CORRESPONDENCE/MEMORANDUM

State of Wisconsin

DATE: February 19, 2014 FILE REF: 3200

TO: Sheri Snowbank, NOR - Spooner

FROM: Dan Peerenboom, NOR – Rhinelander *Daniel J Peerenboom, P. E., 02/19/2014*

SUBJECT: Effluent Limit Recommendations for the Village of Turtle Lake

This memo is in response to your request to review and if necessary revise the effluent limits for the wastewater treatment facility operated by the Village of Turtle Lake prior to reissuing Wisconsin Pollution Discharge Elimination System (WPDES) permit number WI-0025631. No changes to any current limits are proposed but new effluent limitations for chloride and phosphorus are recommended.

Effluent Limit Recommendations – Village of Turtle Lake

Parameter	Daily Limits	Weekly Average	Monthly Average
Ammonia, as NH3-N	Variable Limits Apply (Nov. to April, see table)		11 mg/L (May to October)
Biochemical Oxygen Demand (BOD)		30 mg/L	20 mg/L
Suspended Solids, Total (TSS)		30 mg/L	20 mg/L
pH (std. units)	6.0 - minimum 9.0 - maximum		
Dissolved Oxygen	4.0 mg/L - minimum		
Chloride (mass limit)	1,500 mg/L	400 mg/L (1,800 lbs/day)	
Phosphorus, Total			Interim Limit 2.0 mg/L WQBEL Limits 75 ug/L (six-month) 225 ug/L (monthly)

Administrative rules enacted in 2010 now require more stringent limits for phosphorus and a detailed discussion of the limit recommendations is provided later in this memo. The current alternate phosphorus limit (2.0 mg/L) can remain in effect as an Interim Limit but more stringent WQBELs will be required in the future. Phosphorus mass limits are also required for the Tainter Lake – Lake Menomin TMDL (6.7 lbs-P/day, monthly average) and a WQBEL of 0.34 lbs-P/day (six-month average) is recommended.

This facility is also subject to the effluent limits specified in NR 104.02 (3)(a) for limited aquatic life (LAL) waters - specifically the BOD, DO, pH and TSS limits as noted above. During the next permit term effluent temperature monitoring (weekly for at least one year) and two rounds of WET testing (acute and chronic) are recommended.

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The Village utilizes an activated sludge process for wastewater treatment and the facility is designed for an average daily flow rate of 0.546 MGD. The treatment works were upgraded in 2004 and the facilities include; fine screening, selector tanks for ammonia and phosphorus removal, two oxidation ditches, two final clarifiers, and aerobic sludge digestion.

Effluent is discharged to a shallow open water wetland (12 acres) that outlets to Moon Creek via an intermittent channel that meanders about 3.5 miles before reaching the creek. Moon Creek is in the Hay River portion of the Red Cedar River watershed within the Lower Chippewa River drainage basin.

The wetland and meandering channel are designated as LAL waters except for a 0.1 mile segment classified as a limited forage fish (LFF) community that is located immediately downstream of the wetlands. The low flow rate (7Q10) condition at the outfall location is assumed to be 0 cfs.

Water Quality Based Effluent Limits (WQBELs). This review considered the need for water quality based effluent limitations (WQBELs) based on the requirements of Chapters NR 102, 104, 105, 106, 207 and 217 of Wisconsin Administrative Code. A WQBEL spreadsheet (summary attached) was prepared using data submitted on discharge monitoring reports or included with the permit application. Effluent limits for toxic substances are unnecessary except for ammonia and chloride.

Ammonia. The effluent ammonia limitations currently in effect for this facility were reevaluated and no changes to these limits are proposed. The data considered for this review are described in greater detail in the summary tables attached to this report.

Phosphorus. Effluent phosphorus limits are required and an Interim Limit (2.0 mg/L – monthly average) and WQBELs (75 ug/L six-month average & 225 ug/L monthly average) are recommended. Phosphorus mass limits for the WQBEL and the Total Maximum Daily Load (TMDL) waste load allocation (WLA) are required. Descriptions of the limit evaluations and the basis for each limit recommendation are provided below.

Phosphorus – Technology Based Effluent Limit (TBEL). NR 217.04 requires a technology based effluent limit of 1.0 mg/L (monthly average) for municipal treatment facilities that discharge more than 150 pounds of phosphorus per month. The TBEL requirement applies to this discharge but an alternate phosphorus limit (APL = 2.0 mg/L) has been granted because the phosphorus control technology used by the facility is a biological removal process.

Phosphorus – Interim Limit and WQBELs. WQBELs can be required based on administrative rules enacted in December 2010 that established phosphorus water quality criteria (WQC) for discharges to all fish and aquatic life waters. An Interim Limit of 2.0 mg/L (monthly average) and WQBELs of 75 ug/L (six-month average) and 225 ug/L (monthly average) are recommended.

The recommended Interim Limit is equal to the current APL and correlates closely with the 30-day p99 value (1.99 mg/L) derived from effluent phosphorus monitoring results (779 samples) reported by the facility during the past five years. Initial imposition of the WQBELs may be delayed to allow time for process control optimization and to evaluate options for reducing effluent phosphorus levels.

Phosphorus WQBELs of 300 ug/L or less are considered stringent and are expressed in two forms - as a six-month average limit equal to the calculated limit value (75 ug/L) and as a monthly average limit set three times greater than the WQBEL value (225 ug/L).

The limit calculation formula cited in NR 217.13 is noted below. However when there is no assimilative capacity (Cs > WQC or low flow is 0 cfs) a calculation is unnecessary and the WQBEL is set equal to the WQC. Although WQC have not been established for LAL waters the potential for downstream impacts has to be considered and a WQC of 75 ug/L applies to the LFF stream channel at the wetlands outlet.

Monthly Average Limit = [(WQC)(Qs+(1-f)Qe) – (Qs-fQe)(Cs)]/Qe (Not Applicable with Qs = 0 cfs)

The WQC is 75 ug/L, Qs is the stream low flow (0 cfs), Qe (0.8 cfs) is the facility's average daily design flow (0.546 MGD) and "f" is the fraction of effluent withdrawn from the receiving water (0).

Phosphorus - Mass Limits. Mass limits for phosphorus are recommended. A WQBEL mass limit of 0.34 lbs-P/day (six-month ave.) and TMDL mass limit of 6.7 lbs-P/day (monthly ave.) are recommended.

WQBEL Mass Limit. If a WQBEL for concentration is required a mass limit is also necessary. With a stringent limit the corresponding mass limit is also expressed as a six-month average as noted below.

WQBEL Mass Limit = Qe (MGD) x WQBEL x 8.34 mass conversion factor,

WQBEL Mass Limit = 0.546 MGD x 0.075 mg/L x 8.34 lbs/gal = 0.34 lbs-P/day (six-month average)

TMDL Mass Limit. The revised phosphorus rules allow TMDL models to set WLAs for point source dischargers and include mass limits in their permits. In September 2012 EPA approved the Tainter Lake - Lake Menomin TMDL with a WLA of 1,662 lbs-P/year (4.55 lbs-P/day) specified for Turtle Lake. TMDL implementation must be consistent with applicable federal rules and 40 CFR 122.45 requires the WLA be expressed as a monthly average limit (6.7 lbs-P/day) based on the calculation below (also see EPA Tech. Support Doc. 505 2-90-001 for more details).

Monthly Mass Limit: CV Multiplier (1.47) x 4.55 lbs-P/day = 6.7 lbs-P/day (monthly average, rounded)

The CV multiplier is a conversion factor used for TMDL implementation based on a coefficient of variability (CV) derived from phosphorus monitoring data to express daily loading rates as monthly average limits. The WLA will not be expressed as an annual limit in the permit but reporting of annual and 12-month rolling averages will be required to allow monitoring of phosphorus control efforts

Although the WQBEL mass limit is more stringent the TMDL mass limit should also be included as an effluent phosphorus limitation when the permit is reissued. In addition to the recommended limits the reissued WPDES permit should also include a compliance schedule requiring facility optimization of phosphorus controls and specify that methods necessary to satisfy the effluent limits be evaluated.

Achieving "end of pipe" compliance with stringent limits may not be feasible and other alternatives such as Water Quality Trading or Watershed Adaptive Management may be viable options to consider.

Chloride. Daily maximum and weekly average effluent limitations for chloride are recommended. The chloride concentrations from four samples included with the permit application average 704 mg/L and are significantly higher than past monitoring results (ave. 280 mg/L). The results reported for each sample exceed the chronic toxicity criteria (395 mg/) their average is over 1/5 of the acute criteria (1,510 mg/L). The calculation for the recommended chloride mass limit is noted below.

Chloride Mass Limit = 0.546 MGD x 400 mg/L x 8.34 lbs/gal = 1,800 lbs-P/day (weekly average)

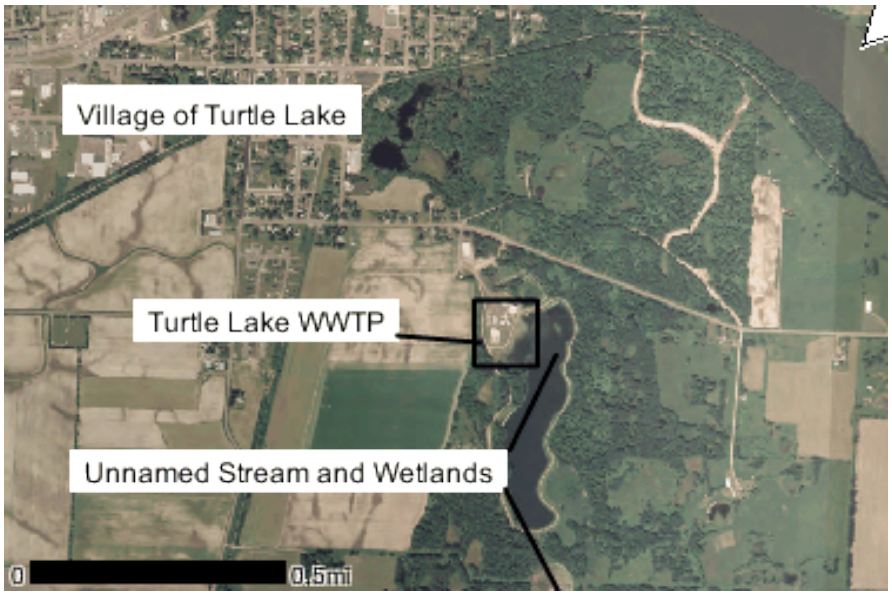
The recommended effluent chloride concentration limits are 1,500 mg/L (daily maximum) and 400 mg/L (weekly average) with a mass limit of 1,800 lbs/day (weekly average).

Disinfection. Effluent disinfection is not required at this facility because the receiving water for the discharge (LAL) is not classified for recreational use.

Thermal Limits. In October 2010 administrative rule changes to Chapters NR 102 and NR 106 set thermal WQC for all water bodies including temperatures ranging from 86 to 120 deg. F for LAL waters. Only a limited amount of thermal monitoring data is currently available for treatment facilities using an activated sludge process in the Northern Region but these data suggest limits are unnecessary. To date the maximum reported effluent temperature is 73 deg. F (1,822 results) and the maximum 1-day p99 value for any month is also 73 deg. F. Therefore limits for effluent temperature are not recommended.

Whole Effluent Toxicity (WET) Testing. A WET Screening Worksheet was prepared for this facility (see summary below) and concludes two rounds of WET testing (acute and chronic) should be done during the next permit term.

Village of Turtle Lake and Wastewater Treatment Plant



Water Quality Based Effluent Limit Review Summary – Village of Turtle Lake				
Substance	**Toxicity Criteria**	**Calculated Limit**	**Mean Effluent Concentration**	**Recommended Action**
Arsenic	HCC	40 ug/L	2.4 ug/L	No Limit
Chloride	Acute Chronic	1,510 mg/L 395 mg/L	**<u>704 mg/L ave.</u>** (four samples from permit application)	**Daily & Weekly Limits Recommended**
Copper	Acute Chronic	54 ug/L 17 ug/L	8.4 ug/L ave. 1-d p99 = 20.0 ug/L 4-d p99 = 13.4 ug/L	No Limit
Zinc	Acute Chronic	400 ug/L 200 ug/L	33 ug/L ave. 1-d p99 = 100 ug/L 4-d p99 = 61 ug/L	No Limit

Monitoring results of "not detected" were also reported for cadmium, chromium, lead and nickel.

Recent chloride results are more than double the average from prior sampling so daily and weekly limits are necessary. A chloride mass limit of 1,800 lbs/day (weekly ave.) is also recommended. An interim limit and/or target value for chloride are not proposed because prior monitoring results from this facility indicated WQBELs were not required so consideration for a variance is not appropriate.

Effluent Ammonia Limit Review Summary – Village of Turtle Lake				
Ammonia Limit	LAL	LFF (DS w/decay)		Recommended Action
Daily Maximum	13 mg/L – winter 21 mg/L - summer	N/A	Eff. Ave. = 0.4 mg/L 1-d p99 = 4.3 mg/L	Retain Variable Limit (winter only)
Weekly Average	27 mg/L – winter 165 mg/L - summer	116 mg/L – winter 390 mg/L - summer	4-d p99 = 2.3 mg/L	No Weekly Limits
Monthly Average	11 mg/L – winter 66 mg/L - summer	47 mg/L – winter 160 mg/L - summer	30-d p99 = 1.1 mg/L	Retain 11 mg/L Limit (summer only)

<u>WQBEL Recommendation: Retain Current Ammonia Limits</u>

Ammonia Limit Calculations Summary – Village of Turtle Lake				
Classification:	LAL at outfall and LFF downstream			
Effluent Flow (MGD):	0.546			
Maximum Effluent pH (1-day p99 value)	8.47 (all Eff. pH data since 2004 facility upgrade)			
Background Information:	Summer	Winter	Summer	Winter
Ammonia (mg/L, default)	0.04	0.08	0.04	0.08
Temp. (deg C, default)	25	3	25	3
Rec. Water pH (s. u. w/updated values)	7.73	7.57	7.73	7.57
7Q10/7Q2 = 7/10 cfs for DS impacts				
Criteria (mg/L):	LAL	LAL	LFF	LFF
Acute	5.23	5.23	-	-
4-day Chronic	28.74	140.50	10.22	50.75
30-day Chronic	11.50	56.20	4.39	20.02
Calculated Effluent Limitations:	Summer	Winter	Summer	Winter
	LAL	LAL	LFF	LFF
	-----	-----	(DS Impact)	(DS Impact)
Daily Maximum (1-d p99 = 4.3 mg/L)	10 mg/L	10 mg/L	w/decay	w/decay
Weekly Average (4-d p99 = 2.7 mg/L)	29 mg/L	140 mg/L	420 mg/L	100 mg/L
Monthly Average (30-d p99 = 1.1 mg/L)	12 mg/L	56 mg/L	170 mg/L	40 mg/L

Variable Limits Table for Determining
Daily Maximum Ammonia Limits based on Effluent pH

Effluent pH (std. units)	Daily Max. Limit	Effluent pH (std. units)	Daily Max. Limit	Effluent pH (std. units)	Daily Max. Limit
pH ≤ 7.7	*No Limit	8.1 < pH ≤ 8.2	18 mg/L	8.6 < pH ≤ 8.7	6.8 mg/L
7.7 < pH ≤ 7.8	37 mg/L	8.2 < pH ≤ 8.3	15 mg/L	8.7 < pH ≤ 8.8	5.7 mg/L
7.8 < pH ≤ 7.9	31 mg/L	8.3 < pH ≤ 8.4	12 mg/L	8.8 < pH ≤ 8.9	4.8 mg/L
7.9 < pH ≤ 8.0	26 mg/L	8.4 < pH ≤ 8.5	9.9 mg/L	8.9 < pH ≤ 9.0	4.1 mg/L
8.0 < pH ≤ 8.1	*21 mg/L	8.5 < pH ≤ 8.6	8.2 mg/L	-	-

Whole Effluent Toxicity (WET) Checklist Summary – Village of Turtle Lake		
Toxicity Factors	**Acute (points)**	**Chronic (points)**
1. IWC (open water wetland)	1A. Not Applicable (0)	1B. IWC = 9% (0)
2. Historical Data	2A. RPF – one passed test (0)	2B. RPF- one passed test (0)
3. Effluent Variability	3A. Variable Loading (5)	3B. same as 3A (5)
4. Stream Classification	4A. LAL (FAL w/in 5 mi.) (0)	4B. same as 4A. (0)
5. Chemical Specific Data	5A. Ammonia & chloride limits; arsenic, copper & zinc detected (9)	5B. Ammonia & chloride limits; arsenic copper & zinc detected (9)
6. Additives	6A. FeCl used for P control (1)	6B. FeCl used for P control (1)
7. Discharge Category	7A. Minor Municipal w/Ind. (5)	7B. same as 7A. (5)
8. Wastewater Treatment	8A. Secondary Treatment (0)	8B. same as 8A. (0)
9. Downstream Impacts	9A. None from discharge (0)	9B. same as 9A. (0)
Point Totals & Test Frequency	20 points – Recommendation – **Two tests during permit term**	20 points – Recommendation - **Two tests during permit term**