Evaluations Supporting Application for Discharger-Specific Water Quality Standards Variance for Mercury:

Bad River Band of Lake Superior Tribe of Chippewa Indians Diaperville, Birch Hill and Bad River WWTPs

Prepared for:
Bad River Band of Lake Superior
Chippewa Indians

August 17, 2026

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1 Introduction

The Bad River Band of Lake Superior Tribe of Chippewa Indians (Bad River Band) is in the process of renewing the National Pollution Discharge Elimination (NPDES) permits for the Diaperville Wastewater Sewage Lagoon (DWWSL), Birch Hill Wastewater Sewage Lagoon (BHWWSL) and Bad River Wastewater Treatment Plant (BRWWTP). The current permits expired July 15, 2024. The applications for reissuance of the permits were submitted on April 3, 2024**.** These facilities, like most treatment plants in the Great Lakes basin, cannot meet water quality-based effluent limits for mercury. These three facilities face an especially difficult task, because the most stringent Bad River Band water quality criterion for mercury is an order of magnitude lower than for most Great Lakes basin facilities. This results in a mercury effluent limit of 0.194 ng/l, versus the water quality-based effluent limit of 1.3 ng/l for most Great Lakes basin governments. The Bad River Band's water quality criterion is based on human health protection and accounts for fish consumption rates typical for its members. The Bad River Band recognizes the need to protect wildlife (1.3 ng/l criterion for wildlife designated use, consistent with other Great Lakes basin governments), but the more restrictive Human Health based standard (0.194 ng/l) governs.

The NPDES permits for these facilities should contain water quality-based effluent limits (0.194 ng/l) for mercury to meet the Band's water quality criteria for human health. This criterion supports the Cultural designated use in the Bad River Band's Water Quality Standards. The limits are, however, much lower than existing mercury concentrations in surface water in and around the Bad River Band's reservation. USGS data indicates that mercury levels in and upstream of the Bad River Reservation are significantly greater than the water quality criteria due to human-caused conditions due to atmospheric deposition of mercury. All 67 surface water samples analyzed for total mercury exceeded 0.194 ng/l, the WQS for mercury. The mean value of 4.2 ng/l is more than twenty times the water quality criteria. The lowest value (0.34 ng/l) was found in the only lake sample in the dataset. The variance application is for rivers and swamps, not lakes. The lowest river sample was 0.77 ng/l mercury, four times the water quality criteria. The source of "background" mercury is atmospheric deposition, driven by the worldwide mercury air emissions. The Bad River Band of Lake Superior Tribe of Chippewa Indians is therefore applying for a discharger-specific water quality standards variance for mercury in the DWWSL, BHWWSL and BRWWTP NPDES permits, based on 40 CFR 131.10(g) Factor 3 (human-caused conditions). The variance would apply to receiving waters, Hanson Swamp, Birch Hill Swamp and the Bad River downstream of these facilities, for a 5-year period, starting after EPA approves the variance request.

1.1 Diaperville WWSL

The Diaperville WWSL is an aerobic wastewater stabilization system consisting of two cells. It is located south of US-2 and west of the Bad River (Figure 1-1). The facility discharges 2.3 MG/year to Hanson Swamp under NPDES permit WI-0036544. It serves a population of 80 people. The designated uses for

Hanson Swamp are: Cultural (C1), Commercial (C2), Navigation (N), Wildlife (W2), Aquatic Life and Fish (A), Recreational (R), and Wetland (W3).

1.2 Birch Hill WWSL

The Birch Hill WWSL is an aerobic wastewater stabilization system consisting of two cells. It is located south of US-2 and ~18 miles west of Hurley, WI (Figure 1-1). The facility discharges 5.5 MG/year to Birch Hill Swamp under NPDES permit WI-0036579-5. It serves a population of 290 people. The designated uses for Birch Hill Swamp are: Cultural (C1), Commercial (C2), Navigation (N), Wildlife (W2), Aquatic Life and Fish (A), Recreational (R), and Wetland (W3).

1.3 Bad River WWTP

The Bad River Wastewater Treatment Plant is a Sequencing Batch Reactor located north of US-2 near Odanah, WI (Figure 1-1). The facility currently discharges approximately 0.077 MGD. Treatment consists of mechanical fine screening, equalization, activated sludge with biological phosphorus removal supplemented by chemical precipitation and ultra-violet disinfection prior to discharge to the Bad River. It serves a population of 650 people. Discharges to the Bad River are permitted by NPDES Permit WI-0036587-5. The designated uses for the Bad River are: Cultural (C1), Commercial (C2), Navigation (N), Wildlife (W2), Aquatic Life and Fish (A), Recreation (R), Wild Rice (W1) and Cool Water Fishery (F2).

1.4 Bad River Watershed

The Bad River Watershed Association's 2008 Strategic Plan describes the watershed:

The Bad River Watershed (BRW) drains over 1,000 square miles along Wisconsin's north shore. The headwaters are found in the Chequamegon-Nicolet National Forest. The lower one-third of the watershed is land of the Bad River Band of Lake Superior Tribes of Chippewa Indians Reservation. Small, rural communities including Mellen, Odanah, Gurney, Mason, Grand View, Delta and Marengo are scattered throughout the watershed. The Kakagon Slough/Bad River Slough, located at the mouth of the watershed on Lake Superior, is the largest and possibly most pristine freshwater estuary remaining on Lake Superior. As the only remaining extensive coastal wild rice wetland in the Great Lakes Basin, the Kakagon Slough provides abundant habitat for wild rice, which is highly important to the Tribe's culture, and also provides exceptional habitat for a variety of wildlife. The Watershed is made up of seven sub watersheds - the Upper Bad River draining 137 square miles, the Lower Bad River draining 123 square miles, Tyler Forks draining 78 square miles, the Marengo River draining 217 square miles, the Potato River which drains 140 square miles and the White River sub watershed which drains 360 square miles. The smaller Beartrap Creek sub watershed is included in this watershed as it too drains into the Kakagon Sloughs. The BRW contains one of the most diverse assemblages of fish in the Lake Superior Basin, many of which are listed as "species of management concern" by the Bad River Tribe, U.S. Fish and Wildlife Service and/or Wisconsin Department of Natural Resources (WDNR). Major land uses within the rural Bad River watershed include agriculture (10%), wetlands (16%) and forest (74%). Originally, large white pine forests covered the watershed. A large logging enterprise grew in the area. By the early 1900s the logging industry had completely depleted the forests. Forests are in recovery but with aspen as the major *forest component replacing the original conifers. Though the water resources of the BRW are currently in good condition, several impacts to water quality indicate they may no longer be termed "pristine". Prior to the formation of the BRWA, comparably little data on water chemistry existed. The need for data to responsibly make decisions affecting water resources in the basin was a major impetuous for the formation of the BRWA.*

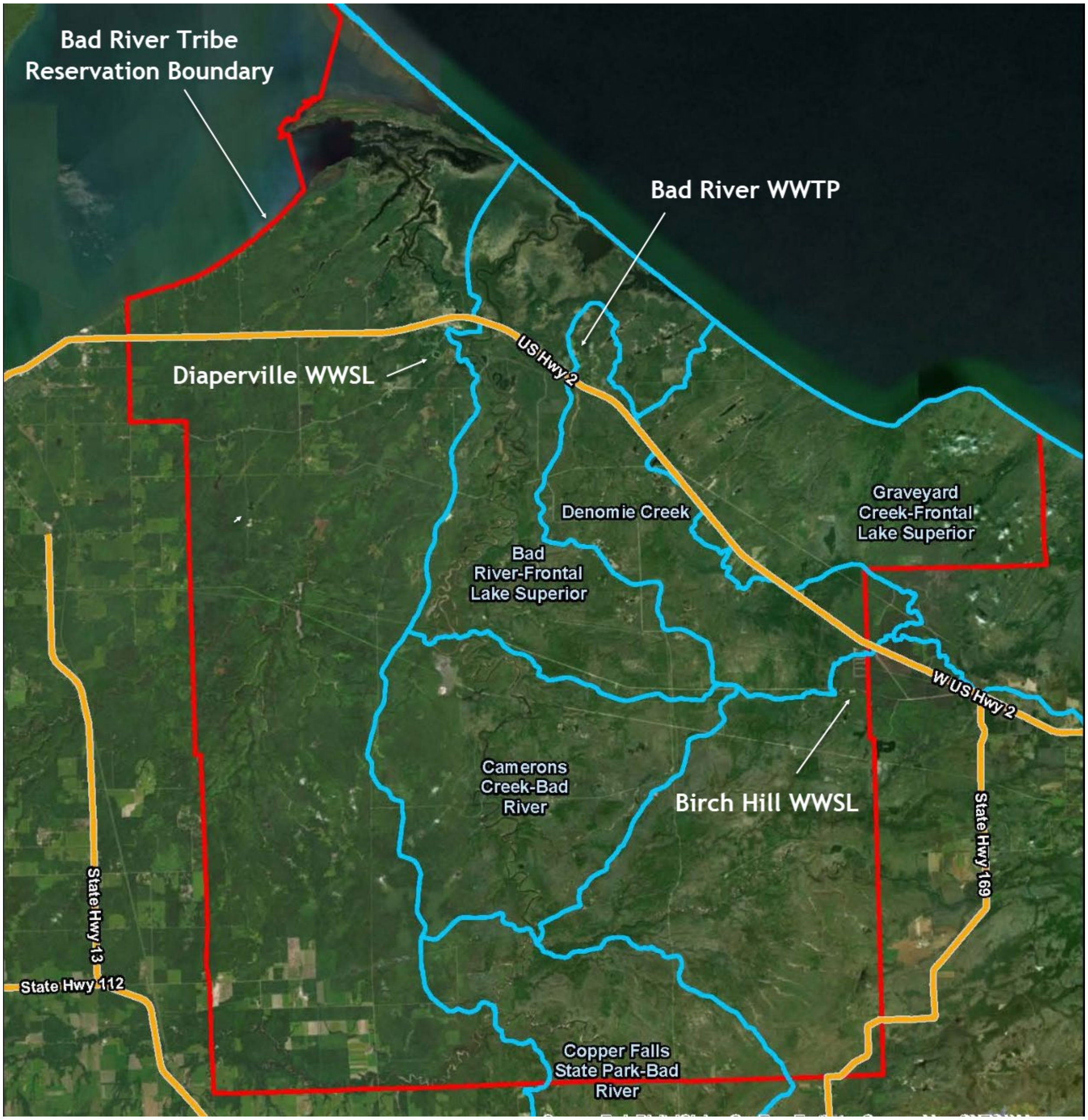

Figure 1-1. Bad River Reservation and Wastewater Treatment Plants

1.5 Regulatory Background

A multiple discharger-specific water quality variance is a time-limited water quality criterion change for a specific pollutant, allowing the Bad River Band relief from meeting the mercury WQBEL. Federal regulations allow the flexibility to adopt a variance based upon one of the six use attainability factors outlined in 40 CFR §131.10(g). A variance serves as the applicable water quality standard for the permit, and only applies to the permittees (in this case, Diaperville WWSL, Birch Hill WWSL and Bad River WWTP) specified in the variance. Federal regulations require that where a tribe adopts a water quality standards variance, the tribe must retain the underlying designated use and criterion addressed by the variance; all other applicable standards not specifically addressed by the variance remain in effect.

The six use attainability factors (40 CFR §131.10(g)) that may be used to justify a variance include:

1. Naturally occurring pollutant concentrations prevent the attainment of the use; or
2. Natural, ephemeral, intermittent or low flow conditions or water levels prevent the attainment of the use, unless these conditions may be compensated for by the discharge of sufficient volume of effluent discharges without violating State water conservation requirements to enable uses to be met; or
3. Human caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place; or
4. Dams, diversions or other types of hydrologic modifications preclude the attainment of the use, and it is not feasible to restore the water body to its original condition or to operate such modification in a way that would result in the attainment of the use; or
5. Physical conditions related to the natural features of the water body, such as the lack of a proper substrate, cover, flow, depth, pools, riffles, and the like, unrelated to water quality, preclude attainment of aquatic life protection uses; or
6. Controls more stringent than those required by sections 301(b) and 306 of the Clean Water Act would result in substantial and widespread economic and social impact.

In this case, the proposed variance is based on Factor 3: Human caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place.

1.6 Basis for Variance

The widespread contamination caused by global air emissions and subsequent deposition of mercury justifies a discharger-specific variance based on Factor 3: human caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place. This report addresses specific parts of Factor 3 to support the variance request:

- Is the source of pollution human-caused?
- Is attainment of the use prevented?
- Can the human-caused condition be remedied?
- What is the Highest Attainable Condition?

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2 Are the sources of pollution human caused?

The first determination to be made is whether the sources of mercury are human caused. This section describes the human activities that led to mercury contamination in the Bad River Watershed.

2.1 History of Atmospheric Mercury Emissions

Mercury concentrations in the Bad River watershed are driven by atmospheric sources that are still increasing and show no signs of abating in the near term. While natural sources of mercury to the atmosphere exist, they are dwarfed by anthropogenic sources. The United Nations 2018 Global Mercury Assessment found that “Human activities have increased total atmospheric concentrations [of mercury] by about 450% above natural levels.” This report further concluded that “Estimated global anthropogenic emissions of mercury to the atmosphere for 2015 are approximately 20% higher than they were in updated estimates for 2010.” The report further concludes that “Reductions in mercury emissions and resulting declines in atmospheric concentrations may take time to show up as reductions of mercury concentrations in biota” (UN Environment, 2019).

2.2 Atmospheric Deposition of Mercury near the Bad River Band Reservation

The National Atmospheric Deposition Program (NADP) has been monitoring mercury in the atmosphere and in deposition since the 1990s. Figure 2-1 shows the location of monitors utilized to collect mercury deposition data near the Great Lakes.

Figure 2-1. Location of monitors in 2021 for the (left) Mercury Deposition Network (MDN), (middle) Mercury Litterfall Network (MLN), and (right) Atmospheric Mercury Network (AMNet) in the Great Lakes Region.

NADP developed annual gradient maps of precipitation-weighted mean mercury concentration (ng/l) and wet mercury deposition (ug/m^2). The 2022 maps are shown in Figure 2-2 and Figure 2-3. Data from these figures is used to illustrate the source of water quality criteria violations in the Bad River watershed.

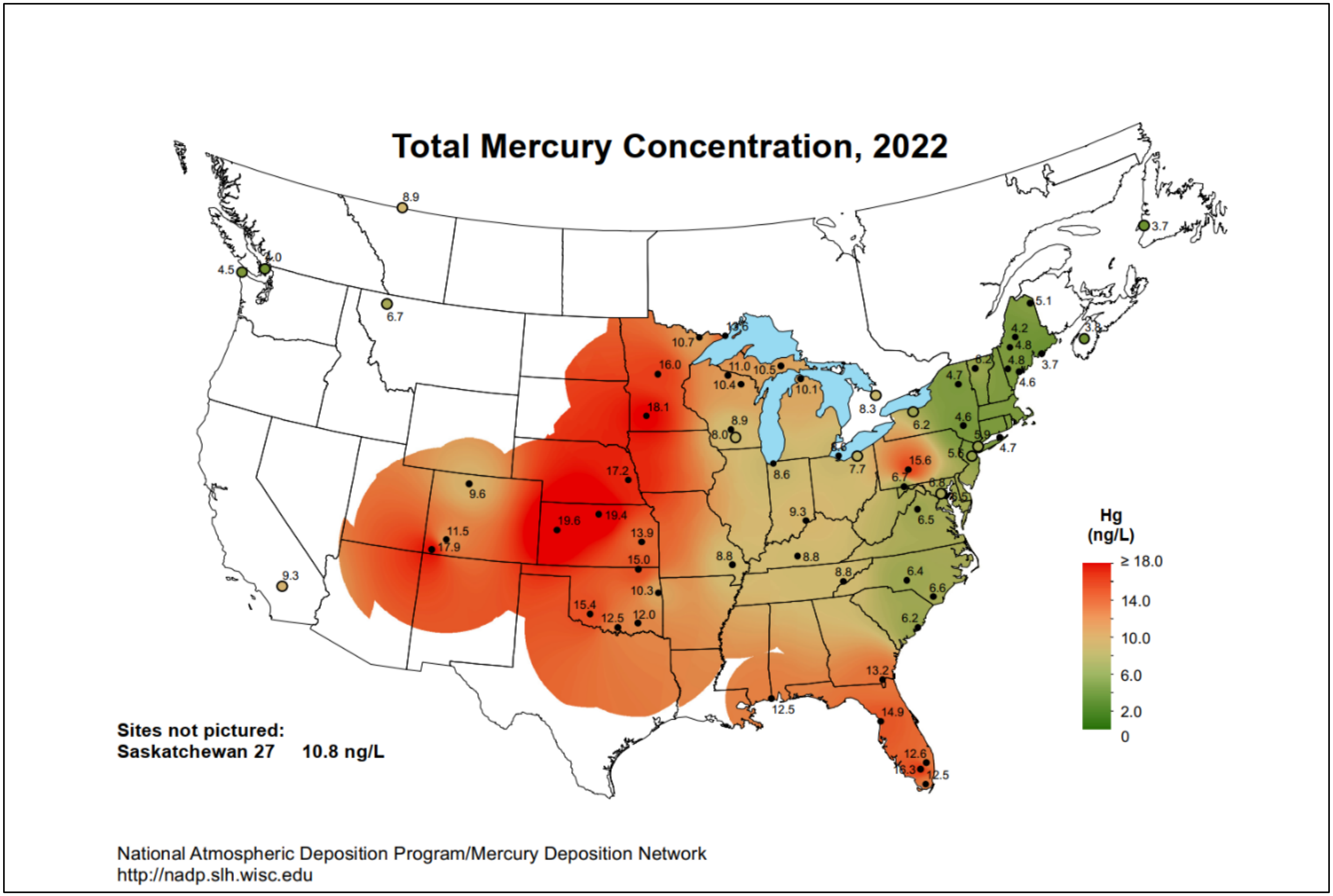

Figure 2-2. Mercury Concentration in Rainfall in the Eastern US, 2022

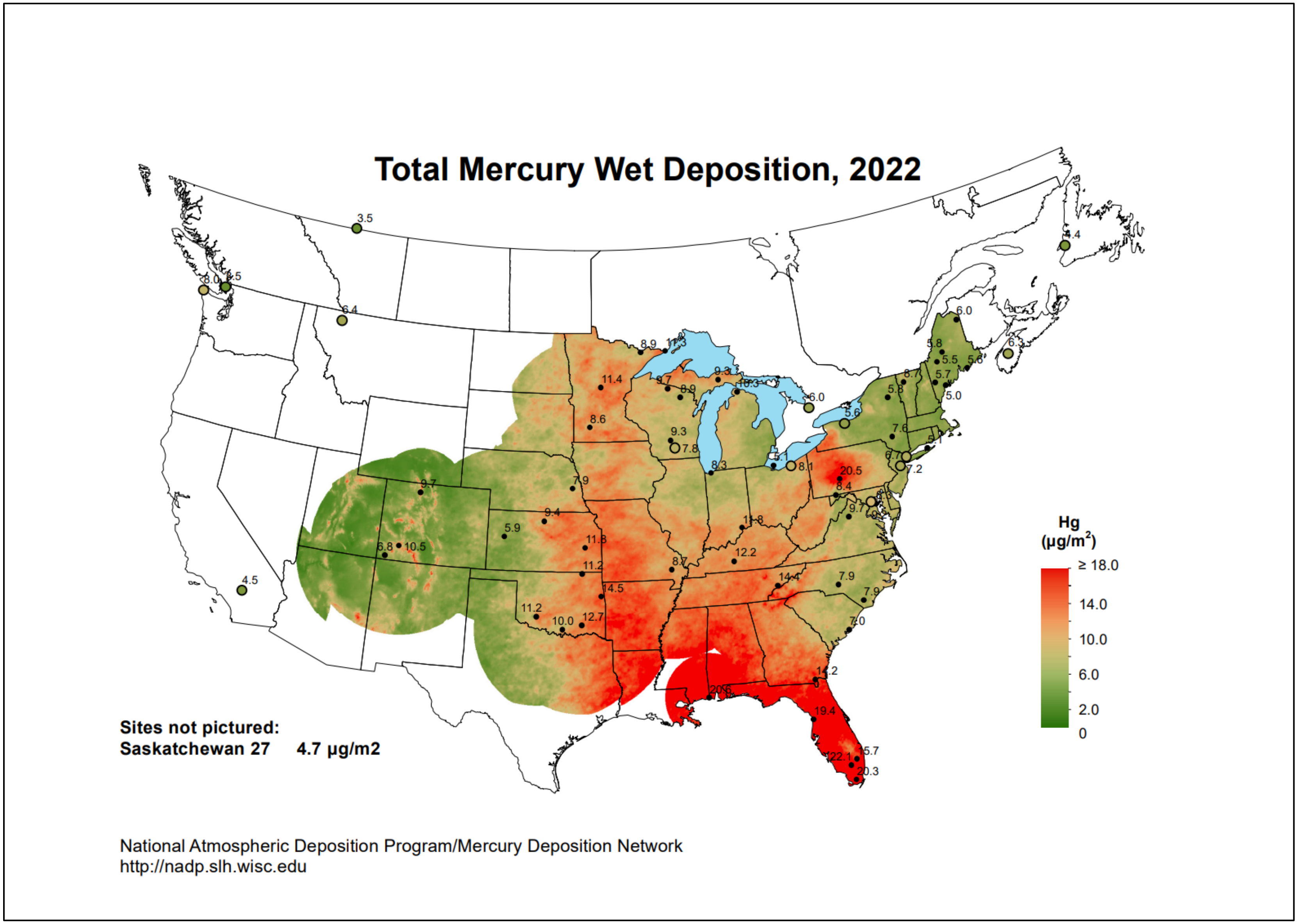

Figure 2-3. Mercury Wet Deposition for the Eastern US, 2022

Data from the three monitoring locations closest to the Bad River Band Reservation are tabularized in Attachment 1. The data for the years 2018 – 2022 were used to estimate the average concentration of mercury in precipitation on the Bad River Band Reservation. The annual average mercury concentration in rainfall for this period ranged from 8.9 ng/l to 13.5 ng/l. The 5-year average was 11.4 ng/l, which is nearly sixty times the Bad River Band water quality criterion (0.194 ng/l).

Wet deposition data from the three closest NADP monitoring sites were averaged from 2018-2022 to estimate wet deposition on the Bad River watershed (2750 km^2) and Bad River Band Reservation (504 km^2). The estimated annual mercury deposition for this period was 53 lbs/year on the Bad River watershed and 9.7 lbs/year on the Bad River Band Reservation (Table 2-1).

Wet deposition dwarfs the combined annual mercury discharges from the three treatment plants (0.0082 lbs/year) that are seeking a mercury variance. Table 2-1 provides an estimate of wet deposition on the wastewater sewage lagoons, Bad River Band Reservation and Bad River watershed. It also provides mercury discharge data for the three wastewater plants and compares the discharges to wet deposition values, as described below.

The annual mercury discharge from Birch Hill WWSL is 0.00031 lbs/year, or 0.003% of the estimated wet deposition on the Bad River Band Reservation and 0.0006% of the estimated mercury deposition on the Bad River watershed. Estimated annual wet deposition onto the 0.022 km^2 lagoons is 0.00042 lbs/year, somewhat greater than the estimated annual discharge from the lagoons of 0.00031 lbs/year.

The annual mercury loading from Diaperville WWSL is 0.00019 lbs/year, or 0.002% of the estimated wet deposition on the Bad River Band Reservation and 0.0004% of the estimated mercury deposition on the Bad River watershed. Estimated annual wet deposition onto the 0.016 km^2 lagoons is 0.00031 lbs/year, somewhat higher than the estimated annual discharge from the lagoons of 0.00019 lbs/year.

The annual mercury loading from Bad River WWTP is 0.0077 lbs/year, or 0.08% of the estimated wet deposition on the Bad River Band Reservation and 0.01% of the estimated mercury deposition on the Bad River watershed.

The estimated total mercury discharge from Bad River Band’s three treatment plants combined is 0.0082 lbs/year. This is <0.02% of the estimated wet deposition of mercury onto the Bad River watershed and <0.1% of the wet deposition of mercury onto the Bad River Band Reservation. Attachment 1 provides detailed calculations.

Table 2-1. Comparison of Atmospheric Deposition of Mercury and Wastewater Discharges

Atmospheric Deposition of Mercury Compared to Wastewater Discharges									
	Area	Wet Deposition	Annual Mercury Wet Depositon	Annual Wastewater Flow (NPDES Application)	Wastewater Mercury Concentration, Average	Annual Average Wastewater Mercury	Discharge as a Percentage of Hg deposited on Bad River Band Reservation	Wastewater Discharge as a Percentage of Mercury on Bad River Watershed	Wastewater Discharge as a Percentage of Wet Deposition on Lagoon surface
	km^2	ug/m2	lbs/year	MG	ng/l	lbs/year	%	%	%
Bad River Band Reservation	504	8.7	9.7						
Bad River Watershed	2750	8.7	53						
Birch Hill WWSL	0.022	8.7	*0.00042*	5.5	6.8	*0.00031*	0.003%	0.001%	74%
Diaperville WWSL	0.016	8.7	*0.00031*	2.3	10	*0.00019*	0.002%	0.0004%	63%
Bad River WWTP	na	na	na	28	33	0.0077	0.08%	0.01%	na
Total Mercury Loading from WWTPs						**0.0082**	**0.085%**	**0.016%**	

Further evidence that atmospheric deposition, not Bad River Band wastewater discharges, is causing non-attainment of water quality criteria is found by evaluating Bad River watershed samples downstream of the wastewater treatment plant discharges. There are six sample locations downstream of the wastewater discharges that were sampled 29 times. For the entire watershed, 14 locations were sampled at total of 68 times. The average total mercury concentration in samples downstream of wastewater discharges is 3.6 ng/l, compared to 4.2 ng/l watershed wide. The median total mercury concentration in samples downstream of wastewater discharges is 2.7 ng/l, compared to 4.3 ng/l watershed wide. Detailed sample results are found in Attachment 2.

2.3 Conclusion

Atmospheric mercury deposition from worldwide emissions has led to significant mercury contamination of the Bad River Watershed. Streams and wetlands in the Bad River Band Reservation do not meet water quality criteria because of human-caused atmospheric mercury deposition. World-wide mercury emissions are continuing to increase. Table 2-1 estimates that the average annual mercury deposition onto the Bad River Watershed is 53 lbs. Conservatively we can assume 1% of the atmospherically deposited mercury enters the Bad River. That gives an annual mercury contribution of 0.53 lbs. By contrast, the treatment plants covered by this variance application discharge 0.0094 lbs of mercury annually, less than 2% of the presumed atmospheric contribution to the river.

3 Is attainment of the use prevented?

The second determination to be made in evaluating Factor 3 is whether conditions in the Bad River Watershed prevent the attainment of the Bad River Band water quality criteria. As described below, mercury concentrations in and upstream of the Bad River Band Reservation consistently exceed both human health and wildlife-based water quality criteria.

3.1 Applicable Water Quality Criteria

Bad River Band's water quality standards specify both human-health and wildlife-based criteria for mercury. The 0.194 ng/l mercury limit in the Diaperville WWSL, Birch Hill WWSL and Bad River WWTP NPDES permits are based on the Human Health based criteria found in Table 3-1.

Table 3-1. Water quality criteria for total mercury

	Human Health (ng/L)	Wildlife (ng/L)
Total Mercury	0.194	1.3

Note that for mercury, the human health cancer and non-cancer water quality criteria are the same. The evaluations described in this section of the report therefore address both cancer and non-cancer criteria.

3.2 Attainment of Criteria in the Bad River Watershed

The Bad River Band and United States Geological Survey (USGS) have measured total mercury in river and lake samples on and upstream of the Bad River Band Reservation sixty times since 2010. All results exceeded the Bad River Band's mercury water quality criteria (criteria) of 0.194 ng/l by a wide margin. The mean mercury level was 4.2 ng/l, more than twenty times the criteria. The lowest river sample contained 0.77 ng/l mercury, still almost four times the criteria. The single sample from a lake (0.34 ng/l at Lake Site 3) also exceeded the criteria. Existing conditions in the Bad River watershed do not meet the Bad River Band's mercury criteria. Figure 3-1 shows sample locations. Table 3-2 summarizes mercury sample results for the Bad River Watershed. All mercury sample results are tabularized in Attachment 2.

Nonattainment is not caused by upstream point source discharges of mercury. The largest upstream point source is the Mellen WWTF, which discharged 0.0009 lbs of mercury per year from 2020-2025 (WDNR's WQBEL development document). In Section 2.3 of this document, we conservatively estimated annual atmospheric contribution to the Bad River as 0.53 lbs per year. The Mellen WWTF discharges less than 0.2% of the atmospheric mercury contribution.

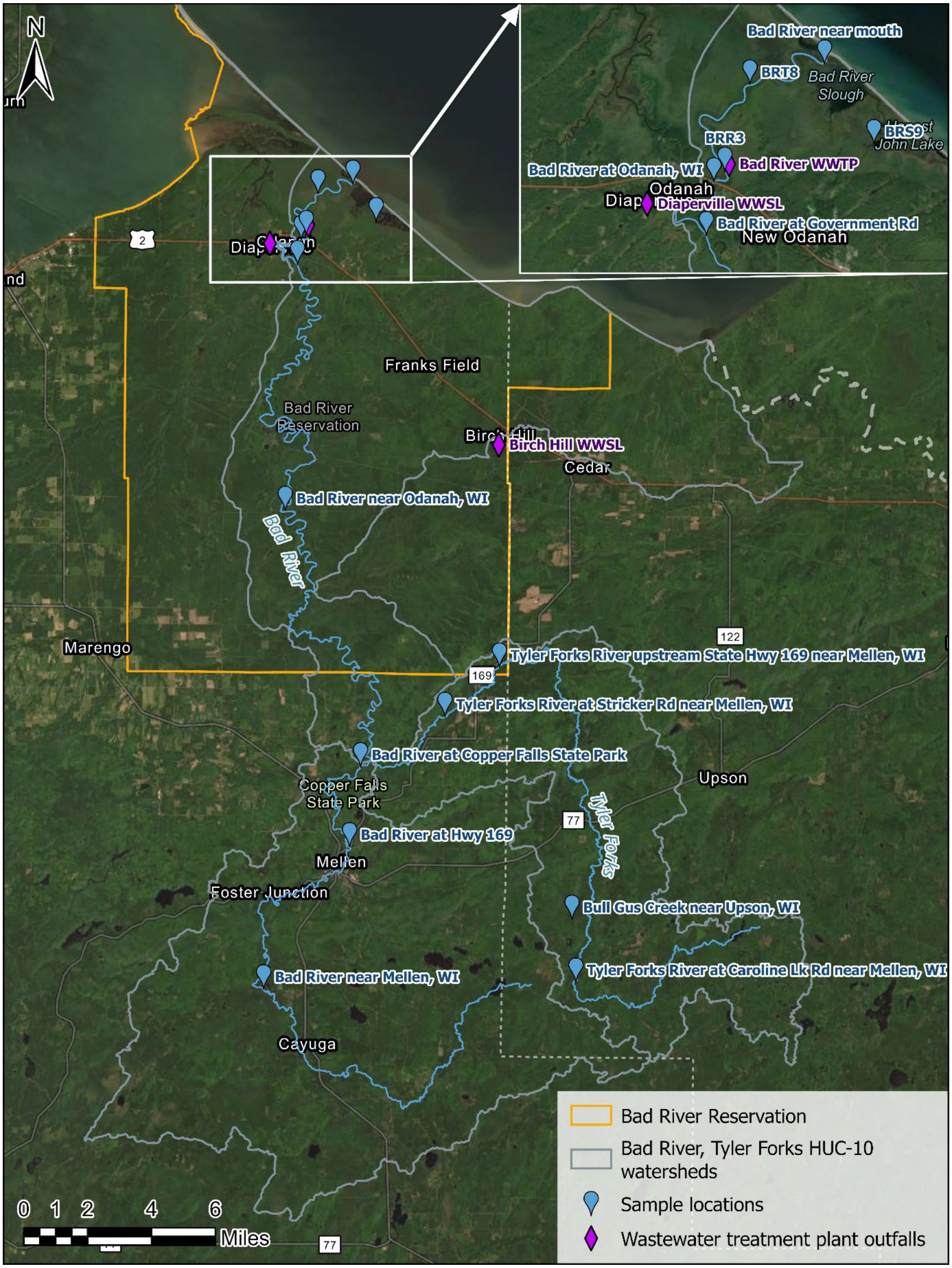

Figure 3-1. Total Mercury Sample Locations

Table 3-2. Mercury Concentrations in the Bad River Watershed

	Mean Concentration (ng/L)	Median Concentration (ng/L)	Maximum Concentration (ug/l)	Minimum Concentration (ug/l)	Water Quality Criterion (ug/l)	Number of Samples
Total Mercury	4.2	4.3	10.4	0.34	0.194	60

3.3 Conclusion

The Bad River Band water quality criteria for mercury are not being attained in the Bad River Watershed upstream of the three discharges covered by this variance application. The largest upstream point source discharge of mercury to the Bad River Watershed is less than 0.2% of the atmospheric contributions to the Bad River. USGS data shows that the mean and median mercury concentration in the watershed are more than twenty times the Bad River Water Quality criteria. Even the lowest river sample (of 59 samples) mercury concentration is four times the Bad River Water Quality criteria. Atmospheric deposition is the primary driver of non-attainment.

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4 Can the human caused condition be remedied during the term of the variance?

Another question to be addressed about Factor 3 is whether the human-caused conditions can be remedied during the term of the variance. The proposed term of the variance is five years, consistent with the term of the DWWSL, BHWWSL and BRWWTP NPDES permits. The variance could be renewed, as appropriate, for future NPDES permit terms based upon a showing that the factors addressed in this report have not changed. This section of the report discusses atmospheric mercury deposition trends, and the likelihood of human caused water quality criteria exceedances in the Bad River Watershed abating over the next five years.

4.1 Atmospheric Mercury Deposition

The primary source of mercury to the Bad River Watershed is atmospheric mercury deposition originating from worldwide mercury emissions. There are no significant air emissions on the Bad River Band Reservation. While awareness of this issue has spawned reductions in emissions from some sectors, worldwide mercury emissions to the atmosphere are still increasing. The United Nation's 2018 Global Mercury Assessment estimates that 2015 anthropogenic global mercury air emissions were 2200 tonnes, 20% higher than their 1818 tonnes estimate for 2010. Even more discouraging, the anthropogenic emissions are only 30% of total atmospheric emissions. Environmental processes comprise 60% of global atmospheric emissions, much of which involves recycling of anthropogenic mercury previously deposited to soils and water. The remaining 10% comes from natural sources, like volcanos. Even if anthropogenic releases decline over the next five years, releases from environmental processes (currently twice the anthropogenic emissions) will lag as mercury previously deposited on soils and water continues to be remobilized. While there are no estimates as to how long it will take for either anthropogenic or environmental processes to decrease significantly, a major turnaround in the next five years is not possible. Since mercury concentrations in the Bad River Watershed are over twenty times the Bad River Band's water quality criteria, it is safe to conclude that mercury concentrations in the Bad River Watershed will remain well above 0.194 ng/l for more than five years.

4.2 Conclusion

The driver for Human-Caused mercury contamination is atmospheric deposition from world-wide mercury sources. The United Nations' most recent estimate shows that worldwide anthropogenic mercury emissions are continuing to increase. The United Nations also estimates that environmental processes emit twice as much mercury to the atmosphere as anthropogenic sources. Since much of the mercury emitted by environmental processes is 'recycled' from previous anthropogenic emissions, there will be a time lag between reductions in anthropogenic emissions and environmental process emissions. Current mercury concentrations in the Bad River Watershed are more than twenty times the Water Quality Criteria. There is no chance that the mercury criteria will be met during the next five years.

5 Highest Attainable Condition

5.1 Finally, a variance under Factor 3 must identify the Highest Attainable Condition that can be achieved during the term of the variance. For the Bad River Band, this entails interim effluent limits for the three wastewater treatment plants and implementation of pollutant minimization plans for each treatment plant. The Bad River Band is emphasizing Pollutant Minimization as the best path to attaining the water quality criteria for mercury. Another alternative, wastewater treatment, transfers mercury from one environmental medium to another, while not eliminating all pathways to the environment. For sanitary wastewater treatment, mercury is transferred to biosolids which are placed in landfills. This mercury is cycled back to wastewater treatment plants in the form of landfill leachate. Prevention and source reduction can ultimately eliminate mercury entry into the environment. While the Bad River Band will continue to optimize wastewater treatment, pollutant minimization will be emphasized. Diaperville, Birch Hill and Bad River Treatment Plant Performance

All three wastewater treatment systems are constructed and operated to meet technology based effluent limits for BOD and suspended solids. Treatment of municipal effluents to meet technology-based limits is known to reduce mercury concentration. USEPA Industrial Pretreatment Guidance[1] suggests a median mercury removal rate of 60% in an activated sludge treatment plant. The Bad River WWTP utilizes activated sludge treatment. The Diaperville and Birch Hill systems utilize wastewater stabilization lagoons. Treatment processes in lagoon systems are like activated sludge, so mercury removal through lagoons is expected to be similar. Mean influent and effluent mercury levels from 2019 – 2023 and percent removals for each system were:

Diaperville WWSL (n=10): 40 ng/l and 10 ng/l, 75%

Birch Hill WWSL (n= 10): 83 ng/l and 6.8 ng/l, 92%

Bad River WWTP (n = 25): 84 ng/l and 33 ng/l, 61%

The actual mercury removal rates for these three systems are better than the median removal rate (60%) for activated sludge plants. This is especially impressive for the lagoon systems, as they are less efficient at suspended solids reduction. Furthermore, lagoons are subject to atmospheric deposition approximately equal to the mass of mercury in their discharges (Attachment 1). If atmospheric deposition is added to the wastewater influent, mercury removal rates would be even higher than reported above. All three plants are removing more mercury than expected.

5.2 Proposed NPDES Mercury Effluent Limitations

Mercury data for Bad River Band's three treatment facilities is found in Attachment 3. Effluent mercury concentrations are variable at these facilities, presenting a challenge for setting interim effluent limits. Mercury contamination is widespread in the environment, making obtaining representative samples at the parts per trillion level a real challenge. Bad River Band staff have improved mercury sampling technique in recent years. As a result, the inexplicable spikes in both influent and effluent mercury results will decline going forward. Using existing data, the "Highest Attainable Condition" proposed is the upper 95% confidence interval for existing effluent data. Using this technique, effluent limits for Bad River Band facilities would be:

Diaperville WWSL– 21 ng/l

Birch Hill WWSL – 9.8 ng/l

Bad River WWTP – 51 ng/l

Inserting these proposed effluent limits (red font) into effluent data shows reasonable compliance for the lagoon systems (90%):

Diaperville WWSL: 54, 21, 11, 9.9, 5.9, 5.9, 4.3, 4.0, 2.8, 2.1 and1.5 ng/l. Historic non-compliance: 10% (1 of 10).

Birch Hill WWSL: 16, 9.8, 9.8, 9, 8, 7.1, 6.5, 3.3, 2.8, 2.8 and 2.4 ng/l. Historic non-compliance: 10% (1 of 10).

For the Bad River system, effluent data is highly variable, ranging from 1.2 to 160 ng/l. Influent mercury concentrations range between 9 and 450 ng/l. Historic non-compliance with an effluent limit equal to the upper 95% confidence interval is quite high, 27%. While improved sampling technique will reduce data variability, a strong focus on mercury minimization is appropriate for this system. Sampling to isolate and eliminate mercury sources is appropriate and is provided for in the Band's proposed Pollutant Minimization Plan for Bad River SBR.

The proposed effluent limit (red font) is inserted into effluent data:

Bad River WWTP: 160, 85, 82, 80, 69, 54, 51, 39, 35, 23, 22, 19, 12, 11, 9.2, 5.4, 4.5, 3.7, 3.5, 2.7, 2.0, 1.8 and1.2 ng/l. Historic non-compliance: 27% (6 of 22).

5.3 Mercury Minimization Program

The Bad River Band has developed facility-specific Mercury Minimization Plans to further reduce mercury discharges during the life of the proposed variances. Key components of those plans include:

(a) Education on what individuals can do to minimize mercury discharges to the environment

(b) Household hazardous waste collection

5.3.1.b Testing the effectiveness of chairside amalgam traps at the dental facility (Bad River WWTP).

5.3.1.c Where appropriate, collection system testing to identify mercury sources

(a) .

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6 Conclusions

Worldwide anthropogenic mercury emissions and resulting deposition on land and water have made complying with the Bad River Band's water quality criteria for mercury impossible at this time. This justifies a discharger specific variance for mercury at the three facilities treating community wastewater based on 40 CFR §131.10(g) Factor 3, human caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place. Specifically, this report demonstrates:

- The source of pollution is human-caused;
- Attainment of the use is prevented; and
- The human-caused condition cannot be remedied over the term of the variance.

For the term of the variance, the Bad River Band proposes a Highest Attainable Condition:

- Mercury effluent limits representing the 95^{th} percentile concentration for each of the three facilities covered by this variance:
    - Diaperville WWSL: 21 ng/l as a monthly average.
    - Birch Hill WWSL: 9.8 ng/l as a monthly average.
    - Bad River WWTP: 51 ng/l as a monthly average.
- The Bad River Band will implement facility-specific Pollutant Minimization Plans attached to this variance application. Those plans include:
    - Education on what individuals can do to minimize mercury discharges to the environment
    - Household hazardous waste collection
    - Testing the effectiveness of chairside amalgam traps at the dental facility (Bad River WWTP).
    - Installation of chairside amalgam traps at new dental facilities (Bad River WWTP).
    - Where appropriate, collection system testing to identify mercury sources.

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7 References

Bad River Watershed Association Strategic Plan, Adopted January 2008

Local Limits Development Guidance Appendices, EPA 833-R-04-002B, July 2004

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UN Environment, 2019. Global Mercury Assessment 2018. UN Environment Programme, Chemicals and Health Branch Geneva, Switzerland ISBN: 978-92-807-3744-8

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Attachment 1. Mercury Deposition Data and Calculations

National Atmospheric Depositon Program

Data near the Bad River Band Reservation

	Wet Deposition, ug/m^2						Precipitation, ng/l			
	Central MN	Near Ashland, WI	Near Presque Isle, WI	Bad River Reservation Estimate			Central MN	Near Ashland, WI	Near Presque Isle, WI	Bad River Reservation Estimate
2022	11.4		9.7	10.6			16.0		11.0	13.5
2021	7.1	9.9		8.5			9.6	14.4		12.0
2020	9.6	6.7		8.2			14.8	10.8		12.8
2019	9.9	7.9		8.9			8.8	9.0		8.9
2018	8.0	7.2		7.6			10.8	8.5		9.7
				8.7						**11.4**

National Atmospheric Deposition Program (NRSP-3). 2022. NADP Program Office, Wisconsin State Laboratory of Hygiene, 465 Henry Mall, Madison, WI 53706.

Atmospheric Deposition of Mercury Compared to Wastewater Discharges

	Area	Wet Deposition	Annual Mercury Wet Depositon	Annual Wastewater Flow (NPDES Application)	Wastewater Mercury Concentration, Average	Annual Average Wastewater Mercury	Discharge as a Percentage of Hg deposited on Bad River Band Reservation	Wastewater Discharge as a Percentage of Mercury on Bad River Watershed	Wastewater Discharge as a Percentage of Wet Deposition on Lagoon surface
	km^2	ug/m2	lbs/year	MG	ng/l	lbs/year	%	%	%
Bad River Band Reservation	504	8.7	9.7						
Bad River Watershed	2750	8.7	53						
Birch Hill WWSL	0.022	8.7	*0.00042*	5.5	6.8	*0.00031*	0.003%	0.001%	74%
Diaperville WWSL	0.016	8.7	*0.00031*	2.3	10	*0.00019*	0.002%	0.0004%	63%
Bad River WWTP	na	na	na	28	33	0.0077	0.08%	0.01%	na
Total Mercury Loading from WWTPs						**0.0082**	**0.085%**	**0.016%**	

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Attachment 2. Mercury Measurements in the Bad River Watershed

Site_name	Date	Depth (m)	Total Hg (ng/l)
BAD RIVER AT COPPER FALLS STATE PARK	9/5/2018	0	7.2
BAD RIVER AT GOVERNMENT ROAD NEAR ODANAH WI	9/17/2014	0.5	5.4
BAD RIVER AT HIGHWAY 169 NEAR MELLEN WI	8/20/2013	0.3	1.6
BAD RIVER AT HIGHWAY 169 NEAR MELLEN WI	9/16/2014	0.5	6.5
BAD RIVER AT HIGHWAY 169 NEAR MELLEN WI	7/21/2015	0.5	4.3
BAD RIVER AT HIGHWAY 169 NEAR MELLEN WI	10/20/2015	0	1.8
BAD RIVER AT HIGHWAY 169 NEAR MELLEN WI	4/5/2016	0.5	5.4
BAD RIVER AT HIGHWAY 169 NEAR MELLEN WI	4/26/2016	0.5	9.0
BAD RIVER AT HIGHWAY 169 NEAR MELLEN WI	8/9/2016	0.5	3.5
BAD RIVER AT HIGHWAY 169 NEAR MELLEN WI	8/9/2016	0.5	3.5 dup
BAD RIVER AT ODANAH WI	7/22/2014	0	2.3
BAD RIVER AT ODANAH WI	9/17/2014	0.5	4.7
BAD RIVER AT ODANAH WI	10/21/2015	0.5	0.95
BAD RIVER NEAR MELLEN WI	8/20/2013	0.2	2.0
BAD RIVER NEAR MELLEN WI	9/16/2014	0.5	7.2
BAD RIVER NEAR MELLEN WI	10/20/2015	0	2.1
BAD RIVER NEAR MELLEN WI	4/5/2016	0.5	5.9
BAD RIVER NEAR MELLEN WI	4/26/2016	0.5	9.5
BAD RIVER NEAR MELLEN WI	8/9/2016	0.5	4.4
BAD RIVER NEAR MOUTH	7/22/2014	0.5	1.3
BAD RIVER NEAR MOUTH	9/16/2014	0	5.6
BAD RIVER NEAR ODANAH WI	10/6/2010	0.1	4.75
BAD RIVER NEAR ODANAH WI	8/9/2011	0.25	5.6
BAD RIVER NEAR ODANAH WI	8/21/2013	2	1.3
BAD RIVER NEAR ODANAH WI	9/17/2014	0.5	5.0
BAD RIVER NEAR ODANAH WI	7/22/2015	0.5	2.7
BAD RIVER NEAR ODANAH WI	8/19/2015	0.5	1.2
BAD RIVER NEAR ODANAH WI	4/5/2016	0.5	5.1
BAD RIVER NEAR ODANAH WI	4/27/2016	0.5	10.4
BAD RIVER NEAR ODANAH WI	8/10/2016	0.5	2.9
BAD RIVER NEAR ODANAH WI	4/27/2021	0	8.0
BAD RIVER NEAR ODANAH WI	5/19/2021	0	1.6
BAD RIVER NEAR ODANAH WI	5/24/2021	0	6.4
BAD RIVER NEAR ODANAH WI	6/30/2021	0	2.8
BAD RIVER NEAR ODANAH WI	7/28/2021	0	1.7
BAD RIVER NEAR ODANAH WI	8/25/2021	0	1.1
BAD RIVER NEAR ODANAH WI	9/29/2021	0.5	1.2
BAD RIVER NEAR ODANAH WI	10/5/2021	0	2.5
BAD RIVER NEAR ODANAH WI	10/25/2021	0	1.3
BAD RIVER NEAR ODANAH WI	4/19/2022	0	7.0
BAD RIVER NEAR ODANAH WI	4/25/2022	0	9.0
BAD RIVER NEAR ODANAH WI	10/11/2022	0	0.77
BRR3	8/2/2017	0	1.1
BRS9	8/3/2017	0	1.4

Site_name	Date	Depth (m)	Total Hg (ng/l)
BRT8	8/2/2017	0	1.1
BULL GUS CREEK NEAR UPSON WI	4/28/2014	0.5	5.4
BULL GUS CREEK NEAR UPSON WI	4/28/2014	0.5	5.5 dup
BULL GUS CREEK NEAR UPSON WI	6/5/2014	0.5	4.2
BULL GUS CREEK NEAR UPSON WI	6/5/2014	0.5	4.1 dup
BULL GUS CREEK NEAR UPSON WI	7/15/2014	0.2	4.5
BULL GUS CREEK NEAR UPSON WI	9/16/2014	0.5	2.6
LAKE SITE 3	7/22/2014	0.5	0.34
TYLER FORKS RIVER AT CAROLINE LK RD NR MELLEN WI	8/21/2013	0.2	1.8
TYLER FORKS RIVER AT CAROLINE LK RD NR MELLEN WI	7/22/2015	0.5	5.1
TYLER FORKS RIVER AT CAROLINE LK RD NR MELLEN WI	10/21/2015	0.5	1.9
TYLER FORKS RIVER AT CAROLINE LK RD NR MELLEN WI	10/21/2015	0.5	2.0 dup
TYLER FORKS RIVER AT CAROLINE LK RD NR MELLEN WI	4/6/2016	0.5	6.6
TYLER FORKS RIVER AT CAROLINE LK RD NR MELLEN WI	4/6/2016	0.5	6.7 dup
TYLER FORKS RIVER AT CAROLINE LK RD NR MELLEN WI	4/27/2016	0.5	9.4
TYLER FORKS RIVER AT CAROLINE LK RD NR MELLEN WI	8/10/2016	0.5	5.1
TYLER FORKS RIVER AT STRICKER ROAD NEAR MELLEN WI	8/20/2013	0.2	1.7
TYLER FORKS RIVER AT STRICKER ROAD NEAR MELLEN WI	8/20/2013	0.2	1.7 dup
TYLER FORKS RIVER AT STRICKER ROAD NEAR MELLEN WI	4/28/2014	0	7.9
TYLER FORKS RIVER AT STRICKER ROAD NEAR MELLEN WI	6/5/2014	0.5	8.2
TYLER FORKS RIVER AT STRICKER ROAD NEAR MELLEN WI	7/15/2014	0.3	5.0
TYLER FORKS RIVER AT STRICKER ROAD NEAR MELLEN WI	9/16/2014	0.5	5.4
TYLER FORKS RIVER AT STRICKER ROAD NEAR MELLEN WI	7/21/2015	0.5	3.7
TYLER FORKS RIVER AT STRICKER ROAD NEAR MELLEN WI	8/19/2015	0.5	1.5
TYLER FORKS RIVER AT STRICKER ROAD NEAR MELLEN WI	10/20/2015	0.5	1.6
TYLER FORKS RIVER AT STRICKER ROAD NEAR MELLEN WI	10/20/2015	0.5	1.5 dup
TYLER FORKS RIVER AT STRICKER ROAD NEAR MELLEN WI	4/6/2016	0.5	5.1
TYLER FORKS RIVER AT STRICKER ROAD NEAR MELLEN WI	4/26/2016	0.5	8.2
TYLER FORKS RIVER AT STRICKER ROAD NEAR MELLEN WI	4/26/2016	0.5	8.2 dup
TYLER FORKS RIVER AT STRICKER ROAD NEAR MELLEN WI	8/9/2016	0.5	3.9
TYLER FORKS RIVER UPSTREAM ST HWY 169 NR MELLEN WI	8/21/2013	0	1.8
	Average Total HG		**4.2**
	Maxium Total HG		**10.4**
	Minimum Total HG		**0.34**
	Min River Total HG		**0.77**
	Results <1 ng/l		**2**
	Median		**4.3**
	N reported samples		**60**
	N River Samples		**59**

Mercury Measurements Downstream of Bad River Band Wastewater Treatment Plants Discharges

site_name	Date	Depth (m)	Total Hg (ng/l)
BAD RIVER AT GOVERNMENT ROAD NEAR ODANAH WI	9/17/2014	0.5	**5.4**
BAD RIVER AT ODANAH WI	7/22/2014	0	**2.3**
BAD RIVER AT ODANAH WI	9/17/2014	0.5	**4.7**
BAD RIVER AT ODANAH WI	10/21/2015	0.5	**0.95**
BAD RIVER NEAR MOUTH	7/22/2014	0.5	**1.3**
BAD RIVER NEAR MOUTH	9/16/2014	0	**5.6**
BAD RIVER NEAR ODANAH WI	10/6/2010	0.1	**4.75**
BAD RIVER NEAR ODANAH WI	8/9/2011	0.25	**5.6**
BAD RIVER NEAR ODANAH WI	8/21/2013	2	**1.3**
BAD RIVER NEAR ODANAH WI	9/17/2014	0.5	**5.0**
BAD RIVER NEAR ODANAH WI	7/22/2015	0.5	**2.7**
BAD RIVER NEAR ODANAH WI	8/19/2015	0.5	**1.2**
BAD RIVER NEAR ODANAH WI	4/5/2016	0.5	**5.1**
BAD RIVER NEAR ODANAH WI	4/27/2016	0.5	**10.4**
BAD RIVER NEAR ODANAH WI	8/10/2016	0.5	**2.9**
BAD RIVER NEAR ODANAH WI	4/27/2021	0	**8.0**
BAD RIVER NEAR ODANAH WI	5/19/2021	0	**1.6**
BAD RIVER NEAR ODANAH WI	5/24/2021	0	**6.4**
BAD RIVER NEAR ODANAH WI	6/30/2021	0	**2.8**
BAD RIVER NEAR ODANAH WI	7/28/2021	0	**1.7**
BAD RIVER NEAR ODANAH WI	8/25/2021	0	**1.1**
BAD RIVER NEAR ODANAH WI	9/29/2021	0.5	**1.2**
BAD RIVER NEAR ODANAH WI	10/5/2021	0	**2.5**
BAD RIVER NEAR ODANAH WI	10/25/2021	0	**1.3**
BAD RIVER NEAR ODANAH WI	4/19/2022	0	**7.0**
BAD RIVER NEAR ODANAH WI	4/25/2022	0	**9.0**
BAD RIVER NEAR ODANAH WI	10/11/2022	0	**0.77**
BRR3	8/2/2017	0	**1.1**
BRT8	8/2/2017	0	**1.1**

Entire Bad River Watershed

Average Total HG	**4.2**
Average Total HG (river samples)	**4.2**
Maxium Total HG	**10.4**
Minimum Total HG	**0.34**
Min River Total HG	**0.77**
Results <1 ng/l	**2**
Median	**4.3**
N reported samples	**67**
N River Samples	**66**

Bad River Downstream of WWTPs

Average Total HG	**3.6**
Average Total HG (river)	**3.6**
Maxium Total HG	**10.4**
Minimum Total HG	**0.77**
Min River Total HG	**0.77**
Results <1 ng/l	**2**
Median	**2.7**
N reported samples	**29**
N River Samples	**29**

Attachment 3. Wastewater Mercury, BOD and Suspended Solids Data

Date	Flow	Total Mercury-influent	Total Mercury-effluent	12 month rollling average	BOD	Suspended Solids
	MGD	ng/l	ng/l		mg/l	mg/l
Diaperville WWSL						
1/8/2019		9.1				
6/4/2019		16	4.3		11	6
8/15/2019		12				
11/26/2019	0.27	4.4	2.1	3.2	6	6
3/4/2020		11				
6/1/2020		17	4.0	3.1		
9/15/2020		6				
12/3/2020		26	2.8	3.4		
3/31/2021		330				
5/25/2021		6.9	5.9	4.4		
9/9/2021		13				
11/9/2021		14	1.5	3.7		
2/10/2022		45				
6/7/2022		45	54	28		
8/17/2022		19				
11/14/2022		33	5.9	30		
3/29/2023		29				
6/26/2023	0.27	18	11	8	5	4
9/31/2023		170				
12/6/2023	0.27	17	9.9	10	7	8
3/27/2024		26				
6/26/2024		8.3				
Average		40	10			
Maximum		330	54			
Minimum		4	2			
n		22	10			

Birch Hill WWSL						
Date	Flow	Total Mercury-influent	Total Mercury-effluent	12 month rollling average	BOD	Suspended Solids
	MGD	ng/l	ng/l		mg/l	mg/l
1/8/2019		6.1				
6/4/2019		61	8			
8/15/2019		460				
11/27/2019		DUPLICATE	3.3			
12/31/2019		5.2	3.3	5.7		
3/4/2020						
6/1/2020			6.4			
6/1/2020		32	90			
9/15/2020		5.6				
12/3/2020		DUPLICATE	2.8			
12/3/2020		13	2.8	2.8		
3/31/2021		22				
5/25/2021		290	7.5	5.2		
9/9/2021		11				
11/9/2021		4.8	2.4	5.0		
2/10/2022		340				
6/7/2022		62	9	5.7		
8/17/2022		33				
11/14/2022		97	2.8	5.9		
3/29/2023		32				
6/26/2023	0.037	14	16	9.4	40	100
9/13/2023		27				
12/6/2023	0.037	35	6.1	11.1	9	25
3/27/2024		190				
6/26/2024	0.037	11	9.8	8.0	33	98
Average		83	6.8			
Maximum		460	16			
Minimum		4.8	2.4			
n		21	10			
Duplicates not in agreement						
Data rejected; QA/QC						

Bad River SBR						
Date	Flow	Total Mercury-influent	Total Mercury-effluent	12 month rollling average	BOD	Suspended Solids
	MGD	ng/l	ng/l		mg/l	mg/l
1/8/2019		38	85		14	18
6/4/2019		450	4.5		6	3
8/15/2019		260	11		2	2
11/27/2019		8.8	22	31	2	2
3/4/2020		200	82	30	6	5
6/1/2020		30	35	38	3	2
9/15/2020		110	1.8	35	7	4
12/3/2020		27	1.2	30	5	3
3/31/2021		72	160	50	10	2
5/25/2021		29	12	44	8	5
9/9/2021		29	2	44	5	3
11/9/2021		140	3.7	44	9	2
2/10/2022		60	54	18	8	2
6/7/2022		76	69	32	4	2
8/17/2022		64	9.2	34	4	2
11/14/2022		38	5.4	34	12	2
3/29/2023	0.08	30	80	55	3	2
6/26/2023	0.05	27	39	45	25	13
9/13/2023	0.092	27	3.5	43	2	2
12/6/2023	0.065	67	23	36	4	6
3/27/2024	0.094	51	19	21	80	46
6/26/2024	0.096	12	2.7	12	8	7
Average		84	33	35		
Maximum		450	160	55		
Minimum		8.8	1.2	12		
n		22	22	19		

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