Estimated Municipal Wastewater Treatment Level Performance

7/15/2014

Purpose

IDEQ requested additional information for ammonia, nitrate, BOD and ortho phosphorus associated with five future total phosphorus treatment levels (1 mg/L, 0.5 mg/l, 0.3 mg/l, 0.1 mg/l, and 0.07 mg/l). The purpose of this document is to provide that input to IDEQ.

Treatment Plants and Technologies

There are currently twelve lower Boise municipal wastewater treatment facilities with a combined design capacity of 85.33 million gallons per day. For the purpose of this exercise, the twelve facilities are anticipated to use three treatment technologies, Enhanced Biological Nutrient Removal (EBNR), Membrane Bioreactor (MBR), or aerated lagoon. In Table 1, the WWTPs current technology is noted as well as the proposed future treatment technology (CAS = conventional activated sludge; BNR= biological nutrient removal).

Table 1. Current Lower Boise River Municipal Wastewater Treatment Facilities

WWTF	Receiving Stream	Design Flow (mgd)	Treatment	Comment
Mainstem LBR				
Lander	Boise River, RM 50	15	CAS/EBNR	
West Boise	Boise River, RM 44	24	CAS/EBNR	
Middleton	Boise River, RM 27	1.8	Lagoon	
Caldwell	Boise River, RM 23	8.5	BNR/EBNR	
Tributary				
Star	Lawrence Kennedy Canal	2.2	MBR	
Meridian	Fivemile Creek	11	BNR/EBNR	
Nampa	Indian Creek	18	CAS/EBNR	
Kuna	Indian Creek	3.5	MBR	
Notus	Conway Gulch	0.11	Lagoon	
Wilder	Wilder Ditch Drain	0.3	Lagoon	
Greenleaf	West End Drain	0.24	Lagoon	Seasonal Discharge
Parma	Sandhollow Creek	0.68	Lagoon	
TOTAL		85.33		

The five large mechanical plants, with a combined design capacity of 76.5 mgd or 90% of watershed treatment design capacity are anticipated to implement EBNR technology. There are two Membrane Bioreactor facilities with a combined capacity of 5.7 mgd, or 6.7% of watershed treatment design capacity. There are five lagoon systems, with a combined design capacity of 3.13 mgd or 3.7 % of watershed design capacity. Requested parameter values will be provided based on average or general anticipated upgrade technologies and associated effluent concentrations.

For this document, it is assumed that biological treatment technology is adequate to reach WWTP TP effluent concentration of 1 mg/L. 0.5 and 0.3 mg/L TP require sand or cloth filters and 0.1 and 0.07 mg/L require membrane technologies.

Lagoons

Lagoon system can be retrofit for phosphorus removal, usually with chemical dosing (UDWQ, 2010; WDOE, 2011), however the retrofits are costly. Utah found those lagoon retrofits are so costly that they exceed the SRF affordability criteria by 147% (UDWQ, 2010). There are five lagoon systems in the Lower Boise watershed with a total design flow of 3.13 mgd, or 3.6% of the municipal design capacity. One of the municipalities using lagoons has a permit that requires land application during the growing season. It appears that similar land application or agricultural use opportunities might be the preferred method for lagoons to comply with the Snake River Hells Canyon TMDL and the expected Lower Boise River TMDL growing season phosphorus requirements.

Sustainability

The Water Environment Research Foundation (WERF) initiated major nutrient initiative in 2010. WERF has compiled a nutrient compendium for WWTF owners and has published numerous reports on the limits of nutrient technology, reliability of best in class nutrient removal plants (WERF, 2011), and the financial and environmental (additional greenhouse gas emissions, additional chemical and electricity use…) costs at four levels of nutrient removal treatment (WERF, 2011a), including two that are in the range of the range being considered by IDEQ for the lower Boise (e.g. level 3 treatment 300 ug/l TP and level 4 treatment or 100 ug/l TP). Key conclusions in the WERF Nutrient Removal and Sustainability report include:

- "…use of treatment technologies for point sources along with existing best management practices (BMPs) for non-point sources is more sustainable for achieving comparable water quality improvements. Instead of focusing strictly on point source dischargers and requiring Level 4 or 5 treatments, Level 3 or 4 treatments complimented with BMPs of non-point sources is more sustainable and can achieve similar results."

- "Because wastewater nutrient removal is intended to improve water quality by reducing eutrophication from algal production in receiving waters, a surrogate parameter – "potential algal production" – was used to assess water quality improvement. Every 100 pounds of algae produced requires 7.2 lbs. of N and 1.0 lbs. of P. This relationship was used to calculate the reduction in algae production as a function of N or P reduction and it showed that nearly 95% of the potential algae production is reduced by changing from Level 1 to Level 3 treatment. A remaining 4% of potential algae production is reduced from Levels 3 to 5; however, this incremental improvement almost doubles the GHG emissions.

	Potential Total Phosphorus Management Scenario (mg/L)											
	May - September Average Values[a]						October - April Average Values[a]					
Constituent	**Current**	**TP = 1**	**TP = 0.5**	**TP = 0.3**	**TP = 0.1**	**TP = 0.07**	**Current**	**TP = 1**	**TP = 0.5**	**TP = 0.3**	**TP = 0.1**	**TP = 0.07**
TP (mg/L)	5-6	1	0.5	0.3	0.1	0.07	5-6	1	0.5	0.3	0.1	0.07
NH_4-N (mg/L)	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
NO_3-N (mg/L)	10-35	5-30	5-30	5-30	5-30	5-30	10-40	5-30	5-30	5-30	5-30	5-30
BOD Total 5-Day (mg/L)	< 10	< 10	< 10	< 5	< 5	< 5	< 10	< 10	< 10	< 5	< 5	< 5
PO_4-P (mg/L)[c]	4.5-5.5	< 0.5	< 0.1	< 0.1	< 0.02	< 0.02	4.5-5.5	< 0.5	< 0.1	< 0.1	< 0.02	< 0.02

a. Calculated as seasonal monthly average

b. Large range of effluent concentrations due to the different WWTP's sources

c. Effluent PO4-P concentrations for the lower effluent TP management scenarios (0.3 mg/L, 0.1 mg/L, and 0.07 mg/L) would depend on the selected tertiary treatment technology for TP removal and the fractionation of phosphorus (i.e., soluble reactive, soluble non-reactive, and particulate) in the effluent.

References:

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