance
(4) A schedule for implementation of the bacteria elimination plan that reflects expeditious reduction with specific actions or benchmarks identified to be implemented during the next permit term.
(5) BMPs identified may be structural, non-structural, targeted outreach, new or revised ordinances, new design criteria, or new plan review considerations, but the plan shall include rationale for using each BMP, the reasons selection of each BMP, and the expected result of BMP implementation.

B. INDIVIDUAL BENCHMARKS

The following requirements represent specific actions each permittee must complete. The requirements build upon the existing pollutant reductions and move the permittees towards achieving future load reduction goals. The requirements are individual in nature because each MS4 has its own pollutant reduction goals and associated plans for achieving the reductions. Where appropriate, completion of a benchmark may incorporate cooperative efforts with other entities regulated or not by this permit on the condition that requirements defined in section I.D.2. of this permit are upheld.

The permittee shall achieve the following benchmarks applicable to their MS4. All benchmarks shall be completed by the end of the permit term unless specified sooner.

1. The **City of Brookfield** shall:

a) Implement control measures identified in its January 8, 2018 SWMP as development and redevelopment occurs.

b) Develop and execute a study to determine the impacts of sediment removal in four storm water ponds. The findings shall be incorporated into the Post-Construction program through the adaptive management process.

2. The **Village of Butler** shall:

   a) Complete at least two water quantity or quality projects. At least one project must be within the Village limits.

3. The **Village of Elm Grove** shall:

   a) Complete the Tonawanda Wetland Restoration project

   b) Complete one project which replaces curb and gutter drainage with grassed swale drainage.

4. The **Village of Germantown** shall:

   a) By, September 30, 2021, develop an enhanced pond maintenance program. The program shall:

      (1) Develop and implement a system for evaluating and maintaining storm water ponds within the Village. The system shall include evaluation criteria to be used during inspections, criteria which inspection results will be compared to for determining maintenance needs, and prioritization criteria for determining which ponds receive maintenance beyond routine maintenance.

      (2) Provide maintenance when inspections identify deficiencies with the structure. The prioritization criteria may be used if multiple structures need maintenance to target the highest need structures.

      (3) Evaluate all ponds by permit expiration.

      (4) Evaluate ponds for retrofit potential. If a pond is identified as a retrofit site, it shall be included in the WLA Attainment Assessment under Section A.2.

   b) Utilize the 10-year Road Capital Improvement Project program to reduce impervious pavement.

      (1) By September 30, 2021, develop Criteria for roadway evaluation which will be used to identify planned road projects which can reduce impervious area.

      (2) Roadways which can reduce impervious area after reconstruction shall be included in the WLA Attainment Assessment under Section A.2

   c) Complete one green infrastructure project within the Village.

5. The **City of Greenfield** shall:

   a) Update the City's storm water website to provide additional educational material and promote usage of rain barrels.

   b) Develop a partnership between the local schools and parks to provide education on storm water management to students.

c) Coordinate education and outreach with planned illicit discharge screening to supply educational material to residents and businesses tributary to the screening locations. The coordinated education shall begin March 31, 2022**.**

d) Develop or update storm water pollution prevention plans for public works yards by December 31, 2020.

e) Complete two storm water quality projects within the City's MS4 boundary.

6. The **Village of Menomonee Falls** shall:

a) Complete three storm water quantity or quality projects. One project must be water quality related and be completed within the Village's MS4 boundary.

b) Revise the municipal street sweeping program by March 31, 2022. The Program shall:

(1) Update and implement the street sweeping program to more effectively remove pollutants.

(2) Develop a coordinated leaf collection and street sweeping program.

c) Clean all catch basins at least once per year beginning January 1, 2021.

d) Develop a Storm Water Pollution Prevention Plan for the new public works facility by December 31, 2020.

e) Inspect stormwater outfalls in accordance with Section II. D.

7. The **City of Milwaukee** shall:

a) Update the storm water management website and provide additional educational material.

b) Install BMPs to provide treatment for an additional 275,000 gallons annually. The quantity can be achieved on an average basis over the permit term. The City shall provide a summary of progress with each annual report.

c) Update storm water pollution prevention plan inspection procedures. Procedures shall be updated by March 31, 2021.

8. **Milwaukee County** shall:

a) Install BMPs to provide treatment for an additional 5,000,000 gallons of storm water over the course of the permit term.

b) Coordinate one storm water workshop as part of the education and outreach program. The workshop shall focus on one of the pollution prevention activities under Section II.G.

c) Develop and Execute one pilot project which evaluates an innovative BMP design or innovative contracting mechanism for storm water related services.

9. The **City of West Allis** shall:

a) Continue to promote and subsidize the sale of rain barrels within the City's MS4 boundary.

b) Develop and implement a green infrastructure plan for City parking lots. The City shall implement green infrastructure on three lots during the permit term.

c) Review existing development ordinances and study feasibility of creating requirements above the existing minimum requirements. This can include new design standards or TMDL performance standards.

10. The **Village of West Milwaukee** shall:

a) Install two storm water quality improvement projects during the permit term.

11. The **City of Wauwatosa** shall:

a) Install BMPs which will provide treatment for an additional 400,000 gallons of storm water during the permit term.

IV. IMPLEMENTATION SCHEDULE

A. ALL PERMITTEES:

The permittees shall comply with the specific permit conditions contained in Permit Sections II and III according to the schedules in Table 3. All permittees shall begin implementing any updates to their storm water management programs no later than March 31, 2022. Required reports and permit compliance documents shall be submitted electronically through the Department's electronic reporting system.

Note: The Department's electronic reporting system is Internet-based and available at: https://dnr.wi.gov/permits/water/. Municipal storm water permit eReporting information and user support tools can be found at: https://dnr.wi.gov/topic/stormwater/municipal/eReporting.html

Table 3: Implementation Schedule for Permit Requirements

PERMIT SECTION	ACTIVITY	COMPLIANCE DATE	COMMENTS
Section I.H.1	Identify discharges to an impaired waterbody.	12 months after 303(d) list is updated.	All permittees
Section II	Submit written Storm Water Management Program document updates and begin implementation.	March 31, 2022	All permittees
Section II.B.1. (b)	Individual Education and Outreach – Submit prioritized education needs based upon survey results.	September 30, 2021	All permittees (excluding Milwaukee County)
Section II.B.2. (a)	Individual Education and Outreach – Complete targeted education and outreach for one high priority education need.	September 30, 2023	All permittees (excluding Milwaukee County)
Section II.B.2. (c)	Individual Education and Outreach – Submit results of education effort and planned future efforts with permit application.	September 30, 2024	All permittees (excluding Milwaukee County)
Section II.D.4	Illicit Discharge Detection and Elimination- Submit Enforcement response plan.	March 31, 2022	All permittees (excluding Milwaukee County)
Section II.E.3	Construction Site Pollutant Control – Conduct inspections according to the specified frequency.	April 1, 2021	All permittees
Section II.F.4	Post-Construction Storm Water Management – Remove barriers to green infrastructure.	March 31, 2022, and 18 months after barrier identification	All permittees
Section II.G.1.b	Pollution Prevention – Calibrate salt application machinery.	Annually beginning November 2020.	All permittees
Section II.G.1.c	Pollution Prevention – Provide salt application training.	Every other year	All permittees

Section II.G.4.d	Leaf Management – Submit the BMPs the permittee will employ to reduce nutrient loading from leaves.	March 31, 2023	All permittees
Section II.G.5.a	Pollution Prevention – Submit storm water pollution prevention plans (SWPPP) for all sites without a current SWPPP.	December 31, 2020	All permittees
Section II.K	Submit Annual Report	March 31 of each year reporting on previous calendar year	All permittees
Section II.L	Submit Permit Application	September 30, 2024	All permittees
Section III.A.1	Total Maximum Daily Load—Submit pollutant reduction analysis report.	March 31, 2023	All Permittees
Section III.A.2	Total Maximum Daily Load—Submit wasteload allocation attainment analysis.	September 30, 2023	All Permittees
Section III.A.3	Total Maximum Daily Load—Submit TSS and TP benchmarks for the next permit term.	September 30, 2024	All Permittees
Section III.A.4 (a)	Total Maximum Daily Load—Develop bacteria action level for illicit discharge screening.	June 30, 2021	All Permittees
Section III.A.4 (b)	Total Maximum Daily Load—Submit fecal coliform source inventory.	March 31, 2023	All Permittees
Section III.A.4 (c)	Total Maximum Daily Load—Submit fecal coliform source elimination plan.	September 30, 2023	All Permittees

B. INDIVIDUAL CONDITIONS:

Each Permittee shall complete their individual benchmarks identified in Section III. B. by the end of the permit, March 31, 2025, unless otherwise specified in Table 3.

Table 3: Individual Benchmark Schedule

PERMITTEE	ACTIVITY	COMPLIANCE DATE	PERMIT SECTION
All Permittees	Complete all individual benchmarks.	March 31, 2025	Section III.B
Village of Germantown	Develop storm water pond maintenance program.	September 30, 2022	Section III.B.4.(a)
Village of Germantown	Develop roadway evaluation criteria for future stormwater projects.	September 30, 2021	Section III.B.4.(b)

City of Greenfield	Coordinate Public Education and Outreach with Illicit Discharge Screening.	March 31, 2022	Section II.B.5. (c)
City of Greenfield	Develop or update all SWPPPs.	December 31, 2020	Section II.B.5. (d)
Village of Menomonee Falls	Update municipal street sweeping program.	March 31, 2022	Section II.B.6. (b)
Village of Menomonee Falls	Clean all catch basins annually.	Beginning 2021, annually thereafter	Section II.B.6. (c)
Village of Menomonee Falls	Develop SWPPP for new public works facility.	December 31, 2020	Section II.B.6. (d)
City of Milwaukee	Update SWPPP inspection procedures.	March 31, 2021	Section II.B.7. (c)

V. STANDARD CONDITIONS

The conditions in s. NR 205.07(1) and (3), Wis. Adm. Code, are incorporated by reference in this permit. The Menomonee River Watershed Permittees shall meet these requirements. Some of these requirements are outlined below in paragraph A. through R. Requirements not specifically outlined below can be found in s. NR 205.07(1) and (3), Wis. Adm. Code.

A. DUTY TO COMPLY:

The municipalities shall comply with all conditions of the permit. Any permit noncompliance is a violation of the permit and is grounds for enforcement action, permit revocation or modification, or denial of a permit reissuance application.

B. COMPLIANCE SCHEDULES:

Reports of compliance or noncompliance with interim and final requirements contained in any compliance schedule of the permit shall be submitted in writing within 14 days after the schedule date, except that progress reports shall be submitted in writing on or before each schedule date for each report. Any report of noncompliance shall include the cause of noncompliance, a description of remedial actions taken, and an estimate of the effect of the noncompliance on the municipality's ability to meet the remaining schedule dates.

C. NONCOMPLIANCE NOTIFICATION:

1. Upon becoming aware of any permit noncompliance that may endanger public health or the environment, each municipality shall report this information by a telephone call to the Department within 24 hours. A written report describing the noncompliance shall be submitted to the Department within 5 days after the municipality became aware of the noncompliance. The Department may waive the written report on a case-by-case basis based on the oral report received within 24 hours. The written report shall contain a description of the noncompliance and its cause; the period of noncompliance, including exact dates and times; the steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance; and if the noncompliance has not been corrected, the length of time it is expected to continue.

2. Reports of any other noncompliance not covered under General Condition's B, C.1, or E shall be submitted with the annual report. The reports shall contain all the information listed in General Condition C.1.

D. DUTY TO MITIGATE

Each municipality shall take all reasonable steps to minimize or prevent any adverse impact on the waters of the state resulting from noncompliance with the permit.

E. SPILL REPORTING

The permittee shall immediately notify the Department, in accordance with s. 292.11(2)(a), Wis. Stats., which requires any person who possesses or controls a hazardous substance or who causes the discharge of a hazardous substance to notify the DNR immediately of any discharge not authorized by the permit. The discharge of a hazardous substance that is not authorized by

this permit or that violates this permit may be a hazardous substance spill. To report a hazardous substance spill, call the DNR's 24-hour HOTLINE at 1-800-943-0003.

Note: For details on state and federal reportable quantities, visit:
https://dnr.wi.gov/topic/Spills/define.html

F. PROPER OPERATION AND MAINTENANCE:
The Permittee shall at all times properly operate and maintain all facilities and systems of treatment and control which are installed or used by the municipality to achieve compliance with the conditions of the permit and the storm water management program. Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing and training and adequate laboratory and process controls, including appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems only when necessary to achieve compliance with conditions of this permit.

G. BYPASS:
The Permittee may temporarily bypass storm water treatment facilities if necessary for maintenance, or due to runoff from a storm event which exceeds the design capacity of the treatment facility, or during an emergency.

H. DUTY TO HALT OR REDUCE ACTIVITY:
Upon failure or impairment of best management practices identified in the storm water management program, each municipality shall, to the extent practicable and necessary to maintain permit compliance, modify or curtail operations until the best management practices are restored, or an alternative method of storm water pollution control is provided.

I. REMOVED SUBSTANCES:
Solids, sludges, filter backwash or other pollutants removed from or resulting from treatment or control of storm water shall be stored and disposed of in a manner to prevent any pollutant from the materials from entering the waters of the state, and to comply with all applicable Federal, State, and Local regulations.

J. ADDITIONAL MONITORING:
If a municipality monitors any pollutant more frequently than required by the permit, the results of that monitoring shall be recorded and reported in accordance with this chapter. Results of this additional monitoring shall be included in the calculation and reporting of the data submitted in the annual report.

K. INSPECTION AND ENTRY:
Each municipality shall allow an authorized representative of the Department, upon the presentation of credentials, to:

1. Enter upon the municipal premises where a regulated facility or activity is located or conducted, or where records are required under the conditions of the permit.
2. Have access to and copy, at reasonable times, any records that are required under the conditions of the permit.

3. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices or operations regulated or required under the permit.
4. Sample or monitor at reasonable times, for the purposes of assuring permit compliance, any substances or parameters at any location.

L. DUTY TO PROVIDE INFORMATION:

Each municipality shall furnish the Department, within a reasonable time, any information which the Department may request to determine whether cause exists for modifying, revoking or reissuing the permit or to determine compliance with the permit. Each municipality shall also furnish the Department, upon request, copies of records required to be kept by the municipality.

M. PROPERTY RIGHTS:

The permit does not convey any property rights of any sort, or any exclusive privilege. The permit does not authorize any injury or damage to private property or an invasion of personal rights, or any infringement of federal, state or local laws or regulations.

N. DUTY TO REAPPLY:

If any of the Menomonee River Watershed Permittees wish to continue an activity regulated by the permit after the expiration date of the permit, the municipality shall apply for a new permit at least 180 days prior to the expiration date of the permit. If a timely and complete application for a new permit is filed and the permit is not reissued by the time the existing permit expires, the existing permit remains in effect until the application is acted upon.

O. OTHER INFORMATION:

Where a municipality becomes aware that it failed to submit any relevant facts in a permit application or submitted incorrect information in a permit application or in any report to the department, it shall promptly submit such facts or correct information to the department.

P. RECORDS RETENTION:

Each municipality shall retain records of all monitoring information, copies of all reports required by the permit, and records of all data used to complete the application for the permit for a period of at least 5 years from the date of the sample, measurement, report or application. The Department may request that this period be extended by issuing a public notice to modify the permit to extend this period.

Q. PERMIT ACTIONS:

As provided in s. 283.53, Wis. Stats., after notice and opportunity for a hearing the permit may be modified or revoked and reissued for cause. If a municipality files a request for a permit modification, revocation or reissuance, or a notification of planned changes or anticipated noncompliance, this action by itself does not relieve the municipalities of any permit condition.

R. SIGNATORY REQUIREMENT:

All applications, reports or information submitted to the Department shall be signed for by a ranking elected official, or other person authorized by them who has responsibility for the overall operation of the municipal separate storm sewer system and storm water management program activities regulated by the permit. The representative shall certify that the information

was gathered and prepared under their supervision and based on inquiry of the people directly under their supervision that, to the best of their knowledge, the information is true, accurate, and complete.

S. ENFORCEMENT ACTION:

The Department is authorized under s. 283.89 and 283.91, Wis. Stats., to use citations or referrals to the Department of Justice to enforce the conditions of this permit. Violation of a condition of this permit is subject to a fine of up to $10,000 per day of violation.

T. ATTAINMENT OF WATER QUALITY STANDARDS AFTER AUTHORIZATION:

Except for situations where a TMDL has been approved by US EPA during the permit term, at any time after authorization, the Department may determine that the discharge of storm water from a permittee's MS4 may cause, have the reasonable potential to cause, or contribute to an excursion of any applicable water quality standard. If such determination is made, the Department may require the permittee to do one of the following:

1. Develop and implement an action plan to address the identified water quality concern to the satisfaction of the Department.

2. Submit valid and verifiable data and information that are representative of ambient conditions to demonstrate to the Department that the receiving water or groundwater is attaining the water quality standard.

VI. DEFINITIONS

Definitions for some of the terms found in this permit are as follows:

A. Department means the Wisconsin Department of Natural Resources.

B. Development means residential, commercial, industrial and institutional land uses and associated roads.

C. Erosion means the process by which the land's surface is worn away by the action of wind, water, ice or gravity.

D. Hazardous substance means any substance or combination of substances including any waste of a solid, semisolid, liquid or gaseous form which may cause or significantly contribute to an increase in mortality or an increase in serious irreversible or incapacitating reversible illness or which may pose a substantial present or potential hazard to human health or the environment because of its quantity, concentration or physical, chemical or infectious characteristics. This term includes, but is not limited to, substances which are toxic, corrosive, flammable, irritants, strong sensitizers or explosives as determined by the Department.

E. Illicit connection means any man-made conveyance connecting an illicit discharge to a municipal separate storm sewer system.

F. Illicit discharge means any discharge to a municipal separate storm sewer system that is not composed entirely of storm water except discharges authorized by a WPDES permit or other discharge not requiring a WPDES permit such as landscape irrigation, individual residential car washing, firefighting, diverted stream flows, uncontaminated groundwater infiltration, uncontaminated pumped groundwater, discharges from potable water sources, foundation drains, air conditioning condensation, irrigation water, lawn watering, flows from riparian habitats and wetlands, and similar discharges. However, the occurrence of a discharge listed above may be considered an illicit discharge on a case-by-case basis if the permittee or the Department identifies it as a significant source of a pollutant to waters of the state.

G. Impaired water means a waterbody impaired in whole or in part and listed by the Department pursuant to 33 USC § 1313(d)(1)(A) and 40 CFR 130.7, for not meeting a water quality standard, including a water quality standard for a specific substance or the waterbody's designated use.

H. Infiltration means the entry and movement of precipitation or runoff into or through soil.

I. Jurisdiction means the area where the permittee has authority to enforce its ordinances or otherwise has authority to exercise control over a particular activity of concern.

J. Land disturbing construction activity means any man-made alteration of the land surface resulting in a change in the topography or existing vegetative or non-vegetative soil cover that may result in storm water runoff and lead to increased soil erosion and movement of sediment

into waters of the state. Land disturbing construction activity includes clearing and grubbing, demolition, excavating, pit trench dewatering, filling and grading activities.

K. Maximum Extent Practicable has the meaning given it in s. NR 151.002(25), Wis. Adm. Code.

L. Major outfall means a municipal separate storm sewer outfall that meets one of the following criteria:

1. A single pipe with an inside diameter of 36 inches or more, or from an equivalent conveyance (cross sectional area of 1,018 square inches) which is associated with a drainage area of more than 50 acres.

2. A municipal separate storm sewer system that receives storm water runoff from lands zoned for industrial activity that is associated with a drainage area of more than 2 acres or from other lands with 2 or more acres of industrial activity, but not land zoned for industrial activity that does not have any industrial activity present.

M. Municipality means any city, town, village, county, county utility district, town sanitary district, town utility district, school district or metropolitan sewage district or any other public entity created pursuant to law and having authority to collect, treat or dispose of sewage, industrial wastes, storm water or other wastes.

N. Municipality Operated BMP means a structural storm water management practice or BMP which is not owned by the Municipality which the municipality has a maintenance agreement with the owner and takes credit for pollutants removed from the BMP.

O. Municipal Separate Storm Sewer System or **MS4** means 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 of the following criteria:

1. Owned or operated by a municipality.

2. Designed or used for collecting or conveying storm water.

3. Which is not a combined sewer conveying both sanitary and storm water.

4. Which is not part of a publicly owned wastewater treatment works that provides secondary or more stringent treatment

P. New MS4 discharge of a pollutant means an MS4 discharge that would first occur after the permittee's original date of initial coverage under an MS4 permit to a surface water to which the MS4 did not previously discharge storm water, and does not include an increase in an MS4's discharge to a surface water to which the MS4 discharged on or before coverage under this permit.

Q. Outfall means the point at which storm water is discharged to waters of the state or to a storm sewer (e.g., leaves one municipality and enters another).

R. Permittee means a person who has applied for and received WPDES permit coverage for storm water discharge. For the purposes of this permit, permittee is the owner or operator of a municipal separate storm sewer system authorized to discharge storm water into waters of the state.

S. Permitted area means the areas of land under the jurisdiction of the permittee that drains into a municipal separate storm sewer system, which is regulated under a permit issued pursuant to Subch. I of NR 216, Wis. Adm. Code

T. Pollutants of concern means a pollutant that is causing impairment of a waterbody.

U. Reach means a specific stream segment, lake or reservoir as identified in a TMDL.

V. Reachshed means the drainage area contributing runoff to a given reach.

W. Redevelopment means areas where development is replacing older development.

X. Riparian landowners are the owners of lands bordering lakes and rivers.

Y. Sediment means settleable solid material that is transported by runoff, suspended within runoff or deposited by runoff away from its original location.

Z. Start Date is the date of permit coverage under this permit, which is specified in the Department letter authorizing coverage.

AA. Storm water management practice or Best Management Practice (BMP) means structural or non-structural measures, practices, techniques or devices employed to avoid or minimize soil, sediment or pollutants carried in stormwater runoff to waters of the state.

BB. Storm Water Pollution Prevention Plan or SWPPP refers to the development of a site-specific plan that describes the measures and controls that will be used to prevent and/or minimize pollution of storm water.

CC. Total maximum daily load or **TMDL** means the amount of pollutants specified as a function of one or more water quality parameters, that can be discharged per day into a water quality limited segment and still ensure attainment of the applicable water quality standard.

DD. Urbanized area means a place and the adjacent densely settled surrounding territory that together have a minimum population of 50,000 people, as determined by the U.S. bureau of the census based on the latest decennial federal census.

EE. Wasteload Allocation or **WLA** means the allocation resulting from the process of distributing or apportioning the total maximum daily load to each individual point source discharge.

FF. Waters of the State has the meaning given it in s. 283.01(20), Wis. Stats.

GG. WPDES permit means a Wisconsin Pollutant Discharge Elimination System permit issued pursuant to ch. 283, Wis. Stats.

VII. TSS AND TP WASTELOAD ALLOCATIONS

The following tables identifies the total suspended solids (TSS) and total phosphorus (TP) reduction goals for each reachshed identified in the "Total Maximum Daily Loads for Total Phosphorus, Total Suspended Solids, and Fecal Coliform Milwaukee River Basin, Wisconsin" Report. The values represent the load reductions required from a no-controls scenario.

Table 1: Kinnickinnic River Basin

Reachshed (TMDL Subbasin)	Waterbody Name	Waterbody Extents	TSS % Reduction from No-controls	TP % Reduction from No-controls
KK-1	Lyons Park Creek	Entire Length	78.4%	68.1%
KK-2	Kinnickinnic River	From Wilson Park Creek to Lyons Park Creek	77.6%	68.1%
KK-3	South 43rd St. Ditch	Entire Length	76.8%	78.7%
KK-4	Edgerton Channel, Wilson Park Creek, Villa Mann Creek	Entire Length	84.0%	89.4%
KK-5	Holmes Avenue Creek	Entire Length	80.0%	78.7%
KK-6	Cherokee Park Creek	Entire Length	77.6%	69.0%
KK-7	Kinnickinnic River	Estuary to Wilson Park Creek	75.2%	45.0%

Table 2: Menomonee River Basin

Reachshed (TMDL Subbasin)	Waterbody Name	Waterbody Extents	TSS % Reduction from No-controls	TP % Reduction from No-controls
MN-1	Menomonee River	From Nor-X-Way Channel to Headwaters	66.4%	63.6%
MN-2	Goldendale Creek	Entire Length	63.2%	47.7%
MN-3	West Branch Menomonee River	Entire Length	65.6%	60.1%
MN-4	Willow Creek	Entire Length	64.0%	51.2%
MN-5	Nor-X-Way Channel	Entire Length	70.4%	72.5%
MN-6	Menomonee River and Dretzka Park Creek	From Little Menomonee River to Nor-X-Way Channel	73.6%	69.0%

Reachshed (TMDL Subbasin)	Waterbody Name	Waterbody Extents	TSS % Reduction from No-controls	TP % Reduction from No-controls
MN-7	Lilly Creek	Entire Length	70.4%	64.5%
MN-8	Butler Ditch	Entire Length	69.6%	58.3%
MN-9	Little Menomonee River	Entire Length	70.4%	64.5%
MN-10	Menomonee River	From Underwood Creek to Little Menomonee River	67.2%	31.7%
MN-11	Underwood Creek and Dousman Ditch	From South Branch Underwood Creek to Headwaters	72.0%	62.7%
MN-12	Underwood Creek	From Menomonee River to South Branch Underwood Creek	80.0%	76.1%
MN-13	South Branch Underwood Creek	Entire Length	76.8%	69.8%
MN-14	Menomonee River	From Honey Creek to Underwood Creek	64.8%	49.4%
MN-15	Honey Creek	Entire Length	73.6%	67.2%
MN-16	Menomonee River	From Estuary to Honey Creek	72.0%	49.4%

Table 3: Milwaukee River Basin

Reachshed (TMDL Subbasin)	Waterbody Name	Waterbody Extents	TSS % Reduction from No-controls	TP % Reduction from No-controls
MI-1	Upper Milwaukee River	From Campbellsport to Headwaters	**	**
MI-2	Upper Milwaukee River	From Kewaskum To Campbellsport and Auburn	73.6%	71.6%
MI-3	West Branch Milwaukee River	Entire Length	77.6%	48.6%
MI-4	Kewaskum Creek	Entire Length	76.8%	55.7%
MI-5	Watercress Creek and East Branch Milwaukee River	Entire Length	73.6%	51.2%
MI-6	Quass Creek and Milwaukee River	Near West Bend	73.6%	86.7%

Reachshed (TMDL Subbasin)	Waterbody Name	Waterbody Extents	TSS % Reduction from No-controls	TP % Reduction from No-controls
MI-7	Myra Creek and Milwaukee River	From North Branch Milwaukee River to West Bend	79.2%	67.2%
MI-8	North Branch Milwaukee River	from Adell Tributary to Headwaters	**	**
MI-9	Adell Tributary	Entire Length	**	**
MI-10	Chambers Creek, Batavia Creek, and North Branch Milwaukee River	Near Sherman	**	**
MI-11	Melius Creek	Entire Length	**	**
MI-12	Mink Creek	Entire Length	**	**
MI-13	Stony Creek, Wallace Creek, and North Branch Milwaukee River	Near Farmington	74.4%	46.8%
MI-14	Silver Creek	Entire Length	**	**
MI-15	Milwaukee River	Near Fredonia	**	**
MI-16	Milwaukee River	Near Saukville	75.2%	77.8%
MI-17	Milwaukee River	From Cedar Creek to Saukville	76.0%	83.1%
MI-18	Cedar Creek	From Jackson Creek to Headwaters	76.8%	71.6%
MI-19	Lehner Creek	Entire Length	77.6%	61.0%
MI-20	Jackson Creek	Entire Length	80.8%	77.8%
MI-21	Little Cedar Creek	Entire Length	80.8%	77.8%
MI-22	Cedar Creek	Near Jackson	76.8%	54.8%
MI-23	Evergreen Creek	Near Jackson	79.2%	53.0%
MI-24	North Branch Cedar Creek and Cedar Creek	From Milwaukee River to Myra Creek	73.6%	79.6%
MI-25	Milwaukee River	From Pigeon Creek to Cedar Creek	81.6%	43.2%
MI-26	Pigeon Creek	Entire Length	90.4%	88.5%
MI-27	Milwaukee River	From Lincoln Creek to Pigeon Creek	72.8%	53.9%
MI-28	Beaver Creek	Entire Length	72.8%	88.5%

Reachshed (TMDL Subbasin)	Waterbody Name	Waterbody Extents	TSS % Reduction from No-controls	TP % Reduction from No-controls
MI-29	South Branch Creek	Entire Length	71.2%	87.6%
MI-30	Indian Creek	Entire Length	65.6%	76.1%
MI-31	Lincoln Creek	Entire Length	71.2%	85.8%
MI-32	Milwaukee River	From Estuary to Lincoln Creek	58.4%	23.7%

Note: **The TMDL did not assign a percent reduction for these reachsheds because modeling indicated that there is no direct MS4 discharge to this subbasin. If more detailed analysis conducted by the permittee indicates the presence of an MS4 discharge, contact your DNR storm water engineer or specialist for more information on how best to proceed.

APPENDIX H. MONITORING METHODOLOGY

Per WDNR's proposed 2022 Wisconsin Consolidated Assessment and Listing Methodology (WisCALM), water quality sampling efforts in the watershed will be representative of current water quality conditions and inclusive of a wide range of weather and flow conditions. Water Quality monitoring for this plan will include:

1. Annual sampling dates spread over representative seasonal periods and,

2. Samples collected under a wide range of weather and flow conditions.

TOTAL PHOSPHORUS (TP)

Water quality sampling will follow WDNR's protocols for Total Phosphorus (TP) and will address seasonality, timing and frequency of sample collection. Sampling protocols will also reflect USGS development of the TP criteria [s. NR 102.06(3) Wis. Adm. Code]. Surface waters will be sampled monthly over a 6-month period from May through October, approximately 30 days apart. If samples are missed, samples collected in different months over multiple years may be combined to create a complete annual data set.

Where multiple years of data are available, the three most recent years of data will be used for making water quality assessments. Total Phosphorus assessments will also be completed in consultation with WDNR staff. Study-specific or project related targeted sampling activities are not appropriate for assessment of attainment of the applicable TP water quality criterion. Appropriate statistical approaches are employed as outlined in WisCALM to achieve a 95% confidence interval around the mean for water quality assessment.

TOTAL SUSPENDED SOLIDS

There are no sampling standards or Water Quality criteria for streams in WDNR WISCALM guidance for total suspended solids (TSS). However, a TSS goal of 12 mg/L is used for surface waters by the Milwaukee River Total Maximum Daily Load (TMDL) approved by US EPA in 2018. TSS will be monitored indirectly through turbidity testing conducted by Milwaukee Riverkeeper (in NTUs), by MMSD (in FNUs), and other stakeholders. Turbidity monitoring or TSS sampling/assessments will be completed in consultation with WDNR staff. TSS could also be monitored at a select group of sites to help assess progress toward TMDL implementation. Also, Suspended Sediment Concentration (SSC) may be used in lieu of TSS concentrations - https://water.usgs.gov/osw/pubs/WRIR00-4191.pdf - to evaluate suspended solids concentrations within Menomonee River watershed streams.

The TSS monitoring approach and methods will be revisited every 3-5 years, and/or if State Water Quality Standards are promulgated for TSS.

FECAL COLIFORM/BACTERIA

Bacteria monitoring is a time intensive and costly endeavor, and there are many different indicators and ways to monitor it. For the purposes of this Plan, we will use existing sources of bacteria data and assess how to adjust sampling design in the future as science changes and resources become more available. As of 2021, comprehensive bacteria monitoring is not currently funded. Monitoring for bacteria is necessary to evaluate compliance with the bacteria TMDL, and assessments of TMDL progress will be completed in consultation with WDNR staff every 3-5 years. In addition, methods and monitoring protocols used shall be revisited every 3-5 years

Milwaukee Riverkeeper Baseline Monitoring:

Milwaukee Riverkeeper volunteers currently collect bacteria samples to determine total coliform and *E. coli* at a selection of monitoring sites in the watershed, using 3M coliscan products, as piloted by and recommended by the Wisconsin Water Action Volunteers Program. Volunteer collect 1 ml samples of river water, plate that sample on the 3M "gel" product, and then incubate that sample for 24 hours. Colonies of total coliform and E. coli show up as different colors and can be counted to determine a number of colonies, and this number is multiplied by 100 to come up with a colony number per 100 ml samples. More information on the sampling protocol and methodologies of the program can be found here: https://www.milwaukeeriverkeeper.org/wp-content/uploads/2018/08/BacteriaMonitoring_Manual.pdf

AND

http://cels.uri.edu/docslink/ww/BacteriaWorkshop/EColiManual.pdf

MMSD Bacteria Monitoring:

The Milwaukee Metropolitan Sewerage District (MMSD) conduct monthly baseline monitoring for fecal coliform as part of their monitoring programs. This data is available at their website at: https://www.mmsd.com/what-we-do/water-quality/monitoring-data

MMSD data is also available of the federal cooperative Water Quality Portal: http://www.waterqualitydata.us/portal/

In addition, MMSD also conducts and/or funds select research on bacteria and pathogen loading in the area waterways, and some of these reports can be found here: https://www.mmsd.com/what-we-do/water-quality/pathogens-bacteria-reports

Stormwater Sampling:

Historically, MMSD, Milwaukee Riverkeeper, and Sandra McLellan's Lab at the University of Wisconsin-School of Freshwater Sciences (UWM-SFS) have conducted sampling for *E. coli,* fecal coliform, and *Enterococcus* in stormwater outfalls discharging from the Menomonee River. A summary of this sampling is included in this Plan. When water samples exceeded 1,000 colony

forming units per 100 ml, addition monitoring for human specific strains of Bacteroides and Lachnospiraceae were conducted using polymerase chain reaction (PCR) and a quantitative PCR (qPCR). Well over 60% of stormwater outfalls in the lower Menomonee were found to be positive for human bacteria, which indicates sewage pollution is getting into the stormwater system and eventually into the river. Historically, MMSD conducted additional sampling efforts in the storm sewer system to identify sources of contamination. In addition, Milwaukee Riverkeeper contracted with Environmental Canine Services to conduct sampling within the drainage areas of stormwater outfalls found to be positive for human sewage.

As part of implementation of the Bacteria TMDL, municipalities in the Menomonee River Watershed, and entire Milwaukee River Basin, will have to develop methodologies to monitor bacteria from their stormwater systems and begin to conduct this monitoring in their new permits. As of 2021, several Menomonee River municipalities have begun to conduct bacteria monitoring at a subset of their outfalls using a similar protocol to the Milwaukee Riverkeeper and Water Action Volunteer protocol for community volunteers. This monitoring will help them develop a better idea of thresholds, which would trigger more find and fix efforts as part of illicit discharge detection and elimination requirements. More information on these requirements can be found in the Group Permit for the Menomonee River municipalities (Appendix F). The Group Permit has an Appendix (B) that details these bacteria monitoring requirements.

Monitoring for Bacteria Communities Using Genetic Sequencing:

UWM-SFS has access now to an Ilumina MySeq genetic sequencing technology can be used to assess bacteria presence/absence and levels, as well as identify the types of bacteria as part of bacteria source analysis work. In Appendix J, there is a summary of analysis of bacteria microbial communities conducted by Ryan Newton at UWM-SFS as part of a grant obtained by Milwaukee Riverkeeper from Fund for Lake Michigan. Milwaukee Riverkeeper collected a variety of water samples from streams with good and bad water quality, and the Newton lab analyzed those samples for different bacteria communities by analyzing the genetic sequences with Ilumina MySeq. This study was set up to determine whether bacteria community diversity differed in streams based on water quality, whether microbial diversity could be correlated with other water quality parameters, and to better understand bacteria communities in the Milwaukee River Basin. Several sites in the Menomonee River were included as part of this study. Research found that bacteria differed in good and poor water quality, and were quite different based on land use, and for streams found in urban and rural communities. Microbial diversity did correlate with dissolved oxygen, temperature, and pH. The sites were also graded for sewage contamination, as the presence of certain bacteria communities indicated the presence of sewage to greater and lesser extents. This tool could be used in the future to better understand sources of bacterial contamination, which could help identify solutions to reducing bacteria loading to rivers. It can also identify bacteria that are endemic to freshwater systems. This work has now been published (2021) and can be found here:
https://www.academia.edu/53787158/Human_Fecal_Contamination_Corresponds_to_Changes_i

n_the_Freshwater_Bacterial_Communities_of_a_Large_River_Basin?email_work_card=interaction-paper

PROPOSED PROTOCOL FOR BACTERIA SAMPLING

Funding currently doesn't exist to establish any new bacteria monitoring in the Menomonee River Watershed or Milwaukee River Basin. Below is a proposed protocol that could be implemented in the future if funding is found to better understand baseline bacteria loading, how it changes seasonally, and to assess whether bacteria levels are changing as part of TMDL implementation efforts and other regulatory requirements.

Surface water and stormwater outfall grab samples will be collected from the Menomonee River (N:5), Kinnickinnic (KK) River (N:4) and Milwaukee River (N:1). A total of 10 samples will be collected during dry weather and wet weather conditions (weather permitting). Sampling may also occur, if funding allows, at additional locations selected based on previous work conducted by Milwaukee Riverkeeper (MRK), Milwaukee Metropolitan Sewerage District (MMSD), and the McLellan Lab at the University of Wisconsin-Milwaukee School of Freshwater Sciences (UWM-SFS).

Samples will be collected five (5) times each month over the period of three (3) select months (April, July, October) to monitor seasonal fluctuations of bacteria. Select samples will be collected from up-gradient surface water samples, near source area "hot-spot" areas near select outfalls, and down-gradient samples at the confluence of the Menomonee and KK River with the Milwaukee.

Sample Collection

Samples will be collected using a surface water sample collection chamber, a 20-foot metal pole with an adjustable arm and a 500mL Nalgene sample bottle attached to the end, and transported in a clean 1L Nalgene bottle. Bottle will be rinsed 2-3 times at each station prior to final sample collection. Sample collection chamber will be rinsed between each sample collection with DI/MQ water. Free flowing surface water samples will be collected from the area adjacent to the suspected source area (i.e., stormwater outfall, point-source discharge location). Samples will be place in a cooler on ice or held at 4º C until laboratory analysis is performed. Samples will be labeled with sample location (i.e. watershed denomination Menomonee (MN-), Kinnickinnic (KK-), Milwaukee (MKE-)), location number, flow condition (i.e. wet weather (W), dry weather (D)), and sample collection date. For example: MN1-W 04-10-14.

Methodology

All water samples will be analyzed within 12 hours using the USEPA 9222.b membrane filter method for Fecal Coliform enumeration (USEPA 2008). Due to the unknown concentration of fecal coliforms, *E. coli*, and Enterococci contamination present in the samples, graduated volume(s) of sample to be filtered will vary from 100ml, 10ml and 1ml. If contaminant

concentrations appear to be high, filtration volumes may be adjusted. Following filtration procedures, plates will be incubated for 18+ hours at 44.5°C and colony forming units (CFUs) will be counted and recorded. Plate counts exceeding 200 CFUs/100 ml sample will be documented as positive results.

Results will be characterized according to the water quality criteria for fecal coliforms identified in s. NR 102.04(5), Wis. Adm. Code: (a) Bacteriological guidelines: the membrane filter fecal coliform count may not exceed 200 CFUs/100 ml as a geometric mean based on not less than 5 samples per month, nor exceed 400 CFUs/100 ml in more than 10% of all samples during any month ("Water Quality Standards", 2010).

Results will also be characterized according to the water quality standards for *E. coli* recommended by the EPA and adopted by the WDNR. Levels may not exceed 235 CFU/100mL for a single sample. Also, the membrane filter *E. coli* count may not exceed 126 CFU/100mL for the monthly geometric mean based on not less than 5 samples per month. WDNR recently adopted new recreational use standards for bacteria, but these haven't changed the target organisms or target levels to a great extent.

Quantitative Polymerase Chain Reaction (qPCR)

All water samples will be filtered within 12 hours for DNA extraction. A volume of 200ml of sample would be filtered onto a 0.22 μm pore size, 47 mm nitrocellulose filter and stored at - 80°C. The frozen filters are broken into small fragments using a metal spatula. DNA is extracted using the MPBIO FastDNA® SPIN Kit for Soil (MP Biomedicals, Santa Anna, CA) and DNA eluted using 150 ul of DES.

Quantitative PCR can be carried out using an Applied Biosystems StepOne Plus ™ Real- Time PCR System Thermal Cycling Block (Applied Biosystems; Foster City, CA) with Taqman hydrolysis probe chemistry. UWM-SFS uses previously published primers and probe for human Bacteroides (Kildare et al. 2007) with the exception that the HF183F was used as the forward primer (Bernard and Fields 2000). UWM-SFS also has access now to an Ilumina MySeq genetic sequencing technology that could also be used to assess bacteria presence/absence and levels, as well as identify the types of bacteria as part of bacteria source analysis work.

Data Analysis

Fecal coliforms, *E. coli*, and Enterococci concentrations per 100 ml will be recorded for each sample, along with weather conditions, site location/TMDL reach, and any significant site parameters, such as proximity to a sewer outfall, etc. Data analysis will be completed using Excel or a statistics software package such as Stata or SPSS. The geometric mean will be determined for each 30-day sampling period, and ANOVA will be used to calculate statistically significant variances among sampling sites and conditions, in order to better isolate potential sources of fecal contamination. The WDNR bacteria standard dictates a 95% data confidence level (WDNR, 2015).

Depending on the preliminary results of the analysis, including number of initial samples and standard deviations, further sampling may be needed to ensure at least 95% confidence in the results. Wider variations in fecal coliform readings will necessitate a greater number of samples for analysis, for example. Further sampling and analysis may also be needed for identification of suspected bacterial hot spots, unexpected results, and outliers.

If expanded bacterial monitoring is increased via additional funds within the watershed, such assessments would be completed in consultation with WDNR staff, with sampling methods and protocols be revisited every 3-5 years.

APPENDIX I. SWWT RESPECT OUR WATERS (ROW) HOUSEHOLD SURVEY, PUBLIC POLICY FORUM 2011; UNIVERSITY OF WISCONSIN WHITEWATER'S FISCAL AND ECONOMIC RESEARCH CENTER 2016-17

Public Policy Forum
moving the region forward
Research Brief

VOLUME 99, NUMBER 1 JANUARY 2011

Ambivalent Attitudes Toward Protecting the Region's Waterways

Support for government protections, mixed feelings about individuals' roles

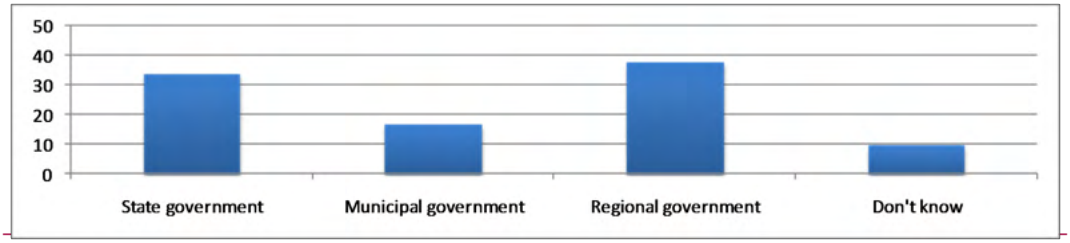
A new survey of nearly 400 residents of the Milwaukee, Kinnickinnic, and Menomonee River watersheds shows general support for government actions to protect water resources, but mixed views on which level of government should be implementing such actions. The survey, designed and analyzed by the Public Policy Forum and commissioned by the Southeast Wisconsin Watersheds Trust, also indicates that local environmental groups may have an important role to play in educating the public about water issues.

Respondents were asked a series of questions designed to elicit their views and understanding of critical water resource issues. The survey shows residents are split on whether water resource management and quality issues should be governed by regional water governance districts or the state. Municipal governments are not favored for the role (**Chart 1**).

When asked about the effectiveness of specific local government actions, most respondents viewed the actions as at least somewhat effective. The role of individuals in protecting local waterways is seen as less important, in that just four percent of respondents agree they "have a responsibility to future generations to protect the region's water resources." Nevertheless, respondents report having taken actions or a willingness to take action to conserve water or protect water quality.

These contradictions in attitudes may reflect the fact that few residents spend time recreating on local rivers or lakes, and that many do not know where stormwater runoff goes after it leaves their neighborhoods. Environmental organizations, which are viewed as the most trustworthy sources of information on water issues, have an opportunity to improve residents' knowledge and understanding of water issues.

Chart 1: Which level of government should be responsible for managing and improving water quality and water use in southeast Wisconsin?



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Research Brief **underwritten by:** Badger Meter

Data and methodology

The 15-minute telephone survey was conducted by Advantage Research from October 5 -19, 2010. Respondents were selected by random digit dialing of exchanges and cell phone numbers located in 47 zip codes in Milwaukee, Waukesha, Washington, Ozaukee, Sheboygan, and Fond du Lac Counties within the Milwaukee, Kinnickinnic, and Menomonee River watersheds. The survey contained 15 opinion questions plus several questions about the respondent's demographics and characteristics. Only adults over age 18 were surveyed.

The 388 completed surveys are fairly representative of the estimated characteristics of the population within these three watersheds. By our estimates, the survey sample over-represents people over age 60 and under-represents wealthier households (**Table 1**). The survey responses were weighted to better reflect the region on these measures, but the weighting did not significantly change the results. The unweighted responses are presented in this *Research Brief*.

The population within each watershed is as follows: Menomonee River watershed, 336,700; Kinnickinnic River watershed, 145,000; and Milwaukee River watershed, 485,000. Thus, a sample of 388 respondents representing a total population of 966,700 people results in a margin of error of plus or minus 4.97% at a confidence level of 95% – meaning that there is a 95% probability that the survey results are accurate within 4.97% in either direction.

Table 1: Representativeness of the survey sample

Percent of population	Survey Sample	Watershed (estimated)
Milwaukee Co.	71	71
Waukesha Co.	13	13
Washington Co.	8	7
Sheboygan Co.	4	4
Ozaukee Co.	2	2
Fond du Lac	2	2
Spanish speakers	1	8
60 or over	43	16
White	72	72
Female	59	51
Household income $50,000 or greater	32	49

Watershed estimates from 2005-2009 American Communities Survey, U.S. Census Bureau

Knowledge of watershed geography

Survey respondents are fairly knowledgeable about watershed geography, although a significant number of people are uncertain about some aspects.

Most respondents, including most in Milwaukee and Waukesha Counties, report that stormwater runs off their property and into a storm sewer drain in the street after a rain or snow storm. (See **Chart 2**.) About a fifth of all respondents don't know where that stormwater goes once it leaves their neighborhood. (See **Chart 3**.) Going "into a river or lake without being treated" is the most frequent response of residents of all counties except Milwaukee.

When asked what type of waterway is closest to their home, the most frequent response was "Lake Michigan," including 32% of Waukesha County residents. (See **Chart 4**.) In all counties except Milwaukee and Washington, more people answered, "A stream or river" than any other option. In Milwaukee County more people offered, "Lake Michigan," while in Washington County more report living closest to an inland lake.

Interestingly, despite the large portion of respondents who report living closest to a river or stream, the portion of people who have been out on the water in the past year was relatively low, as discussed on the following page.

Chart 2: ***After it rains or the snow melts, where does the runoff go after it leaves your property?***

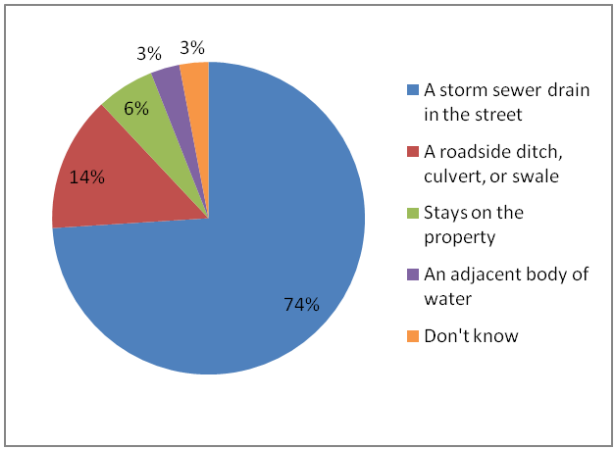


Chart 3: ***Where does this runoff go after it leaves your neighborhood?***

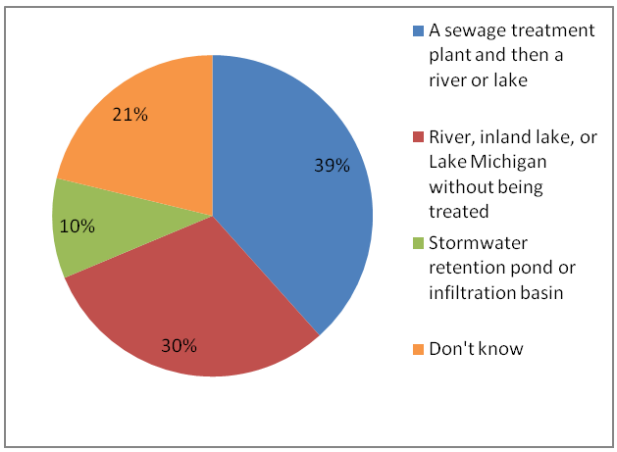
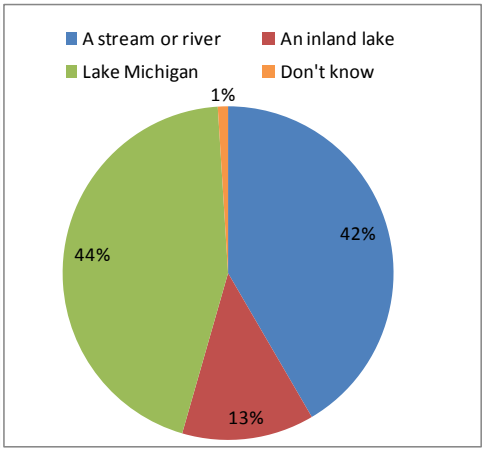


Chart 4: ***What is the closest body of water to your home?***



Water-based recreation

Chart 5 shows the percentage of survey participants that have participated in several water-based recreational activities over the past year. The only activity in which more than half of respondents have participated is walking, bird-watching or appreciating nature near a river, lake or stream.

This was the only survey question in which age is a significant explanatory variable. Those over age 60 are less likely to have participated in any of these activities. Even among the younger age groups, however, with the exception of beach-going among 65% of 18-39 year olds, none of the activities have been conducted by a majority of people over the past year.

In addition, less than a fourth of respondents (23%) agree that "rivers and lakes are an important part of my family's recreational activities."

Opinions on the other questions in the survey do not vary significantly according to participation in water-based recreational activities, indicating that participation in these activities is not related to opinions or perceptions of water issues.

Water quality perceptions and concerns

When asked to judge water quality on a five-point scale, with 5 representing "excellent" and 1 representing "extremely poor," respondents judge the region's water quality to be slightly above average.

Specifically, "the quality of water in the inland lakes, rivers, and streams in southeastern Wisconsin," averages 3.3 among respondents, as does "the quality of water in Lake Michigan." Both inland waters and Lake Michigan average highest scores from Ozaukee County residents and lowest scores from Milwaukee County residents. African-American respondents award the lowest scores among all sub-groups of respondents, rating both types of waters slightly below average at 2.95.

Table 2 shows a list of possible future water problems in the region. Sewer overflows, water quality in surface waters, and water quality in ground water rank first, third, and fourth most concerning. Thus, despite feeling the current water quality in the region is slightly above average, most respondents are concerned water quality will be a problem in the future. Flooding also ranks high in the list of possible problems.

Chart 5: ***Over the past year, have you gone...***

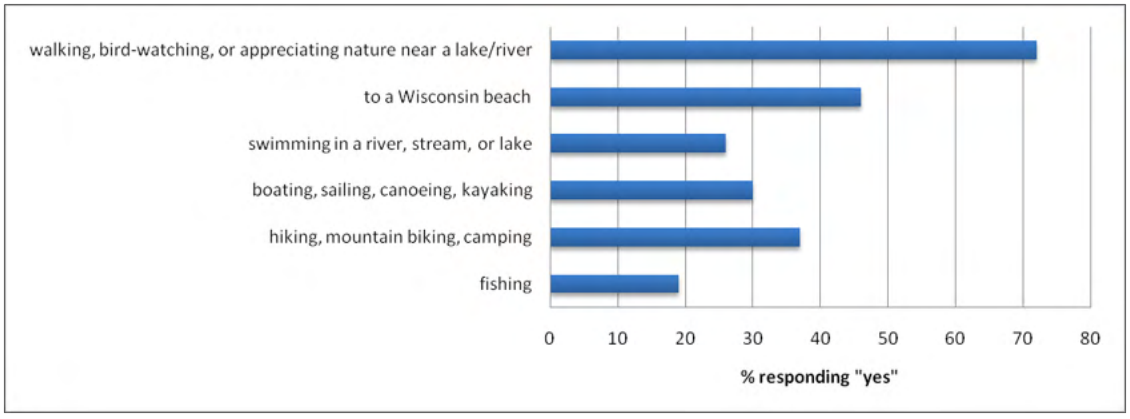


Table 2: ***Which of the following will be a water problem for southeast Wisconsin during the next decade? Will … be a problem?***

% responding "yes"	
Sewer overflows into Lake Michigan	80
Flooding	71
Water quality in lakes and rivers	66
Water quality in underground water sources	57
Climate change	46
Water shortages or low water levels	45
Water availability for new commercial or housing developments	45

Interestingly, the concern about water quality is not reflected in respondents' opinions about the value of clean water to the region. Just 14% of respondents agree that "the quality of water affects property values in my community" and just 4% agree that "water is a key part of the region's economic vitality."

Water pollution sources

Concern about sewer overflows remained high when respondents were asked about various contributors to water quality problems. A large majority of respondents feel sewer overflows are a major problem. (See **Table 3**.) Also ranking high among the list of problems is "industrial waste discharged into waterways." These two contributors are forms of *point source* pollution, as they cause pollution to enter waterways at a specific point and come from a specific source.

Non-point source pollution in the form of "runoff after rain or snow" is seen as less of a problem. Soil erosion also is considered a minor problem, as is waste from pets and geese.

None of the factors probed in the survey are viewed as not contributing to water quality problems by a majority of respondents.

Table 3: ***To what extent do the following contribute to water quality problems in rivers, streams, and lakes in your community?***

% responding…	major contributor	minor contributor
Discharge or overflow from sewage treatment plants or deep tunnels	71	21
Improper disposal of used motor oil, antifreeze, or other hazardous household wastes	53	35
Fertilizers and pesticides from lawns	49	39
Industrial waste discharged into waterways	64	23
Runoff after rain or snow melt from streets, rooftops, driveways, and parking lots	39	48
Flushing unwanted or expired prescription drugs down the toilet or drain	49	37
Fertilizers, such as manure, and pesticides from farms	53	32
Pet waste, geese droppings, or other animal waste	29	55
Air pollution from industries and power plants	42	41
Soil erosion from construction sites	31	49
Soil erosion from farmland	28	52

As a follow-up to this question, perceptions of non-point source pollution were tested by asking the extent to which stormwater runoff contributes to water quality problems in the region. (See **Table 4**, next page.)

The problem for which the most respondents view stormwater as a *major* contributor is not a water quality problem, but flooding. About half of respondents, however, also see stormwater runoff as a major contributor to several water quality problems: weed and algae growth in waterways, bacteria and viruses in waterways, making local fish less safe to eat, beach closings, and negative impacts on fish habitats. Of all the problems probed, only the question of increased temperatures in lakes and streams resulted in a significant (12%) portion of respondents answering "don't know."

Concerns about flooding echo throughout the survey responses and may be related to the fact that roughly half of all respondents agree with the statement, "Basements in my neighborhood are likely to flood during a major storm." When the opinions of flood-prone respondents are compared to those who do not agree that their neighborhood is likely to flood, however, there is not a statistically significant difference in opinion.

Table 4: ***To what extent does stormwater runoff from populated land contribute to each of the following problems?***

% responding…	runoff is major contributor	runoff is minor contributor
Flooding	63	26
Weed and algae growth in rivers and lakes	52	34
Making local fish less safe to eat	53	31
Delivery of bacteria and viruses into rivers and streams	53	30
Negative impacts on habitat for other wildlife	42	39
Beach closings and swimming advisories	50	31
Negative impacts on fish habitats	47	33
Poor quality drinking water	41	37
Increased temperatures in lakes and streams	26	44

Effectiveness of government action

While the majority of respondents do not see government actions to protect the region's water sources as being "very effective," most do believe these actions are at least "somewhat effective."

In contrast to respondents' relatively minor concern about soil erosion (**Table 3**), government efforts to combat erosion by regulating construction and vegetation along stream banks and lake shores are seen as quite effective (**Table 5**).

Regulations to protect and restore wetlands also are seen as highly effective by about half of respondents, as are efforts to prevent or remove invasive aquatic species.

Efforts to combat non-point source pollution from salt– and pesticide-laden stormwater runoff are viewed as effective, but not necessarily "very effective." Requiring developers to reduce the amount of hard pavements in their projects is deemed effective by just over half of respondents. Finally, about half of respondents see using increased water fees as an effective way to fund water quality improvements.

When asked whether they agree that "Southeast Wisconsin is a leader in water resource protection," more than a fourth of respondents say they do not know. Half of respondents feel the region is not a leader in this area (**Chart 6**).

Table 5: ***How effective are the following types of policies or actions by local governments in helping protect your community's lakes, rivers, and streams?***

% responding...	very effective	somewhat effective
Requiring building crews to prevent soil erosion during construction	45	39
Requiring natural vegetation along river and stream banks	47	36
Reducing use of salt on roads and highways	40	41
Frequent street sweeping and leaf and yard waste collection	38	42
Restricting new construction on wetlands or open spaces	47	32
Restoring damaged wetlands	47	32
Preventing or removing invasive aquatic species in rivers and lakes	45	30
Offering tax incentives to encourage homeowners to use less water	31	36
Requiring developers to reduce hard surfaces, by using narrower streets, porous pavement, or green roofs	28	39
Increasing homeowners' water fees to fund water quality improvements	16	39

Effectiveness of individual actions

The survey also asked a series of questions to gauge respondents' views on the effectiveness of individual actions to address water quality and water resource issues, as well as their participation or willingness to participate in such actions.

Tables 6-8 on the following pages highlight respondents' views.

Chart 6: ***"Southeast Wisconsin is a leader in water resource protection"***

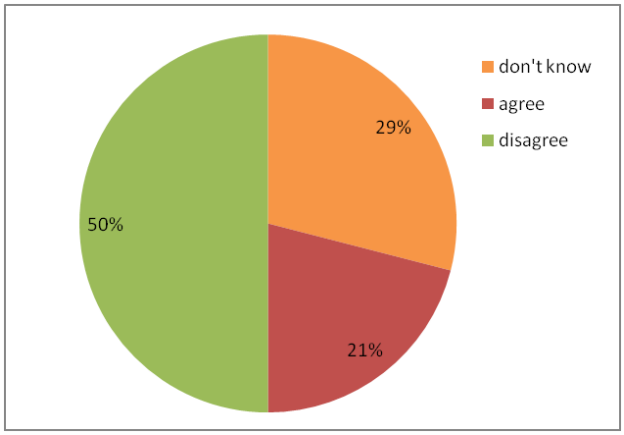


Table 6: ***How effective are the following types of actions by citizens like yourself in helping protect your community's lakes, rivers, and streams?***

% responding…	very effective	somewhat effective
Participating in river or beach clean-up days	54	37
Reducing the amount of pesticides, fertilizer and weed killer used on the garden or lawn	54	36
Conserving water at home by using efficient appliances and fixtures	55	33
Cleaning up pet waste	51	34
Reducing the amount of salt used in the winter	43	41
Participating in river and wetland restoration projects	47	37
Conserving water at home by using less for household tasks	43	39
Composting leaves and yard waste and leaving grass clippings on the lawn	42	40
Installing a rain barrel or rain garden to collect rain from the downspout	39	37
Repairing or replacing privately-owned lateral lines running from the house to the street sewer	44	32
Using less water at home during major storms	35	36

Table 7: ***Which of these actions do you do, or are you willing to do?***

% responding…	already do it	willing to do it	need more info	not willing to do it
Participating in river or beach clean-up days	10	37	16	30
Reducing the amount of pesticides, fertilizer and weed killer used on the garden or lawn	58	16	4	4
Conserving water at home by using efficient appliances and fixtures	69	20	3	5
Cleaning up pet waste	45	6	1	3
Reducing the amount of salt used in the winter	53	18	4	10
Participating in river and wetland restoration projects	9	35	20	29
Conserving water at home by using less for household tasks	71	17	4	7
Composting leaves and yard waste and leaving grass clippings on the lawn	60	12	4	7
Installing a rain barrel or rain garden to collect rain from the downspout	16	31	15	23
Repairing or replacing privately-owned lateral lines running from the house to the street sewer	9	15	25	17
Using less water at home during major storms	52	26	9	8

Table 8: Respondents' actions versus respondents' feelings on effectiveness

	% responding...		Ranked by...	
	effective	already do/ willing to do	effectiveness	action
Participating in river or beach clean-up days	91	47	1	8
Reducing the amount of pesticides, fertilizer and weed killer used on the garden or lawn	90	74	**2**	**4**
Conserving water at home by using efficient appliances and fixtures	88	89	**3**	**1**
Cleaning up pet waste	85	51	4	7
Reducing the amount of salt used in the winter	84	71	**5**	**6**
Participating in river and wetland restoration projects	84	44	5	10
Conserving water at home by using less for household tasks	82	88	7	2
Composting leaves and yard waste and leaving grass clippings on the lawn	82	72	**7**	**5**
Installing a rain barrel or rain garden to collect rain from the downspout	76	47	**9**	**8**
Repairing or replacing privately-owned lateral lines running from the house to the street sewer	76	24	**9**	**11**
Using less water at home during major storms	71	78	10	3

On the whole, most survey respondents feel specific actions taken by individuals are at least somewhat effective in protecting local waterways. Meanwhile, roughly half of respondents feel actions such as river/beach clean-up days, reducing pesticide use, using water-efficient household appliances, cleaning up pet waste, and river/wetland restoration projects are very effective ways to protect local water resources. (See **Table 6**.)

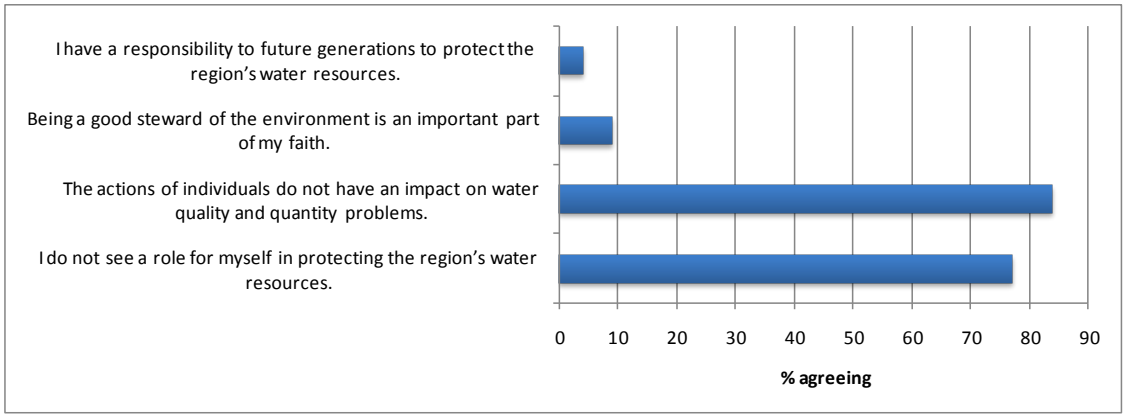
Actions seen as less effective include use of rain barrels and using less water at home during major storms.

Respondents also were asked whether they currently perform any of these actions and, if not, whether they might be willing to do so. In general, most respondents are willing take action to protect local waterways (**Table 7**). The actions they are willing to take are not necessarily those they deem most effective, as shown in **Table 8**. For example, despite seeing participation in river and beach clean-up days as a very effective action, less than half of respondents say they do so, or are willing to do so.

Actions that do align with perceptions of effectiveness include two aimed at reducing non-point pollution: reducing use of pesticides/fertilizer and reducing use of salt. In addition, using water-efficient appliances at home is seen as both effective and doable.

Actions seen as both less effective and less doable include two that would combat non-point source pollution in stormwater runoff (reducing yard waste and using rain barrels) and one that would combat sewer overflows (repairing sewer lateral lines).

Chart 7: Opinions about individual responsibility



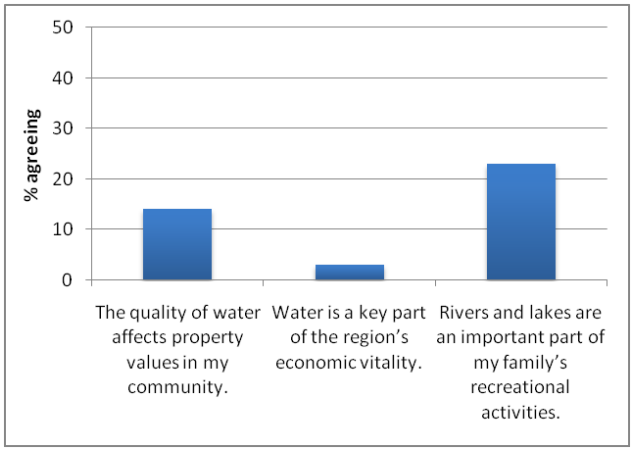
Values

The general mismatch between effectiveness and actionability may not be surprising given the responses to several questions aimed at measuring respondents' sense of individual responsibility toward water resource protection.

Chart 7 shows most respondents do not feel a responsibility to future generations to protect the region's water resources, and that being a good steward of the environment is not an important part of their faith. In addition, most respondents say the actions of individuals do not have an impact on water problems, and they do not see a role for themselves in protecting the region's water resources.

These responses may be explained by respondents' feelings toward water as a regional amenity. **Chart 8** shows that few respondents see water quality as having an impact on property values or as a key part of the region's economy. More respondents—but still less than a quarter—indicate rivers and lakes are important to their family life.

Chart 8: Opinions about water's value



Sources of information

The low value placed on water resources by survey respondents may present an important opportunity for environmental and conservation groups. Such groups garner substantial trust as a source of information about water issues. State and local officials also are seen as reliable sources of information by roughly a third of respondents (**Chart 9**).

With regard to how respondents seek information on water issues, a majority indicate they are most likely to seek such information on the Internet (**Chart 10**).

Chart 9: ***Of the following, who do most trust for information about water issues and water resources?***

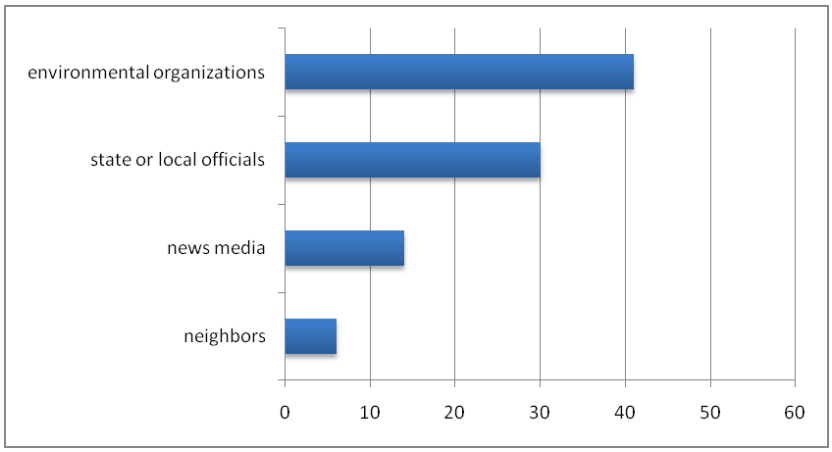
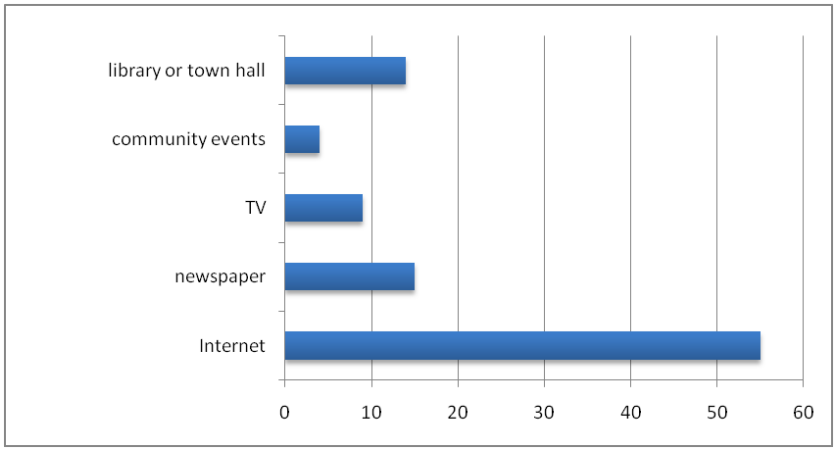


Chart 10: ***Of the following, where would you be most likely to look for information on water and other environmental issues?***



Views on Southeastern Wisconsin Watersheds: Responses from Urban/Suburban Residents

Summary Report

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Executive Summary

This report is intended to summarize new survey data to evaluate water quality outreach and education efforts in the Greater Milwaukee Watersheds. The survey was sent to 3,000 homeowners living in the area.

Survey respondents were more highly educated than the average individuals living in the counties, and may have higher household incomes. It is possible that knowledge regarding water quality issues may be found more often among survey respondents compared to the general population. Indeed, even if there were no education or income differences, respondents to any water quality survey may tend to be those who know and care about the issues, suggesting some bias to the results.

The results of the survey find that 45% of respondents believe the quality of water used for recreational purposes is 'good' or 'excellent', with 78% placing the quality of drinking water at those levels. When asked about specific problems in their area with water for recreational purposes, the issues attracting at least a 'moderate' level of severity included *Algae blooms* (58%); *Polluted/closed beaches and swimming areas* (46%); and *Contaminated fish* (42%).

In terms of the importance of water quality, 81% of respondents 'agree' or 'strongly agree' that it affects *community quality of life* and 75% that it affects *economic stability*. In terms of personal responsibility, only 42% 'agree' or 'strongly agree' that *I would be willing to pay more to improve lakes, rivers, or streams*, but 95% 'agree' or 'strongly agree' that it is their *personal responsibility to help protect water quality*, with 77% agreeing that *I would be willing to change the way I care for my yard to improve water quality*.

When surveyed about the severity of nine specific pollutants, the only item attracting a majority viewing one of these as a 'moderate' or 'severe' problem was 65% for *Nutrients from fertilizers in local streams*. When asked about 15 specific sources for these types of pollutants, the only item attracting a majority agreeing it was a 'moderate' or 'severe' problem was 54% for *Lawn fertilizers and pesticides*.

When asked about nine water quality improvement practices around the home, at least half of respondents reported engaging in *Proper disposal of yard debris* (78%), *Recycling motor oil* (75%), *Directing downspouts away from paved surfaces* (66%), *Properly disposing of pet waste* (54%), and *Applying pesticides and herbicides at manufacturer's guidelines for your lawn* (48%). Still, the most common response regarding three practices was that they were aware of but not using *rain barrels* (63%), *Soil testing* (54%), or a *rain garden* (51%). Out of a list of seven possible reasons why the respondents could not further improve water quality practices around the home, only *Cost* (58%) attracted a majority, with at least 'some' or 'a lot' responses. The survey results find that only 9% had ever used a *Rain garden*, but 77% reported 'maybe' or 'would' consider using; 81% reported currently managing *Yard waste*, with an overlapping 36% willing to improve their use of fertilizer; 18% had ever used a *Rain barrel*, with 65% 'maybe' or 'would' consider using; 63% of dog owners currently clean up *Pet waste* immediately,

with 65% of the remainder at least 'maybe' willing to consider doing so; and 80% of respondents had their automobile or truck inspected regularly for leaks, with 85% fixing any leaks found immediately.

The final section of the survey asked which public service announcement efforts had 'definitely' reached them, and the main provider of this information. The most common responses included *stories addressing stormwater runoff* (40%), *water pollution caused by stormwater runoff* (36%), *ways homeowners potentially contributed to water pollution* (35%), and *ways homeowners can help improve water quality* (34%). Main providers of information included the Wisconsin Department of Natural Resources (40%), and their local city government (31%).

One interpretation of these results is that most respondents are concerned with water quality, and are willing to undertake some actions to improve water quality, so long as these are not financially costly. Not surprisingly, respondents seem most aware of issues that are both visible and close to home, including disposal of yard waste, recycling of motor oil, downspout positioning, fertilizer use, and pet waste. Perhaps the lowest cost initiative which would be utilized by many respondents involves reducing the incidence of over-fertilized gardens and lawns, since over-fertilization involves an unnecessary cost. Rain barrel utilization is currently low, but interest in this water quality improvement device is reasonably high, suggesting a small public subsidy to homeowners installing rain barrels may generate an increase in their utilization.

Introduction

This report presents results of a survey of urban and suburban residents in the Greater Milwaukee Watershed area. The study was conducted by the University of Wisconsin Whitewater's (UWW) Fiscal and Economic Research Center (FERC). The information is intended to help focus water quality outreach and education efforts and provide a baseline for future research. 3,000 surveys were mailed to homeowners, with the mailing list provided by Mailers Haven. 202 households responded.

Results

The survey included eleven sections, measuring demographics, yard and household practices as well as knowledge, attitudes and beliefs regarding water resource issues for the Root Pike watershed.

1. Rating Water Quality

This section asked respondents to rate local water quality for two separate purposes, the quality of local waters in rivers, streams, and lakes for the purposes of swimming, fishing, and other recreational activities (kayaking, etc.) and the quality of drinking water. Respondents generally perceived the water quality in their local rivers, streams, and lakes to be 'okay' to 'good.' The vast majority of respondents believed their quality of drinking water was 'good' or 'excellent.'

1. Overall, how would you rate the quality of the water in your area?

	Poor (0)	Okay (1)	Good (2)	Excellent (3)	Don't Know (4)	No Opinion (5)
Overall, how would you rate the quality of the water in your local rivers, streams, and lakes for purposes of swimming, fishing, and other recreational activities (kayaking, etc.)?	13%	37%	41%	4%	6%	>1%
Overall, how would you rate the quality of your drinking water?	4%	16%	45%	35%	1%	0%

2. Your Water use

Of these activities, which is the most important to you?

- Canoeing / kayaking / other boating: 16%
- Picnicking / family activities near water: 18%
- Eating fish caught locally: 16%
- Swimming: 15%
- Fish habitat / fishing: 20%
- Scenic beauty / enjoyment: 31%

Do you know where the rain water goes when it runs off your property?

- Yes: 86%
- No: 14%

Where does the rain water go when it runs off of your property?

- Gutter: 12%
- Ditch: 16%
- Wastewater Treatment Plant: 10%
- Local Rivers: 19%
- Lake Michigan: 18%
- Storm Sewers: 25%

This section asked about awareness of water run off for individual properties and water use activities. The vast majority of respondents indicated that they were aware where rain water runs off their properties with 25% indicating rain water ran off their property into storm sewers. Scenic beauty / enjoyment was indicated to be the most important activity by respondents with 31% and the rest fairly equally distributed from 15% to 20%.

3. Consequences of Poor Water quality

Respondents were asked to rate the severity of the consequences of poor water quality in their area. Available choices ranged from 'not a problem' to 'severe problem,' with 'don't know' and 'no opinion' as additional options for each.

Several of the consequences listed in the survey were perceived as a 'moderate' to 'severe' problems by respondents. These were: *Algae blooms* (58%); *Polluted/closed beaches and swimming areas* (46%);

and *Contaminated fish* (42%). The three sources with the highest percentage in the 'not a problem' and 'slight problem' categories were: *Odor* (54%); *Reduced beauty of rivers and streams* (51%); *Reduced opportunities for water activities such as boating, canoeing, and fishing* (51%).

3. Poor water quality can lead to a variety of consequences for communities.
In your opinion, how much of a problem are the following issues in your area?

	Not a Problem (0)	Slight Problem (1)	Moderate Problem (2)	Severe Problem (3)	Don't Know (4)	No Opinion (5)
Contaminated drinking water	50%	22%	12%	5%	11%	>1%
Polluted / closed beaches & swimming areas	18%	31%	37%	9%	4%	2%
Contaminated fish	16%	22%	31%	11%	18%	2%
Increase in water / sewage bill	26%	17%	30%	10%	8%	10%
Loss of desirable fish and wildlife species	13%	21%	26%	19%	18%	3%
Reduced beauty of rivers and streams	18%	33%	30%	11%	6%	2%
Reduced opportunities for water activities such as boating, canoeing, and fishing	23%	28%	29%	8%	10%	3%
Algae blooms	8%	19%	34%	24%	15%	>1%
Odor	24%	30%	25%	8%	12%	2%
Lower property values	32%	21%	13%	6%	21%	7%

4. General Water Quality Attitudes
Section three of the questionnaire measured respondents' agreement with a battery of statements regarding water quality and local and personal actions. In general, respondents expressed strongly positive attitudes toward water resource protection. Several highlights are:

- Most respondents 'agree' or 'strongly agree' that *community quality of life* (81%) and *economic stability* (75%) depend on good water quality. When personalized to *I would be willing to pay more to improve lakes, rivers, or streams*, the percent of 'agree' and 'strongly agree' drops significantly (42%).
- A strong majority 'agree' to 'strongly agree' that it is their *personal responsibility to help protect water quality* (95%).

While there is a significant majority in agreement that they have a role in maintaining water quality, a smaller number would be willing to pay to improve water quality. This does not necessarily call into question commitment, as many respondents feel that there are yard care actions they can implement that do not cost anything. This is supported by a large percentage of respondents (77%) stating they 'agree' or 'strongly agree' that they *would be willing to change the way I care for my yard to improve water quality*.

4. What is your level of agreement with the following statements?

	Strongly Disagree (0)	Disagree (1)	Neither Agree or Disagree (2)	Agree (3)	Strongly Agree (4)	No Opinion (5)
The economic stability of my community depends upon clean lakes, rivers, and streams	3%	7%	14%	44%	31%	3%
The way that I care for my yard can influence water quality in lakes, rivers and streams	>1%	1%	6%	51%	39%	1%
It is my personal responsibility to help protect water quality	1%	>1%	2%	57%	38%	1%
What I do on my property doesn't have much impact on overall water quality	31%	42%	11%	11%	4%	>1%
Yard-care practices (on individual lots) do not have an impact on local water quality	36%	50%	6%	6%	1%	1%
My actions can have an impact on lakes, rivers, and streams	1%	2%	4%	60%	29%	1%
I would be willing to pay more to improve lakes, rivers, and streams	4%	16%	33%	33%	9%	4%
I would be willing to change the way I care for my yard to improve water quality	>1%	5%	17%	61%	16%	2%
The quality of life in my community depends on good water quality in local streams, rivers and lakes	1%	6%	10%	47%	34%	3%

5. Types of Water pollutants

Respondents were asked to identify which pollutants were problematic in their area. Available choices on the questionnaire for each ranged from 'not a problem' to 'severe problem,' and 'don't know' and 'no opinion' as additional options for each. Respondents showed a high degree of uncertainty regarding problems in their area, with nearly half of the types of water pollutants having *don't know* as their most common response. Over thirty percent of respondents indicated that they did not know how much of a problem salt, bacteria and viruses, and phosphorus were in their area. This was the highest percentage of response for all of these categories. For those respondents that did not answer 'don't know,' the following pollutants were most frequently identified as a 'severe problem': *Invasive aquatic plants and animals, nutrients, trash and debris, and phosphorus*. Of least concern was *organic matter* and *dirt and soil* in local streams.

5. Below is a list of water pollutants that are generally present in water bodies to some extent. In your opinion, how much of a problem are the following pollutants in your area?

	Not a Problem (0)	Slight Problem (1)	Moderate Problem (2)	Severe Problem (3)	Don't Know (4)	No Opinion (5)
Dirt and Soil in local streams	15%	25%	30%	12%	18%	1%
Nutrients from fertilizers in local streams	4%	19%	35%	30%	14%	0%
Phosphorus in local streams	5%	17%	25%	22%	30%	1%
Bacteria and viruses in local streams (such as E. coli)	9%	15%	25%	19%	32%	1%
Salt in local streams	14%	16%	17%	11%	41%	2%
Invasive aquatic plants and animals	5%	19%	25%	34%	17%	1%
Oil or antifreeze from cars and trucks	14%	22%	16%	17%	31%	1%
Trash and debris	9%	25%	34%	23%	10%	0%
Organic matter, such as fallen trees, branches, grass clippings, leaves	17%	34%	27%	8%	15%	1%

6. Sources of Water Pollution

This section surveyed the perceived severity of eighteen potential sources of water pollution. Available choices on the questionnaire for each ranged from 'not a problem to 'severe problem' and 'don't know' as an additional option for each. For each of the following categories, respondents most commonly indicated that they 'don't know' how much of a problem it is for their area: *Discharges from industry* (22%); *Improper disposal of household Construction sites* (20%); *waste* (20%); *Soil erosion from farm fields* (19%) and *Manure from farm animals* (18%).

Only two pollutants, *Discharge from sewage treatment plants* (25%); and *Agricultural fertilizers and pesticides* (25%), were most commonly identified as 'severe problem'. Respondents most commonly identified the following six sources as a 'moderate problem': *Street salts* (36%); *Stormwater runoff from streets, highways, and/or parking lots* (36%); *Lawn fertilizers and pesticides* (34%); *Droppings from geese, ducks, and other waterfowl* (32%); *Discharges from storm sewers* (27%); and *Discharges from industry into streams and lakes* (25%).

Combining 'moderate problem' and 'severe problems' categories, the following were rated highest by respondents: *Lawn fertilizers and pesticides* (54%); *Stormwater runoff from streets, highways, and/ or parking lots* (52%); *Street salt and sand* (52%); *Discharges from sewage treatment plants* (46%). The three sources with highest percentages in the 'not a problem' and 'slight problem' categories combined were: *Pet Waste* (57%); *Grass clippings and leaves* (57%); and *Soil erosion from construction sites* (49%).

6. The items listed below are sources of water quality pollution across the country. In your opinion, how much of a problem are the following sources in your area?

	Not a Problem (0)	Slight Problem (1)	Moderate Problem (2)	Severe Problem (3)	Don't Know (4)	No Opinion (5)
Discharges from industry into streams and lakes	13%	20%	25%	19%	22%	1%
Discharges from sewage treatment plants	13%	20%	22%	24%	19%	1%
Soil erosion from construction sites	14%	35%	20%	10%	20%	1%
Soil erosion from stream farm fields	11%	29%	22%	17%	19%	2%
Lawn fertilizers and pesticides	5%	27%	34%	20%	13%	2%
Grass clippings and leaves	21%	36%	18%	4%	18%	3%
Discharges from storm sewers	12%	24%	27%	16%	18%	3%
Improper disposal household waste (batteries, medications, chemicals, etc.)	12%	24%	23%	18%	20%	2%
Improper disposal of used motor oil and antifreeze	13%	26%	20%	15%	24%	2%
Manure from animal farms	13%	25%	23%	19%	18%	2%
Stormwater runoff from streets, highways, and/or parking lots	9%	28%	36%	16%	10%	1%
Street salt and sand	5%	29%	36%	16%	12%	2%
Droppings from geese, ducks, and other waterfowl	11%	31%	32%	10%	13%	2%
Pet waste (such as dogs or cats)	17%	40%	17%	4%	19%	2%
Agricultural fertilizers and pesticides	6%	24%	24%	25%	18%	2%

7. Practices to Improve Water Quality

Section seven asked respondents to provide their level of familiarity with nine practices designed to improve water quality. Choices ranged from 'never heard of it' to 'currently use it.'

Respondents most commonly chose 'currently use it' for the following practices:

- Proper disposal of yard debris (78%)
- Recycling motor oil (75%)
- Directing downspouts away from paved surfaces (66%)
- Properly disposing of pet waste (54%)
- Applying pesticides and herbicides at manufacturer's guidelines for your lawn (48%)

The most common response for the following practices was 'Know how to use; not using it':

- Using rain barrels (63%)
- Soil testing (54%)
- Using a rain garden (51%)

7. Please indicate which statement most accurately describes your level of experience with each practice listed below.

	Never Heard Of It (0)	Somewhat Familiar (1)	Aware How to Use it; Not Using it (2)	Currently Using it (3)
Applying pesticides and herbicides at manufacturer's guidelines for your lawn	4%	16%	31%	48%
Using phosphate free fertilizer	18%	23%	36%	22%
Properly disposing of pet waste	9%	13%	23%	54%
Using rain barrels	4%	15%	63%	19%
Recycling motor oil	4%	9%	11%	75%
Directing downspouts away from paved surfaces	6%	10%	16%	66%
Using a rain garden	24%	15%	51%	9%
Proper disposal of yard debris	4%	8%	9%	78%
Soil testing	16%	23%	54%	6%

8. Making Management Decisions

In general, how much does each issue limit your ability to change your household & lawn care practices (such as those in Question 6)?

	Not at All (0)	A Little (1)	Some (2)	A lot (3)	Don't Know (4)	No Opinion (5)
Cost	17%	20%	39%	19%	3%	3%
My own physical abilities	42%	17%	27%	12%	2%	2%
The need to learn new skills or techniques	31%	23%	31%	7%	7%	3%
Legal restriction on my property	47%	6%	16%	6%	22%	4%
Not having access to the necessary equipment that I need	38%	13%	27%	6%	12%	4%
Lack of available information about the practice	30%	16%	26%	10%	14%	3%
Concerns about resale value	42%	14%	21%	11%	7%	5%

This section was designed to determine which factors (constraints) most strongly limit respondents' general ability to change runoff management and lawn care practices. Options ranged from 'not at all' to 'a lot', and included a 'don't know' choice.

Grouping the 'some' to 'a lot' responses together, respondents most commonly identified *Cost* (58%). These constraints were the least influential in changing practices (responses of 'not at all' and 'a little'): *My own physical abilities* (59%); *Legal restriction on my property* (53%); *Not having access to the necessary equipment that I need* (51%); and *Lack of available information about the practice* (46%).

9. Constraints for Specific Practices

Rain Garden: A rain garden is a garden that is designed to absorb and filter stormwater. It is usually designed to collect stormwater from a house or structure.

Do you have or have you had a rain garden?

Yes	Currently Use	Do Not Currently Use	No	Never Used
9%	3%	2%	70%	17%

How familiar are you with rain gardens?

Never Heard of It	Somewhat Familiar With it	Know How To Install, Not Doing It	Have Installed A Rain Garden
35%	45%	12%	8%

Are you willing to try utilizing a rain garden?

Yes	Maybe	No	Already Have One
24%	53%	18%	5%

How much do the following factors limit your ability to build a rain garden (or limited, if you already have one)?

	Not at All (0)	A Little (1)	Some (2)	A lot (3)	Don't Know (4)	No Opinion (5)
Lack of information skills	21%	15%	28%	29%	4%	4%
Time required	17%	18%	29%	18%	12%	5%
Cost	18%	13%	28%	21%	16%	4%
The features of my property do not support it	17%	8%	15%	22%	33%	4%
Physical or health limitations	46%	12%	20%	12%	8%	3%

Yard Waste Management: Yard waste management means keeping grass clippings and leaves out of roads, ditches, and gutters.

Do you manage your yard waste by keeping grass clippings out of street, etc.?

Yes	Maybe	Currently Do	No	Never Have	Currently Do It
81%	3%	8%	6%	2%	2%

How familiar are you with yard waste management?

Never Heard Of It	Somewhat Familiar With It	Know How To Manage, Not Doing It	Currently Managing Yard Waste
4%	25%	3%	68%

Are you willing to manage your use of fertilizer?

Yes	Already Managing It	No	Maybe
36%	51%	4%	7%

Downspouts and rain barrels: Downspouts should be aimed at pervious areas like gardens, lawns, and pervious paved areas and not down driveways or onto sidewalks. A rain barrel installed on a downspout can hold back stormwater.

How familiar are you with rain barrels?

Never Heard Of Them	Somewhat Familiar With Them	Know How To Install, Not Doing It	Have Installed A Rain Barrel
6%	49%	28%	18%

Are you willing to try utilizing a rain barrel?

Yes	Maybe	No	Already Have One
25%	40%	22%	13%

Pet Waste: Dog poop is a major pollutant in runoff. When it reaches our rivers and lakes, poop uses oxygen as it decays and sometimes releases ammonia, both of which can kill fish. Pet poop also contains nutrients that encourage weed and algae growth. Most importantly, pet waste carries diseases, which make water unsafe for swimming or drinking.

Do you own a dog?

Yes	No
43%	56%

How often do you clean up your pet's waste?

Always	In Nice Weather	Rarely	Most Of The Time	When People Will Be In My Yard	Never
63%	2%	3%	16%	3%	12%

Are you willing to clean up your pet's waste every time?

Yes	Maybe	No	I Already Do
56%	9%	16%	20%

Auto & Truck Care: How we care for our vehicles has an impact on water quality. Leaking oil and other fluids along with runoff from washing cars in the driveway lead to an increase in pollutant in our waterways.

Do you have your car inspected for leaks regularly?

Yes	Somewhat Regularly	I Don't Own A Car	No	I'm Not Sure
80%	12%	1%	7%	>1%

When a leak is discovered, how long does it usually take you to get it fixed?

I Get It Fixed As Soon As Possible	I Get It Fixed If It Causes Problems With How My Car Runs	I Don't Own A Car	I Get It Fixed When I Can Afford It	I Don't Worry About It Or Get It Fixed
85%	6%	>1%	8%	>1%

The section asked for detailed information regarding awareness, use, and constraints related to five specific practices: rain gardens, yard waste management, downspouts, pet waste and auto and truck care.

Rain Garden: A rain garden was defined as 'a garden that is designed to absorb and filter stormwater.' Most people (87%) responded 'no' or 'never used' when asked if they have or had a rain garden, though only 35% of the respondents have 'never heard of it,' with 45% indicating they were 'somewhat familiar with it.' Over 75% of the respondents indicated 'Maybe' or 'Yes' they were willing to use a rain garden. Roughly one third of respondents answered, they 'Don't know' whether their property could support a rain garden, and one third suggest, that lack of information skills limited their ability to build a rain garden 'A lot.' Physical limitations were the least important constraint, with 46% responding it was 'not at all' a limitation.

Yard Waste: The definition provided for this practice was 'keeping grass clippings and leaves out of the roads, ditches, and gutters.' Although 89% of the respondents state that they are currently managing yard waste, 29% of them are either 'Somewhat familiar with it' or 'Never heard of it'. 43% of the respondents answered, 'Maybe' or 'Yes' they were willing to manage their yard waste.

Downspouts and rain barrels: This practice involved the usage of rain barrels. When asked how familiar they were with rain barrels over 49% of respondents express they were 'somewhat familiar with them'. 6% of respondents claimed they had 'never heard of them,' while 18% claim to 'have installed a rain barrel.' 65% of respondents indicated they would be willing to try utilizing a rain barrel.

Pet Waste: Respondents were asked if they owned a dog, with 43% indicating they did. When asked how often they clean up their pet's waste, 63% claim to 'always' clean up their pet's waste, with 12% indicating they never clean up their pet's waste.

Auto & Truck Care: Survey respondents were asked about aspects of their vehicle care, with 92% of respondents indicating 'yes' or 'somewhat regularly' when asked how often they had their vehicles inspected for leaks. 85% of respondents indicated 'I get it fixed as soon as possible' when asked how long does it usually take to get their vehicle fixed when a leak is found.

10. About You and Your Property

What is your gender?

Male	Female
50%	50%

What year were you born?

> 1930's *Age 77+	1940's *Age 67-76	1950's *Age 57-66	1960's *Age 47-56	1970's *Age 37-46	1980's *Age 36 & Under
7%	19%	34%	24%	12%	4%

* At Time of Survey

What is the highest level of education you have completed?

Less Than High School	High School Diploma Or Equivalent	Some College	2 Year Associate's Degree	4 Year Bachelor's Degree	Graduate Degree
1%	15%	16%	16%	30%	23%

What is your annual household income level?

Less than $24,999	$25,000 to 49,999	$50,000 to 74,999	$75,000 to 99,999	$100,000 or More
5%	18%	24%	18%	34%

A series of questions were asked regarding the respondent and his or her property.
Information about respondents and their property:

- Less than one percent have an education below high school graduate level, with 15% having a HS diploma. Respondents to the survey were well educated, with 30% having a four-year degree and a large number of graduate degrees (23%). Those figures are above U.S. Census estimates of education for Racine County, where 12.1% of adults do not have a HS diploma, and only 23.4% have a Bachelor's degree or above.[1] Similarly, in Kenosha County, 10.3% of adults do not have a HS diploma, and 24.3% hold a Bachelor's degree or above.[2]

1 - Education and household income figures for Racine from U.S. Census: census.gov/quickfacts/table/PST045215/55101 December 4, 2016. Demographic data for Milwaukee area: http://www.choosemilwaukee.com/index.php?submenu=DataStatistics&src=gendocs&ref=DataStatistics&category=Data Maps

2 - Education and household income figures for Kenosha from U.S. Census: census.gov/quickfacts/table/PST045215/55059 December 4, 2016.

- Roughly 34% of respondents have a household income of over $100,000, while 24% have a household income below $49,999. The median category for income was '$55,000 to $74,999, which fits or is higher than U.S. Census figures. Those estimates place median household income in Racine in 2014 of $55,000, with a similar figure of $54,700 for Kenosha.

These differences suggest that respondents tended to be more highly educated than the average adult living in the area, and may have higher incomes.

11. Information Acquisition

11a. Please look at the loose leaf image provided, Sparkles the Water Spaniel, which represents a public awareness campaign that has run over the past four years. Then answer the questions below:

	Definitely Not (0)	Don't Think So (1)	Don't Know (2)	I Think So (3)	Definitely Have (4)
Do you recall seeing or hearing related advertising about water pollutions caused by stormwater runoff (storms that ultimately carry yard or street pollutant into lakes, rivers, & streams)?	16%	25%	5%	18%	36%
Are you aware of any advertising that carries the message, "Respect Our Waters?" (as seen above)	12%	28%	8%	24%	27%
Do you recall watching, reading, or hearing any news stories that address stormwater runoff?	7%	16%	9%	29%	40%
Do you recall seeing, reading or hearing the Respect Our Water message at any community events (fairs, festivals, farmer's markets, etc.)?	18%	37%	14%	16%	14%
Through advertising or news stories, have you learned of ways homeowners potentially contributed to water pollution?	8%	17%	9%	31%	35%
Through advertising or news stories, have you learned of ways homeowners can help improve water quality?	7%	17%	11%	31%	34%

11b. People receive information about water quality though many different sources. From which of these sources have you received information about water quality, and to what extent did the source assist you in education and awareness regarding the issue?

	Not at All (0)	A Little (1)	Some (2)	A lot (3)	Don't Know (4)
Respect Our Waters	46%	16%	19%	8%	11%
Southeast Wisconsin Watersheds Trust Inc. (aka Sweet Water)	68%	8%	5%	1%	19%
Root Pike Watershed Initiative Network	72%	7%	5%	1%	15%
Your Local School or College	63%	10%	11%	4%	12%
Your Local Home & Garden Center	50%	20%	16%	2%	11%
Your Local City Government	37%	22%	26%	5%	10%
Your County Government	48%	16%	20%	3%	13%
UW Extension	50%	18%	17%	3%	12%
Wisconsin Department of Agriculture, Trade and Consumer Protection	53%	17%	11%	2%	18%
Wisconsin Department of Natural Resources	30%	22%	29%	11%	9%
The United States Environmental Protection Agency	48%	15%	19%	3%	16%
Political Organizations, such as League of Conservation Voters	61%	10%	7%	4%	18%

Respondents were asked if they recalled seeing information regarding water quality regarding 6 different areas. Most respondents responded with the majority 'I Think so' or 'Definitely Have' to the following five areas:

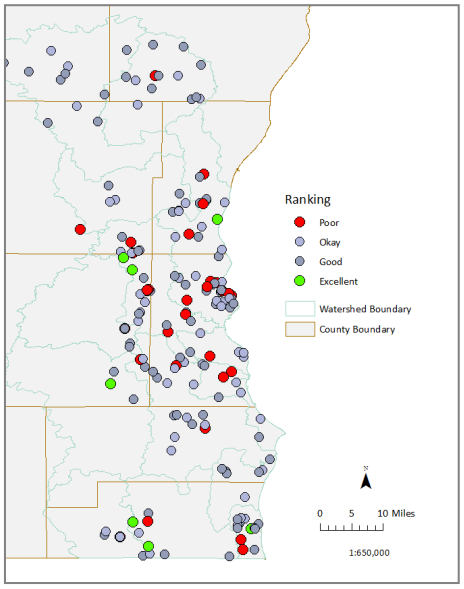
1. *Recall seeing or hearing related advertising about water pollution caused by stormwater runoff (54%)*
2. *Aware of any advertising that carries the message "Respect our Water?" (51%)*
3. *Recall watching, reading, or hearing any news stories that address stormwater runoff (69%)*
4. *Advertising or news stories, have you learned of ways homeowners potentially contributed to water pollution (66%)*
5. *Have you learned of ways homeowners can help improve water quality (65%).*

Respondents were also asked to what extent did the information about water quality come from 22 different sources. Respondents indicated that these sources did not assist in the education and awareness regarding the issue: *Root Pike Watershed Initiative Network* (72%); *your local school or college* (63%); *Political organizations* (61%); *Wisconsin Department of Agriculture, Trade and Consumer Protection* (53%); *UW Extension* (50%; and *your local home and garden center* (50%).

Perception of Water Quality for Recreational Activities

Part 1, Question 1

"Views on Southeastern Wisconsin Watersheds: Responses from Urban/Suburban Residents"



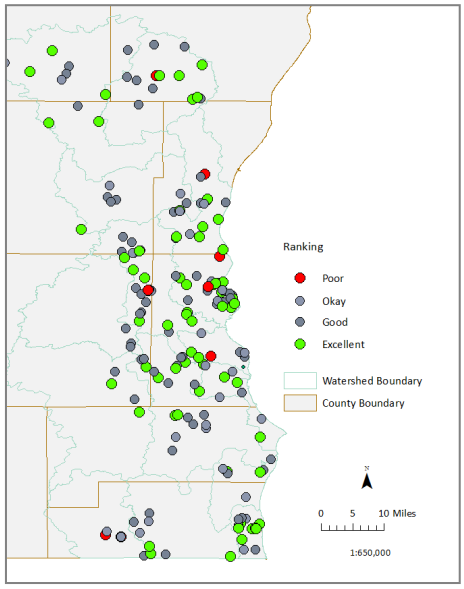
WI Dept. of Natural Resources, 2016
Sweetwater Survey, 2016
ESRI Data, 2014

Marcus Riccio, Nov. 2016
UW-Whitewater

Perception of Drinking Water Quality

Part 1, Question 2

"Views on Southeastern Wisconsin Watersheds: Responses from Urban/Suburban Residents"



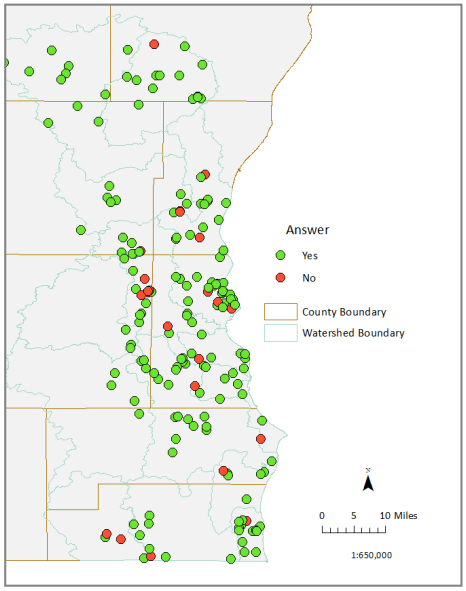
WI Dept. of Natural Resources, 2016
Sweetwater Survey, 2016
ESRI Data, 2014

Marcus Riccio, Dec. 2016
UW-Whitewater

Knowledge of Where Rainwater Runoff Goes?

Part 2, Question 4

"Views on Southeastern Wisconsin Watersheds: Responses from Urban/Suburban Residents"



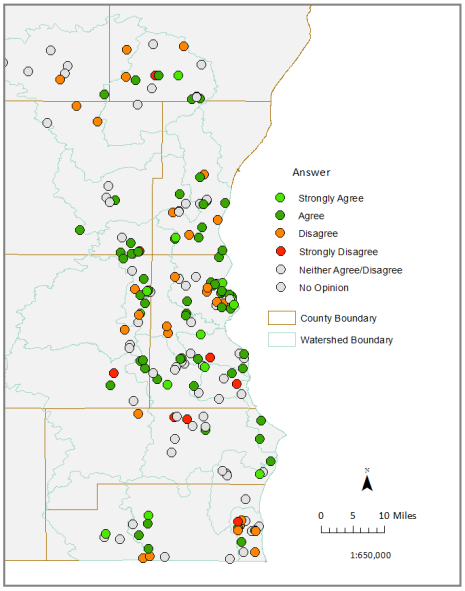
WI Dept. of Natural Resources, 2016
Sweetwater Survey, 2016
ESRI Data, 2014

Marcus Riccio, Dec. 2016
UW-Whitewater

Willingness to Pay More to Improve Lakes, Rivers, Streams

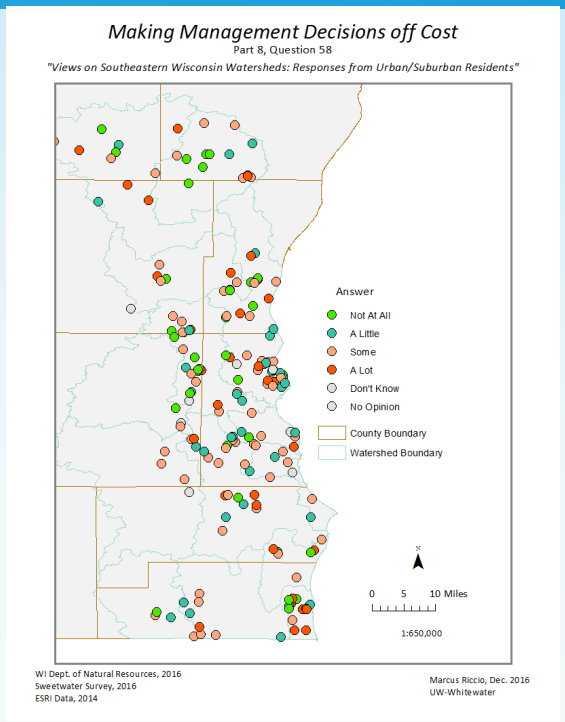
Part 4, Question 22

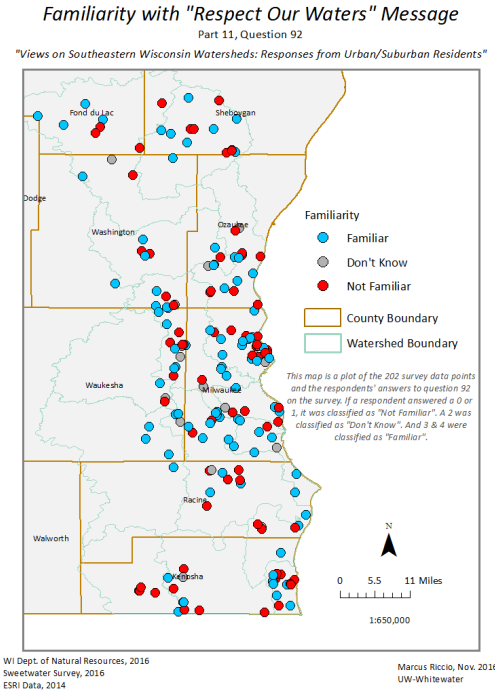
"Views on Southeastern Wisconsin Watersheds: Responses from Urban/Suburban Residents"

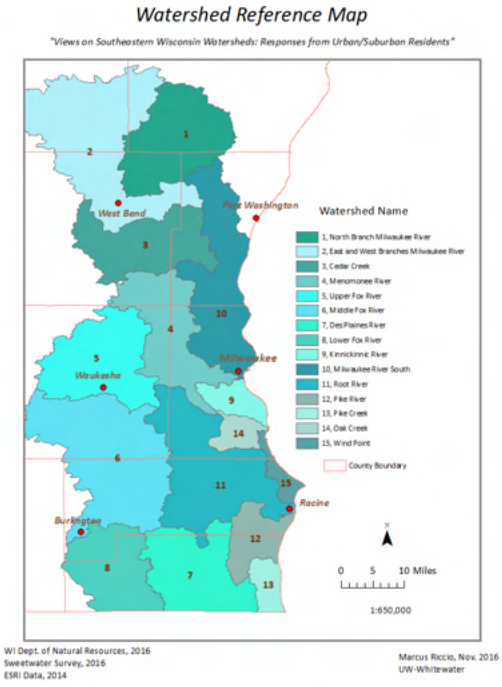


WI Dept. of Natural Resources, 2016
Sweetwater Survey, 2016
ESRI Data, 2014

Marcus Riccio, Dec. 2016
UW-Whitewater


Making Management Decisions off Cost
Part 8, Question 58
"Views on Southeastern Wisconsin Watersheds: Responses from Urban/Suburban Residents"
Answer
Not At All
A Little
Some
A Lot
Don't Know
No Opinion
County Boundary
Watershed Boundary
N
0 5 10 Miles
1:650,000
WI Dept. of Natural Resources, 2016
Sweetwater Survey, 2016
ESRI Data, 2014
Marcus Riccio, Dec. 2016
UW-Whitewater


Familiarity with "Respect Our Waters" Message
Part 11, Question 92
"Views on Southeastern Wisconsin Watersheds: Responses from Urban/Suburban Residents"
Fond du Lac
Sheboygan
Dodge
Washington
Ozaukee
Waukesha
Milwaukee
Racine
Walworth
Kenosha
Familiarity
Familiar
Don't Know
Not Familiar
County Boundary
Watershed Boundary
This map is a plot of the 202 survey data points and the respondents' answers to question 92 on the survey. If a respondent answered a 0 or 1, it was classified as "Not Familiar". A 2 was classified as "Don't Know". And 3 & 4 were classified as "Familiar".
N
0 5.5 11 Miles
1:650,000
WI Dept. of Natural Resources, 2016
Sweetwater Survey, 2016
ESRI Data, 2014
Marcus Riccio, Nov. 2016
UW-Whitewater


Watershed Reference Map
"Views on Southeastern Wisconsin Watersheds: Responses from Urban/Suburban Residents"
West Bend
Port Washington
Milwaukee
Waukesha
Racine
Burlington
Watershed Name
1, North Branch Milwaukee River
2, East and West Branches Milwaukee River
3, Cedar Creek
4, Menomonee River
5, Upper Fox River
6, Middle Fox River
7, Des Plaines River
8, Lower Fox River
9, Kinnickinnic River
10, Milwaukee River South
11, Root River
12, Pike River
13, Pike Creek
14, Oak Creek
15, Wind Point
County Boundary
N
0 5 10 Miles
1:650,000
WI Dept. of Natural Resources, 2016
Sweetwater Survey, 2016
ESRI Data, 2014
Marcus Riccio, Nov. 2016
UW-Whitewater

Appendix:

It is notable that there is strong consistency between the survey results for the 2010 survey and the 2016-2017 survey. Those means that have changed may be partially due to the larger sample size of the most recent survey. The response mean change that may be of greatest interest is the perceived consequences of poor water quality on lowering property values with the 2010 survey mean (1.0) indicating that it was not viewed as a problem with a 2016-2017 survey mean (1.8) moving strongly towards the belief that poor water quality is a slight problem for property value. Other notable changes from the 2010 to 2016-2017 survey results include changes in views of how much a problem salt in local streams was perceived to be, changing from a mild belief that it is a slight problem (2.4) to a mild belief that it is a moderate problem (2.8). The amount of experience indicated by survey respondents using rain barrels has increased from being somewhat familiar (2.6) in 2010 to knowing how to use a rain barrel but not using it (3.0) in 2016-2017, suggesting that a lack of familiarity with the use of rain barrels is no longer a driving factor in their implementation. The survey results in general suggest very little change in respondent mean beliefs about water quality from 2010 to present.

(Note: Each mean value removes respondents who responded "Don't Know" or "No Opinion")
Comparison of 2010 survey mean results to 2016-2017 survey mean results:

Question	**2016-2017 Mean**	2010 Mean
Your Water Use:	-	-
Do you know where the rain water goes when it runs off your property?	**.86**	.7
Consequences of Poor Water Quality: Poor water quality can lead to a variety of consequences for c ommunities. In your opinion, how much of a problem are the following issues in your area?	-	-
Contaminated drinking water	**1.7**	2.1
Polluted / closed beaches & swimming areas	**2.3**	2.6
Contaminated fish	**2.5**	2.8
Increase in water / sewage bill	**2.3**	2.7
Loss of desirable fish and wildlife species	**2.6**	2.8
Reduced beauty of rivers and streams	**2.4**	2.5
Reduced opportunities for water activities such as boating, -canoeing, and fishing	**2.2**	2.4
Odor	**2.2**	2.5
Lower property values	**1.8**	1.0
General Water Quality Attitudes: What it your level of agreement with the following statements?	-	-
The economic stability of my community depends upon clean lakes, rivers, and streams	**4.1**	3.9
The way that I care for my yard can influence water quality in lakes, rivers and streams	**4.3**	4.1

Appendix Continued...

Question	**2016-2017 Mean**	2010 Mean
It is my personal responsibility to help protect water quality	**4.3**	4.2
What I do on my property doesn't have much impact on overall water quality	**2.1**	2.2
Yard-care practices (on individual lots) do not have an impact on local water quality	**1.9**	2.0
My actions can have an impact on lakes, rivers, and streams	**4.2**	3.9
I would be willing to pay more to improve lakes, rivers, and streams	**3.3**	2.9
I would be willing to change the way I care for my yard to improve water quality	**3.9**	3.8
The quality of life in my community depends on good water quality in local streams, rivers and lakes	**3.7**	3.9
Types of Water Pollutants: Bellow is a list of types of water pollutants that are generally present in water bodies to some extent. In your opinion, how much of a problem are the following pollutants in your area?	-	-
Dirt and Soil in local streams	**2.5**	2.3
Nutrients from fertilizers in local streams	**3.0**	3.0
Phosphorus in local streams	**2.6**	3.0
Bacteria and viruses in local streams (such as E. coli)	**2.9**	3.0
Salt in local streams	**2.4**	2.8
Invasive aquatic plants and animals	**3.1**	3.2
Oil or antifreeze from cars and trucks	**2.5**	2.7
Trash and debris	**2.8**	3.0
Organic matter, such as fallen trees, branches, grass clippings, leaves	**2.3**	2.4
Sources of Water Pollution: The items listed below are sources of water quality pollution across the country. In your opinion, how much of a problem are the following sources in your area?	-	-
Discharges from industry into streams and lakes	**2.6**	2.7
Discharges from sewage treatment plants	**2.7**	3.0
Soil erosion from construction sites	**2.8**	2.5
Soil erosion from stream farm fields	**2.6**	2.7
Lawn fertilizers and pesticides	**2.8**	2.9
Grass clippings and leaves	**2.1**	2.1
Discharges from storm sewers	**2.6**	2.9
Improper disposal household waste (such as batteries, -medications, chemicals, fluorescent light bulbs, etc.)	**2.7**	2.7

Appendix Continued...

Improper disposal of used motor oil and antifreeze	**2.5**	2.7
Manure from animal farms	**2.7**	2.6
Storm water runoff from streets, highways, and/or parking lots	**2.7**	2.8
Street salt and sand	**2.7**	2.9
Droppings from geese, ducks, and other waterfowl	**2.5**	2.8
Pet waste (such as dogs or cats)	**2.1**	2.2
Agricultural fertilizers and pesticides	**2.9**	3.0
Practices to Improve Water Quality: Please indicate which statement most accurately describes your level of experience with each practice listed below.	-	-
Applying pesticides and herbicides at manufacturer's guidelines for your lawn	**3.2**	3.2
Using phosphate free fertilizer	**2.6**	2.6
Properly disposing of pet waste	**3.2**	3.0
Using rain barrels	**3.0**	2.6
Recycling motor oil	**3.5**	3.5
Directing downspouts away from paved surfaces	**3.4**	3.5
Making Management Decisions: In general, how much does each issue limit your ability to change you household and lawn care practices?	-	-
Cost	**2.4**	2.4
My own physical abilities	**2.5**	2.9
The need to learn new skills or techniques	**2.9**	2.7
Legal restriction on my property	**3.3**	3.0
Not having access to the necessary equipment that I need	**3.1**	3.0
Lack of available information about the practice	**2.8**	2.6
Concerns about resale value	**2.5**	2.7
Constraints for Specific Practices: How much do the following factors limit your ability to build a rain garden (or limited, if you already have one)?	-	-
Lack of information skills	**2.7**	2.5
Time required	**2.6**	2.4
Cost	**2.6**	2.7
The features of my property do not support it	**2.7**	2.4
Physical or health limitations	**2.0**	1.9
About You and Your Property:	-	-
What is your gender?	**.5**	.35

APPENDIX J. MICROBIAL COMMUNITY ASSESSMENT FOR THE MILWAUKEE RIVER BASIN 2017, DR. RYAN MILLER, UNIVERSITY OF WISCONSIN-MILWAUKEE SCHOOL OF FRESHWATER SCIENCES

Overview

Goals:

1. **To evaluate the utility of microbial community metrics for water quality monitoring**
2. **To determine sources, coupling, and timing of sediment and fecal coliform loads in the Milwaukee harbor**

Can the microbial composition of the Milwaukee River watershed inform more efficient monitoring & pollutant mitigation strategies?

4

Overview

Research Questions:

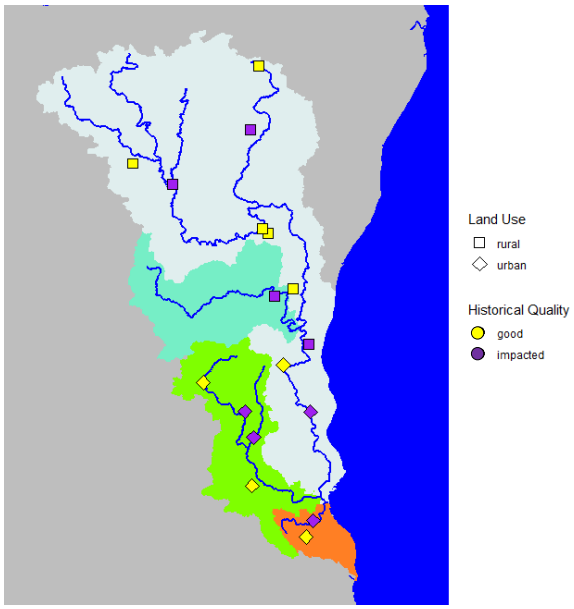
1. **Does bacterial community diversity differ in streams with "good" versus "impacted" water quality?**
2. **What traditional water quality parameters correlate with microbial community diversity in streams?**
3. **How are freshwater and fecal-associated bacteria dispersed throughout the Milwaukee River basin?**

9

Methods: Sampling locations

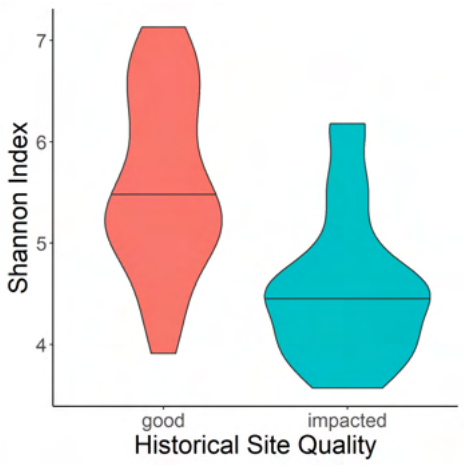
- **16 total sampling locations**
- **Sampled on 5 days in summer 2017 by UWM & Milwaukee Riverkeeper citizen scientists**

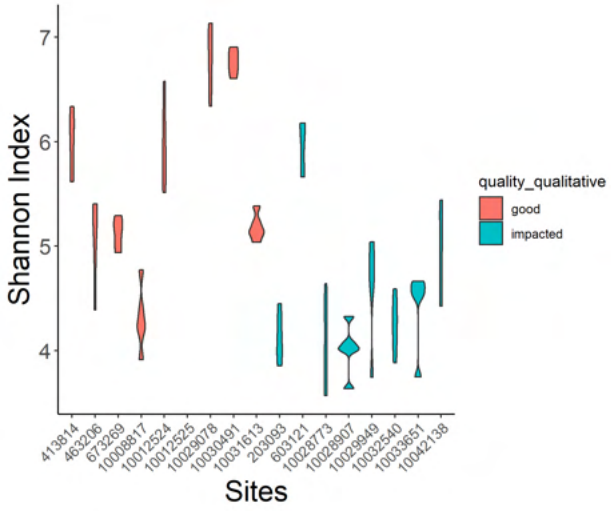
Sample Site Breakdown			
		Surrounding Land Use	
		Rural	Urban
Water Quality	Impacted	4 Sites	4 Sites
	Good	4 Sites	4 Sites



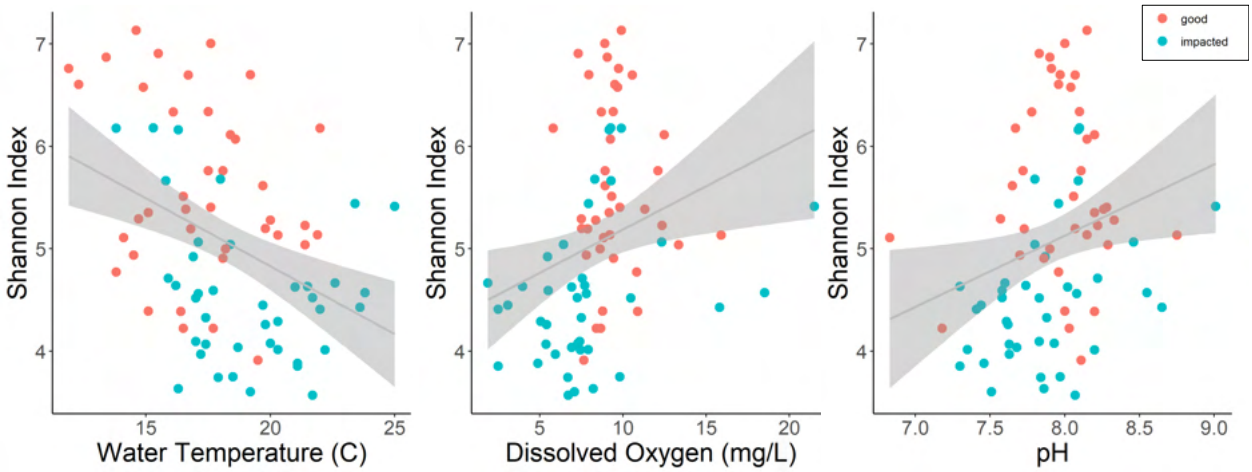
11

Alpha diversity is generally lower at impacted sites and is generally consistent at individual sites across time

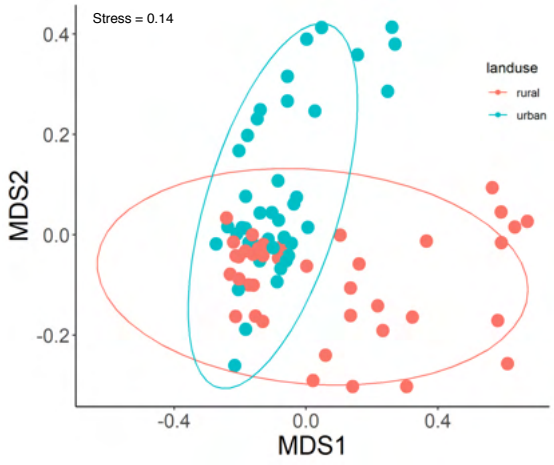




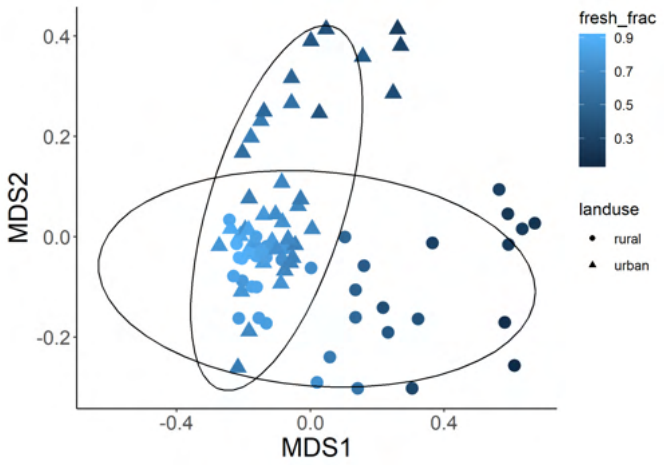
Alpha diversity correlates with typical measures of stream quality



Beta diversity differs between dominant land uses



Urban & rural land use communities are most similar when dominated by freshwater organisms



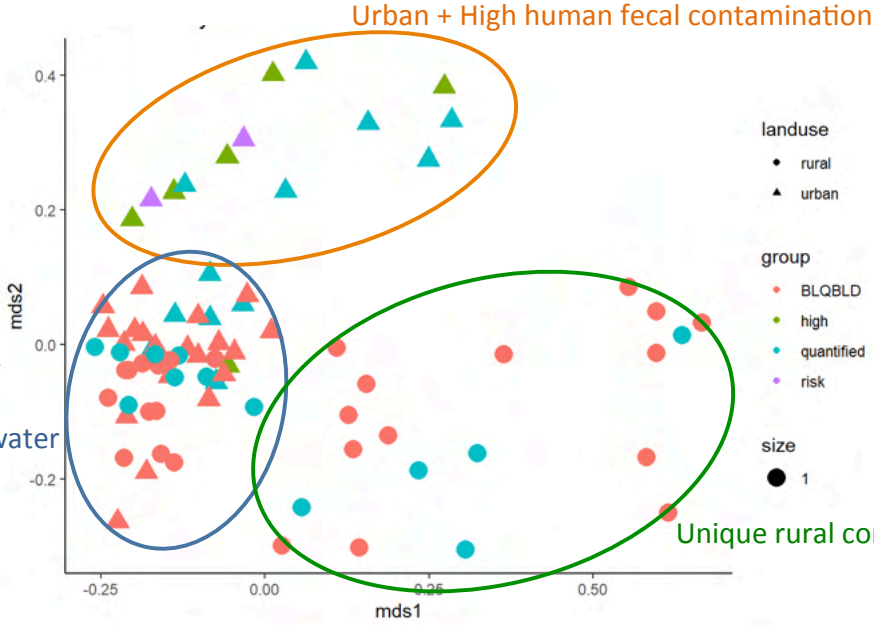
High human fecal contamination is related to shifts in urban bacterial communities

Human fecal contamination measured with standard qPCR assays

Urban + High human fecal contamination

Urban & Rural - Dominated by "typical" freshwater bacteria

Unique rural communities



Grading the Milwaukee Area Rivers for Sewage Contamination

Bacterial genera and (# of sequences) used for sewage tracking

Prevotella (1), *Arcobacter* (4), *Cloacibacterium* (1), *Bacteroides* (1), *Acinetobacter* (1),

Sewage Contamination Level Scoring

<1 in 1000 seq. = very low
1 in 500 to 1000 seq. = low
1 in 200 to 500 seq. = moderate
1 in 100 to 200 seq. = high
>1 in 100 seq. = very high

Very low = 4
Low = 3
Moderate = 2
High = 1
Very high = 0

	Sewage bacteria contamination						
Site	**very low**	**low**	**moderate**	**high**	**very high**	**score**	**Grade**
Batavia Creek at South 28th			2	3		7	C
Cedar Creek at Covered Bridge	5					20	A+
Dretzka Park Crrek at W Bradley Road		1	2		2	7	C
East Branch Milwaukee River at CTH S	1	4				16	A-
Indian Creek DS Bradley Road	2	1	1	1		14	B
KK River DS of 6th St				1	4	1	F
Little Menomonee River at Milwaukee		2	2		1	10	C+
Mole Creek at Maple Road	2	2	1			16	A-
Nichols Creek DS of CTH N				1	4	1	F
Pigeon Creek at Highland Road		1	4			11	B-
Riveredge Creek at Hawthorne			5			10	C+
Ulao Creek at Bonniwell	1	2	1			12	B
Underwood Creek at GRavel Shoals			1	1	3	3	D
Unnamed Tributory - W Townline Rd			3	1		7	C
Willow Creek		1	4			11	B-
Wilson Park Creek, 20th & Wilson					5	0	F

Overview

Research Questions:

1. **Does bacterial community diversity differ in streams with "good" versus "impacted" water quality?**
   Yes
2. **What traditional water quality parameters correlate with microbial community diversity in streams?**
   DO, temperature, & pH → typical markers for ecological quality
3. **How are freshwater and fecal-associated bacteria dispersed throughout the land uses of the Milwaukee River basin?**
   Site-specific distributions; non-freshwater taxa explain land-use distinctions

22

APPENDIX K. WDNR AGRICULTURAL CONVERSION ESTIMATE FOR THE MENOMONEE RIVER WATERSHED

Menomonee Watershed - WDNR Ag Acres Conversion Estimate (WDNR 2021)

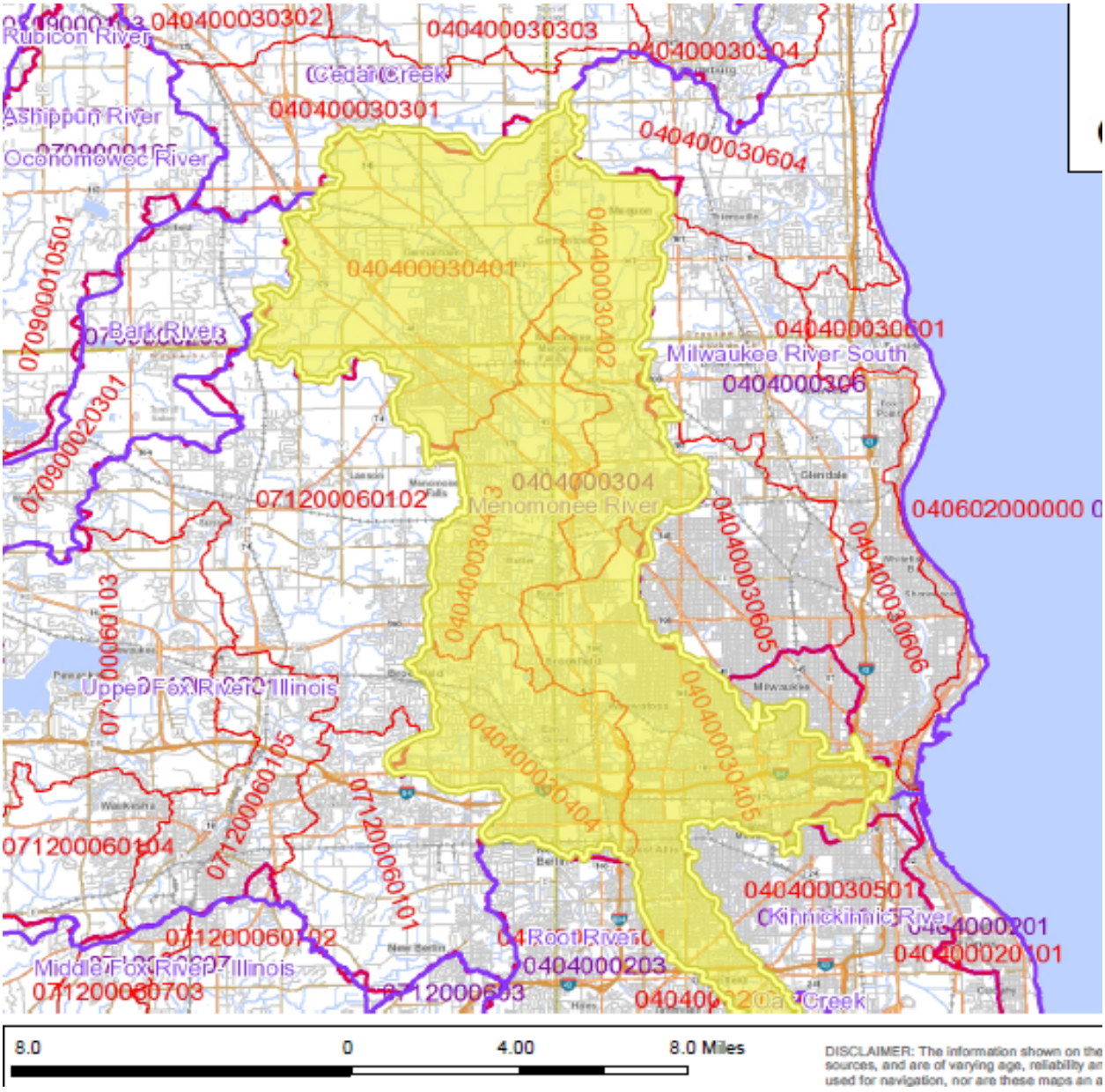
=Revised/increased Remain Ag acres per Washington County – Paul Sebo

HUC 10	404000304			
HUC 12	01			
TMDL Reach	Section	Total Ag Acres	Ag Acres Convert	Ag Acres Remain
1	1-6	280	0	280
1	7,9-13	1450	10	1420
1	8	600	120	480
1	14-16	960	140	820
1	21-24	500	160	340
1	26-29	280	280	0
1	32-35	200	200	0
1	3,4,9,10,15	0	0	0
2	8	200	200	0
2	17-19	405	405	0
3	16	175	175	0
3	17, 19-21	50	50	0
4	29-32	250	250	0
4	25,36,1,6	450	450	0
5	1,2,30,35,36	270	270	0
5	19, 23-26	95	95	0
Total		**6165**	**2805**	**3340**
HUC 12	**02**			
TMDL Reach	**Section**	**Total Ag Acres**	**Ag Acres Convert**	**Ag Acres Remain**
9	7	120	0	120
9	8	0	0	0
9	13	5	0	5
9	16	55	55	0
9	17	380	0	380
9	18	440	0	440
9	19	580	0	580
9	20	560	160	300
9	21	55	55	0
9	28	25	25	0
9	29	290	90	200
9	30	160	40	120
9	31	430	330	100
9	32	190	190	0
9	33	120	120	0
9	36	15	15	0

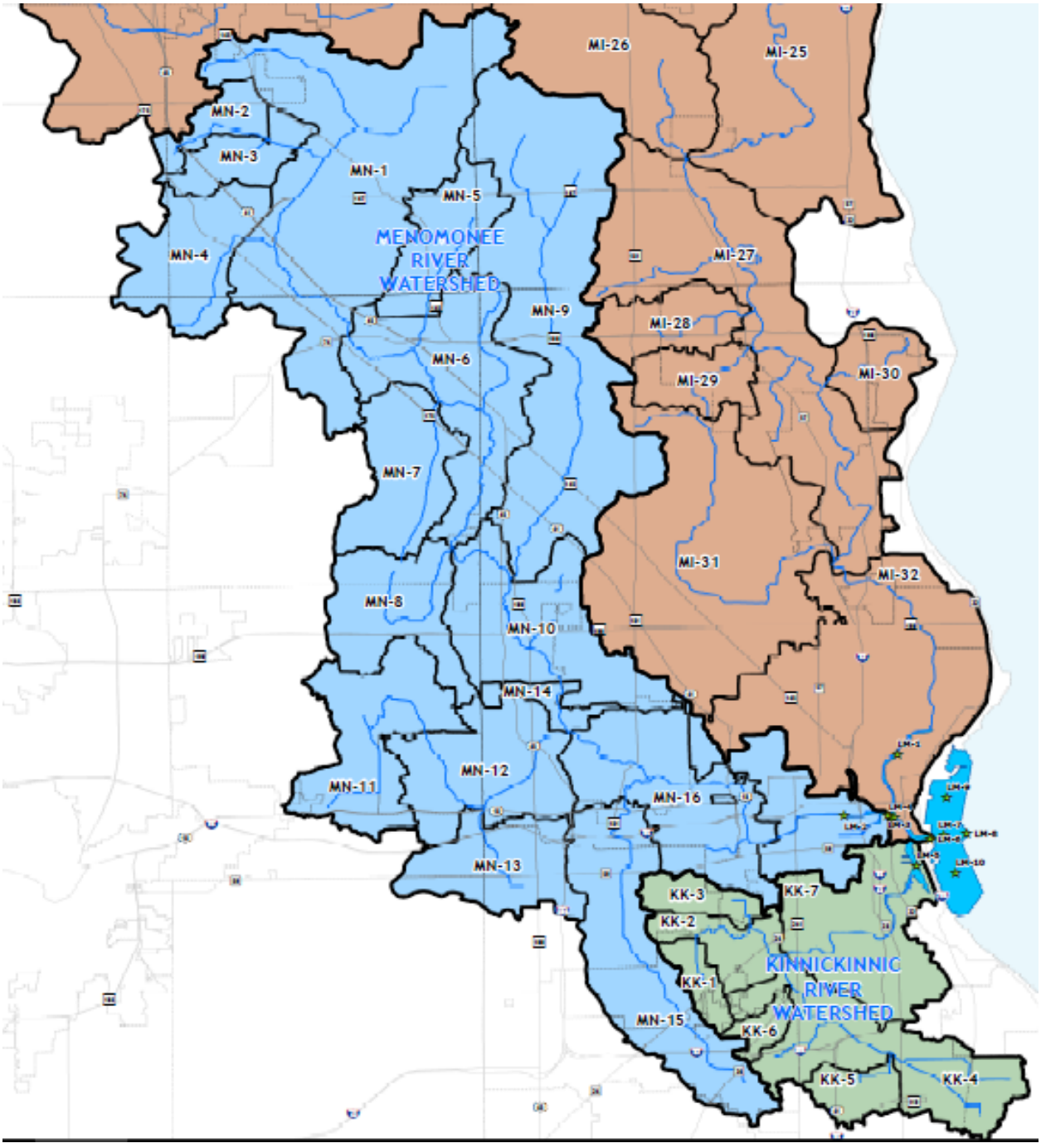
9	4,5,6,7,8,9,13,16-21, 24,25,28-32	35	35	0
Total		**3460**	**1115**	**2245**
HUC 12	**03**			
TMDL Reach	**Section**	**Total Ag Acres**	**Ag Acres Convert**	**Ag Acres Remain**
6	36, 1-3, 6-7, 10-12, 13	0	0	0
6	18-19, 24-25, 30	0	0	0
7	13, 14, 15, 23, 24	0	0	0
7	22	30	30	0
8	34-36, 1-3, 10-12	0	0	0
Total		**30**	**30**	**0**
HUC 12	**04**			
TMDL Reach	**Section**	**Total Ag Acres**	**Ag Acres Convert**	**Ag Acres Remain**
11	27	120	120	0
11	22	20	20	0
11	15	20	20	0
12	13, 17-20, 23-26, 29, 30	0	0	0
13	31, 32, 35, 36, 1, 2, 5, 6	0	0	0
Total		**160**	**160**	**0**
HUC 12	**05**			
TMDL Reach	**Section**	**Total Ag Acres**	**Ag Acres Convert**	**Ag Acres Remain**
12	13, 17-20, 23-26, 29, 30	0	0	0
16	15, 16, 20-22, 26-28	0	0	0
16	34-36, 1, 2	0	0	0
Total		**0**	**0**	**0**

REFERENCE MAPS FOR AGRICULTURAL CONVERSIONS

HUC12 Map for Menomonee River Watershed



TMDL Reaches for Menomonee River Watershed



APPENDIX L. WNDR SNAPPLUS AGRICULTURAL ANALYSIS FOR REMAINING AGRICULTURAL LAND IN THE MENOMONEE RIVER WATERSHED

Cg-Cg-O/As-A-A-A (Reach MN-1) 30% - Washington Cty

HmB2	0.32
HmC2	0.37
Hu	0.31

Soil Type - HmB2					Soil Type - HmC2					Soil Type - Hu				
Year	MB Tillage (lbs P/acre)	Fall Chisel Disk Tillage lbs P/acre	MB Tillage Soil Loss tons/acre	FCD Tillage Soil Loss tons/acre	Year	MB Tillage (lbs P/acre)	Fall Chisel Disk Tillage lbs P/acre	MB Tillage Soil Loss tons/acre	FCD Tillage Soil Loss tons/acre	Year	MB Tillage (lbs P/acre)	Fall Chisel Disk Tillage lbs P/acre	MB Tillage Soil Loss tons/acre	FCD Tillage Soil Loss tons/acre
2014	5	5.6	2.5	1.1	2014	9.9	8.5	5.5	2.3	2014	1.2	1.7	0.0	0.0
2015	5.9	6.1	3	1.2	2015	11.7	9.4	6.6	2.6	2015	1.2	1.8	0.0	0.0
2016	2.5	2	0.9	0.4	2016	4.1	2.8	1.9	0.9	2016	1	0.9	0.0	0.0
2017	0.8	0.9	0.3	0.3	2017	1.1	1.1	0.6	0.6	2017	0.3	0.3	0.0	0.0
2018	0.9	1.1	0.4	0.4	2018	1.2	1.4	0.7	0.7	2018	0.3	0.4	0.0	0.0
2019	0.6	0.7	0.2	0.2	2019	0.7	0.8	0.3	0.3	2019	0.2	0.3	0.0	0.0
Total	15.7	16.4	7.3	3.6	Total	28.7	24.0	15.6	7.4	Total	4.2	5.4	0.0	0.0
AVG	2.6	2.7	1.2	0.6	AVG	4.8	4.0	2.6	1.2	AVG	0.7	0.9	0.0	0.0
WTAVG	0.8	0.9	0.4	0.2	WTAVG	1.8	1.5	1.0	0.5	WTAVG	0.2	0.3	0.0	0.0

Rot Avg P (lbs/acre)	0.8	Soil Loss Avg tons/acre	0.3

p loss	0.42	0.40	0.82
soil loss	0.20	0.10	0.30

Cs-Cs-Cs-Cs(Reach 21) 20% - Washington Cty

Soil Type: Hochiem (HmB2)					Soil Type HmC2					Soil Type Hu				
Year	MB Tillage (lbs P/acre)	Fall Chisel Disk Tillage lbs P/acre	MB Tillage Soil Loss tons/acre	FCD Tillage Soil Loss tons/acre	Year	MB Tillage (lbs P/acre)	Fall Chisel Disk Tillage lbs P/acre	MB Tillage Soil Loss tons/acre	FCD Tillage Soil Loss tons/acre	Year	MB Tillage (lbs P/acre)	Fall Chisel Disk Tillage lbs P/acre	MB Tillage Soil Loss tons/acre	FCD Tillage Soil Loss tons/acre
2014	8.5	5.4	3.4	5.7	2014	16.3	10.9	7.5	12.2	2014	1.6	0.4	0.1	0.1
2015	8.6	5.3	3.4	5.7	2015	16.4	10.7	7.5	12.2	2015	1.6	0.4	0.1	0.1
2016	8.6	5.2	3.4	5.7	2016	16.6	10.6	7.5	12.2	2016	1.7	0.4	0.1	0.1
2017	8.8	5.1	3.4	5.7	2017	16.7	10.4	7.5	12.2	2017	1.7	0.3	0.1	0.1
Total	34.5	21	13.6	22.8	Total	66	42.6	30.0	48.8	Total	6.6	1.5	0.4	0.4
AVG	8.6	5.25	3.4	5.7	AVG	16.5	10.7	7.5	12.2	AVG	1.7	0.4	0.1	0.1
WTAVG	2.8	1.7	1.1	1.8	WTAVG	6.1	3.9	2.8	4.5	WTAVG	0.5	0.1	0.0	0.0

Rot Avg P (lbs/acre)	1.5	Soil Loss Avg tons/acre	1.0

p loss	0.94	0.57	1.51
soil loss	0.39	0.64	1.03

Cg-Cs-Sb-Wh (Reach 21) 20% - Washington County

Soil Type: HmB2 - 32% - 4% slope					Soil Type: HmC2 - 37% - 9% slope					Soil Type: Hu - 31% - 1% slope				
Year	MB Tillage (lbs P/acre)	Fall Chisel Disk Tillage lbs P/acre	MB Tillage Soil Loss tons/acre	FCD Tillage Soil Loss tons/acre	Year	MB Tillage (lbs P/acre)	Fall Chisel Disk Tillage lbs P/acre	MB Tillage Soil Loss tons/acre	FCD Tillage Soil Loss tons/acre	Year	MB Tillage (lbs P/acre)	Fall Chisel Disk Tillage lbs P/acre	MB Tillage Soil Loss tons/acre	FCD Tillage Soil Loss tons/acre
2014	6.9	6	4.9	4	2014	15.4	12.6	12.1	9.5	2014	1	0.8	0.1	0.1
2015	5.3	3.3	3.8	2.1	2015	11.8	6.6	9.3	4.9	2015	0.7	0.6	0.1	0
2016	4.8	2.9	5.3	2.6	2016	11.1	6	13.1	6.3	2016	0.4	0.5	0.1	0
2017	5.4	4.2	3.2	2.1	2017	10.5	7.4	7.6	4.7	2017	1.5	1.5	0.1	0
Total	22.4	16.4	17.2	10.8	Total	48.8	32.6	42.1	25.4	Total	3.6	3.4	0.4	0.1
AVG	5.6	4.1	4.3	2.7	AVG	12.2	8.2	10.5	6.4	AVG	0.9	0.9	0.1	0.0
WTAVG	1.8	1.3	1.4	0.9	WTAVG	4.5	3.0	3.9	2.3	WTAVG	0.3	0.3	0.0	0.0

Below field slope to Water 0-2%

Below field slope to Water 2.1-6%

Below field slope to Water 0-2%

Rot Avg P (lbs/acre)	1.1	**Soil Loss Avg - tons/acre**	0.9
p loss	0.66	0.46	1.12
soil loss	0.53	0.32	0.85

Sc-Sb-Peas (Reach 21) 30% - Washington Cty

Soil Type: HmB2			Soil Type HmC2			Soil Type Hu		
Year	MB Tillage (lbs P/acre)	MB Tillage Soil Loss tons/acre	Year	MB Tillage (lbs P/acre)	MB Tillage Soil Loss tons/acre	Year	MB Tillage (lbs P/acre)	MB Tillage Soil Loss tons/acre
2014	7.8	9.7	2014	16.7	21	2014	0.4	0.1
2015	3.4	4.1	2015	7.2	9	2015	0.2	0.1
2017	8.6	10.6	2017	18.4	23.4	2017	0.4	0.2
Total	19.8	24.4	Total	42.3	53.4	Total	1	0.4
AVG	6.6	8.13	AVG	14.1	17.8	AVG	0.3	0.1
WTAVG	2.1	2.6	WTAVG	5.2	6.6	WTAVG	0.1	0.0

Rot Avg P (lbs/acre)	2.2	**Soil Loss Avg tons/acre**	2.8
p loss	2.23		
soil loss	2.77		

	TMDL Baseline	TMDL LA AG-NPS	TMDL Reduction Target
Reach MN-1 Avg lbs P/acre	5.7	46%	3.1
Reach MN-1 Avg ton/acre	4.9	46%	2.7

Paul Sebo recommended crop rotation % changes for MN-1

Rotation 1 – Cg-Cg-O-As-A-A-A - change from 40% to 30%

Rotation 2 – Cg-Cs-Sb-Wh – change from 35% to 20%

Rotation 3 – Cs-Cs-Cs-Cs – keep at 20%

Rotation 4 - Sc-Sb-Peas - change from 5% to 30%

FUTURE - New/Additional Cropland Practices TMDL Reach MN-01 has 46% TP and TSS Reduction Goal

MB Tillage and Fall Chisel Disk Tillage to No till
Cover Crops - 1 out of 2 corn years for Cg-Cg-O/As-A-A-A and Cg-Cs-Sb-Wh rotations; 2 out of 4 corn years for Cs-Cs-Cs-Cs; 2 out of 3 years for Sc-Sb-Peas rotations
Filter Strips (edge of field)

Cg-Cg-O/As-A-A-A (Reach 21) 30% - Washington Cty

HmB2	0.32
HmC2	0.37
Hu	0.31

Soil Type - HmB2

Year	MB Tillage to No till (lbs P/acre)	Fall Chisel Disk Tillage to No Till (lbs P/acre)	MB Tillage to No Till Soil Loss (tons/acre)	FCD Tillage to No Till Soil Loss (tons/acre)
2014	1.4	3.7	0.1	0
2015	1.5	3.6	0.1	0
2016	1.4	1.3	0	0
2017	0.3	0.4	0	0
2018	0.5	0.5	0.1	0.1
2019	0.3	0.4	0.1	0
Total	5.4	9.9	0.4	0.1
AVG	0.9	1.7	0.1	0.0
WTAVG	0.3	0.5	0.0	0.0
Reduce AVG	1.7	1.1	1.2	0.6
Reduce WT AVG	0.5	0.3	0.4	0.2
Percent Reduce	65.6%	39.6%	94.5%	97.2%

Soil Type - HmC2

Year	MB Tillage to No till (lbs P/acre)	Fall Chisel Disk Tillage to No Till (lbs P/acre)	MB Tillage to No Till Soil Loss (tons/acre)	FCD Tillage to No Till Soil Loss (tons/acre)
2014	1.5	3.7	0.1	0
2015	1.6	3.7	0.1	0.1
2016	1.4	1.4	0.1	0
2017	0.5	0.4	0.1	0
2018	0.4	0.5	0.1	0.1
2019	0.4	0.5	0.1	0.1
Total	5.8	10.2	0.6	0.3
AVG	1.0	1.7	0.1	0.1
WTAVG	0.4	0.6	0.0	0.0
Reduce AVG	3.8	2.3	2.5	1.2
Reduce WT AVG	1.4	0.9	0.9	0.4
Percent Reduce	79.8%	57.5%	96.2%	95.9%

Soil Type - Hu

Year	MB Tillage to No till (lbs P/acre)	Fall Chisel Disk Tillage to No Till (lbs P/acre)	MB Tillage to No Till Soil Loss (tons/acre)	FCD Tillage to No Till Soil Loss (tons/acre)
2014	0.8	1.6	0.0	0.0
2015	0.9	1.5	0.0	0.0
2016	0.8	0.8	0.0	0.0
2017	0.2	0.2	0.0	0.0
2018	0.2	0.2	0.0	0.0
2019	0.2	0.2	0.0	0.0
Total	3.1	4.5	0.0	0.0
AVG	0.5	0.8	0.0	0.0
WTAVG	0.2	0.2	0.0	0.0
Reduce AVG	0.2	0.2	0.0	0.0
Reduce WT AVG	0.1	0.0	0.0	0.0
Percent Reduce	26.2%	16.7%	0.0%	0.0%

Rot Avg P (lbs/acre)	0.3	**Soil Loss Avg tons/acre**	0.0

p loss	0.12	0.21	0.33
soil loss	0.01	0.00	0.01

Cs-Cs-Cs-Cs(Reach 21) 20% - Washington Cty

Soil Type: Hochiem (HmB2)					Soil Type HmC2					Soil Type Hu				
Year	MB Tillage to No till (lbs P/acre)	Fall Chisel Disk Tillage to No Till (lbs P/acre)	MB Tillage to No Till Soil Loss (tons/acre)	FCD Tillage to No Till Soil Loss (tons/acre)	Year	MB Tillage to No till (lbs P/acre)	Fall Chisel Disk Tillage to No Till (lbs P/acre)	MB Tillage to No Till Soil Loss (tons/acre)	FCD Tillage to No Till Soil Loss (tons/acre)	Year	MB Tillage to No till (lbs P/acre)	Fall Chisel Disk Tillage to No Till (lbs P/acre)	MB Tillage to No Till Soil Loss (tons/acre)	FCD Tillage to No Till Soil Loss (tons/acre)
2014	4.9	2.1	1.7	0.3	2014	5.5	3.8	3.7	0.5	2014	1.7	0.4	0	0
2015	4.9	1.7	1.4	0.2	2015	5.3	3	2.9	0.4	2015	1.7	0.3	0	0
2016	5	1.8	1.7	0.3	2016	5.6	3.4	3.7	0.5	2016	1.8	0.3	0	0
2017	5	1.5	1.4	0.2	2017	5.4	2.8	2.9	0.4	2017	1.8	0.2	0	0
Total	19.8	7.1	6.2	1.0	Total	21.8	13.0	13.2	1.8	Total	7	1.2	0.0	0.0
AVG	5.0	1.775	1.55	0.3	AVG	5.5	3.3	3.3	0.5	AVG	1.8	0.3	0.0	0.0
WTAVG	1.6	0.6	0.5	0.1	WTAVG	2.0	1.2	1.2	0.2	WTAVG	0.5	0.1	0.0	0.0

Rot Avg P (lbs/acre)	0.6	**Soil Loss Avg tons/acre**	0.2

p loss	0.41	0.19	0.60
soil loss	0.17	0.02	0.20

Cg-Cs-Sb-Wh (Reach MN-1) 20% - Washington County

Soil Type: HmB2 - 32% - 4% slope					Soil Type: HmC2 - 37% - 9% slope					Soil Type: Hu - 31% - 1% slope				
Year	MB Tillage to No till (lbs P/acre)	Fall Chisel Disk Tillage to No Till (lbs P/acre)	MB Tillage to No Till Soil Loss (tons/acre)	FCD Tillage to No Till Soil Loss (tons/acre)	Year	MB Tillage to No till (lbs P/acre)	Fall Chisel Disk Tillage to No Till (lbs P/acre)	MB Tillage to No Till Soil Loss (tons/acre)	FCD Tillage to No Till Soil Loss (tons/acre)	Year	MB Tillage to No till (lbs P/acre)	Fall Chisel Disk Tillage to No Till (lbs P/acre)	MB Tillage to No Till Soil Loss (tons/acre)	FCD Tillage to No Till Soil Loss (tons/acre)
2014	2	2.1	0.7	0.7	2014	3	3.1	1.4	1.5	2014	0.8	0.9	0.1	0.1
2015	1.1	1.1	0.1	0.1	2015	1.2	1.2	0.2	0.3	2015	0.6	0.6	0.1	0
2016	0.7	0.7	0.4	0.4	2016	1	1.1	0.7	0.8	2016	0.2	0.2	0.1	0
2017	1.6	1.8	0.7	0.7	2017	2.5	2.8	1.4	1.5	2017	0.7	0.7	0.1	0
Total	5.4	5.7	1.9	1.9	Total	7.7	8.2	3.7	4.1	Total	2.3	2.4	0.4	0.1
AVG	1.4	1.4	0.5	0.5	AVG	1.9	2.1	0.9	1.0	AVG	0.6	0.6	0.1	0.0
WTAVG	0.4	0.5	0.2	0.2	WTAVG	0.7	0.8	0.3	0.4	WTAVG	0.2	0.2	0.0	0.0
Reduce AVG	4.3	2.7	3.8	2.2		10.3	6.1	9.6	5.3		0.3	0.3	0.0	0.0
Reduce WT AVG	1.4	0.9	1.2	0.7		3.8	2.3	3.6	2.0		0.1	0.1	0.0	0.0
Percent Reduce	75.9%	65.2%	89.0%	82.4%		84.2%	74.8%		83.9%		36.1%	29.4%	0.0%	0.0%

Rot Avg P (lbs/acre)	0.3	**Soil Loss Avg - tons/acre**	0.1

p loss	0.13	0.14	0.27
soil loss	0.05	0.05	0.11

Sc-Sb-Peas (Reach MN-1) 35% - Washington Cty

Soil Type: HmB2					Soil Type HmC2					Soil Type Hu				
Year	MB Tillage to No till + Cvr (lbs P/acre)	MB Tillage to Filter Strip (lbs P/acre)	MB Tillage to No till + Cvr Soil Loss (tons/acre)	MB Tillage to Filter Strip Soil Loss (tons/acre)	Year	MB Tillage to No till (lbs P/acre)	MB Tillage to No till + Cvr (lbs P/acre)	MB Tillage to No till + Cvr Soil Loss (tons/acre)	MB Tillage to Filter Strip Soil Loss (tons/acre)	Year	MB Tillage to No till + Cvr (lbs P/acre)	MB Tillage to Filter Strip (lbs P/acre)	MB Tillage to No till + Cvr Soil Loss (tons/acre)	MB Tillage to Filter Strip Soil Loss (tons/acre)
2014	0.6	1.5	0.5	0.6	2014	1	2.5	1	1.2	2014	0.1	0.3	0	0
2015	0.4	0.7	0.2	0.3	2015	0.5	1.2	0.3	0.6	2015	0.1	0.1	0	0
2017	0.8	1.6	0.8	0.8	2017	1.4	2.7	1.5	1.3	2017	0.1	0.2	0	0
Total	1.8	3.8	1.5	1.7	Total	2.9	6.4	2.8	3.1	Total	0.3	0.6	0.0	0
AVG	0.6	1.3	0.50	0.6	AVG	1.0	2.1	0.9	1.0	AVG	0.1	0.2	0.0	0.0
WTAVG	0.2	0.4	0.2	0.2	WTAVG	0.4	0.8	0.3	0.4	WTAVG	0.0	0.1	0.0	0.0

	TMDL Reduction	% Reduction
Reach MN-1 Avg lbs P/acre	1.4	71%
Reach MN-1 Avg ton/acre	0.5	88%

	TMDL Baseline	TMDL LA AG-NPS	TMDL Reduction Target
Reach MN-1 Avg lbs P/acre	4.8	46%	2.6
Reach MN-1 Avg ton/acre	4.2	46%	2.3

	% Acres with No Till + Cover Crop Practices				
Area Weighted Avg	**0%**	**25%**	**50%**	**75%**	**100%**
Reach MN-1 Avg lbs P/	4.8	4.0	3.1	2.3	1.4
Reach MN-1 Avg ton/a	4.2	3.3	2.4	1.4	0.5
				65%	
				2.6	
				1.8	

Rot Avg P (lbs/acre)	0.2	**Soil Loss Avg tons/acre**	0.2

p loss	0.20
soil loss	0.18

Cg-Cg-O/As-A-A-A (Reach MN-9) 30% - Ozaukee Cty

	OuB	0.46
	OuB2	0.30
	MtA	0.24

Soil Type - OuB					Soil Type - OuB2					Soil Type - MtA				
Year	MB Tillage (lbs P/acre)	Fall Chisel Disk Tillage lbs P/acre	MB Tillage Soil Loss tons/acre	FCD Tillage Soil Loss tons/acre	Year	MB Tillage (lbs P/acre)	Fall Chisel Disk Tillage lbs P/acre	MB Tillage Soil Loss tons/acre	FCD Tillage Soil Loss tons/acre	Year	MB Tillage (lbs P/acre)	Fall Chisel Disk Tillage lbs P/acre	MB Tillage Soil Loss tons/acre	FCD Tillage Soil Loss tons/acre
2014	6.4	6.9	3.2	1.3	2014	6.3	6.8	3.2	1.3	2014	4	5.8	1.7	0.7
2015	7.7	7.4	3.9	1.5	2015	7.6	7.4	3.9	1.5	2015	4.7	6.2	2.0	0.8
2016	3	4.5	1.2	0.3	2016	2.9	4.5	1.2	0.3	2016	2.2	4.7	0.6	0.2
2017	0.8	1	0.3	0.3	2017	0.8	1	0.4	0.3	2017	0.8	0.9	0.2	0.2
2018	0.9	1.1	0.4	0.4	2018	0.9	1.1	0.4	0.4	2018	0.9	1.1	0.3	0.3
2019	0.6	0.7	0.2	0.2	2019	0.6	0.7	0.2	0.2	2019	0.6	0.8	0.1	0.1
Total	19.4	21.6	9.2	4	Total	19.1	21.5	9.3	4.0	Total	13.2	19.5	4.9	2.3
AVG	3.2	3.6	1.5	0.7	AVG	3.2	3.6	1.6	0.7	AVG	2.2	3.3	0.8	0.4
WTAVG	1.5	1.7	0.7	0.3	WTAVG	1.0	1.1	0.5	0.2	WTAVG	0.5	0.8	0.2	0.1

Rot Avg P (lbs/acre)	1.0	Soil Loss Avg tons/acre	0.3

p loss	0.45	0.53	0.97
soil loss	0.20	0.09	0.29

Cs-Cs-Cs-Cs(MN-9) 20% - Ozaukee Cty

Soil Type - OuB					Soil Type - OuB2					Soil Type - MtA				
Year	MB Tillage (lbs P/acre)	Fall Chisel Disk Tillage lbs P/acre	MB Tillage Soil Loss tons/acre	FCD Tillage Soil Loss tons/acre	Year	MB Tillage (lbs P/acre)	Fall Chisel Disk Tillage lbs P/acre	MB Tillage Soil Loss tons/acre	FCD Tillage Soil Loss tons/acre	Year	MB Tillage (lbs P/acre)	Fall Chisel Disk Tillage lbs P/acre	MB Tillage Soil Loss tons/acre	FCD Tillage Soil Loss tons/acre
2014	11.3	8.1	4.4	7.8	2014	11.3	8	4.3	7.7	2014	7.3	4.5	4	2.3
2015	11.4	8	4.4	7.8	2015	11.4	7.9	4.3	7.7	2015	7.3	4.4	4	2.3
2016	11.5	7.9	4.4	7.8	2016	11.3	7.8	4.3	7.7	2016	7.5	4.4	4	2.3
2017	11.6	7.8	4.4	7.8	2017	11.4	7.7	4.3	7.7	2017	7.5	4.4	4	2.3
Total	45.8	31.8	17.6	31.2	Total	45.4	31.4	17.2	30.8	Total	29.6	17.7	16.0	9.2
AVG	11.5	8.0	4.4	7.8	AVG	11.4	7.9	4.3	7.7	AVG	7.4	4.4	4.0	2.3
WTAVG	5.3	3.7	2.0	3.6	WTAVG	3.4	2.4	1.3	2.3	WTAVG	1.8	1.1	1.0	0.6

Rot Avg P (lbs/acre)	1.8	Soil Loss Avg tons/acre	1.1

p loss	1.04	0.71	1.75
soil loss	0.43	0.65	1.07

Cg-Cs-Sb-Wh (MN-9) 20% - Ozaukee Cty

Soil Type - OuB					Soil Type - OuB2					Soil Type - MtA				
Year	MB Tillage (lbs P/acre)	Fall Chisel Disk Tillage lbs P/acre	MB Tillage Soil Loss tons/acre	FCD Tillage Soil Loss tons/acre	Year	MB Tillage (lbs P/acre)	Fall Chisel Disk Tillage lbs P/acre	MB Tillage Soil Loss tons/acre	FCD Tillage Soil Loss tons/acre	Year	MB Tillage (lbs P/acre)	Fall Chisel Disk Tillage lbs P/acre	MB Tillage Soil Loss tons/acre	FCD Tillage Soil Loss tons/acre
2014	10.1	8.7	6.9	5.6	2014	9.9	8.6	6.8	5.5	2014	5.9	5.1	3.5	2.9
2015	7.5	4.2	5.2	2.7	2015	7.3	4.2	5.1	2.6	2015	4.4	2.7	2.7	1.4
2016	7.4	3.9	7.4	3.5	2016	7.3	3.8	7.2	3.5	2016	4	2.5	3.8	1.9
2017	7.1	4	4.3	2.7	2017	7.1	4	4.2	2.7	2017	4.9	2.9	2.2	1.5
Total	32.1	20.8	23.8	14.5	Total	31.6	20.6	23.3	14.3	Total	19.2	13.2	12.2	7.7
AVG	8.0	5.2	6.0	3.6	AVG	7.9	5.2	5.8	3.6	AVG	4.8	3.3	3.1	1.9
WTAVG	2.6	1.7	1.9	1.2	WTAVG	2.4	1.5	1.7	1.1	WTAVG	1.2	0.8	0.7	0.5

Below field slope to Water 0-2%

Below field slope to Water 2.1-6%

Below field slope to Water 0-2%

Rot Avg P (lbs/acre)	1.0	**Soil Loss Avg - tons/acre**	0.7
p loss	0.61	0.40	1.01
soil loss	0.44	0.27	0.71

Sc-Sb-Peas (MN-9) 30% - Ozaukee Cty

Soil Type - OuB			Soil Type - OuB2			Soil Type - MtA		
Year	MB Tillage (lbs P/acre)	MB Tillage Soil Loss tons/acre	Year	MB Tillage (lbs P/acre)	MB Tillage Soil Loss tons/acre	Year	MB Tillage (lbs P/acre)	MB Tillage Soil Loss tons/acre
2014	12.3	13.5	2014	12.1	13.2	2014	6.5	6.8
2015	5.3	5.7	2015	5.2	5.6	2015	2.8	2.9
2017	13.2	14.4	2017	13.1	14.2	2017	7.1	7.4
Total	30.8	33.6	Total	30.4	33.0	Total	16.4	17.1
AVG	10.3	11.2	AVG	10.1	11.0	AVG	5.5	5.7
WTAVG	4.7	5.2	WTAVG	3.0	3.3	WTAVG	1.3	1.4

Rot Avg P (lbs/acre)	2.7	**Soil Loss Avg tons/acre**	2.9
p loss	2.72		
soil loss	2.95		

	TMDL Baseline	TMDL LA AG-NPS	TMDL Reduction Target
Reach MN-9 Avg lbs P/acre	6.5	49%	3.3
Reach MN-9 Avg ton/acre	5.0	51%	2.5

Paul Sebo recommended crop rotation % changes for MN-1

Rotation 1 – Cg-Cg-O-As-A-A-A - change from 40% to 30%

Rotation 2 – Cg-Cs-Sb-Wh – change from 35% to 20%

Rotation 3 – Cs-Cs-Cs-Cs – keep at 20%

Rotation 4 - Sc-Sb-Peas - change from 5% to 30%

FUTURE - New/Additional Cropland Practices TMDL Reach MN-09 has 49% TP and 51% TSS Reduction Goal

MB Tillage and Fall Chisel Disk Tillage to No till
Cover Crops - 1 out of 2 corn years for Cg-Cg-O/As-A-A-A and Cg-Cs-Sb-Wh rotations; 2 out of 4 corn years for Cs-Cs-Cs-Cs; 2 out of 3 years for Sc-Sb-Peas rotations
Filter Strips (edge of field)

Cg-Cg-O/As-A-A-A (MN-9) 30% - Ozaukee Cty

Soil Type - OuB					Soil Type - OuB2					Soil Type - MtA				
Year	MB Tillage to No till (lbs P/acre)	Fall Chisel Disk Tillage to No Till (lbs P/acre)	MB Tillage to No Till Soil Loss (tons/acre)	FCD Tillage to No Till Soil Loss (tons/acre)	Year	MB Tillage to No till (lbs P/acre)	Fall Chisel Disk Tillage to No Till (lbs P/acre)	MB Tillage to No Till Soil Loss (tons/acre)	FCD Tillage to No Till Soil Loss (tons/acre)	Year	MB Tillage to No till (lbs P/acre)	Fall Chisel Disk Tillage to No Till (lbs P/acre)	MB Tillage to No Till Soil Loss (tons/acre)	FCD Tillage to No Till Soil Loss (tons/acre)
2014	1.7	6.2	0.1	0	2014	1.7	6.2	0.1	0	2014	2	6.7	0.0	0.0
2015	1.9	6.3	0.1	0	2015	1.9	6.3	0.1	0	2015	2.1	6.7	0.1	0.0
2016	1.8	6.4	0.1	0	2016	1.8	6.4	0.1	0	2016	2	6.8	0.0	0.0
2017	0.3	0.4	0	0	2017	0.3	0.4	0	0	2017	0.4	0.5	0.0	0.0
2018	0.4	0.5	0.1	0.1	2018	0.4	0.5	0.1	0.1	2018	0.5	0.5	0.1	0.0
2019	0.4	0.5	0.1	0	2019	0.4	0.5	0.1	0	2019	0.4	0.5	0.0	0.0
Total	6.5	20.3	0.5	0.1	Total	6.5	20.3	0.5	0.1	Total	7.4	21.7	0.2	0.0
AVG	1.1	3.4	0.1	0.0	AVG	1.1	3.4	0.1	0.0	AVG	1.2	3.6	0.0	0.0
WTAVG	0.5	1.6	0.0	0.0	WTAVG	0.3	1.0	0.0	0.0	WTAVG	0.3	0.9	0.0	0.0
Reduce AVG	2.2	0.2	1.5	0.7		2.1	0.2	1.5	0.7		1.0	-0.4	0.8	0.4
Reduce WT AVG	1.0	0.1	0.7	0.3		0.6	0.1	0.4	0.2		0.2	-0.1	0.2	0.1
Percent Reduce	66.5%	6.0%	94.6%	97.5%		66.0%	5.6%	94.6%	97.5%		43.9%	-11.3%	95.9%	100.0%

Rot Avg P (lbs/acre)	0.7	**Soil Loss Avg tons/acre**	0.0
p loss	0.17	0.52	0.68
soil loss	0.01	0.00	0.01

Cs-Cs-Cs-Cs(MN-9) 20% - Ozaukee Cty

Soil Type - OuB					Soil Type - OuB2					Soil Type - MtA				
Year	MB Tillage to No till (lbs P/acre)	Fall Chisel Disk Tillage to No Till (lbs P/acre)	MB Tillage to No Till Soil Loss (tons/acre)	FCD Tillage to No Till Soil Loss (tons/acre)	Year	MB Tillage to No till (lbs P/acre)	Fall Chisel Disk Tillage to No Till (lbs P/acre)	MB Tillage to No Till Soil Loss (tons/acre)	FCD Tillage to No Till Soil Loss (tons/acre)	Year	MB Tillage to No till (lbs P/acre)	Fall Chisel Disk Tillage to No Till (lbs P/acre)	MB Tillage to No Till Soil Loss (tons/acre)	FCD Tillage to No Till Soil Loss (tons/acre)
2014	6.7	2.5	0.3	2.1	2014	6.7	2.5	0.3	2.1	2014	6.7	1.7	1.1	0.2
2015	6.6	2	0.2	1.7	2015	6.6	1.9	0.2	1.7	2015	6.8	1.4	0.9	0.1
2016	6.7	2.3	0.3	2.1	2016	6.7	2.3	0.3	2.1	2016	6.9	1.5	1.1	0.2
2017	6.7	1.8	0.2	1.7	2017	6.7	1.8	0.2	1.7	2017	6.9	1.2	0.9	0.1
Total	26.7	8.6	1	6.7	Total	26.7	8.5	1.0	7.6	Total	27.3	5.8	4.0	0.6
AVG	6.7	2.15	0.25	1.9	AVG	6.7	2.1	0.3	1.9	AVG	6.8	1.5	1.0	0.2
WTAVG	2.7	0.9	0.1	0.8	WTAVG	2.0	0.6	0.1	0.6	WTAVG	1.6	0.3	0.2	0.0

Rot Avg P (lbs/acre)	0.8	**Soil Loss Avg tons/acre**	0.2

p loss	0.63	0.18	0.82
soil loss	0.04	0.14	0.18

Cg-Cs-Sb-Wh (Reach MN-9) 20% - Ozaukee County

Soil Type - OuB					Soil Type - OuB2					Soil Type - MtA				
Year	MB Tillage to No till (lbs P/acre)	Fall Chisel Disk Tillage to No Till (lbs P/acre)	MB Tillage to No Till Soil Loss (tons/acre)	FCD Tillage to No Till Soil Loss (tons/acre)	Year	MB Tillage to No till (lbs P/acre)	Fall Chisel Disk Tillage to No Till (lbs P/acre)	MB Tillage to No Till Soil Loss (tons/acre)	FCD Tillage to No Till Soil Loss (tons/acre)	Year	MB Tillage to No till (lbs P/acre)	Fall Chisel Disk Tillage to No Till (lbs P/acre)	MB Tillage to No Till Soil Loss (tons/acre)	FCD Tillage to No Till Soil Loss (tons/acre)
2014	2	2.1	0.8	0.9	2014	2	2.1	0.8	0.9	2014	1.8	2	0.5	0.5
2015	0.9	0.9	0.1	0.1	2015	0.9	0.9	0.1	0.1	2015	1.1	1.1	0.1	0.1
2016	0.7	0.7	0.4	0.4	2016	0.7	0.7	0.4	0.4	2016	0.7	0.7	0.3	0.3
2017	1.6	1.5	0.8	0.9	2017	1.5	1.5	0.8	0.1	2017	1.4	1.3	0.5	0.6
Total	5.2	5.2	2.1	2.3	Total	5.1	5.2	2.1	1.5	Total	5	5.1	1.4	1.5
AVG	1.3	1.3	0.5	0.6	AVG	1.3	1.3	0.5	0.4	AVG	1.3	1.3	0.4	0.4
WTAVG	0.6	0.6	0.2	0.3	WTAVG	0.4	0.4	0.2	0.1	WTAVG	0.3	0.3	0.1	0.1
Reduce AVG	6.7	3.9	5.4	3.1		6.6	3.9	5.3	3.2		3.6	2.0	2.7	1.6
Reduce WT AVG	2.0	1.1	1.7	0.9		2.0	1.2	1.6	1.0		0.9	0.5	0.6	0.4
Percent Reduce	83.8%	75.0%	91.2%	84.1%		83.9%	74.8%		89.5%		74.0%	61.4%	88.5%	80.5%

Rot Avg P (lbs/acre)	0.3	**Soil Loss Avg - tons/acre**	0.1

p loss	0.13	0.13	0.26
soil loss	0.05	0.05	0.10

Sc-Sb-Peas (Reach MN-9) 35% - Ozaukee Cty

Soil Type - OuB					Soil Type - OuB2					Soil Type - MtA				
Year	MB Tillage to No till + Cvr (lbs P/acre)	MB Tillage to Filter Strip (lbs P/acre)	MB Tillage to No till + Cvr Soil Loss (tons/acre)	MB Tillage to Filter Strip Soil Loss (tons/acre)	Year	MB Tillage to No till (lbs P/acre)	MB Tillage to No till + Cvr (lbs P/acre)	MB Tillage to No till + Cvr Soil Loss (tons/acre)	MB Tillage to Filter Strip Soil Loss (tons/acre)	Year	MB Tillage to No till + Cvr (lbs P/acre)	MB Tillage to Filter Strip (lbs P/acre)	MB Tillage to No till + Cvr Soil Loss (tons/acre)	MB Tillage to Filter Strip Soil Loss (tons/acre)
2014	0.7	2.8	0.6	1.4	2014	0.8	2.9	0.6	1.4	2014	0.5	1.8	0.3	0.9
2015	0.3	1.3	0.2	0.6	2015	0.3	1.4	0.2	0.6	2015	0.2	0.8	0.1	0.4
2017	0.8	3.3	0.8	1.6	2017	0.8	3.5	0.8	1.6	2017	0.6	2.1	0.5	1
Total	1.8	7.4	1.6	3.6	Total	1.9	7.8	1.6	3.6	Total	1.3	4.7	0.9	2.3
AVG	0.6	2.5	0.53	1.2	AVG	0.6	2.6	0.5	1.2	AVG	0.4	1.6	0.3	0.8
WTAVG	0.3	1.1	0.2	0.6	WTAVG	0.2	0.8	0.2	0.4	WTAVG	0.1	0.4	0.1	0.2

Rot Avg P (lbs/acre)	0.2	**Soil Loss Avg tons/acre**	0.2

p loss	0.20
soil loss	0.17

	TMDL Reduction	% Reduction
Reach MN-9 Avg lbs P/acre	2.0	70%
Reach MN-9 Avg ton/acre	0.5	91%

	TMDL Baseline	TMDL LA AG-NPS	TMDL Reduction Target
Reach MN-9 Avg lbs P/acre	6.5	49%	3.3
Reach MN-9 Avg ton/acre	5.0	51%	2.5

	% Acres with No Till + Cover Crop Practices				
Area Weighted Avg	**0%**	**25%**	**50%**	**75%**	**100%**
Reach MN-9 Avg lbs P/	6.5	5.4	4.3	3.1	2.0
Reach MN-9 Avg ton/a	5	3.9	2.8	1.6	0.5
				70%	
				3.4	
				2.1	

APPENDIX M. COST ANALYSIS FOR AGRICULTURAL BMP INSTALLATION

The following costs were obtained through discussions with county Land and Water Management staff. These reflect current incentive payments per acre for the cropland practices modeled in SnapPlus*, hobby/horse operation practices and associated county staff costs for practice adoption. Maintenance costs will be borne by the farmers and are not calculated here.

MENOMONEE RIVER HUC 12 – 040400030401 (TMDL MN 1) COST ANALYSIS			
BMP	Cost/unit	# of units	Total cost
Control on barnyards			
Runoff Management or Manure Compost systems	$25,000/unit (average)	10	$250,000
Upland controls on cropland			
Nutrient Management Plans *	$40/acre	700 acres	$28,000
Reduced tillage combined with Cover crops *	$78/acre	2,100acres	$163,000
Upland controls on pastureland			
Prescribed Grazing	$50/acre	25 acres	$1,250
Use Exclusion	$50/acre	10 acres	$500
Staff/Technical Assistance to promote/adopt practices			
Washington County Staff/Technical Assistance	$16,500/yr	10 years	$165,000
Total Cost for all Practices and Staff			
$607,750			

MENOMONEE RIVER HUC 12 – 040400030402 (TMDL MN 9) COST ANALYSIS			
BMP	Cost/unit	# of units	Total cost
Control on barnyards			
Runoff Management or Manure Compost systems	$25,000/unit (average)	5	$125,000
Upland controls on cropland			
Nutrient Management Plans*	$40/acre	500 acres	$20,000
Reduced tillage combined with Cover crops	$78/acre	1,500 acres	$117,000
Upland controls on pastureland			
Prescribed Grazing	$50/acre	25 acres	$1,250
Use Exclusion	$50/acre	10 acres	$500
Staff/Technical Assistance to promote/adopt practices			
Washington County Staff/Technical Assistance	$9,000/yr	10 years	$90,000
Total Cost for all Practices in HUC12 – 040400030302			
$353,750			