

City of Manitowoc Stormwater Quality Plan
TABLE 1 - Existing BMPs and Street Sweeping Removal Efficiencies

Discharge Location (or BMP) Name	Direct TSS Load ¹ (tons/yr)	Stand Alone BMP Removal Efficiency ²	Max Downstream TSS Efficiency	Stand Alone Street Sweeping Removal Efficiency	Net BMP Removal Efficiency After Street Sweeping	TSS Load Trapped by BMP after Street Sweeping (tons/yr)
1.0 - Pond 1 Royal Oaks Sub	0.1	77.9%	77.9%	9.0%	68.9%	0.05
2.0 - Pond 2 Royal Oaks Sub	0.0	0.0%	0.0%	9.0%	0.0%	0.00
3.0 - Northside Storage	0.6	56.5%	56.5%	9.0%	47.5%	0.28
4.0 - Maritime Pnt Sub	0.1	74.6%	74.6%	9.0%	65.6%	0.09
5.0 - West Unit - Holy Family	0.0	34.0%	34.0%	9.0%	25.0%	0.01
6.0 - East Unit - Holy Family	0.1	33.0%	33.0%	9.0%	24.0%	0.03
7.0 - MPU	0.7	30.7%	30.7%	9.0%	21.7%	0.14
8.0 - Shopko	3.2	70.2%	70.2%	9.0%	61.2%	1.96
9.0 - Dewey St. Pond	3.3	37.3%	37.3%	9.0%	28.3%	0.92
10.0 - Walmart	13.6	0.2%	37.3%	9.0%	28.3%	3.85
11.0 - Red Arrow	2.6	58.3%	58.3%	9.0%	49.3%	1.28
12.0 - Manitowoc Tool and Mach	0.4	41.4%	41.4%	9.0%	32.4%	0.12
13.0 - Harbor Town South	14.4	42.7%	42.7%	9.0%	33.7%	4.83
14.0 - Harbor Town East	0.6	69.2%	69.2%	9.0%	60.2%	0.36
15.0 - Popp Subd #2	2.0	74.3%	74.3%	9.0%	65.2%	1.32
16.0 - Riversbend	0.5	31.9%	31.9%	9.0%	22.9%	0.12
17.0 - Jagemann Pond	2.4	89.5%	89.5%	9.0%	80.5%	1.93
18.0 - I-TEC Phase II	4.1	80.5%	80.5%	9.0%	71.4%	2.95
19.0 - I-TEC Phase III	0.0	73.3%	73.3%	9.0%	64.3%	0.00
20.0 - Pond Filled In	1.1	0.0%	0.0%	9.0%	0.0%	0.00
21.0 - Pond Filled In	0.3	0.0%	0.0%	9.0%	0.0%	0.00
22.0 - Sm East Custer Village	0.1	26.0%	26.0%	9.0%	17.0%	0.02
24.0 - Silveridge Sub Ponds	1.0	76.7%	76.7%	9.0%	67.7%	0.64
25.0 - Extrutech	1.1	44.8%	44.8%	9.0%	35.8%	0.40
26.0 - Harmony Center	0.3	25.0%	25.0%	9.0%	16.0%	0.04
27.0 - Lg West Custer Village	0.1	46.9%	46.9%	9.0%	37.9%	0.04
28.0 - Area 1 Maritime Prop	0.1	31.5%	31.5%	9.0%	22.5%	0.03
29.0 - Area 2 Maritime Prop	0.1	33.5%	33.5%	9.0%	24.5%	0.02
30.0 - Oaks/North Valley Subd	0.5	59.1%	59.1%	9.0%	50.1%	0.25
31.0 - YMCA	0.2	58.3%	58.3%	9.0%	49.3%	0.11
32.0 - Baileigh Industrial	0.0	0.0%	0.0%	9.0%	0.0%	0.00
33.0 - Heimeral Chiro/Smile	0.4	77.1%	77.1%	9.0%	68.1%	0.26
34.0 - West Manitowoc Cranes	0.0	0.0%	0.0%	9.0%	0.0%	0.00
35.0 - East Manitowoc Cranes	0.0	0.0%	0.0%	9.0%	0.0%	0.00

Total TSS Load Captured by Existing Street Sweeping (tons/yr):	83.6
Total TSS Load Captured by Existing BMPs after Street Sweeping (tons/yr):	22.1
Percentage of TSS Removed by Existing BMPs from Regulated City Load:	11.4%

1. TSS generated in the watershed that drains directly to the BMP. Does not include any TSS that first drains to an upstream BMP.
2. TSS attenuation rate of BMP.

City of Manitowoc Stormwater Quality Plan
TABLE 2- All High Efficiency Alternatives Ranked by TSS Removed per \$1000

BMP	Location	Drainage Area (Acres)	Direct Watershed TSS Load Received (tons/yr)	Stand Alone BMP Removal Efficiency ¹	Stand Alone Street Sweeping Removal Efficiency ²	Net BMP Removal Efficiency After Street Sweeping ³	TSS Load Trapped by BMP After Street Sweeping (tons/yr)	40% TSS Removal Area Overall Reduction	Pond Cost	Land Purchase	Total Cost	Amount TSS Removed per \$1000 (lbs/\$1000)	BMP Alternative Ranking
137.0	Within Red Arrow Park Along Lake	1566.2	102.8	52.6%	21.4%	31.2%	32.1	3.5%	\$210,113	\$0	\$210,113	305.4	#1
149.0	Vacant Manitowoc Lot Clay Pit Road	134.5	12.0	50.1%	21.4%	28.7%	3.4	0.4%	\$48,312	\$0	\$48,312	142.3	#2
132.0	NE Corner of N. 11th St. and Waldo Blvd. Intersection	418.2	36.6	77.6%	21.4%	56.2%	20.5	2.2%	\$181,538	\$115,500	\$297,038	138.4	#3
148.0	Vacant Manitowoc Lot Clipper Drive	51.7	11.1	65.3%	21.4%	43.9%	4.9	0.5%	\$79,422	\$0	\$79,422	123.2	#4
9.0 Pond Retrofit	Dewey Street Existing Pond (Retrofit)	744.4	31.3	32.1%	21.4%	10.7%	3.4	0.4%	\$71,366	\$0	\$71,366	94.0	#5
136.0	Schaus Bros. Prop East of S. 30th Street	175.2	22.7	62.1%	21.4%	40.7%	9.2	1.0%	\$164,720	\$136,500	\$301,220	61.4	#6
118.0	SE Corner of E. Magnolia Ave. and Johnston Drive Intersection	171.5	17.5	78.6%	21.4%	57.2%	10.0	1.1%	\$155,235	\$189,000	\$344,235	58.1	#7
131.0	Rheume Park East of Fleetwood Drive	35.7	3.9	82.6%	21.4%	61.2%	2.4	0.3%	\$90,536	\$0	\$90,536	53.1	#8
127.0	Vacant Manitowoc Lot SW of Hubbard Circle	171.4	5.4	50.5%	21.4%	29.1%	1.6	0.2%	\$63,374	\$0	\$63,374	49.4	#9
125.0	Aschenbrenner and Schuette Prop along Lake SE of Memorial Dr.	770.6	19.1	76.0%	21.4%	54.6%	10.4	1.1%	\$221,215	\$204,015	\$425,230	49.1	#10
103.0	Roncalli High School West of Miro Drive	192.4	7.0	81.4%	21.4%	60.0%	4.2	0.5%	\$102,115	\$73,500	\$175,615	47.5	#11
134.0	Bradley Operating Prop. South of Custer Street	127.5	14.9	85.2%	21.4%	63.8%	9.5	1.0%	\$155,798	\$262,604	\$418,402	45.5	#12
150.0	Krish Prop at 1816 Nagle Ave.	63.9	3.9	65.9%	21.4%	44.5%	1.7	0.2%	\$52,633	\$25,725	\$78,358	44.5	#13
147.0	SW Corner of Huron Street and Maritime Drive Intersection	86.1	7.3	95.5%	21.4%	74.1%	5.4	0.6%	\$248,024	\$0	\$248,024	43.9	#14
152.0	EJ Spirtas Manitowoc Prop (Currently Developed)	159.1	18.5	85.6%	21.4%	64.2%	11.9	1.3%	\$356,637	\$189,000	\$545,637	43.5	#15
111.1	Menard, Inc Vacant Lot	85.7	16.6	93.7%	21.4%	72.3%	12.0	1.3%	\$158,375	\$421,785	\$580,160	41.4	#16
115.0	Catholic Diocese of Green Bay Area East of S. 14th St.	73.0	5.6	84.2%	21.4%	62.8%	3.5	0.4%	\$107,256	\$78,750	\$186,006	38.1	#17
116.0	NE of E. Reed Ave. and Manitowoc River Intersection	239.9	9.7	62.4%	21.4%	41.0%	4.0	0.4%	\$122,842	\$138,390	\$261,232	30.4	#18
128.0	Lincolnshire Pk South of Magnolia Ave.	23.1	1.9	93.5%	21.4%	72.1%	1.3	0.1%	\$89,199	\$0	\$89,199	29.9	#19
112.0	Warehouse Terminal Inc. Vacant Lot B/W S. 26th and S 23rd St.	13.6	2.9	93.3%	21.4%	71.9%	2.1	0.2%	\$99,554	\$47,985	\$147,539	28.4	#20
133.0	SW Corner of Rahr Cir. And Waldo Blvd. Intersection	61.0	4.8	94.9%	21.4%	73.5%	3.5	0.4%	\$164,201	\$105,000	\$269,201	26.1	#21
126.0	Calvary Assembly Prop SW of Kellner Street	65.3	5.6	60.9%	21.4%	39.5%	2.2	0.2%	\$81,888	\$89,250	\$171,138	26.1	#22
145.0	NW Corner of S. 23rd Street and Viebahn St. Intersection	87.1	4.7	79.0%	21.4%	57.6%	2.7	0.3%	\$139,798	\$81,795	\$221,593	24.6	#23
146.0	Catholic Diocese of Green Bay Prop East of S. 14th St.	109.9	3.8	75.5%	21.4%	54.1%	2.1	0.2%	\$86,178	\$84,000	\$170,178	24.3	#24
122.0	NW Corner of Remiker Lane and N. Rapids Road	36.8	3.1	79.2%	21.4%	57.8%	1.8	0.2%	\$70,511	\$83,370	\$153,881	23.5	#25
124.0	Within Fleetwood Park South of Fleetwood Drive	20.3	1.1	87.0%	21.4%	65.6%	0.7	0.1%	\$62,672	\$0	\$62,672	23.4	#26
143.0	Malby Prop East of S. 26th Street	38.0	4.4	69.4%	21.4%	48.0%	2.1	0.2%	\$74,899	\$117,180	\$192,079	22.0	#27
105.0	Manitowoc Lutheran High School South of Wildwood Drive	20.7	2.3	94.1%	21.4%	72.7%	1.7	0.2%	\$102,201	\$57,750	\$159,951	20.9	#28
129.0	Manitowoc Acquisitions East of N. 30th St.	58.6	7.5	90.6%	21.4%	69.2%	5.2	0.6%	\$143,012	\$359,730	\$502,742	20.7	#29
107.0	Vacant Manitowoc Lot North of Waldo Blvd.	459.4	3.5	47.5%	21.4%	26.1%	0.9	0.1%	\$87,220	\$0	\$87,220	20.7	#30
102.0	South of Last Court Cul-de-sac	17.8	1.3	89.6%	21.4%	68.2%	0.9	0.1%	\$77,710	\$28,770	\$106,480	17.2	#31
153.0	Eck Prop. NW Corner of S. 21st St and Clay Pit Road Intersection	20.5	1.7	63.3%	21.4%	41.9%	0.7	0.1%	\$53,774	\$36,750	\$90,524	15.4	#32
110.0	SW Corner of Wis Central LTD Prop West of N. 10th St.	8.9	1.8	55.7%	21.4%	34.3%	0.6	0.1%	\$69,436	\$13,020	\$82,456	15.0	#33
109.0	Eck Prop. Between Manitowoc River and Wis. Central R.R.	20.3	1.0	79.8%	21.4%	58.4%	0.6	0.1%	\$61,646	\$31,500	\$93,146	12.1	#34
101.1	Vacant Manitowoc Lot East of Herman Road	26.1	1.5	97.9%	21.4%	76.5%	1.1	0.1%	\$171,609	\$89,250	\$260,859	8.6	#35
123.0	Oak Park Developers Lot East of N. Rapids Road	38.8	0.3	51.8%	21.4%	30.4%	0.1	0.0%	\$57,115	\$14,490	\$71,605	2.6	#36
MSA Alternatives (#1 - #36):								19.5%	\$4,282,134	\$3,074,609	\$7,356,743		

1. Stand Alone BMP Removal Efficiency is equal to the Direct Watershed TSS Load Received/TSS Load Trapped.
2. Stand Alone Street Sweeping Removal is the percent removal achieved by using a Vacuum Sweeper with Parking Controls Enforced
3. Net BMP Removal Efficiency After Street Sweeping is equal to the Stand Alone BMP Efficiency minus the Stand Alone SS Efficiency

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TABLE 3 - Recommended (High Efficiency) Alternatives Ranked by TSS Removed per \$1000

BMP	Drainage Area (Acres)	Direct Watershed TSS Load Received (lbs/yr)	Direct Watershed TSS Load Received (tons/yr)	TSS Load Trapped (lbs/yr)	TSS Load Trapped (tons/yr)	Stand Alone BMP Removal Efficiency ¹	Stand Alone Street Sweeping Removal Efficiency ²	TSS Load Trapped by Street Sweeping (tons/yr)	Net BMP Removal Efficiency After Street Sweeping ³	TSS Load Trapped by BMP after Street Sweeping (tons/yr)	Total TSS Load Trapped by Street Sweeping and BMP (tons/yr)	40% TSS Removal Area Overall Reduction	Pond Cost	Land Purchase	Total Cost	Amount TSS Removed per \$1000 (lbs/\$1000)	BMP Alternative Ranking	
137.0	1566.2	205666	102.8	108180	54.1	52.6%	21.4%	22.0	31.2%	32.1	54.1	3.5%	\$210,113	\$0	\$210,113	305.4	#1	
149.0	134.5	23955	12.0	12001	6.0	50.1%	21.4%	2.6	28.7%	3.4	6.0	0.4%	\$48,312	\$0	\$48,312	142.3	#2	
132.0	418.2	73124	36.6	56744	28.4	77.6%	21.4%	7.8	56.2%	20.5	28.4	2.2%	\$181,538	\$115,500	\$297,038	138.4	#3	
148.0	51.7	22283	11.1	14551	7.3	65.3%	21.4%	2.4	43.9%	4.9	7.3	0.5%	\$79,422	\$0	\$79,422	123.2	#4	
9.0 Pond Retrofit	744.4	62541	31.3	20090	10.0	32.1%	21.4%	6.7	10.7%	3.4	10.0	0.4%	\$71,366	\$0	\$71,366	94.0	#5	
136.0	175.2	45469	22.7	28220	14.1	62.1%	21.4%	4.9	40.7%	9.2	14.1	1.0%	\$164,720	\$136,500	\$301,220	61.4	#6	
118.0	171.5	34986	17.5	27499	13.7	78.6%	21.4%	3.7	57.2%	10.0	13.7	1.1%	\$155,235	\$189,000	\$344,235	58.1	#7	
131.0	35.7	7859	3.9	6493	3.2	82.6%	21.4%	0.8	61.2%	2.4	3.2	0.3%	\$90,536	\$0	\$90,536	53.1	#8	
127.0	171.4	10767	5.4	5437	2.7	50.5%	21.4%	1.2	29.1%	1.6	2.7	0.2%	\$63,374	\$0	\$63,374	49.4	#9	
125.0	770.6	38215	19.1	29043	14.5	76.0%	21.4%	4.1	54.6%	10.4	14.5	1.1%	\$221,215	\$204,015	\$425,230	49.1	#10	
103.0	192.4	13905	7.0	11319	5.7	81.4%	21.4%	1.5	60.0%	4.2	5.7	0.5%	\$102,115	\$73,500	\$175,615	47.5	#11	
134.0	127.5	29858	14.9	25439	12.7	85.2%	21.4%	3.2	63.8%	9.5	12.7	1.0%	\$155,798	\$262,604	\$418,402	45.5	#12	
150.0	63.9	7838	3.9	5165	2.6	65.9%	21.4%	0.8	44.5%	1.7	2.6	0.2%	\$52,633	\$25,725	\$78,358	44.5	#13	
147.0	86.1	14687	7.3	14026	7.0	95.5%	21.4%	1.6	74.1%	5.4	7.0	0.6%	\$248,024	\$0	\$248,024	43.9	#14	
152.0	159.1	36996	18.5	31669	15.8	85.6%	21.4%	4.0	64.2%	11.9	15.8	1.3%	\$356,637	\$189,000	\$545,637	43.5	#15	
111.1	85.7	33213	16.6	31121	15.6	93.7%	21.4%	3.6	72.3%	12.0	15.6	1.3%	\$158,375	\$421,785	\$580,160	41.4	#16	
115.0	73.0	11287	5.6	9504	4.8	84.2%	21.4%	1.2	62.8%	3.5	4.8	0.4%	\$107,256	\$78,750	\$186,006	38.1	#17	
116.0	239.9	19360	9.7	12081	6.0	62.4%	21.4%	2.1	41.0%	4.0	6.0	0.4%	\$122,842	\$138,390	\$261,232	30.4	#18	
128.0	23.1	3700	1.9	3459	1.7	93.5%	21.4%	0.4	72.1%	1.3	1.7	0.1%	\$89,199	\$0	\$89,199	29.9	#19	
112.0	13.6	5835	2.9	5446	2.7	93.3%	21.4%	0.6	71.9%	2.1	2.7	0.2%	\$99,554	\$47,985	\$147,539	28.4	#20	
133.0	61.0	9544	4.8	9061	4.5	94.9%	21.4%	1.0	73.5%	3.5	4.5	0.4%	\$164,201	\$105,000	\$269,201	26.1	#21	
MSA Alternatives #1 - #21 Totals:														\$2,942,465	\$1,987,754	\$4,930,219		
Existing BMP Totals⁴:																		
Vacuum SS with Parking Controls Totals⁵:																		
MSA Alternatives #1 - #20 + Existing BMP's + Vacuum SS with Parking Controls:															40.1%			

1. Stand Alone BMP Removal Efficiency is equal to the Direct Watershed TSS Load Received/TSS Load Trapped.

2. Stand Alone Street Sweeping Removal is the percent removal achieved by using a Vacuum SS, with Parking Controls

3. Net BMP Removal Efficiency After Street Sweeping is equal to the Stand Alone BMP Efficiency minus the Stand Alone SS Efficiency

4. Value Represents Structural BMP Efficiency when Vacuum Sweeping is Applied within Drainage Area

5. Vacuum Street Sweeping with Parking Controls is applied to the entire Regulated City Area

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TABLE 4- Low Efficiency Alternatives (Not Recommended)

BMP	Location	Drainage Area (Acres)	Direct Watershed TSS Load Received (tons/yr)	TSS Load Trapped (tons/yr)	Stand Alone BMP Removal Efficiency ¹	Stand Alone Street Sweeping Removal Efficiency ²	Net BMP Removal Efficiency After Street Sweeping ³	TSS Load Trapped by BMP after Street Sweeping (tons/yr)	40% TSS Removal Area Overall Reduction	Low Efficiency Alternative Reasoning
104.0	Two vacant lots East of Mirro Drive	57.0	3.4	1.2	36.6%	21.4%	15.2%	0.5	0.1%	Downstream BMP 125.0 has a Stand Alone Removal Efficiency of 76.0%
113.0	SW Corner of Canadian National RR and S. 14th St. Intersection	76.4	7.8	2.1	27.0%	21.4%	5.6%	0.4	0.0%	Downstream BMP 137.0 has a Stand Alone Removal Efficiency of 52.6%
114.0	James Monroe Public School Area West of S. 14th St.	23.0	2.4	1.5	63.0%	21.4%	41.6%	1.0	0.1%	Downstream BMP 146.0 has a Stand Alone Removal Efficiency of 75.5%
120.0	Roncalli High School Vacant Lot North of E. Albert Drive	467.2	10.1	6.9	67.6%	21.4%	46.2%	4.7	0.5%	Downstream BMP 125.0 has a Stand Alone Removal Efficiency of 76.0%
121.0	Hanmann Prop B/W E. Albert Drive and Canadian National RR	38.8	31.3	10.0	59.2%	21.4%	37.8%	11.8	1.3%	Downstream BMP 125.0 has a Stand Alone Removal Efficiency of 76.0%
130.0	Redeemer Lutheran Church Prop. NE of Menasha Ave.	100.9	9.3	6.0	64.4%	21.4%	43.0%	4.0	0.4%	Downstream BMP 132.0 has a Stand Alone Removal Efficiency of 77.6%
135.0	Vacant Manitowoc Lot SE of Custer Street	33.5	7.6	3.9	52.0%	21.4%	30.6%	2.3	0.3%	Downstream BMP 148.0 has a Stand Alone Removal Efficiency of 65.3%
138.0	NE Corner of S. 16th St. and Grand Ave. Intersection	318.4	37.2	14.8	39.9%	21.4%	18.5%	6.9	0.7%	Downstream BMP 137.0 has a Stand Alone Removal Efficiency of 52.6%
140.0	NE Corner of S. 23rd St. and Dewey St. Intersection	70.8	7.7	3.7	47.3%	21.4%	25.9%	2.0	0.2%	Downstream BMP 137.0 has a Stand Alone Removal Efficiency of 52.6%
141.0	NW Corner of Dewey St and S. 26th St. Intersection	194.9	24.0	11.2	46.6%	21.4%	25.2%	6.0	0.7%	Downstream BMP 137.0 has a Stand Alone Removal Efficiency of 52.6%
142.0	SW Corner of Dewey St and S. 35th St.	114.5	8.6	4.1	47.4%	21.4%	26.0%	2.2	0.2%	Downstream BMP 137.0 has a Stand Alone Removal Efficiency of 52.6%
144.0	Three Vacant City Lots West of S. 14th Street	47.9	2.9	2.0	69.7%	21.4%	48.3%	1.4	0.1%	Downstream BMP 115.0 has a Stand Alone Removal Efficiency of 84.2%
MSA Low Efficiency Alternatives Total TSS Reduction:									4.7%	

1. Stand Alone BMP Removal Efficiency is equal to the Direct Watershed TSS Load Received/TSS Load Trapped.
2. Stand Alone Street Sweeping Removal is the percent removal achieved by using a Vacuum Sweeper with Parking Controls Enforced
3. Net BMP Removal Efficiency After Street Sweeping is equal to the Stand Alone BMP Efficiency minus the Stand Alone SS Efficiency