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TO : File

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SUBJECT : Phosphorus Effluent Limit Review: Minnesota River Basin

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Executive Summary

This memorandum will explain why additional phosphorus reductions are needed within the Minnesota River Basin from some WWTFs. Over 75% of the WWTFs in the Basin can meet limits outlined in this memorandum if they maintain their current discharge during the critical summer season (i.e. June to September). Since 2000, WWTFs within the Minnesota River Basin have made significant reductions in phosphorus being discharged to the Minnesota River. These reductions were a result of partnership, hard work, and a common goal to protect and improve our state's water resources. Thank you for being a big part of these efforts. However, despite this progress more needs to be done.

The Minnesota River has high levels of algae on average. Algae are an important part of the food web of rivers, but too much is not good. When algal levels are high, only the toughest species of fish and aquatic insects can survive. And, the smelly and murky water makes canoeing and swimming on the river unpleasant.

High levels of the nutrient phosphorus are needed to produce large algal blooms. In 2015, the Minnesota Pollution Control Agency (MPCA) adopted rules which included standards (targets) for total phosphorus (TP) and algae in rivers. Now, when TP levels and algal levels are too high, the MPCA is required by law to develop a plan to reduce levels of TP, which will reduce algal levels to desirable levels. The entire length of the Minnesota River from near Granite Falls to the Mississippi River has too much phosphorus and algae (Executive summary figure 1). All the watersheds in the Minnesota River Basin contribute to high phosphorus and algae levels in the Minnesota River except for the three farthest upstream watersheds that contribute the problem of high phosphorus and algae in Lac Que Parle Lake. As of today's date, five watershed reviews have been completed for local river eutrophication issues. Only one facility in these watersheds have needed more restrictive mass limits than those presented in this memorandum for the Minnesota River. Marshall and ADM Corn Processing – Marshall will also have concentration limits to protect the Redwood River. Their mass limits will be the same as listed in this memorandum.

For a healthier Minnesota River, phosphorus reductions need to be made by both point and non-point sources. Phosphorus contributions from both sources vary depending on weather and river conditions. During periods of high precipitation, non-point sources such as erosion and agriculture contribute most of the phosphorus going into the Minnesota River. During periods of lower precipitation, when the Minnesota River is at low flow, point sources such as WWTFs contribute most of the phosphorus going into the Minnesota River.

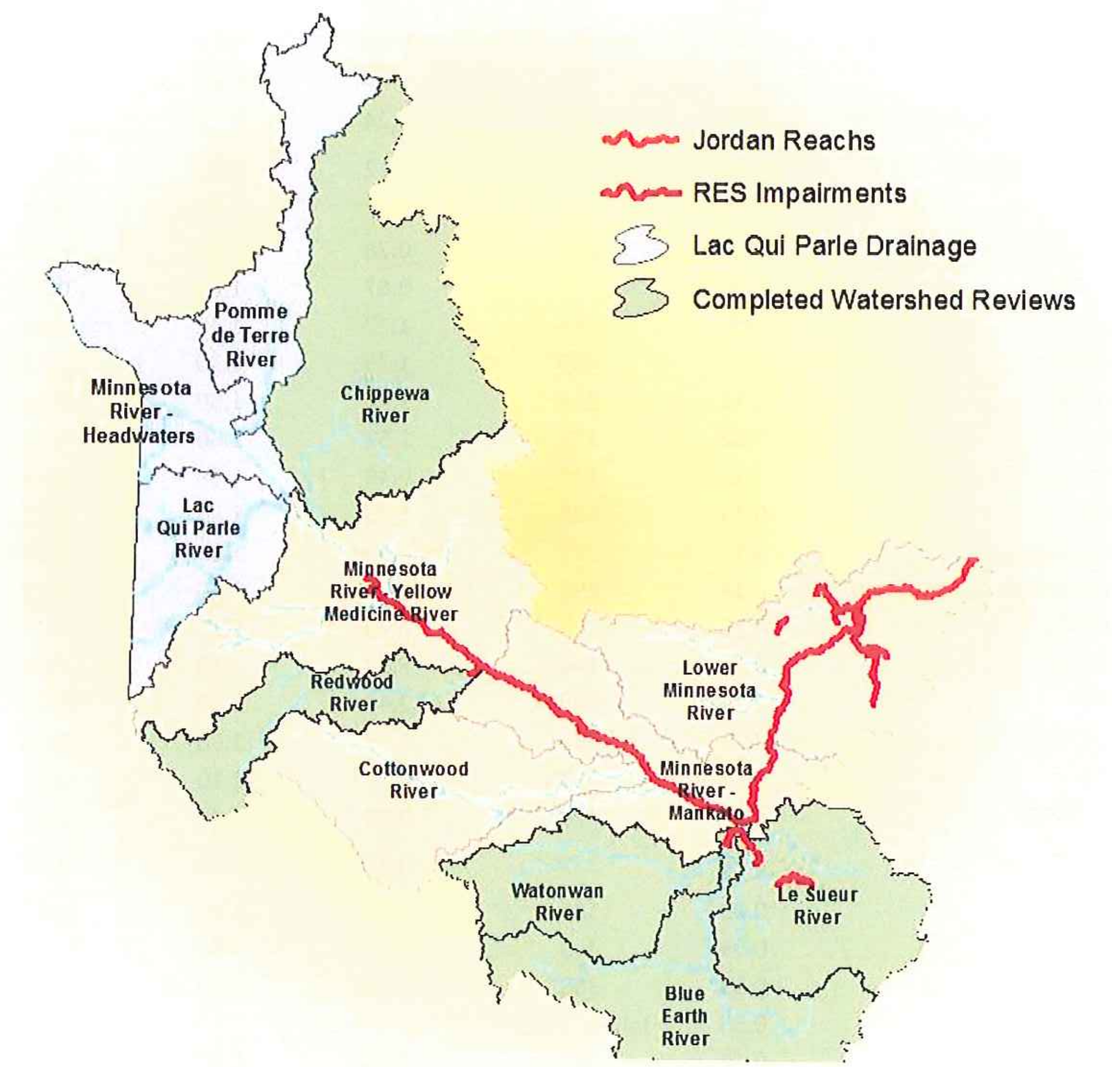
There are many sources of TP to the Minnesota River. The MPCA used a complex computer program (i.e., computer model) to determine how to meet the TP target for the Minnesota River. This model included reductions of TP from non-point sources such as stormwater from cities, runoff from fields, and streambank erosion. The model also included the numerous wastewater treatment facilities (WWTFs) throughout the large drainage area of the Minnesota River Basin. The model did not include the three watersheds upstream of Lac que Parle Lake. Limits for the WWTFs based on the model results are one of several management actions in the Minnesota River Basin needed to achieve a cleaner Minnesota River.

The MPCA worked with the U.S. Environmental Protection Agency for over two years on developing its procedures for implementing effluent limits to meet the phosphorus standards for rivers. In June of 2016, the Minnesota Court of Appeals affirmed a process for setting limits that was the same as the process used for the limits outlined in this memorandum[1].

There are several important details for the new river eutrophication based TP limits (Executive summary table 1). First, the limits only apply from June through September. Second, the limits are mass based which allow the facility to discharge at a higher concentration if their flows are well below design flow. As an individual facility grows, they will have to reduce the concentration of their effluent limit to meet the mass limit. Third, the new limits will have a monthly limit and a long-term goal. The limit is the highest monthly mass the facility can discharge during a summer month. The limit is twice the long-term goal and allows for the inherent variability in

[1] MCEA vs. MCES and MPCA https://mn.gov/law-library-stat/archive/ctapun/2016/opa151622-061316.pdf

WWTF effluent. The long-term goal will be included in the permit text. Complying with the limit each month should result in the facility achieving the long-term goal as an average of all summer months over a 5-yr permit cycle. Each facility will need to look at the variability in their TP concentration and effluent flow during summer to assess if their facility can meet the proposed TP mass limits for river eutrophication standards. The MPCA has developed flow and concentration charts for each WWTF to help the operator identify what concentration they need to achieve at a given flow rate to comply with the monthly and long-term mass goals.



Executive summary figure 1. Rivers in Minnesota River Basin that exceed river eutrophication standards for both phosphorus and algae. Green watersheds have completed river eutrophication reviews for local rivers.

Executive summary table 1. Total phosphorus limits for continuously discharging WWTFs in the Minnesota River Basin.

Facility	AWWDF (mgd)	Lake Pepin Limit (kg/yr)	Lake Pepin daily load (kg/day)	RES monthly mass limit (kg/day)	RES mass long-term goal (kg/d)
Delhi WWTP	0.01	70	0.19	0.20	0.10
Delft Sanitary District WWTP	0.01	28	0.08	0.10	0.04
Saint George District Sewer System	0.01	32	0.09	0.10	0.04
La Salle WWTP	0.02	73	0.20	0.20	0.10
Knollwood Mobile Home Park WWTP	0.02	86	0.24	0.20	0.12
Chippewa Valley Ethanol Co	0.031	43	0.12	0.20	0.12
Prinsburg WWTP	0.05	264	0.72	0.80	0.36
Vernon Center WWTP	0.06	284	0.78	0.80	0.39
Comfrey WWTP	0.08	245	0.67	1.00	0.50
Waldorf WWTP	0.1	464	1.27	1.30	0.64
Lafayette WWTP	0.1	459	1.26	1.30	0.63
Wabasso WWTP	0.11	544	1.49	1.60	0.75
Franklin WWTP	0.12	556	1.52	1.60	0.76
POET Biorefining - Lake Crystal	0.13	179	0.49	1.00	0.49
Morton WWTP	0.13	638	1.75	1.80	0.88
Granite Falls Energy LLC	0.13	182	0.50	1.00	0.50
Dairy Farmers of America – Winthrop*	0.14	193	0.53	1.10	0.53
Kerkhoven WWTP	0.15	725	1.99	2.10	0.99
Maynard WWTP	0.15	740	2.03	2.10	1.01
Trimont WWTP	0.19	899	2.46	2.60	1.23
Walnut Grove WWTP	0.2	280	0.77	1.00	0.48
St Clair WWTP	0.21	293	0.80	1.10	0.51
Sacred Heart WWTP	0.24	327	0.90	1.20	0.57
Welcome WWTP	0.26	359	0.98	1.30	0.62
Amboy WWTP	0.29	396	1.09	1.40	0.68
Cologne WWTP	0.33	449	1.23	1.60	0.77
Starbuck WWTP	0.35	388	1.06	1.80	0.83
Carver WWTP	0.36	Joined MCES			
Morgan WWTP	0.36	496	1.36	1.80	0.86
Clara City WWTP	0.46	636	1.74	2.30	1.10
Lake Crystal WWTP	0.59	815	2.23	3.00	1.41
New Richland WWTP	0.6	829	2.27	3.00	1.43
Springfield WWTP	0.78	1,078	2.95	3.90	1.86
Truman WWTP	0.78	1,078	2.95	3.90	1.86
Granite Falls WWTP	0.8	1,105	3.03	4.00	1.91
Arlington WWTP	0.81	926	2.54	4.00	1.92
Le Center WWTP	0.82	1,138	3.12	4.10	1.96

Facility	AWWDF (mgd)	Lake Pepin Limit (kg/yr)	Lake Pepin daily load (kg/day)	RES monthly mass limit (kg/day)	RES mass long-term goal (kg/d)
Belle Plaine WWTP	0.84	1,160	3.18	4.20	2.00
Renville WWTP	0.85	1,178	3.23	4.30	2.03
Norwood Young America WWTP	0.91	1,254	3.44	4.50	2.17
Montgomery WWTP	0.97	1,337	3.66	4.80	2.31
Blue Earth WWTP	0.98	1,354	3.71	4.90	2.34
Olivia WWTP	0.98	1,354	3.71	4.90	2.34
Benson WWTP	0.99	1,361	3.73	4.90	2.35
Jordan WWTP	1.29	1,425	3.90	3.80	1.81
Madelia WWTP	1.31	1,448	3.97	3.90	1.84
Redwood Falls WWTP	1.32	1,460	4.00	3.90	1.85
Winnebago WWTP	1.7	1,879	5.15	5.00	2.39
New Prague WWTP	1.83	1,523	7.57	5.40	2.57
MRVPUC WWTP	1.84	2,036	5.58	5.40	2.59
Southern MN Beet Sugar	2.26	1,135		13.47	6.42
Rahr Malting Co	2.41	3,329	9.12	10.20	4.83
MA Gedney Co	2.5	292	0.80	19.9**	9.5
ADM Corn Processing - Marshall	2.64	3,647	9.99	11.10	5.30
Saint James WWTP	2.96	3,271	8.96	8.70	4.16
Montevideo WWTP	3	3,316	9.08	8.80	4.21
Waseca WWTP	3.5	3,868	10.60	10.30	4.91
Fairmont WWTP	3.9	4,310	11.81	11.50	5.48
Saint Peter WWTP	4	4,421	12.11	11.80	5.62
Marshall WWTP	4.5	4,973	13.63	13.30	6.32
New Ulm WWTP	6.77	7,482	20.50	20.00	9.51
Willmar WWTP	7.5	8,289	22.71	22.10	10.53
Mankato WWTP	11.25	12,434	34.07	33.20	15.80

*Allocation for process water, has 1.0 mgd non-contact cooling water outfall

**Actual summer limit for MA Gedney is 19.9 kg/day as a monthly average due to the periodic nature of the discharge. This is equivalent to 2.5 mgd at 1.0 mg/L with the "2.1" monthly limit multiplier. This facility is a seasonal discharger that does not discharge in July and September.

Details of column headings

Lake Pepin limit: Annual mass limit for Lake Pepin. Since 2010, these limits have been included reissued NPDES permits.

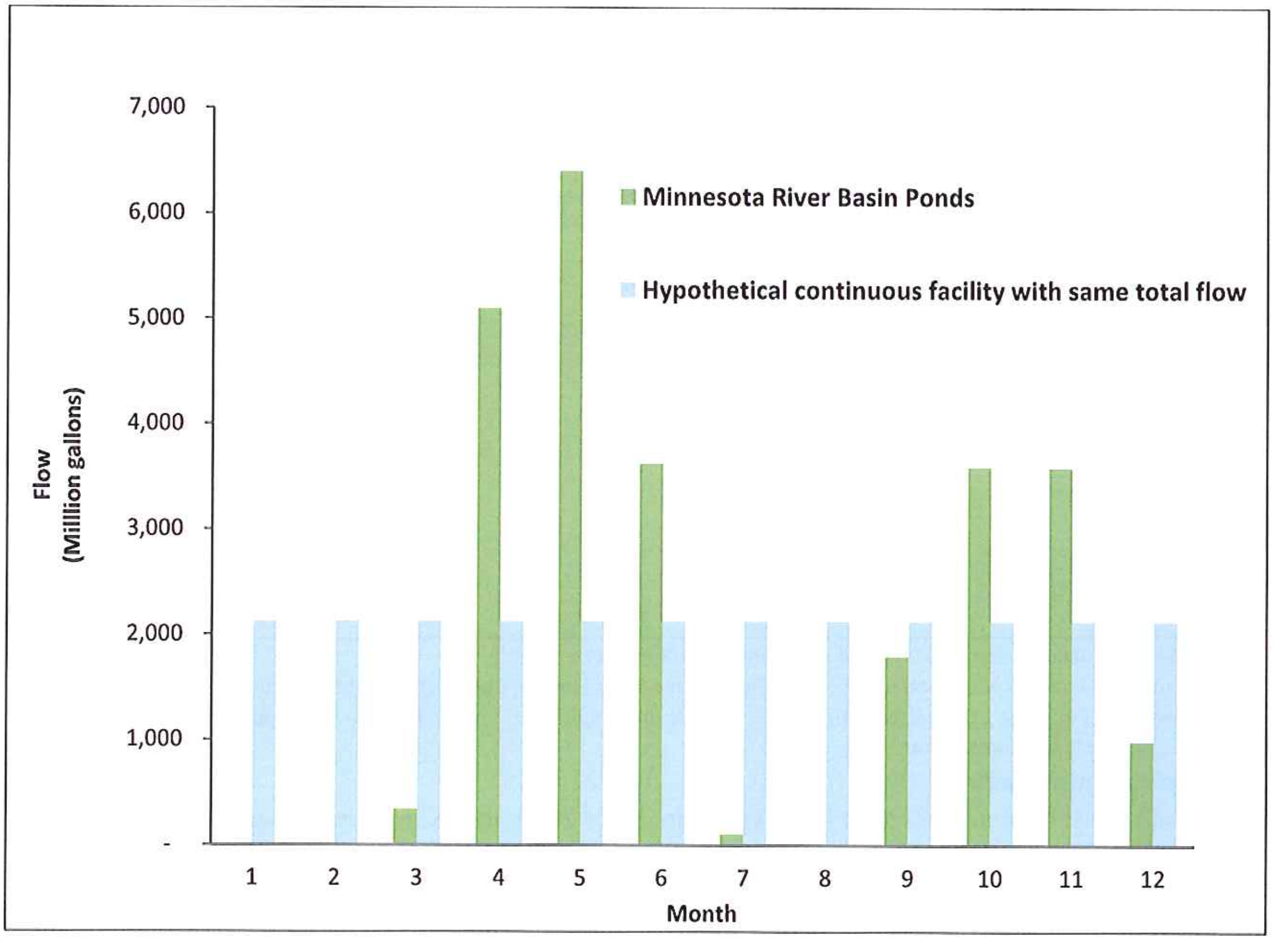
Lake Pepin daily load: This is simply the annual mass divided by 365 days. It is not a limit in permit

RES monthly mass limit: This is the highest monthly mass a facility can discharge during summer. This allows for effluent variability due to fluctuations in flow and concentration at the facility.

RES mass long-term goal: This is the long-term summer average mass that the facility can discharge in kilograms per day. This number will be included in the permit text.

Stabilization Ponds and river eutrophication standards

Stabilization ponds in the Minnesota River can only discharge during a small portion of the June through September summer season for river eutrophication standards. They are allowed to discharge during the first 15 days of June and the last 15 days of September. In general, the pond facilities discharge more often in June when river flows are high and algal grow conditions are not favorable (Executive summary figure 2). In September, the pond facilities discharge less when river flows tend to be lower and algal grow conditions are more favorable. All of the ponds in the Minnesota Basin as a group have less impact on summer river conditions than a hypothetical continuous discharge discharging at the same total overall flow and concentration. The pond facilities in the Minnesota River Basin were issued annual Lake Pepin based limits. June through September limits for pond facilities will be assessed in the local watershed memorandums.



Executive summary figure 2. Total actual flow from all stabilization ponds in Minnesota River Basin by month from 2004 to 2014.

Introduction

The Minnesota River from the outlet of Lac qui Parle Reservoir to the Minnesota River at Fort Snelling has multiple reaches that exceed river eutrophication standards (RES) (Executive summary figure 1, Appendix A). The previous memo for the Minnesota River Basin found that the Lake Pepin WQBELs for facilities in the Minnesota River Basin are sufficient to meet RES in the mainstem of the Minnesota River (Wasley, 2013). Since the time of the original memo, implementation procedures for RES have been completed (Wasley, draft). The remainder of this memorandum will summarize HSPF model outputs and actual monitoring data for three major mainstem watersheds in the Minnesota River Basin (Tetra Tech, 2009). The WWTF loads in the HSPF model serve as a wasteload allocation (WLA) and are translated into to "permitted" mass loads, which are based on a percentage of facility design flow and a concentration multiplier. Categorical water-quality based effluent limits (WQBELs) established in this memorandum are based on the mainstem of the Minnesota River. Resources are not available at this time to run additional HSPF models. Local rivers and lakes may require more restrictive limits for some WWTFs in the Minnesota River Basin. Local resources will be examined in local watershed reviews.

This memorandum will establish monthly total phosphorus (TP) mass limits for continuously discharging municipal facilities and industrial facilities with effluent concentrations greater than 1.0 mg/L. Stabilization ponds and facilities discharging below 1 mg/L were included in the original HSPF model. Both of these facility types need to maintain existing loads to meet RES in the Minnesota River. Lake Pepin WQBELs for stabilization ponds in the Minnesota River Basin are sufficient to meet RES in the mainstem of the Minnesota River. The capacity of stabilization of ponds to avoid the June through September discharge window will be encouraged via updated permit language encouraging this practice. It is particularly important to minimize discharges in September when river flows are typically lower.

The mainstem of the Minnesota River in the Lower Minnesota River Watershed requires the most restrictive effluent limits of the three-mainstem watersheds exceeding RES based on HSPF model outputs. Limits derived for facilities upstream of Shakopee, Minnesota will be applied throughout the basin except for the three upper most watersheds: Lac qui Parle River Watershed, Minnesota River – Headwaters Watershed, and Pomme de Terre River Watershed. Modeling in the Minnesota River low dissolved oxygen TMDL established Lac qui Parle Dam as an upstream boundary for contributions to the lower river. Limits for WWTFs discharging downstream of Shakopee will be based on Lake Pepin.

Outline of 5 step implementation procedures for RES in the Minnesota River Basin

Step 1 – Water quality data review

A review of monitoring data indicates that a several reaches of the Minnesota River are RES in all three major watersheds downstream of Lac Que Parle Lake (Executive summary figure 1, Appendix A). Both the cause variable (i.e. TP) and response variable (i.e. chlorophyll-a) are well above the applicable standards for the south river nutrient region (TP = 0.150 mg/L and Chl-a = 35µg/L).

Step 2 – Reasonable potential analysis

The example reasonable potential analysis in the RES implementation procedures is difficult to apply to a large River like the Minnesota River given the multitude of compliance points for RES that already exceed the standard and very large number of WWTFs. Thus, the Minnesota Pollution Control Agency (MPCA) chose to use a conservative approach like that for Lake Pepin. Basically, all the facilities discharging at a concentration greater than 0.150 mg/L to the Minnesota River Basin downstream of the Lac qui Parle Dam contribute to the RES exceedances on the River.

Step 3 – Calculate wasteload allocation

The wasteload allocation is based off HSPF Scenarios 4 and 5 which both meet the 0.150 TP RES at the critical 80 % exceeds flow at both Jordan and St. Peter on the Minnesota River Mainstem. The flow-weighted WLA concentration is 0.64 mg/L for continuously discharging facilities.

Step 4 – Convert WLA to effluent limits

The sensitivity analysis for the Minnesota-River Yellow Medicine Watershed revealed that there would be little change (0.002 mg/L) from applying monthly mass limits compared to monthly concentration limits. The formulas for monthly mass limits are the following:

*Municipal facilities: WQBEL (kg/day) = WLA (mg/L) * **70% of AWWDF** * 2.1 * 3.785*
*Industrial facilities: WQBEL (kg/day) = WLA (mg/L) * **100% of MDF** * 2.1 * 3.785*

Step 5 – Verify final limits

The limits for RES in the Minnesota River Basin will be monthly mass limits (kg/day) that apply from June through September. These limits are generally more restrictive than the 5-month total mass limits for the lower Minnesota River low dissolved oxygen TMDL. The WWTFs in the Minnesota River Basin are also located upstream of Lake Pepin. The WQBELs for Lake Pepin are annual limits (kg/yr) assessed as a 12-month moving total. Both the RES and Lake Pepin limits can be converted to a kg/day load to compare which limit is more restrictive (Executive summary table 1) The reader must remember that a monthly mass limit requires the WWTF to average roughly half the actual limit as a long-term average to insure compliance with the limit. With this in mind, the RES based limits for the Minnesota River are more restrictive from June through September than the annual Lake Pepin limits.

Minnesota River mainstem watershed overview

Lower Minnesota River Watershed: Minnesota River at Jordan

The Minnesota River at Jordan (river mile 39.4) has historically been the main modeling station for the lower Minnesota River upstream of the dredged channel near the confluence with the Mississippi River. There is a USGS gaging station at Jordan along with a long-term monitoring site sponsored by Metropolitan Environmental Services (MCES). These stations have been critical stations for calibrating the Minnesota River HSPF model (Tetra Tech. 2009). Wasley (2013) extensively examined the applicability of the Minnesota River HSPF model to setting effluent limits. This memorandum will review a portion of previous memorandum applicable to RES as of this date and offer some additional analysis.

Baseline TP conditions at Jordan clearly exceed the 0.150 mg/L RES for the Minnesota River (Table 1, Figure 1). Conditions in the river have improved at low flow in recent years, but this station is still above the RES as a long-term summer average (Figure 2). The HSPF model scenarios were developed to meet endpoints for the Minnesota River Turbidity TMDL. This TMDL requires BMPS beyond those included in Scenario 4 of the HSPF model. Reducing turbidity will be extremely important to reducing high flow TP concentrations in the Minnesota River. Comparing HSPF model runs 4 and 5 illustrates the large contribution of non-point sources since continuous point sources are set at actual flows and 1 mg/L in each scenario. Scenario 4a illustrates that complete removal of point sources will not achieve RES as a long-term summer average. Both Scenario 4 and 5 both meet RESs at the 80% exceeds flow while only Scenario 5 meets the standard as a long-term average.

Table 1. HSPF modeled Long-term summer average total phosphorus for the Minnesota River at Jordan.

Scenario	Average summer TP (mg/L)	Description
Baseline	0.274	Historical conditions from 1993-2006
4	0.213	Level 4 non-point reductions with continuous point sources at 1.0 mg/L
4a	0.206	Level 4 non-point reductions with continuous point sources at 0.0 mg/L
5	0.142	Level 5 non-point reductions with continuous point sources at 1.0 mg/L

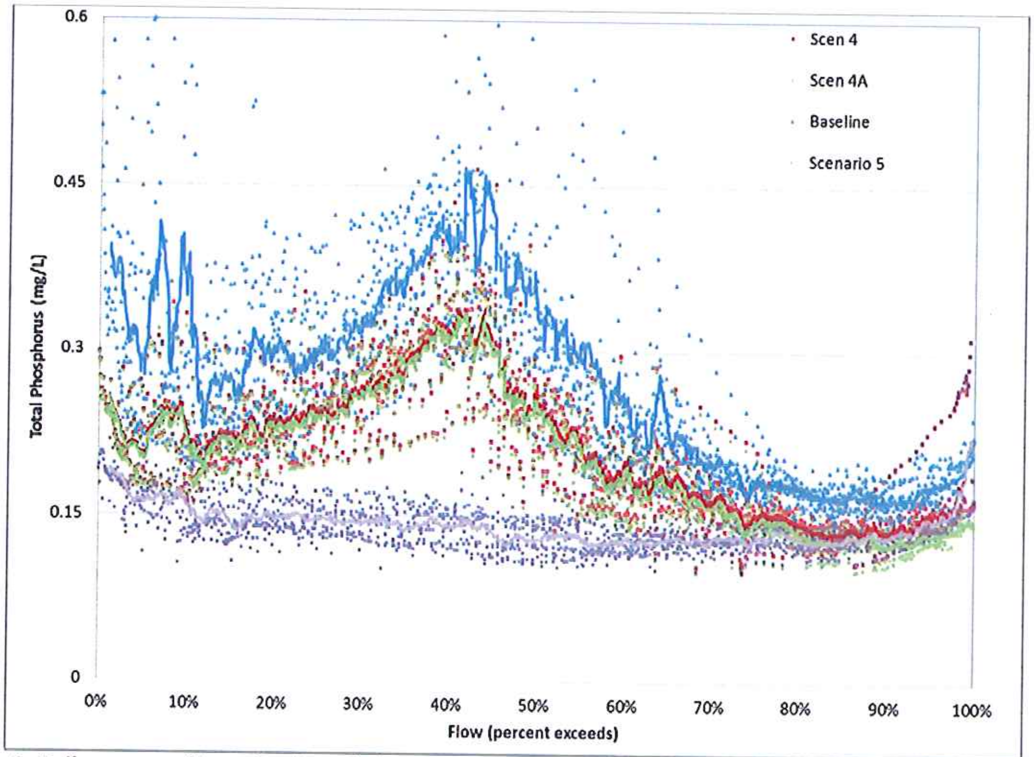


Figure 1. Daily summer (June-Sept) total phosphorus predicted by HSPF for the Minnesota River at Jordan from 1993 – 2006. Note TP data is arranged by flow (percent exceeds) for the Minnesota River based on the summer flow from 1993-2006. See Table 1 for description of scenarios. Lines represent moving average for scenarios (n=20).

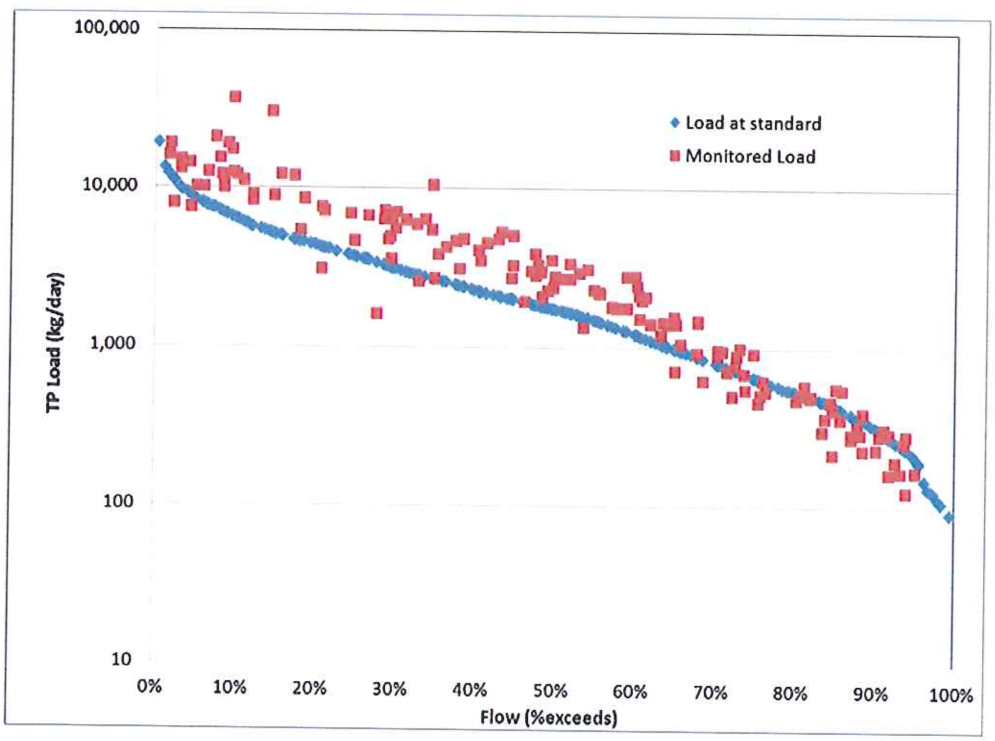


Figure 2. Daily monitored summer (June-September) total phosphorus load of the Minnesota River at Jordan (station MI-39.4) from 2002-2011. Percent exceeds flow based on 1984-2013 summer flows (Minnesota River at Jordan). Concentration at critical flow = 0.132 mg/L (n=15). Blue line represents load at RES (0.150 mg/L).

This paragraph will discuss the conversion of HSPF model runs into effluent limits. Again, HSPF scenario 4 and 5 runs were based off WWTFs at actual flows and 1.0 mg/l from 1993-2006. This was for facilities with the potential to discharge above 1 mg/L. Stabilization pond facilities and facilities with TP consistently below 1.0 were included in the original HSPF scenario 4 and 5 runs at actual flows and concentrations if monitoring data was available. The mass from continuous dischargers from the outlet of Lac qui Parle Dam to Shakopee with the potential to discharge above 1 mg/L in model scenarios 4 and 5 was approximately 138.5 kg/d (Table 2). To maintain this mass at the facilities potential to discharge 70% of AWWDF for municipal facilities and 100% of maximum design flow for industrial facilities the flow-weighted mean concentration of the facilities equated to 0.64 mg/L(Table 2). The flow-weighted concentration WLA was categorically split among continuous facilities in the basin based on design flow (Table 3). Based on the sensitivity analysis for the Minnesota River – Yellow Medicine Watershed, limits will be implemented as monthly average mass limits in kg/day. The details of the sensitivity analysis will be covered in the overview of the Minnesota River – Yellow Medicine Watershed.

Table 2. Flow and concentration inputs for continuous WWTFs in the Minnesota River HSPF model and flow weighted concentration wasteload allocation based on percentage of permitted flows.

Scenario	Flow (mgd)	Concentration (mg/L)	Mass (kg/day)
HSPF scenarios 4 and 5	36.6*	1.0	138.5
RES permitted wasteload allocation	57.0	0.64	138.5

*Estimate of HSPF flows based on actual flows from 2001-2014

Table 3. Categorical mass and concentration wasteload allocation for select facilities in the Minnesota River Basin.

Category	Design flow (mgd)	100% MDF 70% AWWDF	Concentration WLA (mg/L)	Mass WLA (kg/d)
Large Industrial High Concentration (>817 kg/yr; >1.0 mg/L)	5.05	5.1	0.53	10.1
Large Municipals (<1,>0.202 mechanicals)	14.75	10.3	0.9	35.2
Municipal Major (<20,>1mgd)	56.67	39.7	0.53	79.6
Small Industrial High Concentration (<817 kg/yr and conc. > 1.0 mg/L)	0.86	0.9	1	3.3
Small Municipals (mechanical and <0.301 mgd)	1.50	1.0	2.5	9.9
Grand Total	**78.8**	**57.0**		**138.0**

Minnesota River – Mankato Watershed: Minnesota River at St. Peter

The Minnesota River –Mankato Watershed is the next upstream watershed of the Lower Minnesota River Watershed. Concentration at a representative site near the outlet of the watershed in St. Peter indicates that TP is above the RES as a long-term summer average. The HSPF model based limits for the Lower Minnesota River were also protective of the Minnesota River on average near the outlet of the Minnesota River – Mankato Watershed (Figure 3). Like the lower Minnesota, additional non-point reductions beyond scenario 4 BMPs will be needed to meet RES of 0.150 mg/L as a long-term average (Table 4).

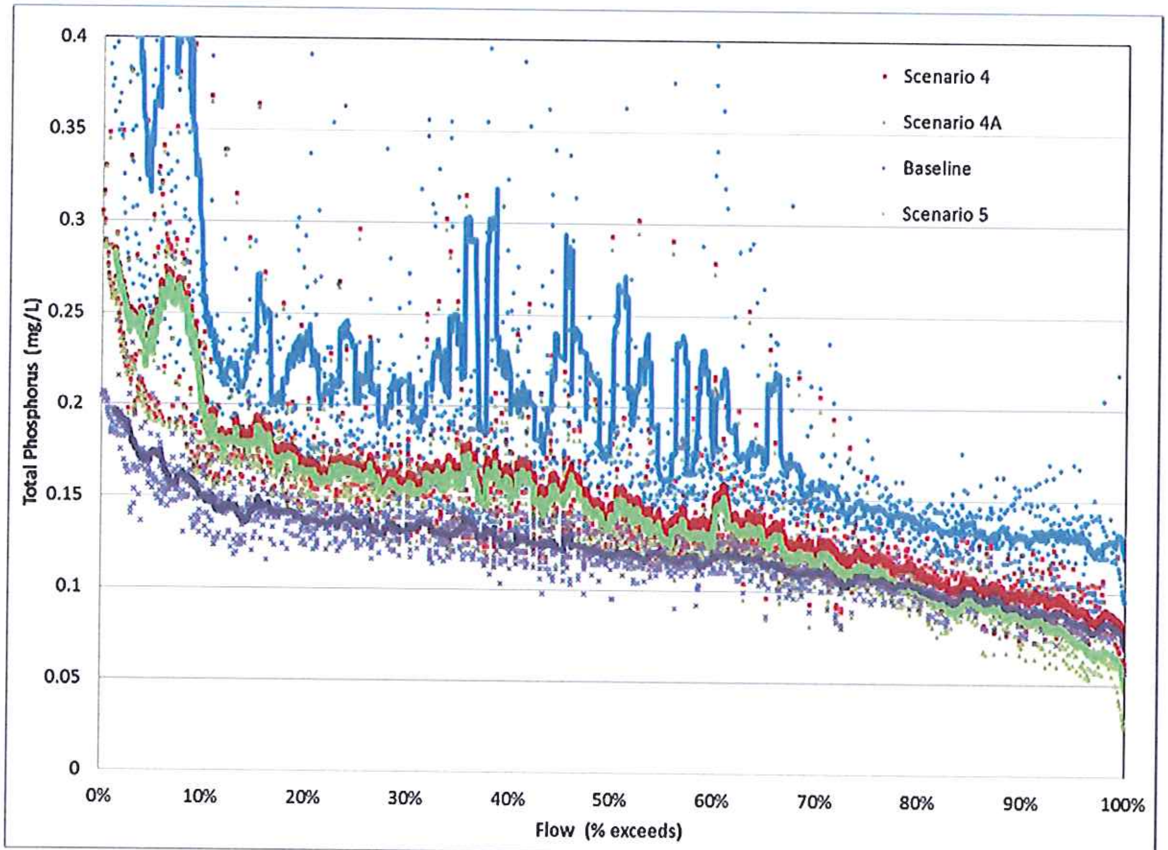


Figure 3. Daily summer (June-Sept) total phosphorus predicted by HSPF for the Minnesota River at St. Peter from 1993 – 2006 excluding 2000. Note TP data is arranged by flow (percent exceeds) for the Minnesota River based on the summer flow from 1993-2006. See Table 1 for description of scenarios. Lines represent moving average for scenarios (n=20).

Table 4. HSPF modeled Long-term summer average total phosphorus for the Minnesota River at St. Peter.

Scenario	Average summer TP (mg/L)	Description
Baseline	0.211	Historical conditions from 1993-2006
4	0.155	Level 4 non-point reductions with continuous point sources at 1.0 mg/L
4a	0.145	Level 4 non-point reductions with continuous point sources at 0.0 mg/L
5	0.126	Level 5 non-point reductions with continuous point sources at 1.0 mg/L

Minnesota River – Yellow Medicine Watershed: Minnesota River at Morton

The Minnesota River – Yellow Medicine Watershed is the next upstream watershed of the Minnesota River - Mankato Watershed. Concentration at a representative site near the outlet of the watershed in Morton indicates that TP is above the RES as a long-term summer average and at the critical 80 % exceeds flow (Figure 4). There are no readily available HSPF data for the Minnesota River at Morton. A reasonable potential equation was constructed to determine if limits based on HSPF model results for the Minnesota River at two downstream watersheds were sufficient to protect Minnesota River at Morton.

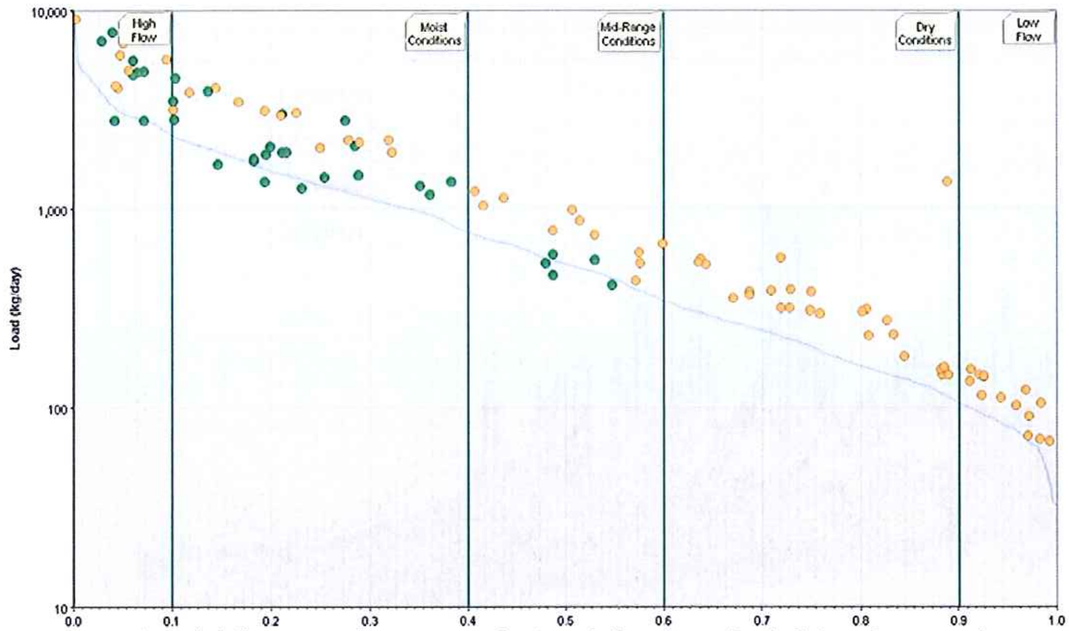


Figure 4. Monitored daily summer (June-September) total phosphorus load of the Minnesota River at Morton (station S000-145) from 2004-2013. Percent exceeds flow based on 2000-2013 summer flows (Minnesota River at Morton). Concentration at critical flow = 0.248 mg/L (n=7). Blue line represents load at RES (0.150 mg/L).

The following equation was used to calculate the reasonable potential (RP) of the continuously discharging facilities (at the WLA for the middle and lower Minnesota River) upstream of Morton to cause or contribute to a nutrient impairment in the Minnesota River (Equation 1).

Equation 1. TP concentration of Minnesota River at Morton based on permitted flow for upstream facilities.

$$Cr = \frac{QsCs + QeCe}{Qr}$$

Cr = downstream TP concentration of river at critical flow (80% exceeds flow)

Qr = downstream river flow (80% exceeds flow)

Qs = flow of river without WWTFs

Cs = concentration of river without WWTFs

Qe = design flow of WWTFs

Ce = long term effluent concentration, existing concentration limit or **concentration target of mass limit**

Qr = 292 mgd; based on permitted flow values and using Qr = Qs + Qe

Qs = 275 mgd; calculated using average daily flow from USGS gauge at the outlet of the watershed during June – September at 80% exceeds flow and subtracting upstream WWTFs' average daily flow during June – September, 2009 – 2013

Cs = 0.046 mg/L; concentration for the Minnesota River at Morton at 80% exceeds flow without WWTFs

Qe = 17.9 mgd; 70% of permitted AWWDF for municipals and 100% of MDF for industrials

Ce = 0.65 mg/L; flow-weighted concentration WLA from downstream HSPF stations

Cr = 0.083 mg/L TP

Cr_{sen} = 0.085 mg/L TP (sensitivity run)

Because the calculated Cr of 0.083 mg/L is less than the RES of 0.150 mg/L, it was determined that the limits needed for downstream reaches of the Minnesota River are protective of the Minnesota River at Morton. Given that this station is the farthest upstream station in the Minnesota River Basin exceeding RES and has 31% of continuous WWTFs by design flow, it is logical to conclude that this river reach would have the greatest potential increase in projected river concentration if summer mass limits were applied instead of concentration limits. The collective mass from the treatment plants (WLA = 44.0 kg/day) was frozen while the collective WWTF flows were reduced from 17.9 to 11.6 mgd. The maximum increase in the concentration of the river from mass only limits would result in an increase from 0.083 to 0.085 mg/L during critical low flow conditions. This slight potential shift would not result in a significant change in algal abundance in the Minnesota River at Morton. Thus, only monthly mass limits will be required during summer for RES in the Minnesota River.

Lower Minnesota River low dissolved oxygen TMDL

A low dissolved oxygen TMDL for the lower Minnesota River established individual total phosphorus allocations as kg/day for 40 WWTFs in the Minnesota River Basin (Gunderson and Klang 2004). This TMDL was designed to protect the last 22 miles of the Minnesota River from excessive BOD loading during summer from the Minnesota River upstream of Jordan, Minnesota. Historically, the BOD loading was the result of algal production in the Minnesota River driven by elevated concentration of TP. Recent reductions of TP loading from point sources in the Minnesota River Basin have been driven by a variety of permit requirements including those included in the Minnesota River Basin General Phosphorus Permit Phase I (http://www.pca.state.mn.us/index.php/view-document.html?gid=5997).

The aggregate sum of the RES based allocations assigned in this memorandum for the original 40 facilities in the low dissolved oxygen TMDL is lower than the aggregate sum of the allocations in the low dissolved oxygen TMDL (Appendix B). The low dissolved TMDL allocations were based on a universal concentration multiplier while the RES based limits were based on a categorical concentration multiplier. Thus, some of the smaller facilities actually received a higher allocation for the RES based limit even though the aggregate sum for all the facilities was approximately 60 kg/day less than the low DO TMDL. Given the that the low DO reach of the Minnesota River is downstream of all the facilities and the aggregate sum of the RES allocations is more restrictive, the RES based TP allocations will be the summer limits for all of the facilities in Executive summary table 1. Facilities will not need coverage under the Minnesota Basin Permit once they are meeting summer limits for RES.

Both the RES analysis and low DO TMDL managed smaller facilities including stabilization ponds in a similar manner. These facilities need to maintain their existing load or possibly reduce their TP load for Lake Pepin. Local watershed reviews will examine these facilities in greater detail.

Summary

This review was completed for the mainstem of the Minnesota River specifically. The primary purpose of this memorandum is to establish summer WQBELs for continuously discharging facilities in the Minnesota River Watershed for RES (Executive summary Table 1). These limits will apply from June-September as a monthly average and are based on meeting RES throughout the mainstem of the Minnesota River downstream of Lac qui Parle Dam. More restrictive TP limits may be assigned for local lakes and rivers in individual watershed reviews if mainstem limits are not sufficient for local resources.

Given the large number of WWTFs in the Minnesota River Basin downstream of Lac qui Parle Dam, a summary table was developed for all categories of TP dischargers (Table 5). Several groups of WWTFs were only briefly discussed in this memorandum. Assumptions made for these facilities will be confirmed in individual TP effluent limit reviews or watershed reviews.

Table 5. WQBELS for municipal and industrial WWTFs in the Minnesota River Basin for Lake Pepin, the Minnesota River, and the Lower Minnesota River.

Facility (AWWDF or MDF)	Components of mass limit to meet Lake Pepin WQBEL	Components of mass limit to meet downstream RES in Minnesota River*	Limit to meet low dissolved oxygen TMDL in metro Minnesota River †
Continuous > 20.0 mgd	AWWDF x 0.3 mg/L	NA, based on Mississippi. R. and Lake Pepin	NA
Continuous 1.0 – 20.0 mgd	AWWDF x 0.8 mg/L	70% AWWDF x 0.53 mg/L	Replaced by RES allocations June-Sept only
Continuous 0.2 – 1.0 mgd	AWWDF x 1.0 mg/L	70% AWWDF x 0.9 mg/L	Replaced by RES allocations June-Sept only
Continuous <0.2 mgd	AWWDF x 3.50 mg/L	70% AWWDF x 2.5 mg/L	Maintain current discharge
Stabilization ponds	AWWDF x 2.0 mg/L	AWWDF x 2.0 mg/L****	Maintain current discharge
WWTFs at conc. below RES	Maintain current discharge**	Maintain current discharge**	Maintain current discharge**
Industrial Discharge with concentration > 1.0 mg/L and MDF > 1.0 mgd	MDF x 1.0 mg/L	MDF x 0.53 mg/L	Replaced by RES allocations June-Sept only
Industrial Discharge with concentration > 1.0 mg/L and MDF < 1.0 mgd	MDF x 1.0 mg/L	MDF x 1.0 mg/L	Replaced by RES allocations June-Sept only
Industrial Discharge with concentration < 1.0 mg/L	Current load x 1.15	Current load x 1.15****	Replaced by RES allocations June-Sept only
Other Industrial	Limits specified on a site specific basis	Limits specified on a site specific basis	Replaced by RES allocations June-Sept only

***Monthly mass limits includes "2.1" variability of treatment multiplier**

**Expansion of these WWTFs may be permitted assuming effluent concentration remains below RES

*** MDF = Maximum Design Flow --> common value used to evaluate industrial discharges.

****annual limits, "2.1" multiplier not included in these limits

†Phase I limits will be replaced by RES limits since RES limits are at least as restrictive as final low DO allocations

References (may not be directly cited in memorandum)

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Appendices

Appendix A. Summer (June – September) average total phosphorus (TP) and chlorophyll-a (Chl-a) for AUIDs on the Minnesota River exceeding proposed RES. Samples collected from 2002-2011.

Watershed (AUID)	TP standard (µg/L)	Chl-a standard (µg/L)	Count Chl-a	Chl-a average (µg/l)	Count TP	TP (µg/l)
Minnesota R. – Yellow Medicine R. (07020004-509)	150	35	12	72	12	197
Minnesota R. Mankato (07020007-501)	150	35	99	69	110	243
Minnesota R. Mankato (07020007-503)	150	35	13	74	13	194
Minnesota R. Mankato (07020007-505)	150	35	73	62	83	223
Minnesota R. Mankato (07020007-514)	150	35	12	76	82	238
Lower Minnesota R. (07020012-503)	150	35	12	93	12	198
Lower Minnesota R. (07020012-505)	150	35	27	64	33	215

Appendix B. Total phosphorus mass allocations for the Minnesota River Low dissolved oxygen TMDL and allocations for river eutrophication standards.

Count	Permittee		Permit number	Low DO kg/day	RES kg/day
1	Blue Earth	WWTP	MN0020532	2.60	2.34
2	Darling International		MN0002313	0.59	*
3	Fairmont	WWTP	MN0030112	10.40	5.48
4	Trimont	WWTP	MN0022071	0.91	1.23
5	Welcome	WWTP	MN0021296	0.68	0.62
6	Winnebago	WWTP	MN0025267	4.51	2.39
7	Benson	WWTP	MN0020036	2.60	2.35
8	Montevideo	WWTP	MN0020133	7.98	4.21
9	Starbuck	WWTP	MN0021415	0.73	0.83
10	Del Monte	WWTP	MN0001171	2.92	*
11	Springfield	WWTP	MN0024953	2.10	1.86
12	Walnut Grove	WWTP	MN0021776	0.55	0.48
13	Clara City	WWTP	MN0023035	1.23	1.1
14	Willmar	WWTP	MN0025259	13.95	10.53
15	Amboy	WWTP	MN0022624	0.73	0.68
16	New Richland	WWTP	MN0021032	1.60	1.43
17	St Clair	WWTP	MN0024716	0.55	0.51
18	Waseca	WWTP	MN0020796	9.30	4.91
19	Granite Falls	WWTP	MN0021211	2.46	1.91
20	Olivia	WWTP	MN0020907	1.46	2.34
21	Redwood Falls	WWTP	MN0020401	3.51	1.85
22	Renville	WWTP	MN0020737	2.42	2.03
23	Sacred Heart	WWTP	MN0024708	0.50	0.57
24	Lake Crystal	WWTP	MN0055981	1.55	1.41
25	Mankato	WWTP	MN0030171	24.72	15.8
26	New Ulm	WWTP	MN0030066	9.90	9.51
27	St Peter	WWTP	MN0022535	7.62	5.62
28	Arlington	WWTP	MN0020834	1.78	1.92
29	Cologne	WWTP	MN0023108	0.87	0.77
30	Henderson	WWTP	MN0023621	0.96	*
31	Le Center	WWTP	MN0023931	2.23	1.96
32	Le Sueur Cheese	WWTP	MN0066494	2.10	*
33	LeSueur/MRVPUC	WWTP	MN0022152	2.37	2.59
34	Milton G Waldbaun		MN0060798	1.50	*
35	Norwood Young America	WWTP	MN0024392	1.37	2.17
36	ADM		MN0057037	18.24	5.3
37	Marshall	WWTP	MN0022179	13.22	6.32
38	Madelia	WWTP	MN0024040	3.47	1.84
39	St James	WWTP	MN0024759	7.89	4.16
40	Truman	WWTP	MN0021652	2.10	1.86
			Total	176.2	110.88
			Missing	5.0	*
			Revised total	**171.1**	**110.9**

*Facility no longer exists or facility specific allocation is needed