



City of Livingston Water Reclamation Facility Upgrade Technical Memorandum No. 1: Projected Effluent Limits Update and Compliance Schedule Proposal

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Introduction

The purpose of this technical memorandum (TM) is to project future anticipated regulatory limitations or ranges of limitations. This TM will provide an update to the regulatory requirements outlined by the 2015 City of Livingston Nutrient Removal Treatment Facility Process Evaluation. Included in this update will be the updated flow projections based on recent data collection that will modify the mixing ratios of Water Quality Based Effluent Limits (WQBELs) from the Water Reclamation Facility (WRF). The regulatory update is based upon the most recent Montana Water Quality Standards (WQS) as administered by the Montana Department of Environmental Quality (DEQ), recent ammonia information that will likely tighten the future WQS, and anticipated river nutrient standard updates.

Executive Summary

Table 1 provides a summary of the existing and anticipated regulatory limits for the City of Livingston WRF. The summary includes existing permit values and projected effluent limitations.

Table 1 – Summary of Existing and Projected Discharge Permit Limits

Parameter	Units	Existing Permit			Projected Permit		
		30 Consecutive Day Avg	7 Consecutive Day Avg	Daily Maximum	30 Consecutive Day Avg	7 Consecutive Day Avg	Daily Maximum
Design Flow Basis	MGD	2.0	N/A	N/A	2.18	N/A	N/A
BOD - 5 day	mg/L	30	45	N/A	25	45	N/A
	lb/day	450	675	N/A	450	675	N/A
Total Suspended Solids	mg/L	45	65	N/A	30	45	N/A
	lb/day	450	675	N/A	450	675	N/A
E. Coli, summer	(number/100ml)	126	252	N/A	126	252	N/A
E. Coli, winter	(number/100ml)	630	1,260	N/A	630	1,260	N/A
Oil & Grease	mg/L	N/A	N/A	10	N/A	N/A	10
Ammonia as N, current WQS ¹	mg/L as N	4.4	N/A	6.0	4.4	N/A	6.0
Ammonia as N, 2013 EPA Basis	mg/L as N	N/A	N/A	N/A	3.10	N/A	4.26
Total Residual Chlorine	mg/L	0.011	N/A	0.019 ²	0.011	N/A	0.019 ²
Total Nitrogen ³	mg/L	N/A	N/A	N/A	16.17 to 174.3	N/A	N/A
	lb/day	294	N/A	N/A	294	N/A	N/A
Total Phosphorus ³	mg/L	N/A	N/A	N/A	4.07 to 17.43	N/A	N/A
	lb/day	74	N/A	N/A	74	N/A	N/A
Nitrate as N ⁴	mg/L	N/A	N/A	N/A	188	N/A	N/A
pH	standard units	Shall remain within the range 7.0 to 9.0					
Percent Removal	%	BOD and TSS shall be greater than 85% removal in a 30 consecutive day period.					
Whole Effluent Toxicity		Pass/Fail Testing					
¹ From "Final Effluent Limit" in the 2009 Statement of Basis							
² Maximum instantaneous							
³ Existing "Permit" limits based on non-degradation load basis from Statement of Basis. Potential range of calculated future effluent limits based upon DEQ preliminary Yellowstone in-stream standards and a range of assumptions.							
⁴ Will not actually be a limit because the high value will result in a determination of No Reasonable Potential to exceed the WQS							

Compliance Schedule

The City of Livingston's existing wastewater treatment plant has multiple critical needs that are driving the City to this WRF Upgrade:

1. As described in Technical Memorandum No. 2, Flows and Loads, hydraulic and mass loadings to the treatment facility are steadily increasing, due to growth and what appears to be increasing I/I in the collection system, as well as what is likely increased tourism associated with Yellowstone National Park.
2. The existing Rotating Biological Contactors are at the end of their useful life, are overloaded and beginning to fail.
 - a. The persistent presence of the sulfate reducing organism *Beggiatoa* on the RBCs indicates that the units are critically overloaded. These filamentous organisms inhibit biofilm sloughing, which reduces RBC performance and results in excessive loading on the RBC shafts.
 - b. Snail infestation in the RBCs has increased to the point that each RBC train needs to be taken offline and cleaned out in 2016. This is made more difficult with the high loading condition.
 - c. The second RBC shaft in the last two years broke in May of 2016. Corrosion of the shafts and over-loading due to *Beggiatoa* inhibition of biomass sloughing are likely the cause. The concern is that the condition of the shafts, combined with the over-loaded condition will result in more frequent stress fractures in the near future. Repair of the shafts is cumbersome and costly, at approximately \$20,000 for a fabricated and welded solution. The shafts cost approximately \$120,000 for complete replacement.
3. The UV disinfection system continues to struggle to adequately disinfect the RBC effluent. This, along with the lack of UV redundancy is requiring increased reliance on the backup sodium hypochlorite – sodium bisulfite chlorination-dechlorination system.

In order to address the above issues and comply with the next DEQ MPDES permit, the City has established the following WRF Upgrade project schedule.

Project Milestone

Current Schedule

PER Amendment and Uniform Funding Application	April 2016
Preliminary Design Report	June 2016
Continuous Flow SBR and Aerobic Digester Equipment Preselection	June 2016
Final Design Development (90% DEQ Submittal)	December 2016
Final Bid Documents	February 2017
Bid Opening and Award	June 2017
Construction Notice to Proceed	July 2017
Substantial Completion	September 2018
Final Completion	October 2018
Warranty Period	October 2019

Based on this planning, design and construction schedule, and barring any unforeseeable delays in funding or construction, **the City requests a final compliance schedule for the ammonia discharge limits listed in Table 1 of October 31st, 2019.**

This will allow the City time to start-up the new WRF, get the microbiology established, and become familiar with new system's operation.

Current and Future Effluent Limits

The Clean Water Act of 1972 established the National Pollution Discharge Elimination System (NPDES) permitting system, which sets the effluent discharge limits for point source discharges to waters of the United States. In Montana, the Department of Environmental Quality has been granted primacy by the US Environmental Protection Agency (EPA) to administer the NPDES program, and the State issues Montana Pollution Discharge Elimination System (MPDES) permits. These permits are typically issued for five years, although a permit can be "re-opened" for modifications. The Livingston WRF discharges under MPDES permit #MT0020435, which was mostly recently renewed November 1, 2009, modified March 19, 2012, and expired October 31, 2014. The WRF has been operating under administrative extension while the permit renewal is finalized. The MPDES permitting process is the focus of this regulatory update. New regulatory limits for nutrients have been finalized since the last permit renewal, and more stringent ammonia limits are on the regulatory horizon. MPDES permit limits are established using several criteria including:

- Technology Based Effluent Limits (TBEL) – TBLs are set based on what a specific technology can achieve. The most common TBELs are BOD and TSS "secondary standards".

- Water Quality Based Effluent Limits (WQBELs) – WQBELs are established to meet a result in the receiving stream. In Montana, the State Water Quality Standards (WQS) must be met. Ammonia is a common WQBEL.
- Total Maximum Daily Loads (TMDLs) – TMDLs are established when a receiving water is impaired (i.e., listed on the 303d list) for one or more parameters (nutrients, sediment, etc.).
- Non-degradation is a site specific permitting procedure to determine if a limit is required to protect the receiving water. The procedure is defined in the WQS and is generally associated with new or significantly modified discharges. Non-degradation can also set a maximum allowable load limit for a discharge based upon historically permitted discharges. A non-degradation review can be performed under certain circumstances to determine if modification to a non-degradation limit meets set criteria established by the non-degradation review procedure.

Future limits projections were based upon data obtained from the Livingston Permit No. MT 0020435 Statement of Basis (2009) for USGS Gauging Station 06192500, Yellowstone River at Livingston for the time period of January 18, 1990 through September 24, 2007. A summary of the flow parameters is provided in Table 2.

The 14Q5 flow value was obtained from Appendix A of the 2015 *City of Livingston Nutrient Removal Treatment Facility Process Evaluation*. These values were indicated to have been provided by DEQ, but it is unclear if this flow was an annual 14Q5 or a seasonal 14Q5. The values will be used as a “worst-case” scenario because the appropriate seasonal 14Q5 values will be higher if the values are actually annual 14Q5 values. These flows are used in limits calculations related to allowable mixing.

Table 2. Historical Flow Results for the Yellowstone River at Livingston

Parameter	CFS	MGD
7Q10	767	496
14Q5	1,550	1,002

Summary of Future Limits

Table 3 shows the ranges of potential future ammonia-N, total nitrogen, and total phosphorus effluent limits based upon a range of assumptions.

Table 3. Summary of Potential Future Discharge Limits for the City of Livingston WRF.

Parameter	Condition	Time Period	Basis	Calculated Effluent Limit, MM Flow ¹	Calculated Effluent Limit, AA Flow ¹
Ammonia, mg/L as N	MDL (Acute)	Year Round	Current WQS	6.0	N/A
Ammonia, mg/L as N	MDL (Acute)	Year Round	2013 EPA Ammonia, Oncorhynchus and Unionids present	4.26	N/A
Ammonia, mg/L as N	MDL (Acute)	Year Round	2013 EPA Ammonia, Oncorhynchus present, Unionids absent	5.69	N/A
Ammonia, mg/L as N	AML (Chronic)	Year Round	Current WQS	4.4	N/A
Ammonia, mg/L as N	AML (Chronic)	Year Round	2013 EPA Ammonia, Oncorhynchus and Unionids present	3.10	N/A
Ammonia, mg/L as N	AML (Chronic)	Year Round	2013 EPA Ammonia, Oncorhynchus present, Unionids absent	4.14	N/A
Total Nitrogen, mg TN/L	AML	July 1-Sept 30 ²	Upper Yellowstone – instream TN <= 0.30	46.4	87.3
Total Nitrogen, mg TN/L	AML	July 1-Sept 30 ²	Upper Yellowstone – instream TN <= 0.40	92.6	174.3
Total Phosphorus, mg TP/L	AML	July 1-Sept 30 ²	Upper Yellowstone – instream TP <= 0.030	4.64	8.73
Total Phosphorus, mg TP/L	AML	July 1-Sept 30 ²	Upper Yellowstone – instream TN <= 0.40	9.26	17.43
Total Nitrogen, mg TN/L	AML	Year Round	Non-Deg TN <= 294 ppd	16.2	30.7
Total Phosphorus, mg TP/L	AML	Year Round	Non-Deg TP <= 74 ppd	4.1	7.7
Nitrate as N, mg/L	AML	Year Round	Current WQS	188	N/A
¹ Ranges represent the boundaries of limits based on different flow assumptions					
² Provisional date, pending final approval of Yellowstone River period for TN and TP limits.					

Ammonia Criteria

The ammonia form of nitrogen, primarily the un-ionized form (NH_3), is toxic to aquatic life. Excess ammonia can accumulate in the organism and cause alteration of metabolism or increases in body pH. The level of toxicity is pH, temperature and duration of exposure dependent. As pH increases, the toxicity of ammonia increases because the relative proportion of unionized ammonia. Toxicity is elevated at higher temperatures because the metabolism of aquatic animals is generally elevated as well.

Permitting for ammonia is different from permitting for total nitrogen because ammonia is a toxin, whereas total nitrogen is generally permitted based on its contribution to eutrophication and water quality degradation.

EPA published guidance in 2013 for updated freshwater ammonia standards titled, "Aquatic Life Ambient Water Quality Criteria for Ammonia – Freshwater, 2013". The updated ammonia standards are intended to be nationwide guidance for updating state WQSs. The 2013 EPA Ammonia Standards incorporate the most recent science for ammonia toxicity for aquatic life. The acute ammonia criterion is becoming more stringent as additional species with increasing ammonia sensitivity are tested and incorporated into the guidance. The pre-2013 criteria are based on the presence/absence of salmonid species, temperature, and pH. The updated criteria are also based on pH, and temperature, but incorporate *Oncorhynchus*, which is a subset of salmonid species, as the presence/absence criteria as well as the presence/absence of unionid mussels.

Limits determination for ammonia based on the current WQS was previously conducted for acute and chronic conditions by DEQ. The following assumptions were used:

- Chronic Conditions
 - Background pH and temperature at 75th percentile
 - CV value of 0.6 for EPA "Technical Support Document for Water Quality-based Toxics Control, 1991" (TSD)
 - Projected effluent flow for mixing zone calculations
 - Standard 10-percent mixing zone for chronic
 - Mixing with 7Q10 flow
- Acute conditions
 - Salmonids absent
 - Background pH and temperature at 95th percentile
 - CV value of 0.6 for EPA TSD
 - Projected effluent flow for mixing zone calculations
 - Standard 1-percent mixing zone for acute
 - Mixing with 7Q10 flow

Additional assumptions were made for the 2013 EPA Ammonia criteria projections.

- Chronic and acute conditions
 - *Oncorhynchus* present
 - Unionids present or absent (calculated range)

Nutrient Criteria

Future nutrient limits were also projected based upon recently adopted nutrient criteria in Montana (Circular DEQ-12A, Montana Base Numeric Nutrient Standards). The nutrient limits are an important consideration for the proposed upgrades because the infrastructure necessary for future permit compliance is directly impacted by the upgrades necessary for ammonia compliance and vice versa. The following assumptions were used for the future nutrient limits calculations:

- Initial limits screening will use the average 30-day wet weather effluent flow to provide a factor of safety for future in-stream background concentration changes
- The draft Upper Yellowstone River in-stream criteria will be used with the two draft levels (0.3 TN / 0.03 TP or 0.4 TN / 0.04 TP) used to establish a range of TN and TP effluent limits
- Dilution flow will be based upon the 14Q5 (1,550 cfs) previously provided by DEQ (note that it is unclear if this value represents an annual 14Q5 or a seasonal 14Q5)
- Background concentrations will be based upon values previously provided by DEQ (0.2 TN / 0.02 TP)
- A CV factor of 0.6 was used with 95th percentile effluent probability distribution on a chronic basis (per DEQ-12A), and “n” of four samples per month (effluent)
- Nutrient loads based upon non-degradation table published in the 2009 statement of basis

Attachments:

List of Acronyms

Acronyms

- 14Q5 Fourteen day low flow in a five year period
- 303d Impaired Waters List (Clean Water Act)
- 7Q10 Seven day low flow in a ten year period
- Ammonia-N Ammonia as nitrogen (also NH₃-N)
- AML Average Monthly Load
- BOD Biochemical Oxygen Demand
- CBOD5 Carbonaceous BOD5
- DEQ Department of Environmental Quality (Montana)
- EPA Environmental Protection Agency
- LTA Long Term Average
- MDL Maximum Day Limit
- MGD Million Gallons per Day
- mg/L Milligram per Liter
- MPDES Montana Pollutant Discharge Elimination System
- NPDES National Pollutant Discharge Elimination System
- O&G Oils and Grease
- pH Negative Logarithm of the Hydronium Ion (Acidity)
- ppd Pounds per day
- ppcd Pounds per capita per day
- ppm Parts per million
- TBEL Technology Based Effluent Limit
- TKN Total Kjeldahl Nitrogen
- TMDL Total Maximum Daily Load
- TN Total Nitrogen
- TP Total Phosphorus
- TSS Total Suspended Solids
- VSS Volatile Suspended Solids
- WET Whole Effluent Toxicity
- WLA Waste Load Allocation
- WQBEL Water Quality Based Effluent Limit
- WQS Water Quality Standard
- WRF Water Reclamation Facility