CORRESPONDENCE/MEMORANDUM

State of Wisconsin

DATE: Februrary 10, 2022

TO: Phillip Spranger – SCR/Fitchburg

FROM: Benjamin Hartenbower – WCR/Eau Claire

SUBJECT: Water Quality-Based Effluent Limitations for the City of Hudson Wastewater Treatment Facility
WPDES Permit No. WI-0024279

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 City of Hudson Wastewater Treatment Facility in St. Croix County. This municipal wastewater treatment facility (WWTF) discharges to the St. Croix River, located in the Lower Willow River Watershed in the St. Croix River Basin. This discharge is included in the Lake St. Croix TMDL as approved by EPA. 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	Footnotes
Flow Rate					2
$CBOD_5$			40 mg/L	25 mg/L	1
TSS			45 mg/L	30 mg/L	1
pH	9.0 s.u.	6.0 s.u.			1
Ammonia Nitrogen	29 mg/L		**29 mg/L**	**29 mg/L**	3
Bacteria					4
E. coli May – September or Year-round				126 #/100 mL geometric mean	
Fecal Coliform October – April				400 #/100 mL geometric mean	
Mercury				1.3 ng/L	5
Phosphorus TBEL WQBEL				1.0 mg/L 22 lbs/day	6
TKN, Nitrate+Nitrite, and Total Nitrogen					2,7
Acute WET	1.0 TUa				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.

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4. Bacteria limits apply year-round. Outside of the recreation period of May through September, the facility may either continue to meet the *E. coli* limits year-round, or the geometric mean of the fecal coliform bacteria. Additional E. coli limit: No more than 10 percent of *E. coli* bacteria samples collected in any applicable calendar month may exceed 410 count/100 mL.
5. This is the WQBEL for mercury. If this limit is included in the permit, mass limits would also need to be included. An alternative effluent limitation of 6.8 ng/L may be included in the permit as a daily maximum in place of the WQBEL if the mercury variance application that was submitted is approved by EPA.
6. The phosphorus mass limit is based on the Total Maximum Daily Load (TMDL) for Lake St. Croix to address phosphorus water quality impairments. The TMDL was approved by EPA on August 8, 2012.
7. As recommended in the Department's October 1, 2019 Guidance for Total Nitrogen Monitoring in Wastewater Permits, quarterly total nitrogen monitoring is recommended for all municipal major permittees. Total Nitrogen is the sum of nitrate (NO_3), nitrite (NO_2), and total kjeldahl nitrogen (TKN) (all expressed as N).
8. A minimum of annual acute monitoring is required because an acute WET limit is required. Federal regulations in 40 CFR Part 122.44(i) require that monitoring occur at least once per year when a limit is present. According to the *State of Wisconsin Aquatic Life Toxicity Testing Methods Manual* (s. NR 219.04, Table A, Wis. Adm. Code), a synthetic (standard) laboratory water may be used as the dilution water and primary control in acute WET tests.
9. 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).

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, 2015 Ammonia Calculations, & Map

PREPARED BY: _____ Date: 02/10/2022

Benjamin Hartenbower, PE,
Water Resources Engineer

E-cc: Adebowale Adesanwo, Wastewater Engineer – Baldwin
Geisa Thielen, Regional Wastewater Supervisor – Eau Claire
Diane Figiel, Water Resources Engineer – WY/3
Chris Willger, Water Quality Biologist– Eau Claire
Kari Fleming, Environmental Toxicologist – WY/3
Laura Dietrich, Variance Coordinator – Waukesha

Attachment #1

Water Quality-Based Effluent Limitations for
City of Hudson Wastewater Treatment Facility

WPDES Permit No. WI-0024279

Prepared by: Benjamin P. Hartenbower

PART 1 – BACKGROUND INFORMATION

Facility Description

The City of Hudson wastewater treatment plant includes static screening, aerated grit removal, anaerobic basins for biological phosphorus removal with chemical (alum) addition for back-up phosphorus removal, activated sludge aeration, and final clarification. In 2020, the facility upgraded to ultraviolet disinfection. Sludge is thickened with dissolved air flotation (DAF) and digested anaerobically. All sludge is hauled to the West Central Wisconsin Biosolids Facility for treatment & reuse. The annual average design flow is 2.2 million gallons per day (MGD). The facility accepts domestic and non-domestic wastewater, septic tank waste and landfill leachate for treatment.

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

Existing Permit Limitations

The current permit, expiring on June 30, 2022, includes the following effluent limitations and monitoring requirements.

Parameter	Daily Maximum	Daily Minimum	Weekly Average	Monthly Average	Footnotes
$CBOD_5$			40 mg/L	25 mg/L	1
TSS			45 mg/L	30 mg/L	1
pH	9.0 s.u.	6.0 s.u.			1
Ammonia Nitrogen	34 mg/L		34 mg/L	34 mg/L	
Fecal Coliform May – September			656#/100 mL geometric mean	400#/100 mL geometric mean	
Chlorine, Total Residual	38 µg/L		38 µg/L	38 µg/L	
Mercury	6.8 ng/L				3
Phosphorus TBEL WQBEL				 1.0 mg/L 22 lbs/day	
TKN, Nitrate+Nitrite, and Total Nitrogen					2
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. A compliance schedule is in the current permit to meet the final WQBEL of 1.3 ng/L by June 30, 2022.
4. Acute WET Testing: October-December 2017, January-March 2018, April-June 2019, July-September 2020, October-December 2021, and January-March 2022.

Receiving Water Information

- Name: St. Croix River
- Waterbody Identification Code (WBIC): 2601400
- Classification used in accordance with chs. NR 102 and 104, Wis. Adm. Code: Warm Water Sport Fish (WWSF) community, Public Water Supply (s. NR 104.22(1), Wis. Adm. Code), Exceptional Resource Water (s. NR 102.11, Wis. Adm. Code)
- Low flows used in accordance with chs. NR 106 and 217, Wis. Adm. Code: The following 7-Q_{10} and 7-Q_2 values are from USGS for Station 05340500, at St. Croix Falls on the left bank of the St. Croix River, upstream of where Outfall 001 is located.
  7-Q_{10} = 1100 cfs (cubic feet per second)
  7-Q_2 = 1530 cfs
  90-Q_{10} = 1301 cfs
  Harmonic Mean Flow = 3200 cfs
- Hardness = 81 mg/L as $CaCO_3$. This value represents the geometric mean of data from the St. Croix River, downstream of HWY 8 taken from 10/09/2003 to 04/14/2015. (n=15)
- % 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: Metals data from the St. Croix River at St. Croix Falls is used for 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 St. Croix 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 St. Croix River is listed as impaired for PCBs from river mile zero, upstream 54 miles to Polk County and includes the discharge location. Lake St. Croix, is listed as impaired for total phosphorus and this discharge is included in the Lake St. Croix TMDL.

Effluent Information

- Design flow rate(s):
  Annual average = 2.2 MGD (Million Gallons per Day)
  For reference, the actual average flow from August 2017 to November 2021 was 1.50 MGD.
- Hardness = 237 mg/L as $CaCO_3$. This value represents the geometric mean of data four samples taken from 02/11/2021 to 02/22/2021.
- 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 City of Hudson and the Village of North Hudson with landfill leachate. Industrial sources include United Gear, Saint Croix Gear, Phillips Plastics, Niro Inc, and Empire Manufacturing.
- Total Phosphorus Wasteload Allocation: 5,936 lbs/year, 16.3 lbs/day (*Lake St. Croix Nutrient Total Maximum Daily Load, May 2012, page 70*).

- Additives: One water quality conditioner (Alum)
- Effluent characterization: This facility is categorized as a major municipal, so the permit application required effluent sample analyses for all the "priority pollutants" except for the Dioxins and Furans as specified in s. NR 200.065, Table 1, Wis. Adm. Code. The permit-required monitoring for Hg, Ammonia, Phosphorus and Chlorine from August 2017 to November 2021 is used in this evaluation.
- 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.". Otherwise, substances with multiple effluent data are shown in the tables below or in their respective parts in this evaluation.

Sample Date	Copper µg/L	Chloride mg/L	Sample Date	Mercury ng/L
02/11/2021	13	260	11/08/2017	2.0
02/15/2021	14	270	03/13/2018	3.6
02/18/2021	14	230	05/15/2018	6.7
02/22/2021	15	320	08/21/2018	1.5
02/25/2021	16		11/07/2018	1.7
03/01/2021	19		01/23/2019	3.3
03/04/2021	15		04/24/2019	2.8
03/08/2021	14		08/07/2019	2.5
03/11/2021	13		11/06/2019	1.4
03/15/2021	15		02/17/2020	2.6
03/18/2021	12		05/12/2020	2.5
			07/29/2020	1.5
			11/18/2020	5.1
			03/18/2021	4.3
			04/21/2021	4.1
			09/14/2021	4.7
1-day P_{99}	19.4		1-day P_{99}	8.2
4-day P_{99}	16.8		4-day P_{99}	5.3
Mean		270	30-day P_{99}	3.8

The following table presents the average concentrations and loadings at Outfall 001 from August 2017 to November 2021 for all parameters with limits in the current permit to meet the requirements of s. NR 201.03(6), Wis. Adm. Code:

Averages of Parameters with Limits

	Average Measurement	Average Mass Discharged
$CBOD_5$	10.3 mg/L	
TSS	16.1 mg/L	
pH field	7.36 s.u.	
Phosphorus	0.68 mg/L	8.58 lbs/day
Ammonia Nitrogen	21.0 mg/L	
Mercury	3.1 ng/L	
Fecal Coliform	119 #/100mL	
Chlorine	<100 µg/L	

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. Adm. 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 City of Hudson 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 for all the detected substances. All concentrations are expressed in terms of micrograms per Liter (µg/L), except for hardness and chloride (mg/L) and mercury (ng/L).

Daily Maximum Limits based on Acute Toxicity Criteria (ATC)

RECEIVING WATER FLOW = 880 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	MAX. EFFL. LIMIT**	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.	1-day P_{99}	1-day MAX. CONC.
Chlorine		19.0	38.1	7.6	<100		
Chromium (+3)	237	3660	7320	1464	1.1		
Chromium (+6)		16.0	32.0	6.4	5.3		
Copper	237	35.1	70.1			19.4	19.0
Mercury (ng/L)		830	1660			8.2	6.7
Nickel	237	975	1950	390	6.3		
Zinc	237	256	513	103	59		
Chloride (mg/L)		757	1514	303	270		320

* * 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 = 275 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.	WEEKLY AVE. LIMIT	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.	4-day P_{99}
Chlorine		7.28		595	119	<100	
Chromium (+3)	81	111		9072	1814	1.10	
Chromium (+6)		11.0		898	180	5.3	
Copper	81	8.62	0.661	652			16.9
Mercury (ng/L)		440	1.480	35867			5.3
Nickel	81	43.6		3563	713	6.3	
Zinc	81	99.9	0.750	8108	1622	59	
Selenium		5.00		409	82	1.3	
Chloride (mg/L)		395		32306	6461	270	

Monthly Average Limits based on Wildlife Criteria (WC)

RECEIVING WATER FLOW = 325 cfs (¼ of the 90-Q_{10}), as specified in s. NR 106.06(4), Wis. Adm. Code

SUBSTANCE	WC	MEAN BACK-GRD.	MO'LY AVE. LIMIT	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.	30-day P_{99}
Mercury (ng/L)	1.3	1.48	1.3			**3.8**

Monthly Average Limits based on Human Threshold Criteria (HTC)

RECEIVING WATER FLOW = 800 cfs (¼ of Harmonic Mean), as specified in s. NR 106.06(4), Wis. Adm. Code.

SUBSTANCE	HTC	MEAN BACK-GRD.	MO'LY AVE. LIMIT	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.	30-day P_{99}
Antimony	5.6		1322	264	0.44	
Chromium (+3)	100		23602	4720	1.10	
Chromium (+6)	83.5		19708	3942	5.3	
Mercury (ng/L)	1.5	1.48	6.2			3.8
Nickel	100		23602	4720	6.3	
Selenium	50		11801	2360	1.3	

Monthly Average Limits based on Human Cancer Criteria (HCC)

RECEIVING WATER FLOW = 800 cfs (¼ of Harmonic Mean), as specified in s. NR 106.06(4), Wis. Adm. Code.

SUBSTANCE	HCC	MEAN BACK-GRD.	MO'LY AVE. LIMIT	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.
Arsenic	0.2		47.2	9.4	<2.6
Chloroform	55		12981	2596	0.48
Di(2-ethylhexyl)phthalate*	5.4		1274	255	3.7
Benzo(a)pyrene*	0.0133		3.1	0.63	0.067

* The limit for this substance is based on a secondary value.

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.

Monthly Average Limits based on Taste and Odor Criteria (TOC)

RECEIVING WATER FLOW = 4368 cfs (Mean Annual Flow), as specified in s. NR 106.06(4), Wis. Adm. Code.

SUBSTANCE	TOC	MEAN BACK-GRD.	MONTHLY AVE. LIMIT	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.	30-day P_{99}
Copper	1000	0.661	1832930			15.4
Zinc	5000	0.750	9169334	1833867	59	

Conclusions and Recommendations

Total Residual Chlorine – Because chlorine is not added as a disinfectant, effluent limits are not required.

Mercury – The WQBEL for total recoverable mercury is set equal to the most stringent criterion of 1.3 ng/L, according to s. NR 106.06(6), Wis. Adm. Code, because the background concentration in the receiving water and similar inland streams is known to exceed 1.3 ng/L. A review of data from November 2017 to September 2021 indicates the 30-day P_{99} is 3.8 ng/L, which is above the wildlife criterion of 1.3 ng/L. Therefore, **a mercury effluent limit is required for the City of Hudson Wastewater Treatment Facility.**

Section NR 106.145(4), Wis. Adm. Code, allows for eligibility for an alternative mercury effluent limitation if the permittee applies for an alternative mercury limit, which includes the submittal of a pollutant minimization plan. The City of Hudson has submitted this application. Section NR 106.145(5), Wis. Adm. Code, specifies that an alternative limitation shall equal the 1-day P_{99} of the effluent data, and shall be expressed as a daily maximum concentration. Additionally, an alternative effluent limit for Mercury may not be set greater than a previously established alternative mercury effluent limit unless previous monitoring was not representative of the discharge. The calculated 1-day P_{99} of 8.2 ng/L is greater than the current alternative effluent limit of 6.8 ng/L, therefore, if a variance is granted and approved by US Environmental Protection Agency **an alternative mercury limitation of 6.8 ng/l, expressed as a daily maximum, is required for the City of Hudson Wastewater Treatment Facility.**

In the absence of a mercury variance, mass limits and additional concentration limits to meet the expression of limits requirements in s. NR 106.07, Wis. Adm. Code, would be required.

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.
- 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 1583 sample results were reported from August 2017 to November 2021. The maximum reported value was 7.80 s.u. (Standard pH Units). The effluent pH was 7.70 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 7.68 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 7.67 s.u. Therefore, a value of 7.70 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 7.70 s.u. into the equation above yields an ATC = 14.44 mg/L.

Potential Changes to Daily Maximum Ammonia Nitrogen Effluent Limitations

Subchapter IV of ch. NR 106, Wis. Adm. Code (effective September 1, 2016) specifies methods for the use of the 1-Q_{10} receiving water low flow to calculate daily maximum ammonia nitrogen limits 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.

Daily Maximum Ammonia Nitrogen Determination

	Ammonia Nitrogen Limit mg/L
2×ATC	28.88
1-Q_{10}	3693

The 2×ATC method yields the most stringent limits for the City of Hudson 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, WWFF & LFF

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 weekly and monthly average ammonia nitrogen limits calculation from the previous memo do not change because there have been no changes in the effluent and receiving water flow rates. The calculations from the previous WQBEL memo are shown in attachment #2.

Effluent Data

The following table evaluates the statistics based upon ammonia data reported from August 2017 to November 2021.

	Ammonia Nitrogen mg/L
1-day P_{99}	48.1
4-day P_{99}	32.8
30-day P_{99}	24.8
Mean	21.0
Std	8.5
Sample size	222
Range	1.9 - 33.5

Based on this comparison, a daily limit of 29 mg/L is required.

Expression of Limits

Revisions to ch. NR 106, Wis. Adm. Code, in September 2016 aligned Wisconsin's WQBELs with 40 CFR § 122.45(d), which specifies that effluent limits for continuous dischargers must be expressed as weekly and monthly averages for publicly owned treatment works and as daily maximums and monthly averages for all other dischargers, unless shown to be impracticable. Because a daily maximum ammonia limit is necessary for Hudson, weekly and monthly average limits are also required under this code revision.

The methods for calculating limitations for municipal treatment facilities to conform to 40 CFR 122.45(d) are specified in s. NR 106.07(3), Wis. Adm. Code, and are as follows:

> Whenever a daily maximum limitation is determined necessary to protect water quality, a weekly and monthly average limitation shall also be included in the permit and set equal to the daily maximum limit unless a more restrictive limit is already determined necessary to protect water quality.

Therefore, **monthly and weekly average limits of 29 mg/L** are recommended in the permit. Monitoring frequency is recommended to **increase to 5x/week**.

Conclusions and Recommendations

In summary, after rounding to two significant figures, the following ammonia nitrogen limitations are recommended. No mass limitations are recommended in accordance with s. NR 106.32(5), Wis. Adm Code.

Final Ammonia Nitrogen Limits

Daily Maximum mg/L	Weekly Average mg/L	Monthly Average mg/L
29	29	29

PART 4 – WATER QUALITY-BASED EFFLUENT LIMITATIONS FOR BACTERIA

On May 1, 2020, revisions to chs. NR 102 and NR 210, Wis. Adm. Codes, became effective which replace fecal coliform limits with new *Escherichia coli* (*E. coli*) limits for protection of recreational uses. Section NR 210.06(2)(a)1, Wis. Adm. Code, includes two limits which must be included in permits for facilities which are required to disinfect:

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 City of Hudson's permit requires weekly 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.

The current permit requires the City of Hudson Wastewater Treatment Facility to disinfect May through September. However, s. NR 104.22, Wis. Adm. Code designates that the standards for public water supply shall be met in the St. Croix River downstream from the north line of Polk County. Therefore, disinfection should be year-round for protection of the public water supply.

Because the *E. coli* limits listed in NR 210.06(2)(a)1, Wis. Adm. Code, are set for protection of recreational uses and not drinking water supply, these *E. coli* limits do not necessarily need to be applied year-round. However, either *E. coli* or fecal coliform bacteria limits are needed year-round in order to ensure that there is no reduction from the current level of disinfection needed to protect the public drinking water source.

In accordance with s. NR 210.06(2)(a)2, Wis. Adm. Code, outside of the recreational season, bacteria limits may either be set equal to the previous fecal coliform limits or the listed *E. coli* limits. Therefore, the facility can select one of the two possible sets of permit limits:

- *E. coli* limits as listed above during the recreation period of May through September and a fecal coliform limit of 400 counts/100 mL as a monthly geometric mean in November through April. Any fecal coliform weekly geometric mean limit which was included in the previous permit for expression of limits purposes does not need to be included in the reissued permit.
- *E. coli* limits as listed above apply year-round.

The City of Hudson Wastewater Treatment Facility has monitored effluent *E. coli* from 05/04/2021 to 09/27/2021 and a total of 22 results are available. A geometric mean of 126 counts/100 mL was never exceeded during this sample period with a maximum monthly geometric mean of 42 counts/100 mL. Effluent data did not exceed 410 counts/100 mL. The maximum reported value was 80 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 City of Hudson Wastewater Treatment Facility currently has a limit of 1.0 mg/L, this limit should be included in the reissued permit. This limit remains applicable unless a more stringent WQBEL is given.

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.

The Lake St. Croix TMDL report was written to ensure that phosphorus water quality criteria are attained in Lake St. Croix and are not necessarily protective of phosphorus water quality of other surface waterbodies in the TMDL area. However, this discharge is directly to Lake St Croix. Therefore, the TMDL-derived WQBEL for phosphorus may be included in the permit in lieu of, a WQBEL based on s. NR 217.13, Wis. Adm. Code.

Effluent Data:
The following table summarizes effluent total phosphorus monitoring data from August 2017 – November 2021.

Total Phosphorus Effluent Data

	Phosphorus mg/L	Phosphorus lbs/day
1-day P_{99}	2.40	29.8
4-day P_{99}	1.42	17.5
30-day P_{99}	0.91	11.3
Mean	0.68	8.5
Std	0.47	5.8
Sample size	1133	1133
Range	0.18 - 6.19	2.3 - 73.4

TMDL Limits:
The Lake St. Croix TMDL established a waste load allocation (WLA) for the City of Hudson of 5,936 lbs/year and 16.3 lbs/day. The monthly average limit of 22 lbs/day was determined in the WQBEL memorandum signed on February 20, 2015. The multiplier of 1.34 was chosen as described in the Department TMDL Implementation guidance using a coefficient of variation (CV) of 0.6 and 5X/week effluent monitoring.

This TMDL-based WQBEL will be re-evaluated if the annual WLA is not being met as described in the prior stated guidance. Rolling 12-month sums can be compared directly to the annual wasteload allocation. In this case, the peak rolling sum of 4,026 lbs/yr (February 2018 – January 2019) is less than the annual WLA of 5,936 lbs/yr. **Therefore, the City of Hudson is meeting their annual WLA and the TMDL-based WQBEL of 22 lbs/day as a monthly average will be continued in the reissued permit.**

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.

Due to the amount of upstream flow available for dilution in the limit calculation (Qs:Qe >20:1), the lowest calculated limitation is 120° F (s. NR 106.55(6)(a), Wis. Adm. Code). There is no reasonable potential for the calculated limitation to be exceeded at this facility. Neither a limit nor routine monitoring is recommended to be included in the reissued permit.

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 (October 29, 2019).*

- 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 LC_{50} (Lethal Concentration to 50% of the test organisms) greater than 100% effluent, according to s. NR 106.09(2)(b), Wis. Adm Code.

- Chronic testing is usually not recommended where the ratio of the 7-Q_{10} to the effluent flow exceeds 100:1. For the City of Hudson Wastewater Treatment Facility, that ratio is approximately 323:1. With this amount of dilution, there is believed to be little potential for chronic toxicity effects in the St. Croix River associated with the discharge from the City of Hudson Wastewater Treatment Facility, so the need for chronic WET testing will not be considered further.

- According to the *State of Wisconsin Aquatic Life Toxicity Testing Methods Manual* (s. NR 219.04, Table A, Wis. Adm. Code), 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.

- 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.

WET Data History

Date Test Initiated	Acute Results LC_{50} %				Footnotes or Comments
	C. dubia	Fathead minnow	Pass or Fail?	Used in RP?	
09/17/1991			Pass	No	1
03/20/1996			Pass	No	1
07/24/1996	>100	>100	Pass	No	1
06/26/1997	>100	>100	Pass	No	1
09/02/1998	>100	**63.7**	Fail	No	1
10/21/1998	>100	>100	Pass	No	1
11/18/1998	>100	>100	Pass	No	1
10/27/1999	>100	**63**	Fail	No	1
03/15/2000	>100	**68.3**	Fail	No	1
04/26/2000	>100	>100	Pass	No	1
06/21/2000	>100	>100	Pass	No	1
10/23/2001	>100	>100	Pass	No	1
01/09/2002	>100	>100	Pass	No	1
09/25/2002	>100	>100	Pass	No	1
06/11/2003	>100	>100	Pass	No	1
10/29/2003	>100	>100	Pass	No	1
03/31/2004	>100	>100	Pass	No	1
09/01/2004	>100	**89.09**	Fail	No	1
09/29/2004	>100	>100	Pass	No	1
11/03/2004	>100	>100	Pass	No	1
06/29/2005	>100	**57.36**	Fail	No	1
09/14/2005	>100	>100	Pass	No	1
10/05/2005	>100	>100	Pass	No	1
11/30/2005	>100	>100	Pass	No	1
05/17/2006	>100	>100	Pass	No	1
06/21/2006	>100	>100	Pass	No	1
10/18/2006	>100	>100	Pass	No	1
04/04/2007	>100	**72.15**	Fail	No	1
06/06/2007	>100	>100	Pass	No	1
06/20/2007	>100	>100	Pass	No	1
09/12/2007	>100	>100	Pass	No	1
12/15/2010	>100	>100	Pass	No	1
02/09/2011	>100	>100	Pass	No	1
05/23/2012	**93.9**	**58.5**	Fail	No	1

09/12/2012	>100	>100	Pass	No	1
09/19/2012	>100	>100	Pass	No	1
09/05/2013	>100	>100	Pass	No	1
06/04/2014	>100	>100	Pass	No	1
12/03/2014	>100	>100	Pass	No	1
07/29/2015	>100	>100	Pass	No	
03/07/2018	>100	**48.2**	Fail	Yes	
06/19/2019	>100	**96.6**	Pass	Yes	
12/15/2021	>100	>100	Pass	Yes	

Footnotes:

1. *Data Not Representative.* Past WET failures were determined to be due to high levels of ammonia in the final effluent. Ammonia limits were added in lieu of an acute WET limit in 2017.

- 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 = [(TU_a effluent) (B)]

Acute WET Limit Parameters

TUa (maximum) $100/LC_{50}$	**B** (multiplication factor from s. NR 106.08(5)(c), Wis. Adm. Code, Table 4)
100/48.2 =2.07 TUa	3.8 Based on 2 detects

[(TUa effluent) (B)] = 7.88 > 1.0

Therefore, reasonable potential is shown for acute WET limits using the procedures in s. NR 106.08(6) and representative data from 03/07/2018 and 06/19/2019.

<u>Expression of WET limits</u>

Acute WET limit = 1.0 TU_a (daily maximum)

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

Attachment #1

Document: https://dnr.wisconsin.gov/topic/Wastewater/WET.html.

WET Checklist Summary

	Acute	Chronic
AMZ/IWC	Not Applicable. **0 Points**	Chronic not evaluated
Historical Data	2 tests used to calculate RP. 1 tests failed. **0 Points**	
Effluent Variability	Little variability, no violations or upsets, consistent WWTF operations. **0 Points**	
Receiving Water Classification	Exceptional Resource Water (12 pts) **12 Points**	
Chemical-Specific Data	Reasonable potential for Ammonia limits based on ATC (5 pts) Chromium, Copper, Mercury, Nickel, Zinc and Chloride detected. (3 pts) Additional Compounds of Concern: (2 pts) Selenium Chloroform Di(2-ethylhexyl)phthalate Benzo(a)pyrene **10 Points**	
Additives	No Biocides and one Water Quality Conditioners added. (1 pt) P treatment chemical other than Ferric Chloride (FeCl), Ferrous Sulfate ($FeSO_4$), or alum used: No **1 Points**	
Discharge Category	6 Industrial Contributors. (10 pts) **10 Points**	
Wastewater Treatment	Secondary or Better **0 Points**	
Downstream Impacts	No impacts known **0 Points**	
Total Checklist Points:	**33 Points**	
Recommended Monitoring Frequency (from Checklist):	1x yearly	
Limit Required?	Yes Limit = 1.0 TU_a	
TRE Recommended? (from Checklist)	No	

- According to the requirements specified in s. NR 106.08, Wis. Adm. Code, an acute WET limit is required. The acute WET limit shall be expressed as 1.0 TUa as a daily maximum in the effluent limits table of the permit. A minimum of annual acute monitoring is required because federal regulations in 40 CFR Part 122.44(i) require that monitoring occur at least once per year when a limit is present.

Attachment #2

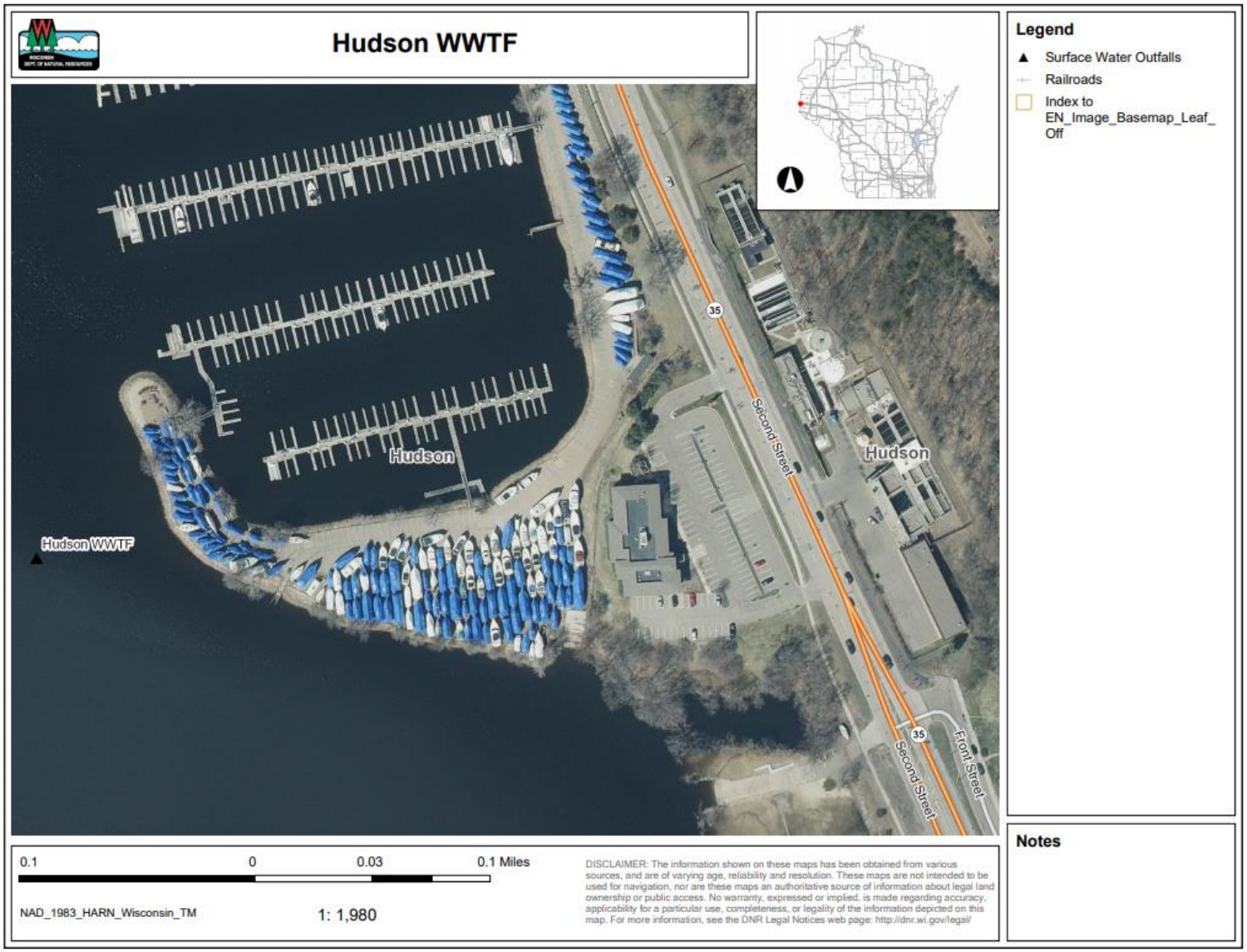
Ammonia Nitrogen Calculations from the February 20, 2015 WQBEL Memo

AMMONIA (as N) LIMITS

Effluent Flow (mgd):	2.2
Effluent Flow (cfs):	3.404
Effluent pH data:	
Begin Date	01-Jan-12
End Date	31-Dec-14
# of Samples	1096
Maximum	7.7
Average	7.29
Standard Deviation	0.121
Estimated 99th Percentile	7.57
Max. Effluent pH (s.u.):	7.50

BACKGROUND INFORMATION:

	summer	***winter***	***spring***	***fall***
4Q3 (cfs)				
7Q10 (cfs)	1194	1194		
30Q5 (cfs)				
7Q2 (cfs)	1700	1700		
Ammonia (mg/L) (1)	0.04	0.08		
Temperature (deg C) (2)	23	10		
pH (std. units) (3)	7.87	7.51		
% of river flow used:	100	25		
Reference weekly flow:	1194	298.5		
Reference monthly flow:	1445.0	361.3		
CRITERIA (in mg/L):				
Acute (@ effl. pH):	19.89	19.89		
4-day Chronic (@ backgrd. pH):				
early life stages present	4.21	10.81		
early life stages absent	4.21	14.47		
30-day Chronic (@ backgrd. pH)				
early life stages present	1.68	4.33		
early life stages absent	1.68	5.79		
EFFLUENT LIMITS (in mg/L):				
Daily maximum	40	40		
Weekly average				
early life stages present	1468	952		
early life stages absent		1277		
Monthly average				
early life stages present	700	455		
early life stages absent		612		

(1) Default Data
(2) Default Data
(3) Default Data

Attachment #3