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Excellence in Engineering℠

2026 Waukesha County Stormwater Workshop

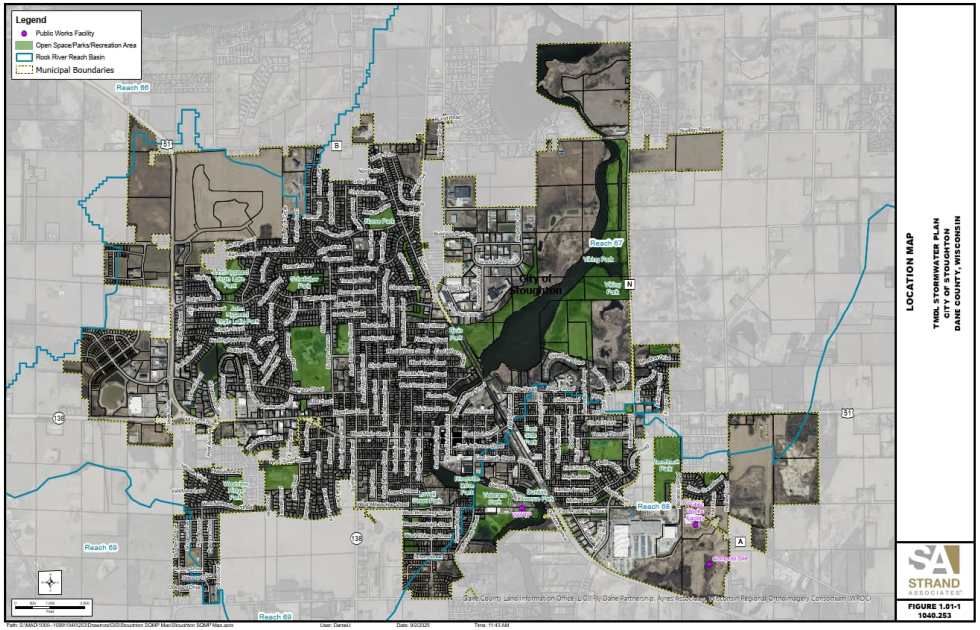
March 24, 2026

MS4/TMDL Success Story: How Stoughton Gained Compliance Without Breaking the Bank

Jon Lindert, P.E., LEED AP, Strand Associates, Inc.®
Daniel Johnstone, P.E., Strand Associates, Inc. ®

Agenda

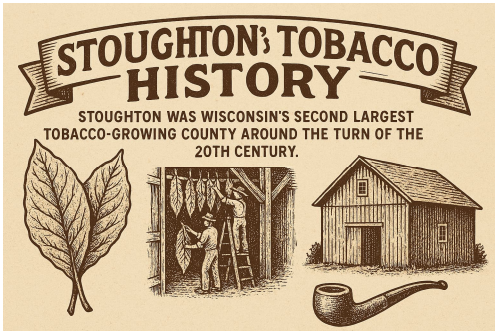
- Stoughton History
- Introduction
- Current/Updated Stormwater Program
  - Stormwater BMP Field Reviews
- Stormwater Quality Modeling
- Alternative Analysis
  - BMPs in City
  - Water Quality Trading and WAM
- Implementation Plan
- Key Takeaways



Stoughton History

Syttende Mai Festival
STOUGHTON, WISCONSIN

Stoughton's Syttende Mai Festival is a weekend-long celebration of Norwegian heritage featuring fun activities and cultural experiences for the whole family. Come join us for three days of amazing food and drink, arts and music, athletic competitions, kids' activities, and even a parade steeped in centuries of Norwegian culture.



Population: 13,134

Yahara River Park

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Introduction

- City's stormwater permit for its Municipal Separate Storm Sewer System (MS4)
  - WPDES Permit No. WI-S058416-4 (July 1, 2019 to June 30, 2024)
- Stormwater Quality Management Plan (SQMP) history
  - 2006 (Original), 2010 (Update), 2018 (TMDL), 2020 (TP Leaf Credit for Leaf Management Program), 2021 (Appendix-MS4 Program Updates)
- MS4 and Rock River Basin TMDL requirements
  - Rock River is a 303 (d) listed impaired water
  - Rock River Basin TMDL approved by EPA on September 28, 2011
- Main objective of SQMP update:
  Assess compliance with TMDL requirements

Reach	MS4	Rock River TMDL	
	TSS Reduction (%)	TSS Reduction (%)	TP Reduction (%)
66	20	62	54
67	20	40	27
68	20	51	65
69	20	53	80

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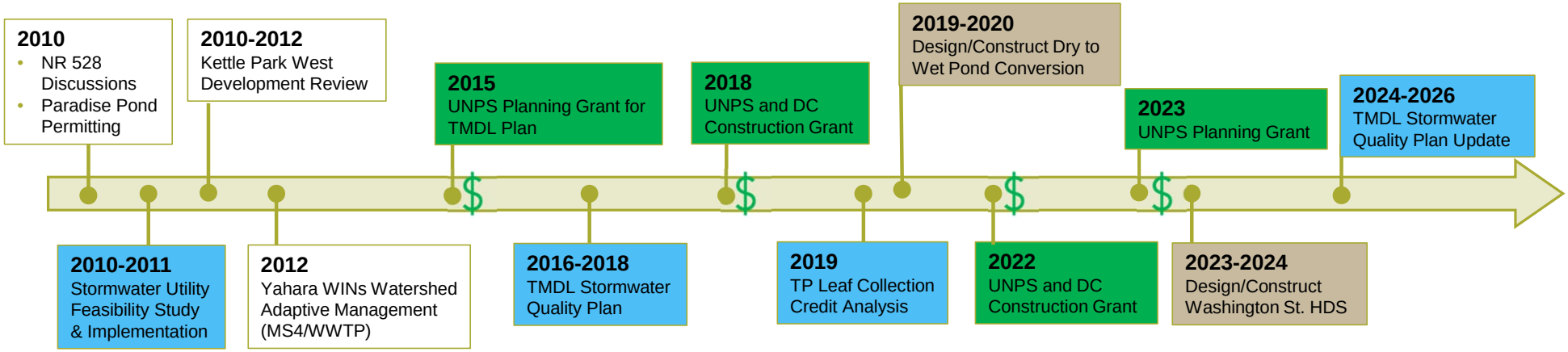
Stoughton Timeline Shows Commitment to Stormwater Quality and Grants



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Stoughton Stormwater Expenditures Didn't Break the Bank

Year	Project	Engineering Amount	Construction Cost	UNPS Grant Amount	Dane County Urban Water Quality Grant	Total Grant $
2010	Stormwater Utility Feasibility Study					
2011	Stormwater Utility Implementation					
2015	*UNPS Planning Grant Application*					
2016-2017	Stormwater Quality Management Plan			$45,900		$45,900
2018	*UNPS and Dane County Construction Grant Application*					
2018-2023	Paradise Pond Monitoring Analysis					
2019-2020	Industrial Park Dry to Wet Pond Conversion Design		$380,100	$130,800	$100,000	$230,800
2019	TP Leaf Collection Credit Analysis					
2022	*UNPS and Dane County Construction Grant Application*					
2023-2024	Washington Street Hydrodynamic Separator Design		$373,300	$135,300	$186,700	$322,000
2023	*UNPS Planning Grant Application*					
2025-2026	Stormwater Quality Management Plan Update			$61,000		$61,000
	Total	**$568,000**	**$753,400**	**$373,000**	**$286,700**	**$659,700**

Year	Project
Engineering	$568,000
Construction	$753,400
Total	**$1,321,400**
Grants	$659,700 (49.9%)
City Investment	$661,700 (50.1%)
Yahara WINs Buy-In 2017-2026	$47,148
Total City Investment	**$708,848**

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City Stormwater Quality Management Plan Progression

2010 – Stormwater Management Plan, Water Quality Modeling

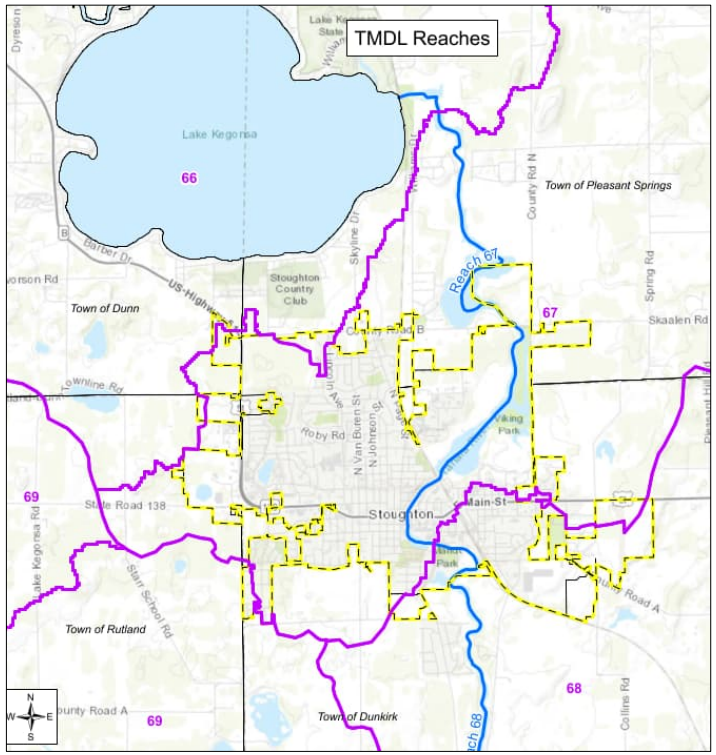
- 20% TSS reduction requirement
- **City at 29.6% TSS and 20.3% TP reduction**

2018 – Stormwater Quality Management Plan

- Rock River TMDL (40% to 62% for TSS and 27% to 80% for TP)
- Yahara WINs buy-in: 40% TSS and 27% TP for each TMDL reach
- Reach 69 meets TSS reduction requirement, and Reach 67 meets TP reduction requirement
- Reaches 67 and 68 are unable to buy-in to Yahara WINs for TSS
- Reach 68 is unable to buy-in to Yahara WINs for TP
- **City at 31.7% TSS and 27.0% TP reduction ($2-$5 million in BMPs)**

2026 – Stormwater Quality Management Plan Update

- Rock River TMDL (40% to 62% for TSS and 27% to 80% for TP)
- Yahara WINs buy-in: 40% TSS and 27% TP for each TMDL reach
- Reaches 66, 67, and 69 are in full TMDL compliance
- Reach 68 does not meet TMDL requirements for TSS or TP
- **City at 49.6% TSS and 45.6% TP reduction**
- Reach 67, which is upstream of Reach 68, will trade excess pollutant reduction to Reach 68
- City is in full TMDL compliance



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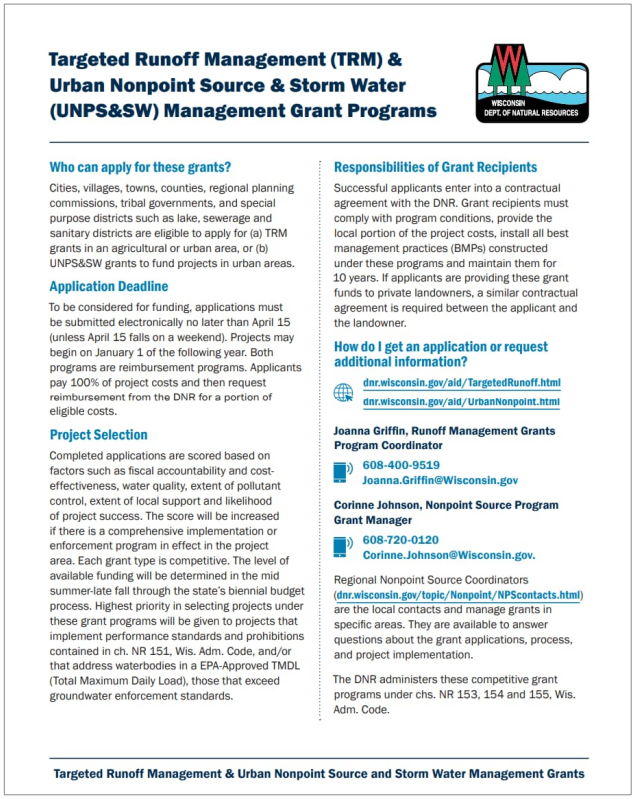
2025 Stormwater Quality Management Plan Update Funded by WDNR Urban Nonpoint Source and Stormwater Grant

Project Cost	State Share (50%)	Local Share (50%)
$122,000	$61,000	$61,000



Targeted Runoff Management (TRM) & Urban Nonpoint Source & Storm Water (UNPS&SW) Management Grant Programs

WISCONSIN DEPT. OF NATURAL RESOURCES

Who can apply for these grants?

Cities, villages, towns, counties, regional planning commissions, tribal governments, and special purpose districts such as lake, sewerage and sanitary districts are eligible to apply for (a) TRM grants in an agricultural or urban area, or (b) UNPS&SW grants to fund projects in urban areas.

Application Deadline

To be considered for funding, applications must be submitted electronically no later than April 15 (unless April 15 falls on a weekend). Projects may begin on January 1 of the following year. Both programs are reimbursement programs. Applicants pay 100% of project costs and then request reimbursement from the DNR for a portion of eligible costs.

Project Selection

Completed applications are scored based on factors such as fiscal accountability and cost-effectiveness, water quality, extent of pollutant control, extent of local support and likelihood of project success. The score will be increased if there is a comprehensive implementation or enforcement program in effect in the project area. Each grant type is competitive. The level of available funding will be determined in the mid summer-late fall through the state's biennial budget process. Highest priority in selecting projects under these grant programs will be given to projects that implement performance standards and prohibitions contained in ch. NR 151, Wis. Adm. Code, and/or that address waterbodies in a EPA-Approved TMDL (Total Maximum Daily Load), those that exceed groundwater enforcement standards.

Responsibilities of Grant Recipients

Successful applicants enter into a contractual agreement with the DNR. Grant recipients must comply with program conditions, provide the local portion of the project costs, install all best management practices (BMPs) constructed under these programs and maintain them for 10 years. If applicants are providing these grant funds to private landowners, a similar contractual agreement is required between the applicant and the landowner.

How do I get an application or request additional information?

dnr.wisconsin.gov/aid/TargetedRunoff.html
dnr.wisconsin.gov/aid/UrbanNonpoint.html

Joanna Griffin, Runoff Management Grants Program Coordinator

608-400-9519
Joanna.Griffin@Wisconsin.gov

Corinne Johnson, Nonpoint Source Program Grant Manager

608-720-0120
Corinne.Johnson@Wisconsin.gov.

Regional Nonpoint Source Coordinators (dnr.wisconsin.gov/topic/Nonpoint/NPScontacts.html) are the local contacts and manage grants in specific areas. They are available to answer questions about the grant applications, process, and project implementation.

The DNR administers these competitive grant programs under chs. NR 153, 154 and 155, Wis. Adm. Code.

Targeted Runoff Management & Urban Nonpoint Source and Storm Water Management Grants

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Current/Updated Stormwater Program

- Public education/outreach involvement/participation
- Illicit discharge detection and elimination
- Construction site pollutant control
- Postconstruction stormwater management
- Pollution prevention – Municipal operations
  - Public stormwater BMP field reviews
- Stormwater quality management
  - WinSLAMM modeling and alternatives analysis
- Storm sewer system map
  - Update annually
- Annual Report – March 31, annually

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WPDES Permit No. WI-S058416-4

WISCONSIN
DEPT. OF NATURAL RESOURCES

STATE OF WISCONSIN
DEPARTMENT OF NATURAL RESOURCES

INDIVIDUAL PERMIT TO DISCHARGE UNDER THE
WISCONSIN POLLUTANT DISCHARGE ELIMINATION SYSTEM
WPDES PERMIT NO. WI-S058416-4

In compliance with the provisions of ch. 283.33, Wis. Stats., and chs. NR 151 and 216, Wis. Adm. Code,

THE CITIES OF FITCHBURG, MADISON, MIDDLETON, MONONA, STOUGHTON, SUN PRAIRIE, AND VERONA; THE VILLAGES OF COTTAGE GROVE, DEFOREST, MAPLE BLUFF, MCFARLAND, SHOREWOOD HILLS, WAUNAKEE AND WINDSOR; THE TOWNS OF BLOOMING GROVE, BURKE, MADISON, MIDDLETON AND WESTPORT; DANE COUNTY; AND THE UNIVERSITY OF WISCONSIN – MADISON

are permitted to discharge storm water from all portions of the

MUNICIPAL SEPARATE STORM SEWER SYSTEMS

owned or operated by the co-permittees listed above to waters of the state in accordance with the conditions set forth in this permit.

With written authorization by the Department, this permit will be used to cover a municipal separate storm sewer system initially covered under a previous version of a municipal separate storm sewer system permit. The **Start Date** of coverage under this permit is the date of the Department letter sent to the municipality authorizing coverage under this permit. 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: Eric S. Rortvedt
Storm Water Engineer & Permit Drafter

7/01/19
Date Permit Signed/Issued

PERMIT EFFECTIVE DATE: July 1, 2019

EXPIRATION DATE: June 30, 2024

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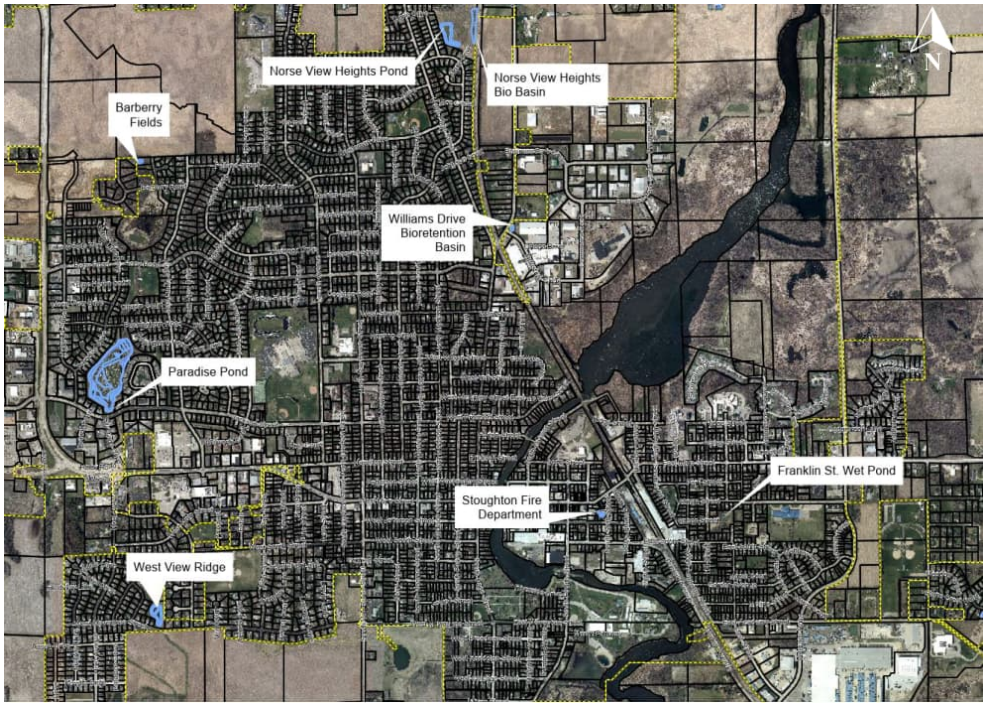
Existing Public Stormwater BMPs Field Reviews

- Eight BMPs reviewed to help comply with pollution prevention – Municipal operations permit condition



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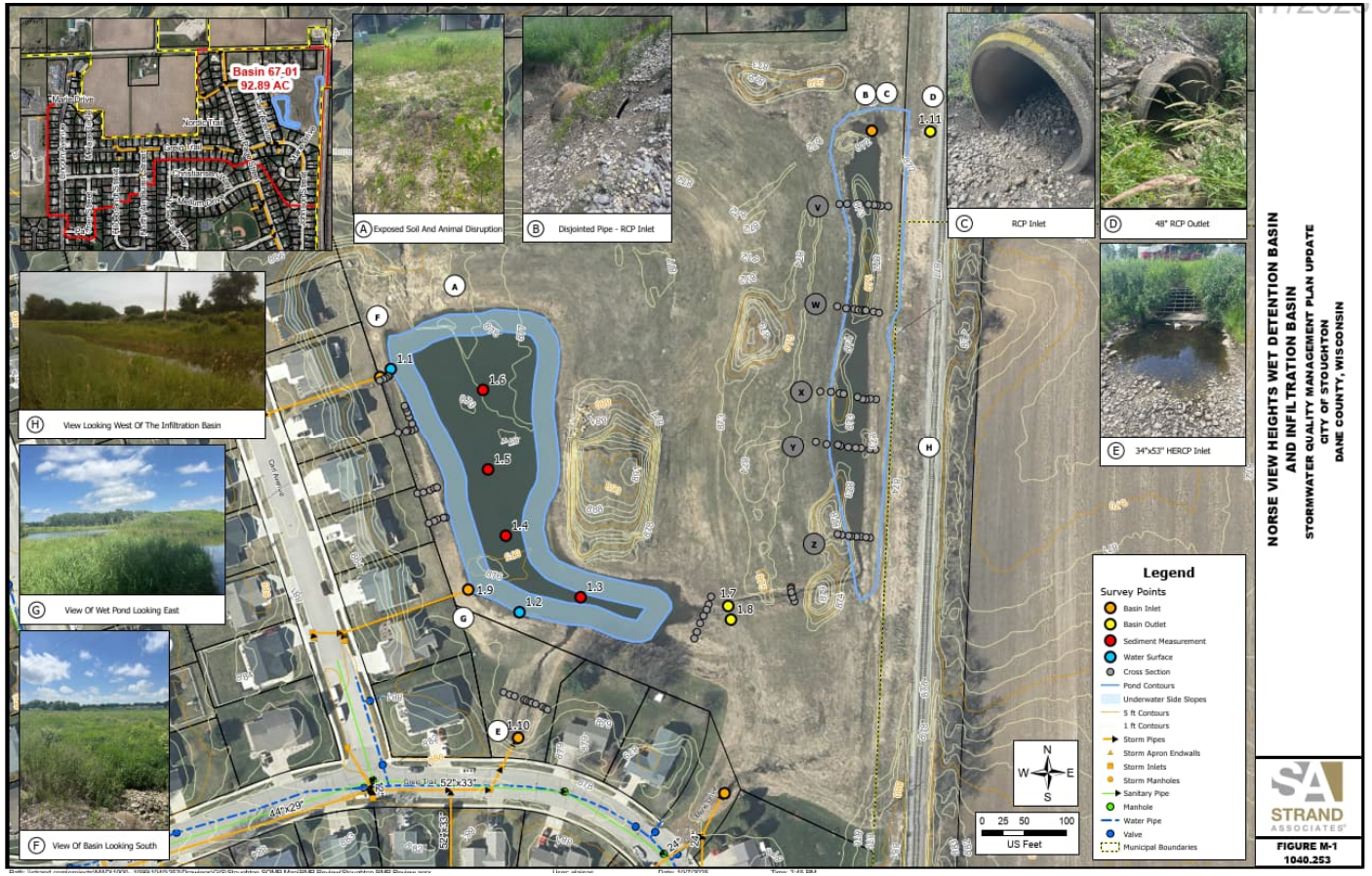
Existing Public Stormwater BMPs Field Review: Example



Existing Public Stormwater BMPs Field Review

Table 6.02-1 Wet Detention Basin Information

Figure or Table No.	Location	(A) Surveyed Average Sediment Depth (ft)	(B) Surveyed Average Water Depth (ft)	(C) Estimated Space Between Water Surface and Outlet Structure (ft)	(A+B+C) Estimated Existing Pond Depth (ft)	(B+C) Estimated Water Storage (ft)	Original Wet Pond Depth from Plans (ft)	Construction Year	Average Sediment Fill Rate (ft/yr)	Estimated Years Before (less than 3 feet) Water Depth
1	Norse View Heights–Wet Detention Basin	2.67	6.64	-3.31	6.00	3.33	6.00	2016	0.33	1.0
2	Barberry Fields–Wet Pond (Main Pond) (a)	0.71	5.49	2.34	8.54	7.83	7.00	2004	0.04	135.0
2	Barberry Fields–Wet Pond (Forebay) (a) (b)	1.31	0.83	2.34	4.47	3.17	3.00	2004	0.07	2.5
3	Paradise–Wet Pond (a) (b)	0.51	2.56	0.99	4.06	3.55	4.00	2000	0.02	25.7
4	Westview Ridge–Wet Pond	0.15	3.19	0.11	3.45	3.30	3.00	2003	0.01	43.1
5	Stoughton Fire Station–Wet Pond (a) (b)	1.00	1.75	1.59	4.34	3.34	5.00	2007	0.06	5.7
6	Franklin Street–Wet Pond	1.18	3.32	0.22	4.72	3.54	5.00	2016	0.15	3.7

ft/yr=feet per year

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Modified Philip Dunne (MPD) Infiltrometer

Infiltration Report

Strand Associates, Inc.

Norse View Heights Infiltration Basin - 1040.253 -
Stoughton, WI

K_{sat} best-fit site average: 19 mm/hr or 0.730 in/hr

GPS Infiltration Test Site Map

Map Pin #	Test #	Test Name	Ksat (mm/hr)	Ksat (in/hr)	C (mm)	RMS Error of Regression (s)	Normalized RMS
1	27355	north 1	38	1.49	-154.9	34	0.6%
2	27356	north 2	14	0.559	-273.6	139	1.3%
3	27357	north 3	10.0	0.392	-212.2	20.0	0.3%

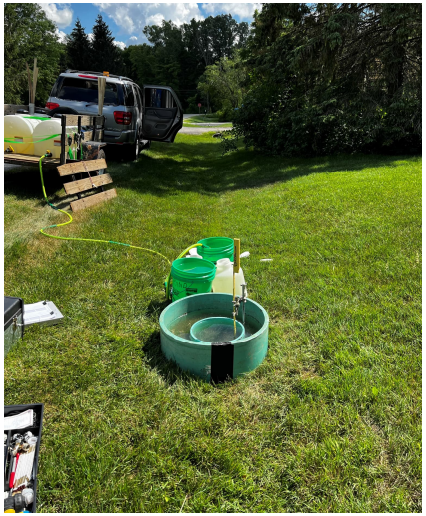
Table 6.02-2 Infiltration and Bioretention Basins Information

Figure or Table No.	Location	Construction Year	Average Bottom Elevation	Bottom Elevation Per Design	Depth of Sediment (Survey-Plan Elevation)	WDNR Infiltration Rate	MPD Measured Infiltration Rate	Double Ring Measured Infiltration Rate
1.1	Norse View Heights–Infiltration Basin	2016	868.3	868	0.3	3.60	0.73	N/A
7	Williams Drive–Bioretention Basin	2016	862.99	863	0	3.60	13.63	13.95

MPD Infiltrometer

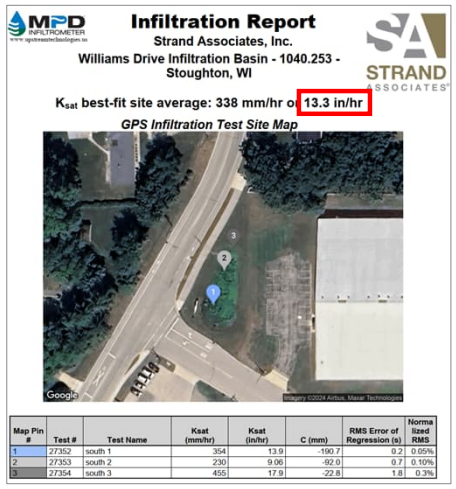
Double-Ring and Modified Philip Dunne (MPD) Infiltrometer Comparison

Infiltrometer Type	Test Time	Water Need Per Test	Concurrent Tests	Test of	Calculation Method
Double-ring	2 hours	50-100 gallons	1	Infiltration rate	By hand
MPD	Soil dependent: • Sandy – 5 to 10 minutes • Silty – 20 minutes • Clayey – 1 to 2 hours	0.25 gallons	3	Soil conductivity	Computer-automated

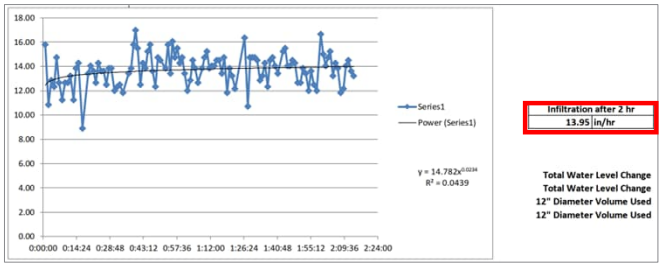


Double-ring Infiltrometer

MPD infiltrometer



MPD calculations



Double-ring calculations

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Existing Public Stormwater BMPs Field Review – Action Items Summary

Table 6.02-3 BMP Maintenance–Action Items Summary

		Nonroutine Maintenance Needed			Routine Maintenance Needed					
Figure or Table No.	Location	Whole Pond Dredging	Partial Pond or Forebay Dredging	Infiltration Basin Bottom Tilling and Native Vegetation Planting	Erosion Remediation	Woody Vegetation Removal	Mowing or Selective Weed Control	Removal of Temporary Rock Check Dam	Pipe Fix	Comments
1	Norse View Heights–Wet Detention Basin	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Some erosion found.
1.1	Norse View Heights–Infiltration Basin	No	No	No	No	No	Yes	No	Yes	Disjointed endwall for 48-inch reinforced concrete pipe (RCP) outlet.
2	Barberry Fields–Wet Pond	No	Yes	No	No	No	No	No	No	Infiltration seems to be occurring, algae throughout pond.
3	Paradise–Wet Pond	No	No	No	Yes	No	No	No	No	Infiltration seems to be occurring here, some channelization in banks.
4	Westview Ridge–Wet Pond	No	No	No	No	No	Yes	No	Yes	Mild erosion seen on berm, disjointed apron endwall for 30-inch RCP inlet, algae throughout pond.
5	Stoughton Fire Station–Wet Pond	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Infiltration seems to be occurring, thick vegetation around pond structures. Reconstructed as a bioretention basin in 2025.
6	Franklin Street–Wet Pond	Yes	No	No	No	No	Yes	No	No	Thick vegetation around pond structures, algae in pond.
7	Williams Drive–Bioretention Basin	No	No	No	No	No	Yes	No	No	Some non-native plants seen in biobasin.

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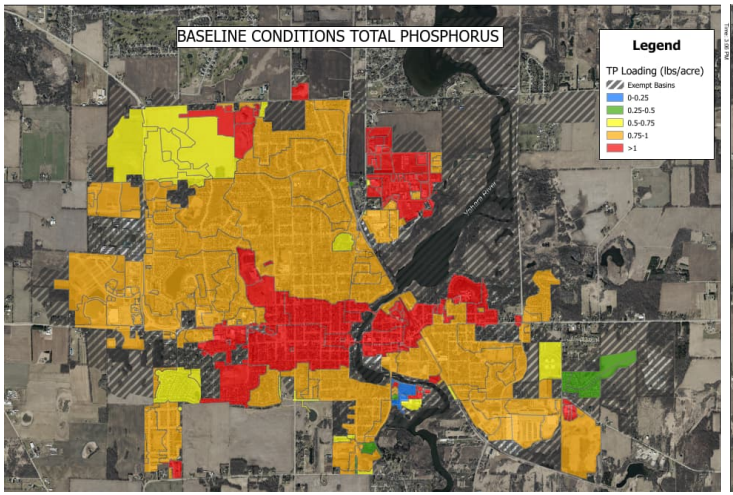
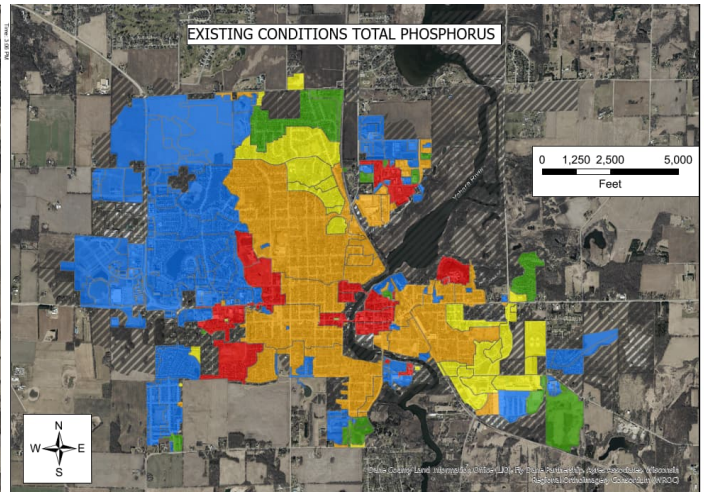
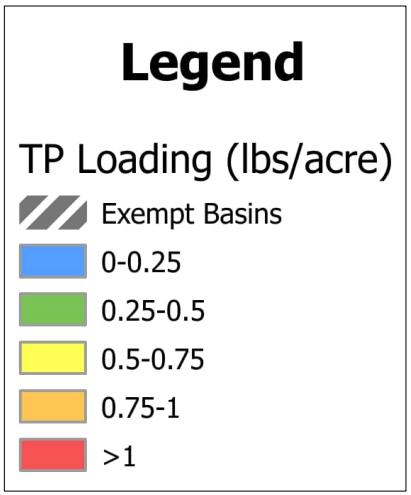
Stormwater Quality Modeling



Baseline with no controls condition



Existing conditions with controls



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Stormwater Quality Modeling (Continued)

Pollutant	MS4 Permit Required Reductions	Yahara WINs Buy-In Required Reductions	Rock River TMDL Required Reductions	MS4 Modeled Existing Conditions City-Wide Reduction (%)	TMDL Pollutant Reduction Gap (%)	TMDL Pollutant Reduction Gap (lb)
City of Stoughton (WinSLAMM Version 10.5)						
TSS	20% (in compliance)	40% (meeting)	Reach 66: 62.2% Reach 67: 40.0% Reach 68: 50.8% Reach 69: 52.6%	Reach 66: 91.2% Reach 67: 49.5% Reach 68: 42.8% Reach 69: 98.7%	Reach 66: -29.0% Reach 67: -9.5% Reach 68: 8.0% Reach 69: -46.1%	Reach 66: -6,143.3 Reach 67: -62,670.7 Reach 68: 12,572.9 Reach 69: -2,946.5
TP	N/A	27% (meeting)	Reach 66: 54.0% Reach 67: 27.0% Reach 68: 65.0% Reach 69: 79.6%	Reach 66: 90.9% Reach 67: 45.6% Reach 68: 35.5% Reach 69: 97.1%	Reach 66: -36.9% Reach 67: -18.6% Reach 68: 29.5% Reach 69: -17.5%	Reach 66: -25.2 Reach 67: -391.6 Reach 68: 127.2 Reach 69: -4.6

Citywide TSS and TP Improvement Since 2018: **TSS: 49.6% (was 31.7%)** **TP: 45.6% (was 27.0%)**

Internal Water Quality Trade from Reach 67 to Reach 68 Brings Full TMDL Compliance

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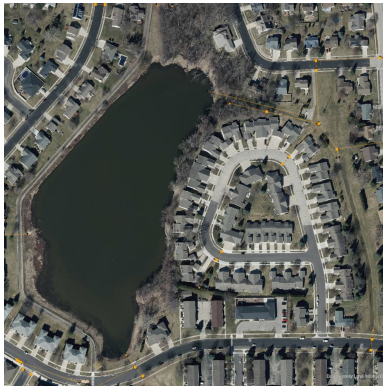
Stormwater Best Management Practices (BMPs) Implemented Since 2018

- Enhanced Street Sweeping Program
  - Vacuum street sweeper purchase with WDNR UNPS&S Grant (2020)
- TP Leaf Collection Credit Analysis
  - 2020 and 2025 analyses performed before and after guidance updates
- Paradise Pond monitoring: 88.8% TSS reduction and 78.3% TP reduction
- Industrial Park Dry to Wet Pond conversion: 30 lbs TP
- Washington Street Hydrodynamic Separator (HDS): 4.2 lbs TP
- New Development Pollutant reduction: (21 sites and 569 lbs TP)
- Redevelopment Pollutant reduction: (11 sites and 13.8 lbs TP)
- BMP modifications: (6 BMPS and 58.5 lbs TP)

Industrial Park Dry to Wet Pond



Paradise Pond Monitoring

Washington Street HDS

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TP Leaf Collection Credit Analysis

- Enhanced Street Sweeping Program
  - Vacuum street sweeper purchase with WDNR UNPS&S Grant (2020)
  - $54,464 Grant
  - Street sweeping (once every 2 weeks) with vacuum street sweeper
- TP Leaf Collection Credit Analysis

Analysis Year	Guidance Document	Reach 66 (lbs TP)	Reach 67 (lbs TP)	Reach 68 (lbs TP)	Total (lbs TP)
2020		0.0	31.6	6.1	37.7
2025	2022	0.3	71.7	10.3	82.3
Difference		**+0.3**	**+40.1**	**+4.1**	**+44.6**

BUREAU OF WATERSHED MANAGEMENT
PROGRAM GUIDANCE

WATERSHED MANAGEMENT TEAM
Storm Water Runoff Management Program

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

Municipal Phosphorus Reduction Credit for Leaf Management Programs

02-17-2022
EGAD Number: 3800-2022-01

This document is intended solely as guidance and does not contain any mandatory requirements except where requirements found in statute or administrative rule are referenced. Any regulatory decisions made by the Department of Natural Resources in any matter addressed by this guidance will be made by applying the governing statutes and administrative rules to the relevant facts.

APPROVED:

2/22/2022

Jill Schoen, Acting Director — Date
Bureau of Watershed Management

WDNR's 2022 guidance

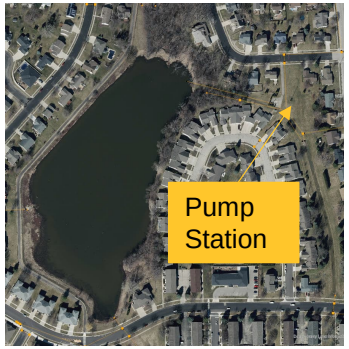
Leaf collection vehicle

Paradise Pond Monitoring: 2017 to 2021

- Paradise Pond characteristics:
  - Internally-drained wet pond with 11-acre surface area
  - 1,066-acre watershed with residential and commercial land use
  - Discharge only via hand-operated stormwater pump station
- WDNR-required monitoring of pumped discharge per 2019-2024 MS4 permit
  - 2018 SQMP used incoming TSS and TP loads from WinSLAMM
  - Performance was 82.1% TSS and 56.0% TP reduction with weir outlet in WinSLAMM

Paradise Pond (looking north)

Submersible stormwater pump station

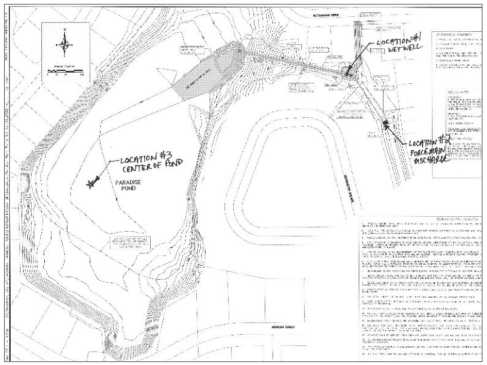


Pump station location

1,066-acre watershed map

Paradise Pond Monitoring: 2017 to 2021 (Continued)

- Provide samples of discharged stormwater each time stormwater pump station is operated
- **Stormwater Quality Monitoring/Sampling:** Sample at pumping station wet well and force main discharge twice during each pumping event
- **Stormwater Quantity Monitoring:** Use pump run times and wet well water surface elevations at pump START and STOP, calculate the total volume pumped out



Sampling locations map

Stage	Elevation	Area (ac)	Depth	Incremental Volume (ac-ft)	Cumulative Volume (ac-ft)
0.01	880	0.003			
			1.00	0.04	
1	881	0.069			0.04
			1.00	0.09	
2	882	0.104			0.12
			1.00	0.83	
3	883	1.562			0.95
			1.00	4.22	
4	884	6.872			5.17
			1.00	7.58	
5	885	8.280			12.75
			1.00	8.95	
6	886	9.627			21.70
			1.00	10.14	
7	887	10.645			31.84
			1.00	11.24	
8	888	11.838			43.08
			1.00	12.10	
9	889	12.368			55.18
			1.00	12.63	
10	890	12.889			67.81
			1.00	13.15	
11	891	13.402			80.96
					TOTAL

Pond stage-storage information

Permit Conditions:

1.5.4 *The City of Stoughton is authorized to discharge pumped water from Paradise Pond, which will flow over a mile before entering the Yahara River, with additional requirements in section 4.4.*

4.4 City of Stoughton

The City of Stoughton is required to comply with the following:

4.4.1 *The pumped discharge from Paradise Pond shall be operated in a manner to prevent accumulated sediment from discharging from Paradise Pond.*

4.4.2 *The discharge shall be operated in a manner to prevent downgradient erosion.*

4.4.3 *For the term on this permit, the City of Stoughton's annual average pollutant load reductions applied to the drainage area to Paradise Pond have been calculated to be 82.1% for TSS and 56.0% for TP.*

Note: *The above reductions were based on WinSLAMM modeling of annual average conditions with a weir outlet as opposed to pumping. At next permit reissuance (or upon DNR concurrence of the treatment performance documented by analysis of the 2017 to 2021 monitoring data), the future treatment performance can be calculated using effluent monitoring data representing annual average conditions as compared to WinSLAMM predicted annual average influent load.*

4.4.4 Monitor *the discharge from Paradise Pond at a location representative of the discharge from the pond as identified in Table 5. The sampling of* ***total phosphorus*** *and* ***total suspended solids*** *is required through calendar year 2021. The results shall be reported to the Department as indicated in section 6.22 of this permit.*

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Paradise Pond Monitoring: 2017 to 2021 (Continued)

Analysis A: Full Year, All Events

		Total Volume Pumped (2021):								Total Volume Pumped (2021):									
		Method 1 (Direct Volume Calculation From Wet Well Elevations)								Method 2 (Pumped Volume Calculation from Pump Run Times)								Difference (Method 1-2)	
	Test Location	TSS (lbs)	TP (lbs)					TSS % Red.	TP % Red.	TSS (lbs)	TP (lbs)					TSS % Red.	TP % Red.	TSS % Reduction	TP % Reduction
2021	Location 1: Wet Well	10,324	108					92.5%	76.5%	12,567	118					90.9%	74.3%	1.6%	2.2%
	Location 2: Forcemain Discharge	10,665	94					92.3%	79.5%	13,035	110					90.5%	76.0%	1.7%	3.5%
	Average of Locations 1 and 2 (2020)	10,495	101					92.4%	78.0%	12,801	114					90.7%	75.1%	1.7%	2.8%
2020	Location 1: Wet Well	Total Volume Pumped (2020):			31,831,124	gallons		86.9%	76.2%	Total Volume Pumped (2020):			37,032,940	gallons		85.3%	74.3%	1.6%	1.9%
	Location 2: Forcemain Discharge	% less pumped in 2020			-44%			88.4%	77.5%	% less pumped in 2020			-37%			87.5%	76.2%	0.9%	1.3%
	Average of Locations 1 and 2 (2020)							87.7%	76.9%							86.4%	75.2%	1.3%	1.6%
2019	Comparison to 2019:	Total Volume Pumped (2019):			78,702,639	gallons				Total Volume Pumped (2019):			90,764,610	gallons					
	Location 1: Wet Well	% less pumped in 2019			-77%			77.8%	63.7%	% less pumped in 2019			-74%			77.9%	59.8%	-0.1%	3.9%
	Location 2: Forcemain Discharge							75.1%	64.0%							73.0%	60.6%	2.1%	3.4%
	Average (2019)							76.5%	63.9%							75.4%	60.2%	1.0%	3.7%
2018	Comparison to 2018:	Total Volume Pumped (2018):			76,587,207	gallons				Total Volume Pumped (2018):			117,284,880	gallons					
	Location 1: Wet Well	% less pumped in 2018			-77%			76.3%	45.1%	% less pumped in 2018			-80%			69.0%	15.2%	7.3%	29.9%
	Location 2: Forcemain Discharge							76.5%	48.0%							66.8%	20.6%	9.7%	27.4%
	Average (2018)							76.4%	46.5%							67.9%	17.9%	8.5%	28.6%
2017	Comparison to 2017:	Total Volume Pumped (2017):			38,473,373	gallons				Total Volume Pumped (2017):			39,161,944	gallons					
	Location 1: Wet Well	% less pumped in 2017			-53%			86.5%	79.9%	% less pumped in 2017			-41%			86.7%	80.2%	-0.2%	-0.3%
	Location 2: Forcemain Discharge							87.7%	81.8%							86.8%	80.6%	0.9%	1.2%
	Average (2017)							87.1%	80.9%							86.7%	80.4%	0.4%	0.4%
WinSLAMM (without off-site)	Comparison of 2021 to WinSLAMM:	TSS (lbs)	TP (lbs)																
	WinSLAMM Baseline/No Controls Load (lbs)	90,762	273.5																
	WinSLAMM Existing Conditions Load (lbs)	16,212	120.3					82.1%	56.0%							82.1%	56.0%		
	Difference (Load Reduction-lbs)	74,550	153.2																
WinSLAMM (with off-site)	Comparison of 2021 to WinSLAMM:																		
	WinSLAMM Baseline/No Controls Load (lbs)	137,695	459.4							137,695	459.4								
	WinSLAMM Existing Conditions Load (lbs)	25,470	201.4					81.5%	56.2%	25,470	201.4					81.5%	56.2%		
	WinSLAMM Existing Conditions Load Reduction (lbs)	112,224	258.0							112,224	258.0								
	WinSLAMM Existing Conditions Load Reduction (%)	81.5%	56.2%							81.5%	56.2%								
	2021 Sampling Load Reduction (lbs)	127,200	358							124,894	345								
	2021 Sampling Load Reduction (%)	92.4%	78.0%							90.7%	75.1%								
	2021 Additional Load Reduction (lbs)	14,976	100.1							12,670	87.1								
	2021 Additional Load Reduction (%)	13.3%	38.8%							11.3%	33.8%								
	Difference 2021 Load and WinSLAMM Load (lb)	-14,976	-100.1							-12,670	-87.1								
	Difference 2021 Load and WinSLAMM Load (%)	-58.8%	-49.7%							-49.7%	-43.3%								

Revised Paradise Pond Performance:

		Method 1 (Direct Volume Calculation from Wet Well Elevations)			Method 2 (Pumped Volume Calculation from Pump Run Times)			Avg. 2 Methods	
Option #1	Average (2017 2018, 2019, 2020, 2021)	85.2%	69.2%		Average (2017 2018, 2019, 2020, 2021)	83.6%	61.8%	84.4%	65.5%
	Difference compared to WinSLAMM	3.7%	13.1%		Difference compared to WinSLAMM	2.1%	5.6%	2.9%	9.3%
Option #2	Average (2017, 2020, 2021)	89.3%	79.1%		Average (2017, 2020, 2021)	88.2%	77.6%	88.8%	78.3%
	Difference compared to WinSLAMM	7.8%	22.9%		Difference compared to WinSLAMM	6.7%	21.4%	7.3%	22.2%
Option #3	Average (2020, 2021)	90.4%	78.2%		Average (2020, 2021)	89.0%	76.2%	89.7%	77.2%
	Difference compared to WinSLAMM	8.8%	22.0%		Difference compared to WinSLAMM	7.5%	20.0%	8.2%	21.0%
Option #4	Average (2020 only)	88.3%	78.4%		Average (2020 only)	87.3%	77.2%	87.8%	77.8%
	Difference compared to WinSLAMM	6.8%	22.2%		Difference compared to WinSLAMM	5.8%	21.0%	6.3%	21.6%
		TSS	TP			TSS	TP	TSS	TP

Recommend Use This (Option #2)

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Paradise Pond Monitoring Results Discussion

Volume Calculation

Method 1 – Direct Volume Calculation	Method 2 – Pumped Volume Calculation
1. Measure depth of water from rim at pumping station at pump on and off. 2. Use stage-storage for pond to calculate volume of water pumped.	1. Record pump on time. 2. Record pump off time. 3. Use known pumping rates to calculate the volume of water pumped.

Pollutant Sampling

Take 2 samples at wet well and 2 samples at force main discharge and test for TSS and TP concentrations

Loading Calculations

Multiply pollutant concentration by direct volume measured for each storm and sum over the entire year to calculate annual pounds of pollutant discharged.	Multiply pollutant concentration by pumped volume measured for each storm and sum over the entire year to calculate annual pounds of pollutant discharged.
Use WinSLAMM calculated baseline pollutant loading to calculate annual pollutant reduction by pond.	Use WinSLAMM calculated baseline pollutant loading to calculate annual pollutant reduction by pond.

Average pollutant reduction by pond across the two methods.

Final Calculations (Monitored from 2017 through 2021)

Record annual rainfall depth and compare to WinSLAMM average annual rainfall depth. Final calculation removed 2018 and 2019 due to high rainfalls compared to the average. 2017 was slightly above average, and 2020 and 2021 were slightly below average.

Average the annual pollutant reduction for 2017, 2020, and 2021: **88.8% TSS Reduction and 78.3% TP Reduction**

Analysis Year	TSS Reduction (%)	TP Reduction (%)
2018	82.1	56.0
2025	88.8	78.3
Difference	**+6.7**	**+22.3**

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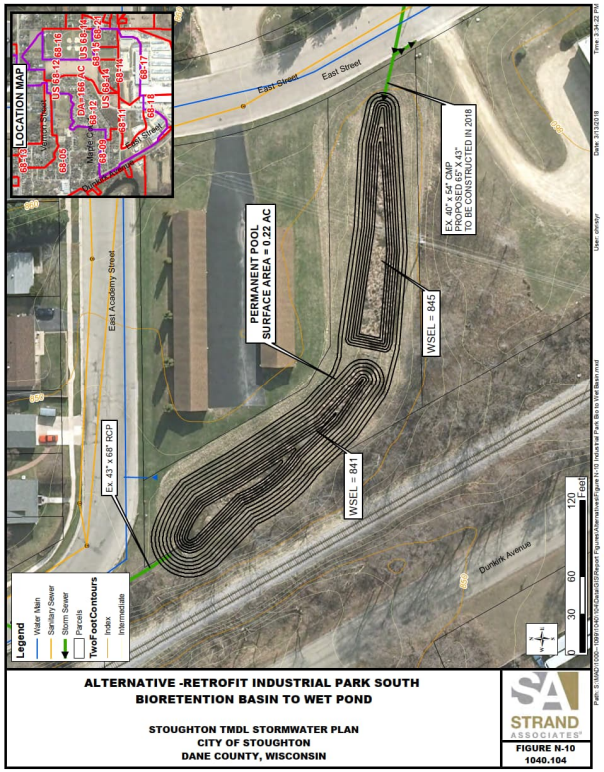
Industrial Park Dry to Wet Pond Conversion

- Highest priority in 2018 Stormwater Quality Management Plan
- Performance:
  - 39.6% TSS reduction
  - 29.0% TP reduction = 30 lbs of TP reduction
- Drains 166 acres of residential and industrial lands
- TMDL Reach 68

Before (inlet)

Before (outlet)



Concept drawing from 2018 Stormwater Quality Plan

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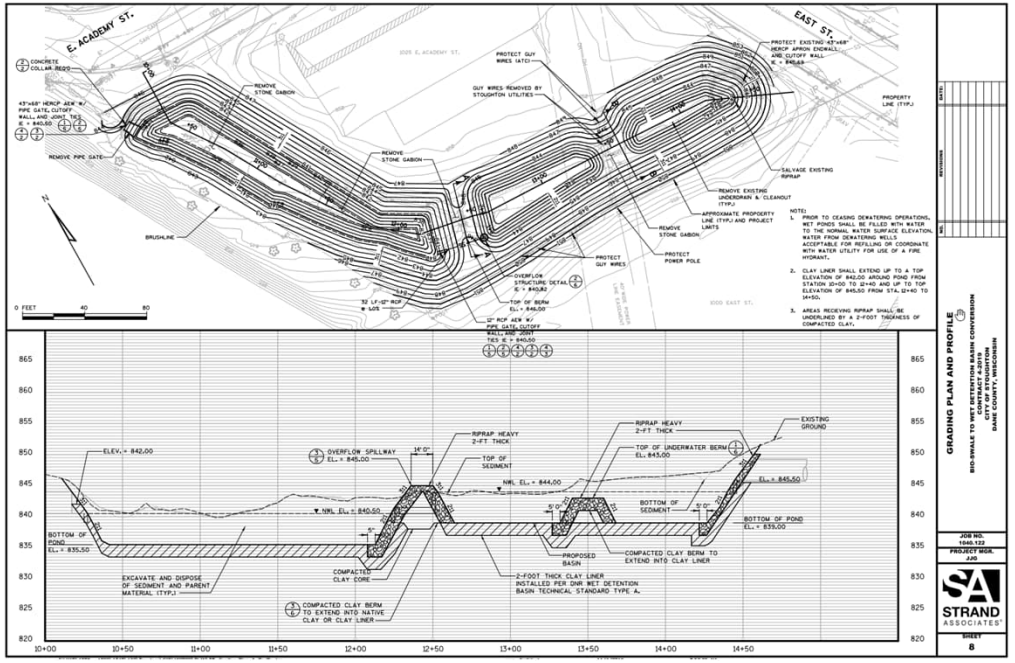
Industrial Park Dry to Wet Pond Conversion (2020)

Item	Cost	% of Total
Construction and Engineering Cost	$380,000	100.0
WDNR UNPS Grant	$135,000	34.4
Dane County Urban Water Quality Grant	$100,000	26.3
City Share	**$145,000**	**38.2**

After (inlet)

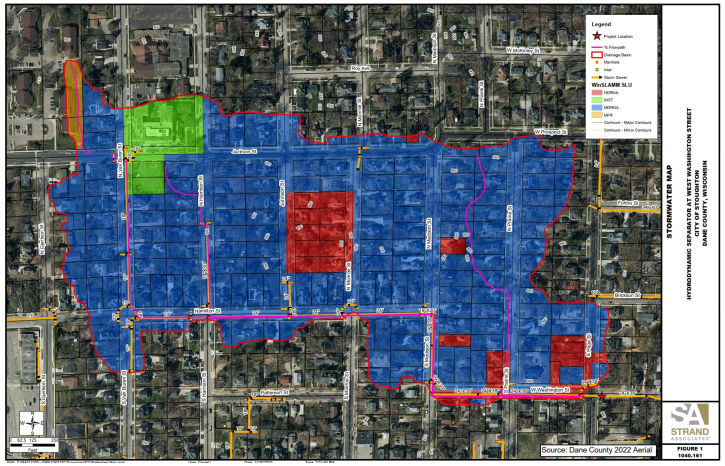
After (outlet)



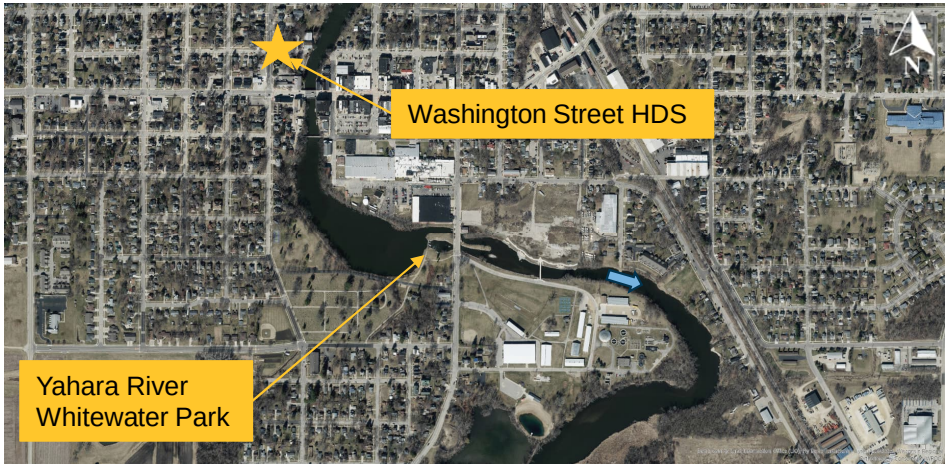
Design Drawing

Washington Street Hydrodynamic Separator (HDS)

- Second highest priority in 2018 Stormwater Quality Management Plan
- Washington Street Hydrodynamic Separator (2024): 18.5% TSS reduction and 12.5% TP reduction, 4.2 lbs TP, trash capture, grease and oil control
- Drains 46 acres of residential lands
- River Park revitalization with new Whitewater Park



46-acre watershed map



Location in relation to future Yahara River Whitewater Park

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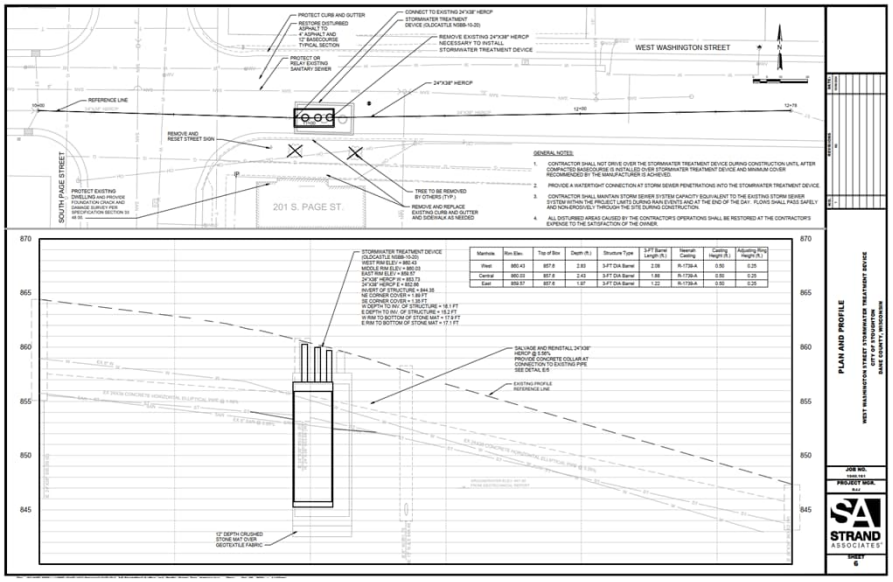
Washington Street Hydrodynamic Separator (2025)

Item	Cost	% of Total
Construction and Engineering Cost	$373,300	100.0
WDNR UNPS Grant	$135,300	36.2
Dane County Urban Water Quality Grant	$186,700	50.0
City Share	**$51,300**	**13.8**

After (Restored Washington Street)

During construction (StormTrap Site Saver with Lamella Plates)

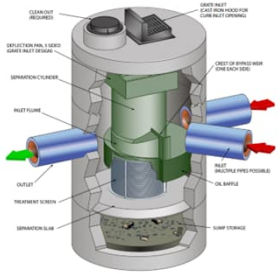


Design Drawing

Hydrodynamic Separator Type Comparison

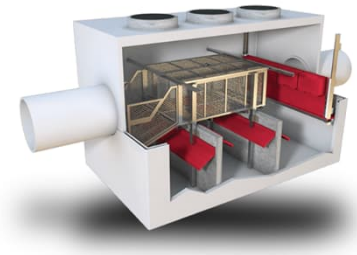
Manhole Structures

Oldcastle DVS

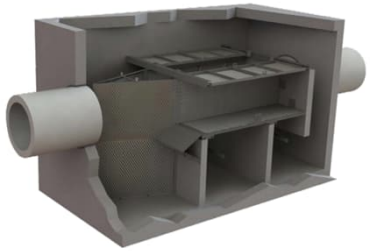


Contech CDS

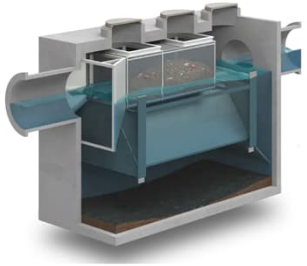
Box Structures



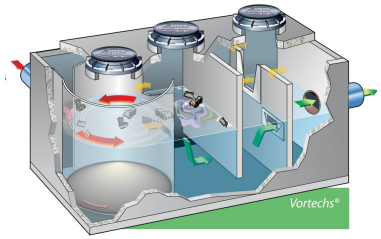
Oldcastle NSBB



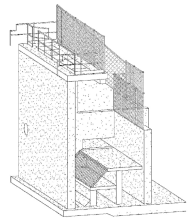
Contech DSBB



StormTrap SiteSaver



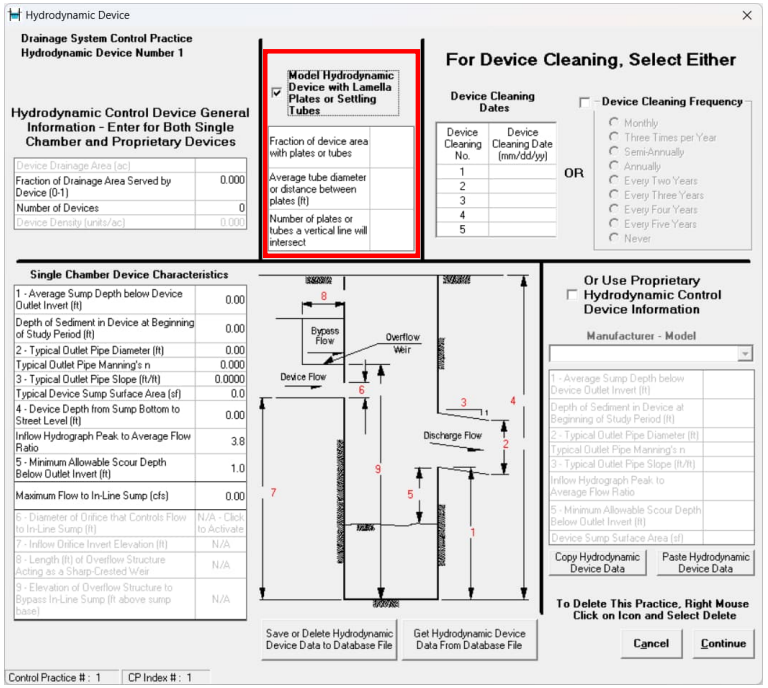
Contech Vortechs



Coanda Screen

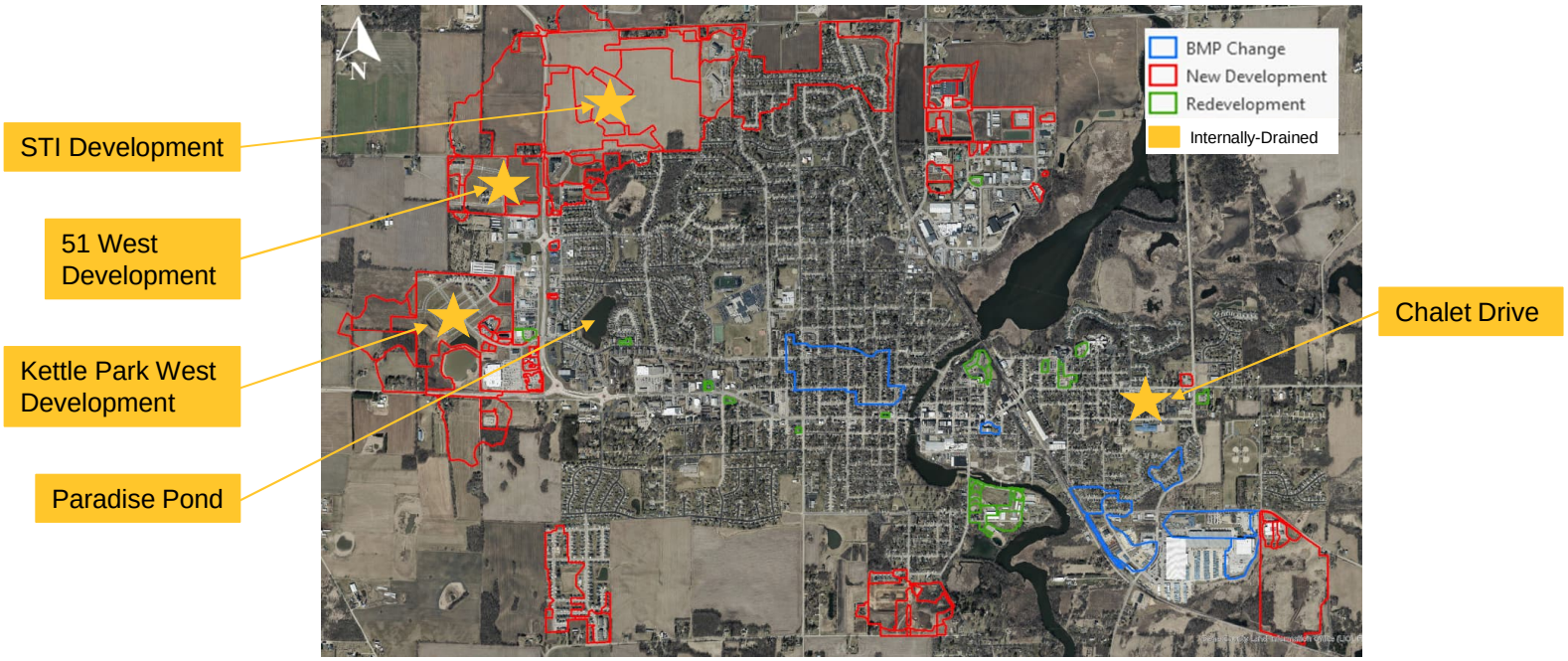
Hydrodynamic Separator Type Comparison

	Manhole Structure	Box Structure
Common manufacturers	Contech, Oldcastle, and others	StormTrap, Oldcastle, Contech, and others
Cost	↓	↑
Treatment	↓	↑
Pros	Smaller systems that can take the place of a manhole in smaller systems	Larger size allows for online systems for larger watersheds and more pollutant reduction
Cons	Can easily be undersized in a large watershed and may need diversion structures. Reduced footprint leads to reduced pollutant reduction.	More costly due to the larger sizes and can cause more utility conflicts
Ability to be on-line	Only for small watersheds	Some units can be on-line, others will require diversion manholes
Key features	Can capture floatables such as oil, grease, and trash	Can capture floatables such as oil, grease, and trash



WinSLAMM Hydrodynamic Device – Lamella Plates Entry

New and Redevelopment Reduction



Update Type	Quantity	# of BMPs	Acres Of Development	Acres Affected	Pounds of TP Removed
New development	21 sites	74	565.6 acres	929.7 acres	569 lbs
Redevelopment	11 sites	22	46.0 acres	38.7 acres	13.8 lbs
BMP modifications	6 sites	6	0.0 acres	183.9 acres	58.5 lbs

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New and Redevelopment Reduction

Table 4.04-1 Internally Drained Areas

Location	Does Runoff From 10-Year, 24-Hour Event Leave Depressional Area?	Remove From Calculations Unless it Meets 3 Criteria, in Which Case, 100% TSS and TP Credit Can Be Taken	Criteria No. 1 Met[1]	Criteria No. 2 Met[2]	Criteria No. 3 Met[3]
Chalet Drive (Basin 68-13)	No	Removed From Calculations	No	No	No
Paradise Pond[4] (Basins: 67-PP xx)	No	Included in analysis as pumped discharge with WDNR-approved pollutant reduction performance of 88.8 percent TSS reduction and 78.3 percent TP reduction (see Appendix J).	N/A	N/A	N/A
Kettle Park West (Basins: KPW xx)	No	Included in analysis with 100 percent TSS and TP reduction: Stormwater is pretreated to an 80 percent TSS level by a wet detention basin before discharge via pumping station to an infiltration basin per WDNR-approved stormwater quality plan.	Yes	Yes	Yes
51 West (Basins: 51 West 1, 51 West 2, 51 West 3, 51 West 4, 51 West 5)	No	Included in analysis with 100 percent TSS and TP reduction: Stormwater is pretreated to an 80 percent TSS level by a wet detention basin before discharge to an infiltration basin per WDNR-approved stormwater quality plan.	Yes	Yes	Yes
STI (Basins: STxx)	Yes	Included in analysis with 100.0 percent TSS and 100.0 percent TP reduction per WinSLAMM modeling. 1- and 2-year do not discharge but 5-year and greater discharge. Stormwater is pretreated to 80 percent TSS level by wet detention basin before discharge to an infiltration basin	Yes	Yes	Yes

[1]Criteria No. 1–Minimize Level of Pollutant Infiltrating to Groundwater: Soils between bottom of infiltration practice and seasonal high groundwater or top of bedrock have: (a) 3-foot soil layer with 20 percent fines or greater, or, (b) 5-foot soil layer with 10 percent fines or greater

[2]Criteria No. 2–Any runoff from parking lots or roads in commercial, institutional, or industrial areas directed into an internally drained area shall be pretreated to help prevent clogging of the internally drained area.

[3]Criteria No. 3–If the area is owned by the municipality, then the municipality must have a long-term maintenance agreement in place with the property owner to ensure that the internally drained area will be maintained. If the municipality owns the area, then the municipality must include maintenance of the area in its stormwater management program.

[4]Paradise Pond pollutant reduction performance (88.8 percent TSS reduction and 78.3 percent TP reduction) per WDNR's April 8, 2022, approval included in Appendix J that was based on WDNR-required Paradise Pond monitoring data collection and analysis from 2017 to 2021. Based on the approval, the City discontinued monitoring of Paradise Pond in August 2022. The 2018 SQMP had previously assumed an 82.1 percent TSS reduction and 56.0 percent TP reduction for Paradise Pond.

Internally Drained Protocol

Runoff from 10-yr 24-hr storm event does not leave depressional area

Remove from calculations unless meet 3 criteria, in which case 100% TSS and TP credit can be taken

Criteria 1: Minimize level of pollutant infiltrating to groundwater
Soils between bottom of infiltration practice and seasonal high groundwater or top of bedrock have:
- *3-ft soil layer with 20% fines or greater, OR,*
- *5-ft soil layer with 10% fines or greater*

Criteria 2: Any runoff from parking lots or roads in commercial, institutional, or industrial areas directed into an internally drained area shall be pretreated to help prevent clogging of the internally drained area

Criteria 3: If the area is not owned by the municipality, then the municipality must have a long-term maintenance agreement in place with the property owner to ensure that the internally-drained area will be maintained. If the municipality owns the area, then the municipality must include maintenance of the area in its stormwater management program.

Source: TMDL Guidance for MS4 Permits: Planning, Implementation, and Modeling Guidance: Addendum B (Internally Drained Areas), May 2016

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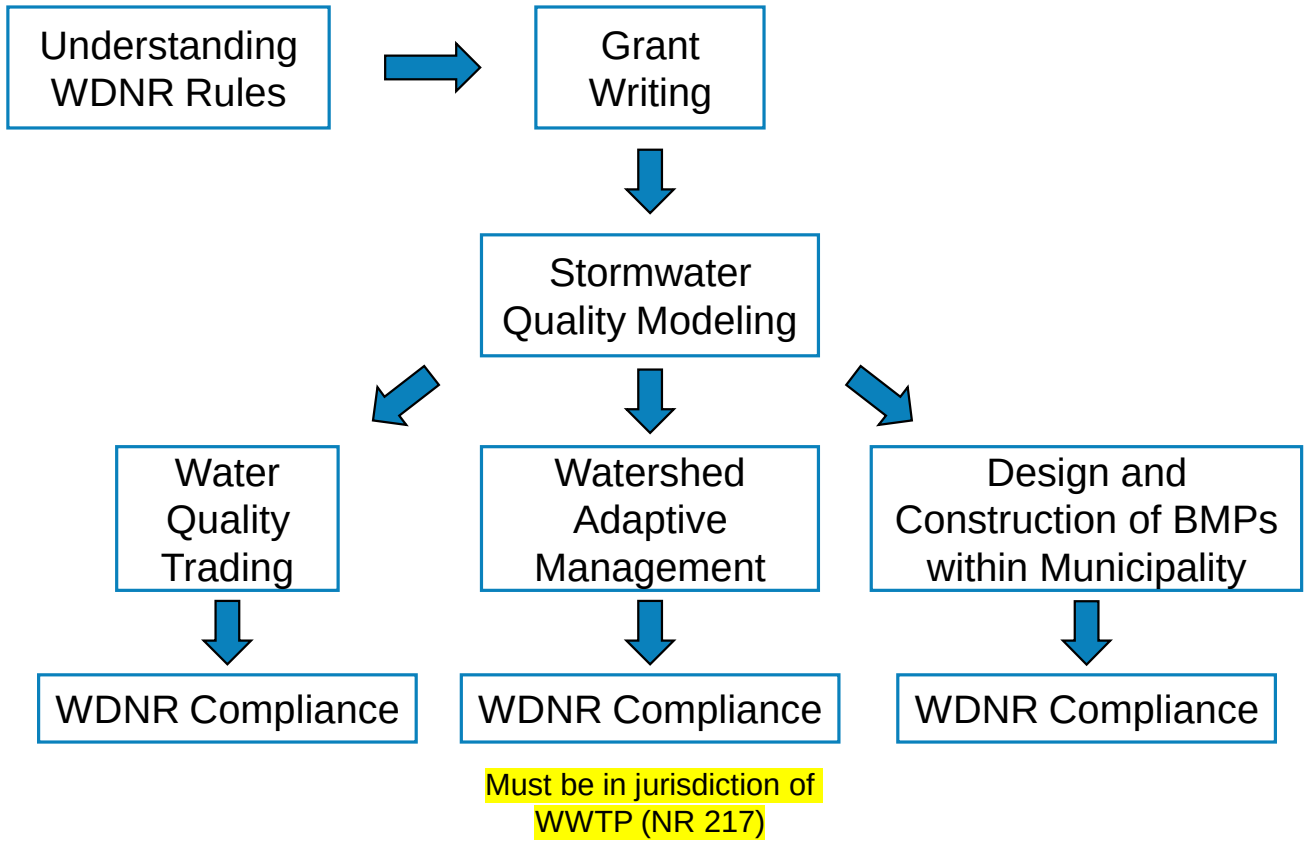
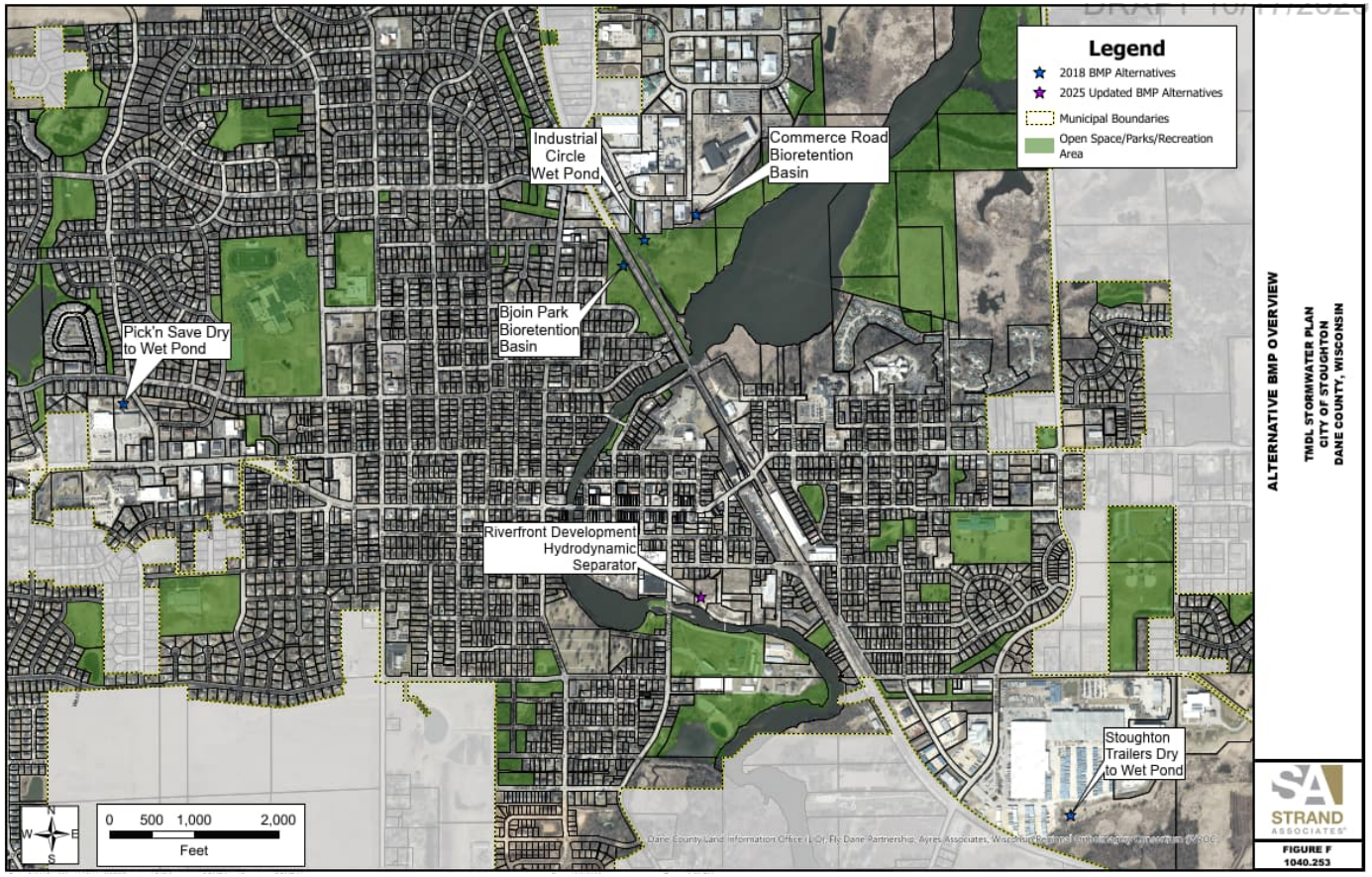
Alternatives Analysis

MS4 must first achieve the following to participate in Water Quality Trading and **Yahara WINs** Watershed Adaptive Management Programs:

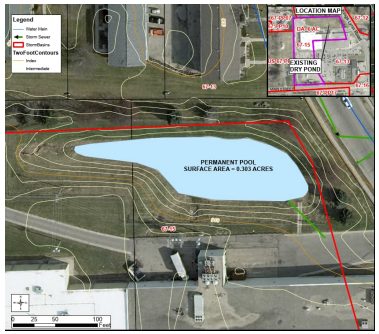
- **Water Quality Trading:** 40% TSS Reduction in Each Reach
- **Yahara WINs WAM:** 40% TSS and 27% TP Reduction in Each Reach



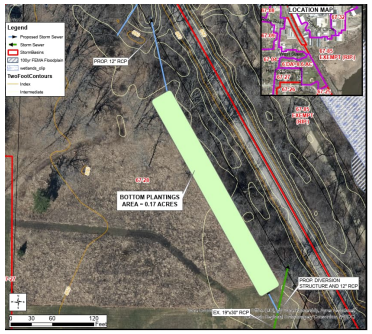
New Stormwater BMPs Evaluated in the City



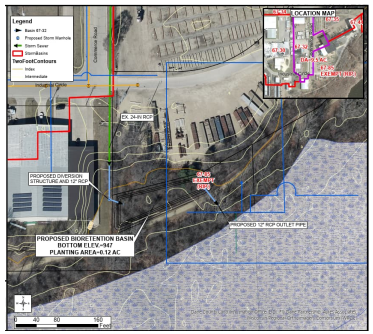
Stormwater BMPs in the City (Alternative #2 Example)



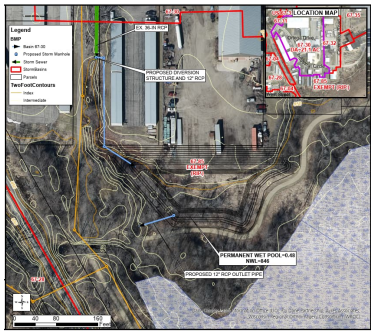
Pick ‘N Save Dry to Wet Pond
- 0.2 lbs TP
- $408,100



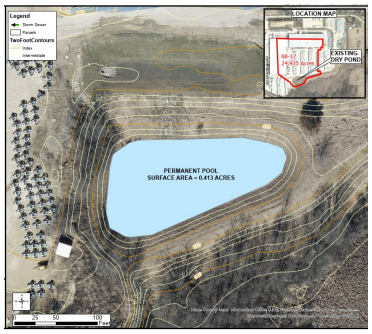
Bjoin Park Biobasin
- 12.2 lbs TP
- $485,100



Commerce Road Biobasin
- 8.1 lbs TP
- $402,700



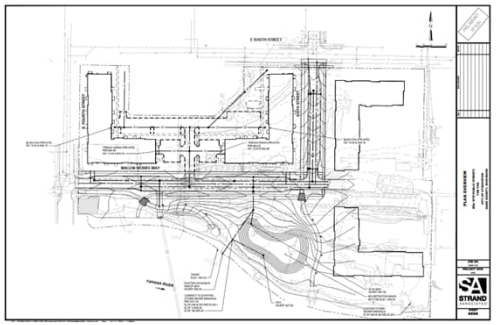
Industrial Circle Wet Pond
- 9.9 lbs TP
- $686,300



Stoughton Trailers Dry to Wet Pond
- 0.0 lbs TP
- $420,900

Redevelopment at 80% TSS reduction
- 6.5 lbs TP over 20 years

Internal Water Quality Trading
- Reach 67 to 68: 12,573 lb TSS
- Beach 67 to 68: 127.2 lb TP



Yahara River Park Biobasin
- Performance TBD
- Cost TBD

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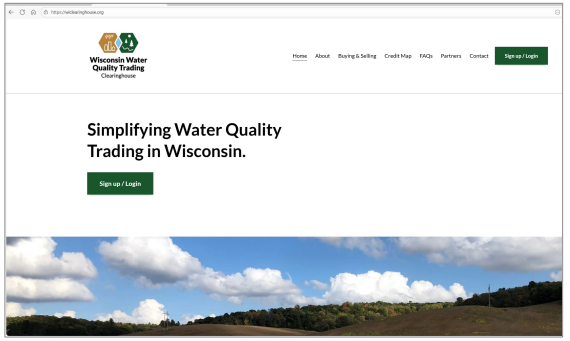
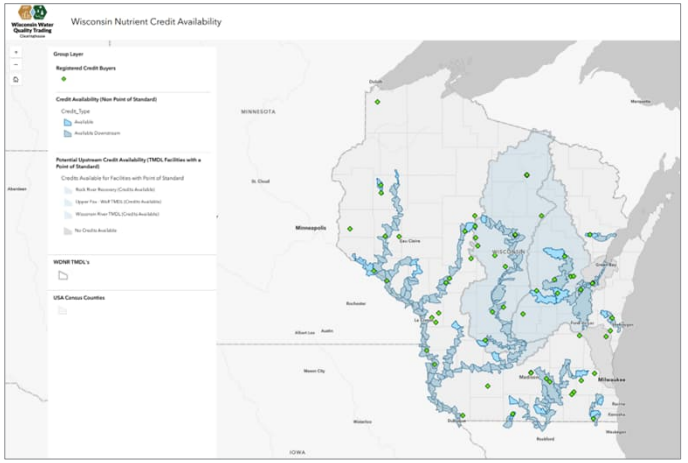
Water Quality Trading

- Agricultural lands
  - Approximately $160/lb TP
  - Water Quality Trading Clearinghouse
- Other MS4s
  - Town of Dunn, Town of Pleasant Springs, Town of Rutland (Non-MS4), Town of Dunkirk
- WWTFs
  - City of Stoughton
- Private point dischargers

Agricultural filter strip



Water Quality Trading Clearinghouse website



Water Quality Trading Clearinghouse – Credit availability

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Watershed Adaptive Management

- **Program Administrator:** Madison Metropolitan Sewerage District (MMSD)
- **Broker for Ag BMPs with farmers:** Dane County
- **Water Quality Monitoring:** USGS
- **Goal:** Point and nonpoint sources work collaboratively in protecting and restoring local water resources
- Members must achieve 40% TSS and 27% TP reductions before buy-in
- City is a member
- To close TSS and TP TMDL reduction gaps, City buy-in to Yahara WINs at approximately $48.03/lb TP

Yahara WINS

Original Buy-in	Buy-in After 2018 Modeling Update	Buy-in After 2025 Modeling Update
$11,000	$8,076	$0.00
Difference	$2,924	$8,076

Alternatives Analysis (Table 5.04-1)

Condition or BMP	Description	Figure Number	Basin Treated	Treated Area (ac)	Property Acquisition or Easement Needed?	Wetland Delineation Needed?	Soil Contamination On-Site Per WDNR RR Sites Map?	2025 BMP Cost	BMP Cost (20-Year NPW)	20-Year NPW Cost-Effectiveness ($/lb TSS Removed)	20-Year NPW Cost-Effectiveness ($/lb TP Removed)		Alternative No. 1 TSS (lb/yr)	Alternative No. 2 TSS (lb/yr)		Alternative No. 1 TP (lb/yr)	Alternative No. 2 TP (lb/yr)
Reach 66																	
No BMPs								$0	$0	$0	$0						
TP Leaf Collection Credit–2025								$0	$0	$0	$0						0.3
Reach 67																	
Redevelopment Areas–40%. Assume 20 years of redevelopment. Distributed 80% to Reach 67 and 20% to Reach 68								$0	$0	$0	$0			2,949			6.5
Pick 'n Save Dry to Wet Pond Retrofit	Privately Owned–Dry to Wet Retrofit	N-1	67-15	6	Easement	No	No	$408,138	$444,495	$167.48	$111,124			133			0.2
Bjoin Park Bioretention Basin	New BMP	N-3	67-28	14.7	No	Yes–Wetland indicator soils	No	$485,078	$490,564	$5.64	$2,011			4,351			12.2
Commerce Road Bioretention Basin	New BMP	N-15	67-32	9.5	Easement	No	No	$402,660	$411,601	$4.07	$2,541			5,057			8.1
Industrial Circle Wet Pond	New BMP	N-16	67-30	21.1	Easement	No	No	$686,305	$741,919	$4.45	$3,747			8,338			9.9
TP Leaf Collection Credit–2025								$0	$0	$0	$0						71.7
Internal WQT (Reach 67 to 68)								$0	$0	$0	$0		-12,573			-127.2	
Reach 68																	
Redevelopment Areas–40%. Assume 20 years of redevelopment. Distributed 80% to Reach 67 and 20% to Reach 68								$0	$0	$0	$0			737			1.6
Stoughton Trailers Dry to Wet Pond Retrofit (57%)	Privately Owned - Dry to Wet Retrofit	N-9	68-17	37.4	Easement	Yes–Wetland indicator soils	No	$420,895	$476,286	-$16.09	-$3,354						
Riverfront Redevelopment HDS		F-6	68-04	10	N/A	Maybe	Yes	$443,968	$458,486	$9.47	$5,458			2,422			4.2
TP Leaf Collection Credit–2025								$0	$0	$0	$0						10.3
Internal WQT (Reach 67 to 68)								$0	$0	$0	$0		12,573			127.2	
Reach 69																	
No BMPs								$0	$0	$0	$0						
												Total (lb/yr)	**0**	**23,986**		**0**	**125**
											Reach						
											66		0	0		0	0.3
											67	**Total TSS Removed (lb/yr)**	-12,573	20,827	**Total TP Removed (lb/yr)**	-127	109
											68		12,573	3,159		127	16
											69		0	0		0	0
										Total 2025 Cost			**$ -**	**$2,426,148**		**$ -**	**$2,426,148**
										Total 20-Year NPW Cost			**$ -**	**$2,547,065**		**$ -**	**$2,547,065**
										20-Year NPW Cost Per Pound Captured			**$ -**	**$5.31**		**$ -**	**$1,019**

HDS=hydrodynamic separator

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Alternatives Analysis Summary

Alternative #	Total 20-year NPW	$/lb TP Removed (20-year NPW)
1 – Internal Water Quality Trading	$0	$0
2 – 5 BMPs (discretionary future projects)	$2.5 million	$1,019

Key Takeaways

- MS4/TMDL Compliance Need Not Break the Bank
- Commitment to a Water Quality Program and Grants Assists in Doing So
- Municipal Phosphorus Reduction Credit for Leaf Management Programs Analysis Brings A Low Cost Credit for Work You Are Already Doing
- Internal Water Quality Trading Can Get You Over the Compliance Hump
- Evaluation and Maintenance of Existing Stormwater BMPs Is Next Wave of Compliance
- Modified Philip Dunne (MPD) Infiltrometer Testing Has Advantages over Double-Ring Infiltrometer Testing for Grass-Lined Swales and Infiltration BMPs
- Hydrodynamic Separator Retrofits Can Be Key Component of Water Quality Improvement for Local Waterbodies

Questions and Answers

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