CORRESPONDENCE/MEMORANDUM

State of Wisconsin

DATE: September 27, 2024

TO: Holly Heldstab – WCR/Eau Claire

FROM: Benjamin Hartenbower – WCR/Eau Claire

SUBJECT: Water Quality-Based Effluent Limitations for the Greenwood Wastewater Treatment Facility
WPDES Permit No. WI-0020249

This is in response to your request for an evaluation of the need for water quality-based effluent limitations (WQBELs) using chapters NR 102, 104, 105, 106, 207, 210, 212, and 217 of the Wisconsin Administrative Code (where applicable), for the discharge from the Greenwood Wastewater Treatment Facility in Clark County. This municipal wastewater treatment facility (WWTF) discharges to the Black River, located in the Rock and Cawley Creeks Watershed in the Black River Basin. The evaluation of the permit recommendations is discussed in more detail in the attached report.

Based on our review, the following recommendations are made on a chemical-specific basis at Outfall 001:

Parameter	Daily Maximum	Daily Minimum	Weekly Average	Monthly Average	Six-Month Average	Footnotes
Flow Rate						1,2
BOD_5 May - September October - April			 15 mg/L 45 mg/L	 15 mg/L 30 mg/L		1
TSS May - September October - April			 15 mg/L 45 mg/L	 15 mg/L 30 mg/L		1
pH	9.0 s.u.	6.0 s.u.				1
Ammonia Nitrogen	14 mg/L		**14 mg/L**	**14 mg/L**		1,3
E. Coli				126 #/100 mL geometric mean		4
PFOS and PFOA						5
Phosphorus MCL WQT Computed (TP)				 1.0 mg/L 0.225 mg/L	 0.075 mg/L, 0.33 lbs/day	6
TKN, Nitrate+Nitrite, and Total Nitrogen						7
Acute WET						8
Chronic WET						8,9

Footnotes:

1. No changes from the current permit.
2. Monitoring only.
3. Additional limits to comply with the expression of limits requirements in ss. NR 106.07 and NR 205.065(7), Wis. Adm. Codes, are included in bold.
4. Bacteria limits apply during the disinfection season of May - September. Additional limit: No more than 10 percent of *E. coli* bacteria samples collected in any calendar month may exceed 410 count/100 mL.

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5. Monitoring once every two months is required in accordance with s. NR 106.98(2), Wis. Adm. Code.
6. Phosphorus WQBELS are met through WQT computed compliance limits which also require a corresponding Minimum Control Level (MCL) to be met at the discharge.
7. As recommended in the Department's October 1, 2019 Guidance for Total Nitrogen Monitoring in Wastewater Permits, annual total nitrogen monitoring is recommended for all minor municipal permittees. Total Nitrogen is the sum of nitrate (NO_3), nitrite (NO_2), and total kjeldahl nitrogen (TKN) (all expressed as N).
8. Two acute and three chronic WET tests are recommended in the reissued permit. Sampling WET concurrently with any chemical-specific toxic substances is recommended. Tests should be done in rotating quarters, to collect seasonal information about this discharge and should continue after the permit expiration date (until the permit is reissued).
9. The Instream Waste Concentration (IWC) to assess chronic test results is 32%. According to the State of Wisconsin Aquatic Life Toxicity Testing Methods Manual (s. NR 219.04, Table A, Wis. Adm. Code), chronic testing shall be performed using a dilution series of 100%, 75%, 50%, 25% & 12.5% and the dilution water used in WET tests conducted on Outfall 001 shall be a grab sample collected from the Black River.

Please consult the attached report for details regarding the above recommendations. If there are any questions or comments, please contact Benjamin Hartenbower at (715) 225-4705 or Benjamin.Hartenbower@wisconsin.gov or Diane Figiel at Diane.Figiel@wisconsin.gov.

Attachments (3) – Narrative, Thermal Table, & Map

PREPARED BY: _____ Date: 09/27/2024

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Attachment #1

Water Quality-Based Effluent Limitations for the Greenwood Wastewater Treatment Facility WPDES Permit No. WI-0020249

Prepared by: Benjamin P. Hartenbower

PART 1 – BACKGROUND INFORMATION

Facility Description:
All wastewater enters the influent wet well then gets pumped to an anoxic zone where it is mixed with RAS. Flow then goes to one of the two oxidation ditches and then to one of three final clarifiers before being pumped to the Black River. Phosphorus is being removed using both biological and the chemical addition of ferric chloride. The wastewater is seasonally disinfected by the use of ultraviolet light prior to discharge. Sludge is treated both anaerobically and aerobically and thickened with a gravity belt thickener before being land applied. Greenwood WWTP has significant flow from the City of Loyal and also from holding tanks.

Attachment #3 is a map of the area showing the approximate location of Outfall 001.

Existing Permit Limitations
The current permit, which expired on June 30, 2024, includes the following effluent limitations and monitoring requirements.

Parameter	Daily Maximum	Daily Minimum	Weekly Average	Monthly Average	Six-Month Average	Footnotes
Flow Rate						1,2
BOD_5 May - September October - April			 15 mg/L 45 mg/L	 15 mg/L 30 mg/L		1
TSS May - September October - April			 15 mg/L 45 mg/L	 15 mg/L 30 mg/L		1
pH	9.0 s.u.	6.0 s.u.				1
Ammonia Nitrogen	14 mg/L		**14 mg/L**	**14 mg/L**		3
Fecal Coliform May - September			 **780 #/100 mL geometric mean**	 400 #/100 mL geometric mean		3
Phosphorus MCL WQT Computed (TP)				 1.00 mg/L 0.225 mg/L	 0.075 mg/L, 0.33 lbs/day	
Acute WET						4

Footnotes:
1. These limitations are not being evaluated as part of this review. Because the water quality criteria (WQC), reference effluent flow rates, and receiving water characteristics have not changed, limitations for these water quality characteristics do not need to be re-evaluated at this time.
2. Monitoring only.

3. Additional limits to comply with the expression of limits requirements in ss. NR 106.07 and NR 205.065(7), Wis. Adm. Codes, are included in bold.
4. Acute WET testing required: Jan - March 2020 and July - Sept 2023.

Receiving Water Information

- Name: Black River
- Waterbody Identification Code (WBIC): 1676700
- Classification used in accordance with chs. NR 102 and 104, Wis. Adm. Code: Warm Water Sport Fish (WWSF) community, non-public water supply.
- Low flows used in accordance with chs. NR 106 and 217, Wis. Adm. Code: USGS for Station 05380915, in the Black River at Greenwood

  $7\text{-}Q_{10}$ = 6.90 cfs
  $7\text{-}Q_{2}$ = 26.0 cfs

  Harmonic Mean Flow = 60.4 cfs using a drainage area of 524.0 mi^2.
  The Harmonic Mean has been estimated based on average flow and the $7\text{-}Q_{10}$ using an equation from U.S. EPA's *Technical Support Document for Water Quality-Based Toxics Control* (March 1991, EPA/505/2-90-001, pgs. 88-89).
- Hardness = 123 mg/L as $CaCO_3$. This value represents the geometric mean of 4 samples collected in the Black River from 11/30/2004 to 01/28/2014.
- % of low flow used to calculate limits in accordance with s. NR 106.06(4)(c)5., Wis. Adm. Code: 25%
- Source of background concentration data: Chloride data is from the Black River. Metals data taken from the Black River is used in this evaluation. The numerical values are shown in the tables below. If no data is available, the background concentration is assumed to be negligible and a value of zero is used in the computations. Background data for calculating effluent limitations for ammonia nitrogen are described later.
- Multiple dischargers: There are several other dischargers to the Black River however they are not in the immediate vicinity and the mixing zones do not overlap. Therefore, the other dischargers do not impact this evaluation.
- Impaired water status: The Black River is listed as impaired for PCBs, Total Phosphorus, and Mercury, and Dissolved Oxygen.

Effluent Information:

- Design Flow Rates(s):

  Annual Average = 0.524 MGD (Million Gallons per Day)

  For reference, the actual average flow from July 2019 to August 2024 was 0.250 MGD.
- Hardness = 171 mg/L as $CaCO_3$. This value represents the geometric mean of 4 effluent samples collected from 05/03/2023 to 08/08/2023.
- Acute dilution factor used in accordance with s. NR 106.06 (3) (c), Wis. Adm. Code: Not applicable – this facility does not have an approved Zone of Initial Dilution (ZID).
- Water Source: Domestic wastewater from the Cities of Loyal and Greenwood with water supply from wells and nondomestic contributions from Greenwood Milk Products and Dairi Concepts.
- Additives: Ferric Chloride

- Effluent characterization: This facility is categorized as a minor municipality, so the permit application required effluent sample analyses for a limited number of common pollutants, as specified in s. NR 200.065, Table 1, Wis. Adm. Code, primarily metal substances plus Chloride and Hardness. The permit-required monitoring for Ammonia Nitrogen and Phosphorus from July 2019 to August 2024 is used in this evaluation.

Chemical Specific Effluent Data at Outfall 001

Sample Date	Copper µg/L	Sample Date	Chloride mg/L
04/24/2023	9.46	05/03/2023	194
05/03/2023	7.53	06/06/2023	146
05/15/2023	7.61	07/05/2023	151
06/19/2023	10	08/02/2023	163
06/27/2023	16		
08/02/2023	0.034		
08/15/2023	0.034		
08/22/2023	0.034		
09/12/2023	0.034		
10/03/2023	13		
10/17/2023	16		
1-day P_{99}	31.70	mean	164
4-day P_{99}	17.66		

- Effluent data for substances for which a single sample was analyzed is shown in the tables in Part 2 below, in the column titled “MEAN EFFL. CONC.”.

The following table presents the average concentrations and loadings at Outfall 001 from July 2019 to August 2024 for all parameters with limits in the current permit to meet the requirements of s. NR 201.03(6):

Parameter Averages with Limits

	Average Measurement	Average Mass Discharged
BOD_5	3.3 mg/L*	
TSS	4.2 mg/L	
pH	6.59 s.u.	
Ammonia Nitrogen	1.10 mg/L*	
Fecal Coliform	49#/100 mL	
Phosphorus	0.43 mg/L	0.85 lbs/day

*Results below the level of detection (LOD) were included as zeroes in calculation of average.

PART 2 – WATER QUALITY-BASED EFFLUENT LIMITATIONS FOR TOXIC SUBSTANCES – EXCEPT AMMONIA NITROGEN

Permit limits for toxic substances are required whenever any of the following occur:

1. The maximum effluent concentration exceeds the calculated limit (s. NR 106.05(3), Wis. Adm. Code)
2. If 11 or more detected results are available in the effluent, the upper 99th percentile (or P_{99}) value exceeds the comparable calculated limit (s. NR 106.05(4), Wis. Adm. Code)
3. If fewer than 11 detected results are available, the mean effluent concentration exceeds 1/5 of the calculated limit (s. NR 106.05(6), Wis. Adm. Code)

Acute Limits based on 1-Q_{10}

Daily maximum effluent limitations for toxic substances are based on the acute toxicity criteria (ATC), listed in ch. NR 105, Wis. Adm. Code. Previously daily maximum limits for toxic substances were calculated as two times the ATC. However, changes to ch. NR 106, Wis. Code, (September 1, 2016) require the Department to calculate acute limitations using the same mass balance equation as used for other limits along with the 1-Q_{10} receiving water low flow to determine if more restrictive effluent limitations are needed to protect the receiving stream from discharges which may cause or contribute to an exceedance of the acute water quality standards. The mass balance equation is provided below.

$$\text{Limitation} = \frac{(WQC)\,(Qs + (1-f)\,Qe) - (Qs - f\,Qe)\,(Cs)}{Qe}$$

Where:

WQC =Acute toxicity criterion or secondary acute value according to ch. NR 105, Wis. Adm. Code.

Qs = average minimum 1-day flow which occurs once in 10 years (1-day Q_{10}) if the 1-day Q_{10} flow data is not available = 80% of the average minimum 7-day flow which occurs once in 10 years (7-day Q_{10}).

Qe = Effluent flow (in units of volume per unit time) as specified in s. NR 106.06(4)(d), Wis. Adm. Code.

f = Fraction of the effluent flow that is withdrawn from the receiving water, and

Cs = Background concentration of the substance (in units of mass per unit volume) as specified in s. NR 106.06(4)(e), Wis. Adm. Code.

If the receiving water is effluent dominated under low stream flow conditions, the 1-Q_{10} method of limit calculation produces the most stringent daily maximum limitations and should be used while making reasonable potential determinations. This is not the case for the Greenwood Wastewater Treatment Facility and the limits are set based on two times the acute toxicity criteria.

The following tables list the calculated WQBELs for this discharge along with the results of effluent sampling. All concentrations are expressed in terms of micrograms per Liter (µg/L), except for hardness and chloride (mg/L).

Daily Maximum Limits based on Acute Toxicity Criteria (ATC)

RECEIVING WATER FLOW = 5.5 cfs, (1-Q_{10} (estimated as 80% of 7-Q_{10})), as specified in s. NR 106.06(3)(bm), Wis. Adm. Code.

SUBSTANCE	REF. HARD. mg/L	ATC	MEAN BACK-GRD.	MAX. EFFL. LIMIT**	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.	1-day P_{99}	1-day MAX. CONC.
Arsenic		340		680	136	1		
Cadmium	171	19.0	0.023	38.1	7.6	<0.19		
Chromium (+3)	171	2795	0.397	5591	1118	<1.1		
Copper	171	25.7	1.447	51.4			31.7	16.0
Lead	171	179	0.266	359	72	<4.3		
Nickel	171	738		1476	295	4.7		
Zinc	171	192	2.341	385	77		60	110
Chloride		757	10.1	1514			220	194

* * The 2 × ATC method of limit calculation yields a more restrictive limit than consideration of ambient concentrations and 1-Q_{10} flow rates per the changes to s. NR 106.07(3), Wis. Adm. Code, effective 09/01/2016.

Weekly Average Limits based on Chronic Toxicity Criteria (CTC)

RECEIVING WATER FLOW = 1.7 cfs (¼ of the 7-Q_{10}), as specified in s. NR 106.06(4)(c), Wis. Adm. Code.

SUBSTANCE	REF. HARD.* mg/L	CTC	MEAN BACK-GRD.	MAX. EFFL. LIMIT	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.	4-day P_{99}
Arsenic		152		476	95	1	
Cadmium	123	2.9	0.023	9.0	1.8	<0.19	
Chromium (+3)	123	156	0.397	487	97	<1.1	
Copper	123	12.3	1.447	35.5			17.7
Lead	123	34	0.266	106	21	<4.3	
Nickel	123	62		194	39	4.7	
Zinc	123	144	2.341	445	89	60	
Chloride		395	10.1	1214			190

Monthly Average Limits based on Wildlife Criteria (WC)

The effluent characterization did not include any effluent sampling results for substances for which Wildlife Criteria exist.

Monthly Average Limits based on Human Threshold Criteria (HTC)

RECEIVING WATER FLOW = 15 cfs (¼ of the Harmonic Mean), as specified in s. NR 106.06(4), Wis. Adm. Code.

SUBSTANCE	HTC	MEAN BACK-GRD.	MAX. EFFL. LIMIT	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.	30-day P_{99}
Cadmium	370.0	0.023	7257.3	1451.5	<0.19	
Chromium (+3)	3818000	0.397	74891905	14978381	<1.1	
Lead	140	0.266	2741	548	<4.3	
Nickel	43000		843466	168693	4.7	

Monthly Average Limits based on Human Cancer Criteria (HCC)
RECEIVING WATER FLOW = 15 cfs (¼ of the Harmonic Mean), as specified in s. NR 106.06(4), Wis. Adm. Code.

SUBSTANCE	HCC	MEAN BACK-GRD.	MAX. EFFL. LIMIT**	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.	30-day P_{99}
Arsenic	13.3		260.9	52.2	1	

In addition to evaluating the need for limits for each individual substance for which HCC exist, s. NR 106.06(8), Wis. Adm. Code, requires the evaluation of the cumulative cancer risk. Because no effluent limits are needed based on HCC, determination of the cumulative cancer risk is not needed per s. NR 106.06(8), Wis. Adm. Code.

Conclusions and Recommendations: Based on a comparison of the effluent data and calculated effluent limitations, limits are not required for toxic substances.

PFOS and PFOA
The need for PFOS and PFOA monitoring is evaluated in accordance with s. NR 106.98, Wis. Adm. Code. PFOS and PFOA were not detected in the water supply. Based on the nondomestic contributions, **PFOS and PFOA monitoring is recommended once every two months.**

Mercury – The permit application did not require monitoring for mercury because the Greenwood Wastewater Treatment Facility is categorized as a minor facility as defined in s. NR 200.02(8), Wis. Adm. Code. In accordance with s. NR 106.145(3)(a)3., Wis. Adm. Code, a minor municipal discharger shall monitor, and report results of influent and effluent mercury monitoring once every three months if, there are two or more exceedances in the last five years of the high-quality sludge mercury concentration of 17 mg/kg specified in s. NR 204.07(5). A review of the past five years of sludge characteristics data reveals that all the sample results are within expected analytical ranges and well below the 17 mg/kg level. The average concentration in the sludge from 2020 to 2022 was 1.06 mg/kg, with a maximum reported concentration of 1.30 mg/kg. Therefore, no mercury monitoring is recommended at Outfall 001.

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PART 3 – WATER QUALITY-BASED EFFLUENT LIMITATIONS FOR AMMONIA NITROGEN

The State of Wisconsin promulgated revised water quality standards for ammonia nitrogen in ch. NR 105, Wis. Adm. Code, effective March 1, 2004 which includes criteria based on both acute and chronic toxicity to aquatic life. The current permit has daily maximum, weekly average, and monthly average limits. These limits are re-evaluated at this time due to the following changes:

- Subchapter IV of ch. NR 106, Wis. Adm. Code allows limits based on available dilution instead of limits set to twice the acute criteria.
- Section NR 106.07(3), Wis. Adm. Code requires weekly and monthly average limits for municipal treatment plants.
- The maximum expected effluent pH has changed

Daily Maximum Limits based on Acute Toxicity Criteria (ATC):

Daily maximum limitations are based on acute toxicity criteria in ch. NR 105, Wis. Adm. Code, which are a function of the effluent pH and the receiving water classification. The acute toxicity criterion (ATC) for ammonia is calculated using the following equation.

$$\text{ATC in mg/L} = [A \div (1 + 10^{(7.204 - pH)})] + [B \div (1 + 10^{(pH - 7.204)})]$$

Where:

A = 0.411 and B = 58.4 for a Warm Water Sport fishery, and
pH (s.u.) = that characteristic of the <u>effluent.</u>

The effluent pH data was examined as part of this evaluation. A total of 1889 sample results were reported from July 2019 to August 2024. The maximum reported value was 7.64 s.u. (Standard pH Units). The effluent pH was 7.32 s.u. or less 99% of the time. The 1-day P_{99}, calculated in accordance with s. NR 106.05(5), Wis. Adm. Code, is 7.42 s.u. The mean plus the standard deviation multiplied by a factor of 2.33, an estimate of the upper ninety ninth percentile for a normally distributed dataset, is 7.38 s.u. Therefore, a value of 7.42 s.u. is believed to represent the maximum reasonably expected pH, and therefore most appropriate for determining daily maximum limitations for ammonia nitrogen. Substituting a value of 7.42 s.u. into the equation above yields an ATC = 22.34 mg/L.

Daily Maximum Ammonia Nitrogen Effluent Limitations Calculation Method

In accordance with s. NR 106.32(2), Wis. Adm. Code daily maximum ammonia limitations are calculated using the 1-Q_{10} receiving water low flow if it is determined that the previous method of acute ammonia limit calculation (2×ATC) is not sufficiently protective of the fish and aquatic life. The more restrictive calculated limits shall apply.

The calculated daily maximum ammonia nitrogen effluent limits using the mass balance approach with the 1-Q_{10} (estimated as 80 % of 7-Q_{10}) and the 2×ATC approach are shown below.

Attachment #1

	Ammonia Nitrogen Limit mg/L
2×ATC	44.68
1-Q_{10}	173.96

The 2×ATC method yields the most stringent limits for the Greenwood Wastewater Treatment Facility.

Presented below is a table of daily maximum limitations corresponding to various effluent pH values. Use of this table is not necessarily recommended in the permit, but it is presented herein for informational purposes.

Daily Maximum Ammonia Nitrogen Limits – WWSF

Effluent pH s.u.	Limit mg/L	Effluent pH s.u.	Limit mg/L	Effluent pH s.u.	Limit mg/L
6.0 ≤ pH ≤ 6.1	108	7.0 < pH ≤ 7.1	66	8.0 < pH ≤ 8.1	14
6.1 < pH ≤ 6.2	106	7.1 < pH ≤ 7.2	59	8.1 < pH ≤ 8.2	11
6.2 < pH ≤ 6.3	104	7.2 < pH ≤ 7.3	52	8.2 < pH ≤ 8.3	9.4
6.3 < pH ≤ 6.4	101	7.3 < pH ≤ 7.4	46	8.3 < pH ≤ 8.4	7.8
6.4 < pH ≤ 6.5	98	7.4 < pH ≤ 7.5	40	8.4 < pH ≤ 8.5	6.4
6.5 < pH ≤ 6.6	94	7.5 < pH ≤ 7.6	34	8.5 < pH ≤ 8.6	5.3
6.6 < pH ≤ 6.7	89	7.6 < pH ≤ 7.7	29	8.6 < pH ≤ 8.7	4.4
6.7 < pH ≤ 6.8	84	7.7 < pH ≤ 7.8	24	8.7 < pH ≤ 8.8	3.7
6.8 < pH ≤ 6.9	78	7.8 < pH ≤ 7.9	20	8.8 < pH ≤ 8.9	3.1
6.9 < pH ≤ 7.0	72	7.9 < pH ≤ 8.0	17	8.9 < pH ≤ 9.0	2.6

Weekly and Monthly Average Limits based on Chronic Toxicity Criteria (CTC)

The ammonia limit calculation also warrants evaluation of weekly and monthly average limits based on chronic toxicity criteria for ammonia, since those limits relate to the assimilative capacity of the receiving water.

Weekly average and monthly average limits for ammonia nitrogen are based on chronic toxicity criteria in ch. NR 105, Wis. Adm. Code.

The 30-day chronic toxicity criterion (CTC) for ammonia in waters classified as Warm Water Sport Fish Community is calculated by the following equation, according to subchapter IV of NR 106, Wis. Adm. Code.

$$CTC = E \times \{[0.0676 \div (1 + 10^{(7.688 - pH)})] + [2.912 \div (1 + 10^{(pH - 7.688)})]\} \times C$$

Where:

pH = the pH (s.u.) of the <u>receiving water</u>,
E = 0.854,
C = the minimum of 2.85 or $1.45\times 10^{(0.028 \times (25 - T))}$ – (Early Life Stages Present), or
C = $1.45\times 10^{(0.028 \times (25 - T))}$ – (Early Life Stages Absent), and
T= the temperature (ºC) of the receiving water – (Early Life Stages Present), or
T = the maximum of the actual temperature (ºC) and 7 - (Early Life Stages Absent)

The 4-day criterion is equal to the 30-day criterion multiplied by 2.5. The 4-day criteria are used in a mass-balance equation with the 7-Q_{10} (4-Q3, if available) to derive weekly average limitations. And the 30-day criteria are used with the 30-Q_5 (estimated as 85% of the 7-Q_2 if the 30-Q_5 is not available) to derive monthly average limitations. The stream flow value is further adjusted to temperature; 100% of the flow is used if the Temperature ≥ 16 ºC, 25% of the flow is used if the Temperature < 11 ºC, and 50% of the flow is used if the Temperature ≥ 11 ºC but < 16 ºC.

Section NR 106.32 (3), Wis. Adm. Code, provides a mechanism for less stringent weekly average and monthly average effluent limitations when early life stages (ELS) of critical organisms are absent from the receiving water. This applies only when the water temperature is less than 14.5 ºC, during the winter and spring months. Based on a review of the DNR Fisheries database, burbot, an early spawning species, are believed to be present in the Black River. So "ELS Absent" criteria apply from October through December, and "ELS Present" criteria will apply from January through September for a WWSF classification.

The "default" basin assumed values are used for temperature and background ammonia concentrations, because minimum ambient data is available. The values for pH are based on data collected from the Black River. These values are shown in the table below, with the resulting criteria and effluent limitations.

Weekly and Monthly Ammonia Nitrogen Limits – WWSF

		May-September	October-April
Effluent Flow	Qe (MGD)	0.524	0.524
Background Information	7-Q_{10} (cfs)	6.9	6.9
	7-Q_2 (cfs)	26	26
	Ammonia (mg/L)	0.07	0.13
	Temperature (°C)	20.6	10.0
	pH (s.u.)	7.52	7.51
	% of Flow used	100	25
	Reference Weekly Flow (cfs)	6.9	1.7
	Reference Monthly Flow (cfs)	22	5.5
Criteria mg/L	4-day Chronic		
	Early Life Stages Present	7.27	10.82
	Early Life Stages Absent	7.27	14.48
	30-day Chronic		
	Early Life Stages Present	2.91	4.33
	Early Life Stages Absent	2.91	5.79
Effluent Limitations mg/L	Weekly Average		
	Early Life Stages Present	69	34
	Early Life Stages Absent		
	Monthly Average		
	Early Life Stages Present	80	33
	Early Life Stages Absent		

Effluent Data

Attachment #1

The following table evaluates the statistics based upon ammonia data reported from July 2019 to August 2024, with those results being compared to the calculated limits to determine the need to include ammonia limits in the Greenwood Wastewater Treatment Facility permit for the respective month ranges.

Ammonia Nitrogen Effluent Data

Ammonia Nitrogen mg/L	May-September	October-April
1-day P_{99}	3.345	12.595
4-day P_{99}	2.203	6.922
30-day P_{99}	0.924	3.23
Mean*	0.292	1.735
Std	1.003	2.759
Sample size	327	420
Range	<0.13 - 9.742	0.13 - 15

*Values lower than the level of detection were substituted with a zero.

Based on this comparison, there is no reasonable potential for the discharge to exceed any of the calculated ammonia nitrogen limits.

The permit currently has daily maximum, weekly average, and monthly average limits. Where there are existing ammonia nitrogen limits in the permit, the limits must be retained regardless of reasonable potential, consistent with s. NR 106.33(1)(b), Wis. Adm. Code:

> (b) If a permittee is subject to an ammonia limitation in an existing permit, the limitation shall be included in any reissued permit. Ammonia limitations shall be included in the permit if the permitted facility will be providing treatment for ammonia discharges.

Conclusions and Recommendations

In summary, **the current limits and monitoring for ammonia nitrogen are recommended to continue.**

Final Ammonia Nitrogen Limits

Daily Maximum mg/L	Weekly Average mg/L	Monthly Average mg/L
14	14	14

FOR BACTERIA

Section NR 102.04(5), Wis. Adm. Code, states that all surface waters shall be suitable for supporting recreational use and shall meet *E. coli* criteria during the recreation season. Section NR 102.04(5)(b), Wis. Adm. Code, allows the Department to make exceptions when it determines, in accordance with s. NR 210.06(3), Wis. Adm. Code, that wastewater disinfection is not required to meet *E. coli* limits and protect the recreational use. Section NR 210.06(3), Wis. Adm. Code, tasks the Department with determining the need for disinfection using a site-specific analysis based on potential risk to human or animal health. It sets out the factors that must be considered in determining the necessity to disinfect municipal wastewater or to change the length of the disinfection season.

1. The geometric mean of *E. coli* bacteria in effluent samples collected in any calendar month may not exceed 126 counts/100 mL.
2. No more than 10 percent of *E. coli*bacteria samples collected in any calendar month may exceed 410 counts/100 mL.

E. coli monitoring is recommended at the same frequency that fecal coliform monitoring is required in the current permit. Because the Greenwood Wastewater Treatment Facility permit requires 2/week monitoring, the 410 counts/100 mL limit will effectively function as a daily maximum limit unless the facility performs additional monitoring. Any additional monitoring beyond what is required by the permit must also be reported on the DMR as required in the standard requirements section of the permit.

These limits are required during May through September. No changes are recommended to the required disinfection season.

Effluent Data
The Greenwood Wastewater Treatment Facility has monitored effluent *E. coli* from May 2023 to September 2023 and a total of 44 results are available. A geometric mean of 126 counts/100 mL was exceeded in 1 out of 5 months, with a maximum monthly geometric mean of 140 counts/100 mL. Effluent data exceeded 410 counts/100 mL one time (which is 2% of the total sample results). The maximum reported value was 700 counts/100 mL. Based on this effluent data it appears that the facility can meet new *E. coli* limits and a compliance schedule is not needed in the reissued permit.

PART 5 – PHOSPHORUS

Technology-Based Effluent Limit
Subchapter II of Chapter NR 217, Wis. Adm. Code, requires municipal wastewater treatment facilities that discharge greater than 150 pounds of Total Phosphorus per month to comply with a monthly average limit of 1.0 mg/L, or an approved alternative concentration limit.

Because the Greenwood Wastewater Treatment Facility does not currently have an existing technology-based limit, the need for this limit in the reissued permit is evaluated. The data demonstrates that the annual monthly average phosphorus loading is less than 150 lbs/month, which is the threshold for municipalities in accordance to s. NR 217.04(1)(a)1, Wis. Adm. Code, and therefore a technology-based limit is not required.

Annual Average Mass Total Phosphorus Loading

Attachment #1

Month	Monthly Avg. mg/L	Total Flow MG/month	Total Phosphorus lb./mo.
Sep 2023	0.56	4.64	21.81
Oct 2023	1.23	5.65	58.13
Nov 2023	0.48	4.73	19.09
Dec 2023	0.21	3.53	6.29
Jan 2024	0.26	2.77	6.01
Feb 2024	0.19	3.11	4.82
Mar 2024	0.61	3.71	18.79
Apr 2024	0.48	5.87	23.29
May 2024	1.30	7.73	83.87
Jun 2024	0.97	7.21	58.18
Jul 2024	0.69	8.97	51.47
Aug 2024	0.45	8.31	30.86
		Average =	**31.89**

Total P (lbs/month) = Monthly average (mg/L) × total flow (MG/month) × 8.34 (lbs/gallon)
Where total flow is the sum of the actual (not design) flow (in MGD) for that month

In addition, the need for a WQBEL for phosphorus must be considered.

Water Quality-Based Effluent Limits (WQBEL)
Revisions to administrative rules regulating phosphorus took effect on December 1, 2010. These rule revisions include additions to s. NR 102.06, Wis. Adm. Code, which establish phosphorus standards for surface waters. Subchapter III of NR 217, Wis. Adm. Code, establishes procedures for determining WQBELs for phosphorus, based on the applicable standards in ch. NR 102, Wis. Adm. Code.

Section NR 102.06(3)(a), Wis. Adm. Code, specifically names river segments for which a phosphorus criterion of 0.100 mg/L applies. For other stream segments that are not specified in s. NR 102.06(3)(a), Wis. Adm. Code, s. NR 102.06(3)(b), Wis. Adm. Code, specifies a phosphorus criterion of 0.075 mg/L. The phosphorus criterion of 0.075 mg/L applies for the Black River.

The conservation of mass equation is described in s. NR 217.13(2)(a), Wis. Adm. Code, for phosphorus WQBELs and includes variables of water quality criterion (WQC), receiving water flow rate (Qs), effluent flow rate (Qe), and upstream phosphorus concentrations (Cs) provided below.

$$\text{Limitation} = [(WQC)(Qs+(1-f)\,Qe) - (Qs-f\,Qe)\,(Cs)]/Qe$$

Where:

WQC = 0.075 mg/L for the Black River.
Qs = 100% of the 7-Q_2 of 26 cfs
Cs = background concentration of phosphorus in the receiving water pursuant to s. NR 217.13(2)(d), Wis. Adm. Code
Qe = effluent flow rate = 0.524 MGD = 0.811 cfs
f = the fraction of effluent withdrawn from the receiving water = 0

Section NR 217.13(2)(d), Wis. Adm. Code, specifies that the background phosphorus concentration used

in the limit calculation formula shall be calculated using the procedures specified in s. NR 102.07(1)(b) to (c), Wis. Adm. Code. The median shall be calculated with at least one year of data using samples collected once per month during the period of May through October. All representative data from the most recent 5 years shall be used, but data from the most recent 10 years may be used if representative of current conditions.

The following data were considered in estimating the background phosphorus concentration:

SWIMS ID	10039659	103107	103108
Station Name	Monitoring station at Black River at CTH H	Monitoring station at Black River at Hwy 00 Bridge	Monitoring station at Black River at Hwy G Bridge
Waterbody	Black River	Black River	Black River
Sample Count	6	1	1
First Sample	05/12/2015	07/19/2006	07/19/2006
Last Sample	10/13/2015	07/19/2006	07/19/2006
Mean	0.240 mg/L	0.206 mg/L	0.175 mg/L
Median	0.238 mg/L	0.206 mg/L	0.175 mg/L

Substituting a background concentration above criteria into the limit calculation equation above would result in a calculated limit that is less than the applicable criterion of 0.075 mg/L. However, s. NR 217.13(7), Wis. Adm. Code, specifies that "if the water quality-based effluent limitation calculated pursuant to the procedures in this section is less than the phosphorus criterion specified in s. NR 102.06, Wis. Adm. Code, for the water body, the effluent limit shall be set equal to the criterion."

The impaired water listing of the Black River also points towards the notion that effluent phosphorus limits equal to the water quality criterion are needed to prevent the discharge from contributing to further impairment of the receiving water. The Guidance for Implementing Wisconsin's Phosphorus Water Quality Standards for Point Source Discharges (2020) suggests setting effluent limits equal to the criterion in the absence of an EPA approved total maximum daily load for discharges of phosphorus to phosphorus impaired waters.

Effluent Data

The following table summarizes effluent total phosphorus monitoring data from July 2019 to August 2024.

Phosphorus Effluent Data

	Phosphorus mg/L
1-day P_{99}	1.96
4-day P_{99}	1.08
30-day P_{99}	0.62
Mean	0.43
Std	0.40
Sample size	748
Range	0.011 - 2.63

Reasonable Potential Determination

Since the 30-day P_{99} of reported effluent total phosphorus data is greater than the calculated WQBEL, the discharge has reasonable potential to cause or contribute to an exceedance of the water quality criterion. Therefore, a WQBEL is required.

In accordance with s. NR 217.15(2), Wis. Adm. Code, there is reasonable potential for the discharge to cause or contribute to an exceedance of the water quality criteria. The data suggest that a compliance schedule will be necessary for the facility to meet the given phosphorus limits.

Limit Expression

According to s. NR 217.14 (2), Wis. Adm. Code, because the calculated WQBEL is less than or equal to 0.3 mg/L, the effluent limit of 0.075 mg/L may be expressed as a six-month average. If a concentration limitation expressed as a six-month average is included in the permit, a monthly average concentration limitation of 0.225 mg/L, equal to three times the WQBEL calculated under s. NR 217.13, Wis. Adm. Code shall also be included in the permit. The six-month average should be averaged during the months of May – October and November – April.

Mass Limits

Because the discharge is to a surface water that is to or upstream of a phosphorus impaired water, a mass limit is also required, pursuant to s. NR 217.14(1)(a), Wis. Adm. Code. This final mass limit shall be 0.075 mg/L × 8.34 × 0.524 MGD = 0.33 lbs/day expressed as a six-month average.

WQT Minimum Control Level (MCL)

A water quality trading plan has been submitted as an alternative compliance option to offset any Total Phosphorus discharged from Outfall 001 that exceeds the WQBELs. The phosphorus WQBELs may be expressed as computed compliance limits, but a Minimum Control Level (MCL) must be set as a limit not to be exceeded at the outfall location. **The limit of 1.0 mg/L is recommended as the MCL.**

PART 6 – WATER QUALITY-BASED EFFLUENT LIMITATIONS FOR THERMAL

Surface water quality standards for temperature took effect on October 1, 2010. These regulations are detailed in chs. NR 102 (Subchapter II – Water Quality Standards for Temperature) and NR 106 (Subchapter V – Effluent Limitations for Temperature) of the Wisconsin Administrative Code. Daily maximum and weekly average temperature criteria are available for the 12 different months of the year depending on the receiving water classification.

In accordance with s. NR 106.53(2)(b), Wis. Adm. Code, the highest daily maximum flow rate for a calendar month is used to determine the acute (daily maximum) effluent limitation. In accordance with s. NR 106.53(2)(c), Wis. Adm. Code, the highest 7-day rolling average flow rate for a calendar month is used to determine the sub-lethal (weekly average) effluent limitation. These values were based off actual flow reported from July 2019 to August 2024.

The table below summarizes the maximum temperatures reported during monitoring from January 2014 to December 2015.

Monthly Temperature Effluent Data & Limits

Month	Representative Highest Monthly Effluent Temperature		Calculated Effluent Limit	
	Weekly Maximum (°F)	Daily Maximum (°F)	Weekly Average Effluent Limitation (°F)	Daily Maximum Effluent Limitation (°F)
JAN	50	51	89	120
FEB	48	54	101	120
MAR	52	57	80	120
APR	56	60	69	113
MAY	63	65	81	115
JUN	69	72	105	105
JUL	73	75	110	111
AUG	73	75	119	115
SEP	75	75	101	110
OCT	70	70	85	120
NOV	65	65	73	119
DEC	60	60	82	120

Reasonable Potential

Permit limits for temperature are recommended based on the procedures in s. NR 106.56, Wis. Adm. Code.

- An acute limit for temperature is recommended for each month in which the representative daily maximum effluent temperature for that month exceeds the acute WQBEL. The representative daily maximum effluent temperature is the greater of the following:
  - (a) The highest recorded representative daily maximum effluent temperature
  - (b) The projected 99th percentile of all representative daily maximum effluent temperatures
- A sub−lethal limitation for temperature is recommended for each month in which the representative weekly average effluent temperature for that month exceeds the weekly average WQBEL. The representative weekly average effluent temperature is the greater of the following:
  - (a) The highest weekly average effluent temperature for the month.
  - (b) The projected 99th percentile of all representative weekly average effluent temperatures for the month

Comparing the representative highest effluent temperature to the calculated effluent limits determines the reasonable potential of exceeding the effluent limits. The months in which limitations are recommended are shown in bold. Based on this analysis, temperature limits are not required. The complete thermal table used for the limit calculation is attached. **Therefore, no thermal limits or monitoring are required.**

PART 7 – WHOLE EFFLUENT TOXICITY (WET)

WET testing is used to measure, predict, and control the discharge of toxic materials that may be harmful to aquatic life. In WET tests, organisms are exposed to a series of effluent concentrations for a given time and effects are recorded. Decisions below related to the selection of representative data and the need for WET limits were made according to ss. NR 106.08 and 106.09, Wis. Adm. Code. WET monitoring frequency and toxicity reduction evaluation (TRE) recommendations were made using the best professional judgment of staff familiar with the discharge after consideration of the guidance in the *Whole Effluent Toxicity (WET) Program Guidance Document (2022).*

- Acute tests predict the concentration that causes lethality of aquatic organisms during a 48 to 96-hour exposure. To assure that a discharge is not acutely toxic to organisms in the receiving water, WET tests must produce a statistically valid LC50 (Lethal Concentration to 50% of the test organisms) greater than 100% effluent, according to s. NR 106.09(2)(b), Wis. Adm Code.

- Chronic tests predict the concentration that interferes with the growth or reproduction of test organisms during a seven-day exposure. To assure that a discharge is not chronically toxic to organisms in the receiving water, WET tests must produce a statistically valid IC_{25} (Inhibition Concentration) greater than the instream waste concentration (IWC), according to s. NR 106.09(3)(b), Wis. Adm Code. The IWC is an estimate of the proportion of effluent to total volume of water (receiving water + effluent). The IWC of 32% shown in the WET Checklist summary below was calculated according to the following equation, as specified in s. NR 106.03(6), Wis. Adm Code:

$$IWC\ (as\ \%) = Qe \div \{(1 - f)\ Qe + Qs\} \times 100$$

Where:

Qe = annual average flow = 0.524 MGD = 0.811 cfs
f = fraction of the Qe withdrawn from the receiving water = 0
Qs = ¼ of the 7-Q_{10} = 6.90 cfs ÷ 4 = 1.73 cfs

- According to the *State of Wisconsin Aquatic Life Toxicity Testing Methods Manual*, a synthetic (standard) laboratory water may be used as the dilution water and primary control in acute WET tests, unless the use of different dilution water is approved by the Department prior to use. The primary control water must be specified in the WPDES permit.

- Receiving water must be used as the dilution water and primary control in chronic WET tests, unless the use of different dilution water is approved by the Department prior to use. The dilution water used in WET tests conducted on Outfall 001 shall be a grab sample collected from the receiving water location, upstream and out of the influence of the mixing zone and any other known discharge. The specific receiving water location must be specified in the WPDES permit.

- Shown below is a tabulation of all available WET data for Outfall 001. Efforts are made to ensure that decisions about WET monitoring and limits are made based on representative data, as specified in s. NR 106.08(3), Wis. Adm Code. Data which is not believed to be representative of the discharge was not included in reasonable potential calculations. The table below differentiates between tests used and not used when making WET determinations.

Attachment #1

WET Data History

Date Test Initiated	Acute Results LC_{50} %				Chronic Results IC_{25} %					Footnotes or Comments
	C. dubia	Fathead minnow	Pass or Fail?	Used in RP?	*C. dubia*	Fathead Minnow	Algae (IC_{50})	Pass or Fail?	Use in RP?	
09/30/1997	>100	>100	Pass	No						1
10/28/1997					49.2	>100		Pass	No	1
05/02/2000	>100	>100	Pass	No	>100			Fail	No	1
04/30/2002	>100	>100	Pass	No	>100			Fail	No	1
11/30/2004	>100	>100	Pass	No	>100	>100		Pass	No	1
01/31/2007	>100	>100	Pass	Yes						
09/11/2012	>100	>100	Pass	Yes	>100	>100		Pass	Yes	
01/28/2014	>100	>100	Pass	Yes	>100	>100		Pass	Yes	
03/11/2020	>100	>100	Pass	Yes						
08/01/2023	>100	>100	Pass	Yes						

Footnotes:

1. *Data Not Representative.* Significant changes were made to WET test methods in 2004 and these changes were assumed to be fully implemented by certified labs by no later than June 2005.

- According to s. NR 106.08, Wis. Adm. Code, WET reasonable potential is determined by multiplying the highest toxicity value that has been measured in the effluent by a safety factor, to predict the likelihood (95% probability) of toxicity occurring in the effluent above the applicable WET limit. The safety factor used in the equation changes based on the number of toxicity detects in the dataset. The fewer detects present, the higher the safety factor, because there is more uncertainty surrounding the predicted value. WET limits must be given, according to s. NR 106.08(6), Wis. Adm. Code, whenever the applicable Reasonable Potential equation results in a value greater than 1.0.

  Acute Reasonable Potential = [(TUa effluent)(B)]
  Chronic Reasonable Potential = [(TUc effluent)(B)(IWC)]

  According to s. NR 106.08(6)(d), Wis. Adm. Code, TUa and TUc effluent values are equal to zero whenever toxicity is not detected (i.e. when the LC_{50} IC_{25} or $IC_{50} \geq 100\%$).

  Acute Reasonable Potential = 0 < 1.0, reasonable potential is not shown, and a limit is not required.

  Chronic Reasonable Potential = 0 < 1.0, reasonable potential is not shown, and a limit is not required.

The WET checklist was developed to help DNR staff make recommendations regarding WET limits, monitoring, and other related permit conditions. The checklist indicates whether acute and chronic WET limits are needed, based on requirements specified in s. NR 106.08, Wis. Adm. Code. The checklist steps the user through a series of questions, assesses points based on the potential for effluent toxicity, and suggests monitoring frequencies based on points accumulated during the checklist analysis. As toxicity potential increases, more points accumulate, and more monitoring is recommended to ensure that toxicity is not occurring. A summary of the WET checklist analysis completed for this permittee is shown in the table below. Staff recommendations based on best professional judgment are provided below the summary table. For guidance related to reasonable potential and the WET checklist, see Chapter 1.3 of the WET Guidance Document: https://dnr.wisconsin.gov/topic/Wastewater/WET.html.

WET Checklist Summary

	Acute	Chronic
AMZ/IWC	Not Applicable. **0 Points**	IWC = 32% **0 Points**
Historical Data	Five tests used to calculate RP. No tests failed. **0 Points**	Two tests used to calculate RP. No tests failed. Data not available in past 5 years. **5 Points**
Effluent Variability	Ammonia Nitrogen, pH, and Phosphorus exceedances. **5 Points**	Same as Acute. **5 Points**
Receiving Water Classification	Warm Water Sport Fish (WWSF) (5 pts) **5 Points**	Same as Acute. **5 Points**
Chemical-Specific Data	No reasonable potential for limits based on ATC. Ammonia nitrogen limit carried over from the current permit. Arsenic, Copper, Nickel, Zinc, and Chloride detected. (3 pts) Additional Compounds of Concern: none **3 Points**	No reasonable potential for limits based on CTC. Ammonia nitrogen limit carried over from the current permit. Arsenic, Copper, Nickel Zinc, and Chloride detected. (3 pts) Additional Compounds of Concern: none **3 Points**
Additives	No biocides and one water quality conditioner (1 pt) added. Permittee has proper P chemical SOPs in place. **1 Point**	All additives used more than once per 4 days. **1 Point**
Discharge Category	Two Industrial Contributors (6 pts) **6 Points**	Same as Acute. **6 Points**
Wastewater Treatment	Secondary or Better **0 Points**	Same as Acute. **0 Points**
Downstream Impacts	No impacts known. **0 Points**	Same as Acute. **0 Points**
Total Checklist Points:	**20 Points**	**25 Points**
Recommended Monitoring Frequency (from Checklist):	2 tests during permit term	3 tests during permit term
Limit Required?	No	No

Attachment #1

	Acute	Chronic
TRE Recommended? (from Checklist)	No	No

- After consideration of the guidance provided in the Department's WET Program Guidance Document (2022) and other information described above, two acute and three chronic WET tests are recommended in the reissued permit. Sampling WET concurrently with any chemical-specific toxic substances is recommended. Tests should be done in rotating quarters, to collect seasonal information about this discharge and should continue after the permit expiration date (until the permit is reissued).

Attachment #2

Temperature limits for receiving waters with unidirectional flow

(calculation using default ambient temperature data)

Facility:	Greenwood WWTF		**7-Q_{10}:**	6.90	cfs	**Temp Dates**	**Flow Dates**
Outfall(s):	001		**Dilution:**	25%		**Start:** 01/01/14	07/01/19
Date Prepared:	09/13/2024		**f:**	0		**End:** 12/31/15	08/31/24
Design Flow (Qe):	0.524	MGD	**Stream type:**	Small warm water sport or forage fish community			
Storm Sewer Dist.	0	ft	**Qs:Qe ratio:**	2.1	:1		
			Calculation Needed?	YES			

Month	Water Quality Criteria			Receiving Water Flow Rate (Qs)	Representative Highest Effluent Flow Rate (Qe)		f	Representative Highest Monthly Effluent Temperature		Calculated Effluent Limit	
	Ta (default)	Sub-Lethal WQC	Acute WQC		7-day Rolling Average (Qesl)	Daily Maximum Flow Rate (Qea)		Weekly Average	Daily Maximum	Weekly Average Effluent Limitation	Daily Maximum Effluent Limitation
	(°F)	(°F)	(°F)	(cfs)	(MGD)	(MGD)		(°F)	(°F)	(°F)	(°F)
JAN	33	49	76	1.73	0.441	0.840	0	50	51	89	120
FEB	34	50	76	1.73	0.352	0.779	0	48	54	101	120
MAR	38	52	77	1.73	0.554	1.012	0	52	57	80	120
APR	48	55	79	1.73	0.540	1.026	0	56	60	69	113
MAY	58	65	82	1.73	0.500	0.818	0	63	65	81	115
JUN	66	76	84	1.73	0.384	0.960	0	69	72	105	105
JUL	69	81	85	1.73	0.467	0.685	0	73	75	110	111
AUG	67	81	84	1.73	0.409	0.616	0	73	75	119	115
SEP	60	73	82	1.73	0.513	0.875	0	75	75	101	110
OCT	50	61	80	1.73	0.519	0.742	0	70	70	85	120
NOV	40	49	77	1.73	0.411	0.990	0	65	65	73	119
DEC	35	49	76	1.73	0.468	0.850	0	60	60	82	120

WISCONSIN DEPARTMENT OF NATURAL RESOURCES

Greenwood WWTF

Legend

Permits

Surface Water Outfalls

Basemaps

Imagery

Latest Leaf Off Imagery

Red: Band_1

Green: Band_2

Blue: Band_3

Notes

Service layer credits:
WI Dept. of Natural Resources, Division of Water

1:6,098

0 500 1000 ft

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