Design Review Committee Briefing #15

Subject: Tertiary Treatment Business Case Evaluation Recommendation

Date: January 14, 2019

The Issue

Tertiary treatment is a common process used in low-level nutrient removal and recycled water applications. The Nampa Wastewater Treatment Plant (WWTP) will implement this final filtration step to remove suspended solids and particulate phosphorus to very low levels. The Preliminary Design Technical Team (Technical Team) has performed a Business Case Evaluation (BCE) to identify the recommended technology for tertiary treatment. The analyses include consideration of outstanding unknown conditions: the timing of recycled water discharge and the final reuse permit limits for total phosphorus (TP). The Technical Team is requesting the DRC to confirm the recommended technology selections and timing for the recycled water program given two potential effluent TP limits.

Background and Analyses

The selection of the tertiary treatment technology is heavily dependent on the effluent TP limit for the Nampa WWTP. As a conservative assumption, the Facility Plan assumed that an effluent TP limit of 0.1 mg/L (15 pounds per day of TP) would be required during the summer (see DRC Briefing #3). However, the City is actively negotiating the reuse permit for discharge to Phyllis Canal with the Idaho Department of Environmental Quality (IDEQ). The City has proposed that effluent TP limits of greater than equal to 0.35 mg/L would be sufficient to protect the uses of Phyllis Canal. If IDEQ accepts this limit, the Nampa WWTP would have an effective TP limit of 0.35 mg/L year-round (summer limit of 0.35 mg/L from the reuse permit and winter limit of 0.35 mg/L from the NPDES permit). Assuming the City is successful in the negotiation of the 0.35 mg/L effluent TP limit, the cost savings from this could only be realized by accelerating the recycled water program (see DRC Briefing #11).

Understanding the potential impacts of the effluent TP limit, the Technical Team evaluated the preferred approach to tertiary treatment assuming both potential effluent TP limits (i.e. 0.1 mg/L and 0.35 mg/L). The Tertiary Treatment BCE considered the following alternatives (see Figures 3 to 6 for process configurations):

Table 1. Tertiary Treatment BCE Alternatives

Alternative Name	Description	Target TP Limit
Alternative 1: Membranes	• "Base case" alternative assumed in the Facility Plan • Small membrane pore size achieves highest effluent quality for total suspended solids, biochemical oxygen demand, and total phosphorus	0.1 mg/L and 0.35 mg/L
Alternative 2: 1-Stage Downflow Sand Filters	• Granular media filtration commonly used within the industry • Water percolates downward through sand bed and exits the bottom of the filter	0.35 mg/L
Alternative 2B: 2-Stage Downflow Sand Filters	• Same technology as Alternative 2 • Two stages of downflow filters required for desired TP limit of 0.1 mg/L	0.1 mg/L
Alternative 3: 1-Stage Upflow Sand Filters	• Granular media filtration commonly used within the industry • Water flows upward through sand media while the sand bed moves downward; filtered effluent exits the top of the filter over a weir	0.35 mg/L
Alternative 3B: 2-Stage Upflow Sand Filters	• Same technology as Alternative 3 • Two stages of upflow filters required for desired TP limit of 0.1 mg/L	0.1 mg/L
Alternative 4: Cloth Disk Filters	• High-density woven fiber or polyester disks used to filter water	0.35 mg/L

Table 1. Tertiary Treatment BCE Alternatives		
Alternative Name	Description	Target TP Limit
	• Effluent flows through the discs in an inside-out or outside-in configuration	

The Technical Team developed capital costs, operating and maintenance (O&M) costs, and repair and replacement (R&R) costs for each of the alternatives. Capital costs are based on vendor quotes and cost estimates (note: these are Class 4 cost opinions). The O&M costs include labor, chemical, and power consumption projections. Annual repair and replacement (R&R) costs are based on equipment expected life and the equipment's capital cost. The Technical Team estimated risk and benefit costs for each alternative. These consider various regulatory, technical, or financial consequences (both positive and negative) associated with an alternative.

BCE Results Based on Effluent TP Limit of 0.1 mg/L

The first evaluation assumed the City would be required to meet an effluent TP limit of 0.1 mg/L. This could be the result of following the project implementation timeline described in the Facility Plan (see Figure 1) or the reuse permit requiring this limit. Table 2 provides a summary of the Tertiary Treatment BCE results based on achieving an effluent TP limit of 0.1 mg/L. For this condition, Alternative 1 has the lowest total cost of asset ownership. Capital costs, operating costs, and repair and replacement costs were similar between the alternatives evaluated. The recommendation of Alternative 1 is driven primarily by the benefit associated with the reduction in size of the disinfection system that can be realized by implementing tertiary membranes.

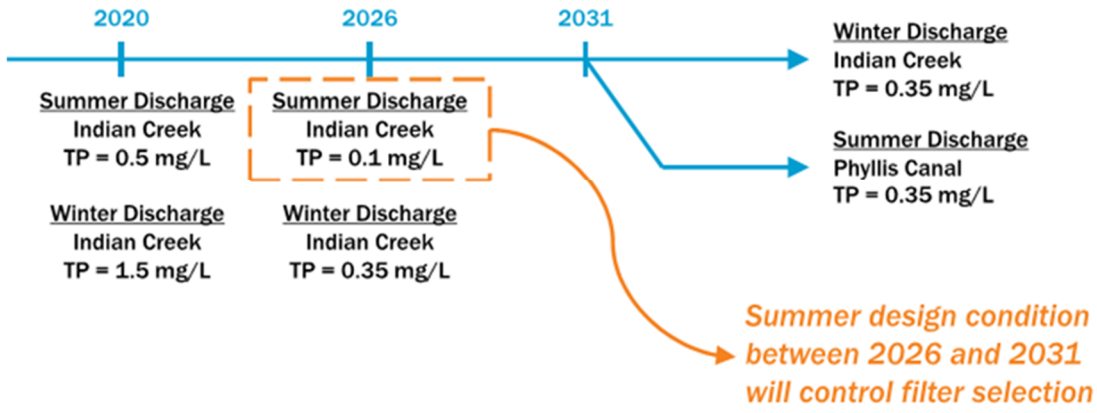

Figure 1. Current timeline and discharge limits for the City's recycled water program.

Table 2. Tertiary Treatment Technology BCE Total Net Present Value Summary[1,2]						
Alternative	Capital	O&M	R&R	Risks	Benefits	NPV
Alternative 1: Membranes	$40,654,000	$9,276,000	$26,976,000	$1,078,000	$3,154,000	$80,645,000
Alternative 2B: 2-Stage Downflow Sand Filter	$44,761,000	$9,163,000	$27,443,000	$121,000	–	$87,521,000
Alternative 3B: 2-Stage Upflow Sand Filter	$40,660,000	$11,811,000	$25,074,000	$129,000	–	$83,573,000

[1]*Cells highlighted in green indicate the lowest cost alternative for the conditions shown.*

[2]*Total costs are shown in 2018 dollars, represent the period 2021 through 2040, and are rounded to the nearest $1,000.*

NPV = net present value.

BCE Results based on Effluent TP Limit of 0.35 mg/L

The second evaluation assumed the City would be required to meet an effluent TP limit of 0.35 mg/L. As described previously and shown in Figure 2, this would require the timing of the recycled water program to be accelerated to realize the cost reductions resulting from successful negotiation of the reuse permit. For this condition, Alternative 3 has the lowest total cost of asset ownership (Table 3). Alternative 4 has the lowest capital cost in this analysis followed by Alternatives 2 and 3, which have similar capital costs. However, risks associated with Alternative 4 not meeting the required effluent TP limit result in Alternative 3 having the lowest total cost of asset ownership.

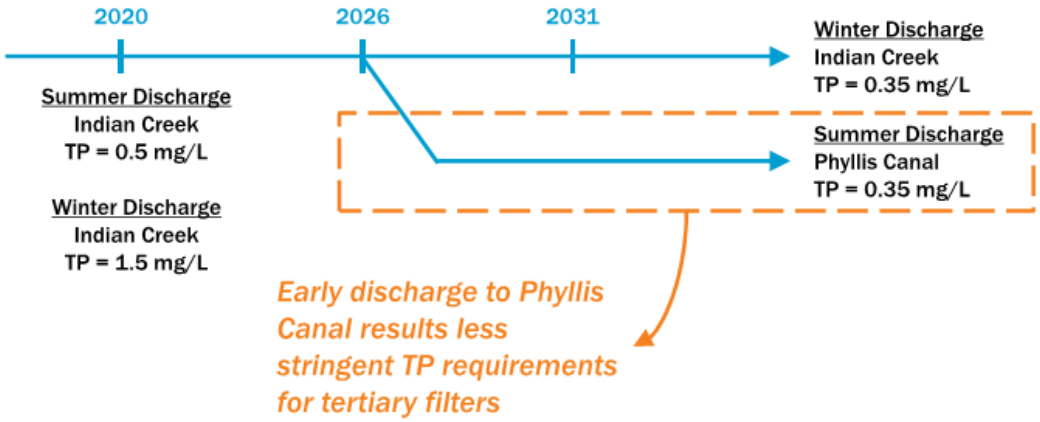

Figure 2. Accelerated timeline and discharge limits for the City's recycled water program.

Table 3. Tertiary Treatment Technology BCE Total Net Present Value Summary[1,2]

Alternative	Capital	O&M	R&R	Risks	Benefits	NPV
Alternative 1: Membranes	$40,654,000	$9,276,000	$26,977,000	$1,078,000	$3,155,000	$80,645,000
Alternative 2: Downflow Sand Filter	$23,982,000	$6,406,000	$14,630,000	$17,059,000	–	$67,389,000
Alternative 3: Upflow Sand Filter	$22,466,000	$8,788,000	$13,802,000	$15,200,000	–	$65,481,000
Alternative 4: Cloth Disc Filters	$16,220,000	$6,961,000	$11,009,000	$30,455,000	–	$70,713,000

[1]*Cells highlighted in green indicate the lowest cost alternative for the conditions shown (recycled water discharge beginning in 2026).*

[2]*Total costs are shown in 2018 dollars, represent the period 2021 through 2040, and are rounded to the nearest $1,000*

NPV = net present value.

Potential Consequences

Table 2 and Table 3 illustrate the different selections the City can make for tertiary treatment. The Technical Team is providing the DRC with specific considerations related to this selection:

- **Shift of Recycled Water Program Costs to Phase II:** Producing and distributing Class A recycled water will require the inclusion of several projects in the Phase II Upgrades (completed by 2026) that the City originally planned to be completed as part of the Phase III Upgrades (completed by 2031). This would include the recycled water pump station and distribution pipeline as well as the internal mixed liquor recycle (IMLR) pumps. Using the Facility Plan cost estimates, these projects have an estimated capital cost of $11.9M (2017 dollars). However, the by accelerating the timeline the City could save approximately $15.0M (2018 dollars) in capital costs associated with the tertiary treatment system (the difference in

capital and benefits costs between Alternative 1 and Alternative 3). While this reduces the overall cost of the City's Wastewater Program, the full extent of the capital cost savings would not be realized until after the Phase II Upgrades.

- **Future Risk of More Stringent TP Limits**. The probability and timing of future, more stringent effluent TP limits is a key consideration in the tertiary treatment decision under the second scenario presented (i.e. designing to an effluent limit of 0.35 mg/L TP). As demonstrated in Table 1, Alternative 1 is the preferred approach to meeting an effluent TP limit of 0.1 mg/L. If the City elects to proceed with designing the Phase II Upgrades to accommodate a higher effluent TP limit (i.e. 0.35 mg/L) there would be the potential for increased capital costs in the future to address a lower future limit. The Technical Team has tested the sensitivity of the recommendation to this factor and has shown that the more likely the lower TP limits are implemented in the near future (i.e. 2026 or 2031), the more favorable Alternative 1 becomes under the second scenario. However, given the relatively small increase in future capital cost and the low likelihood of the lower limits being imposed within the next several permit cycles, the Technical Team recommends proceeding with Alternative 3 for the effluent limit of 0.35 mg/L TP.
- **Final Reuse Permit TP Limits**. The City and IDEQ are in the process of negotiating the reuse permit. The City expects that the final reuse permit application will be submitted in February and a final permit will be issued in the summer of 2019. During this timeframe, the City will gain additional clarity about the reuse permit effluent TP limit. Proceeding with additional design of the tertiary treatment system before this clarity is gained could result in sunk investment in the design should the limit differ from the design assumption.

Recommendation

The selection of the preferred tertiary treatment technology is heavily dependent on the effluent TP limit, as shown in the difference in the recommendation between the two scenarios presented in this briefing. ***Given this sensitivity, the Technical Team recommends pausing design activities on the tertiary treatment system until additional information is available on the effluent TP limit for the reuse permit***. This will limit the potential for sunk design costs related to this system.

With this recommended pause in design progress, there will be increased pressure on the overall Phase II Upgrades schedule when design resumes on the tertiary treatment system. With the pause in design activities there would be an extension for completion of the preliminary design and a delay to procurement of the final designer for this work. As a means of limiting the potential time delays, the Technical Team is presenting the following tertiary treatment and recycled water program timing recommendations to the DRC:

- ***If the reuse permit negotiations are successful (i.e. the effluent TP limit is 0.35 mg/L or higher), the Technical Team recommends accelerating the recycled water program and proceeding with Alternative 3: Upflow Sand Filters. This recommendation would increase the scope of the Phase II Upgrades but result in an overall reduction in capital cost for the Wastewater Program.***
- ***If the reuse permit negotiations are unsuccessful (i.e. the effluent TP limit is less than 0.35 mg/L), the Technical Team recommends proceeding with Alternative 1: Membranes. This would maintain the current capital cost assumptions from the Facility Plan and completion of the Phase III Upgrades between 2026 and 2031 which includes the recycled water program.***

Direction on these items will limit the schedule impacts and allow the Technical Team to continue advancing with preliminary design of Phase II Upgrades for other facilities, excluding disinfection and post aeration processes.

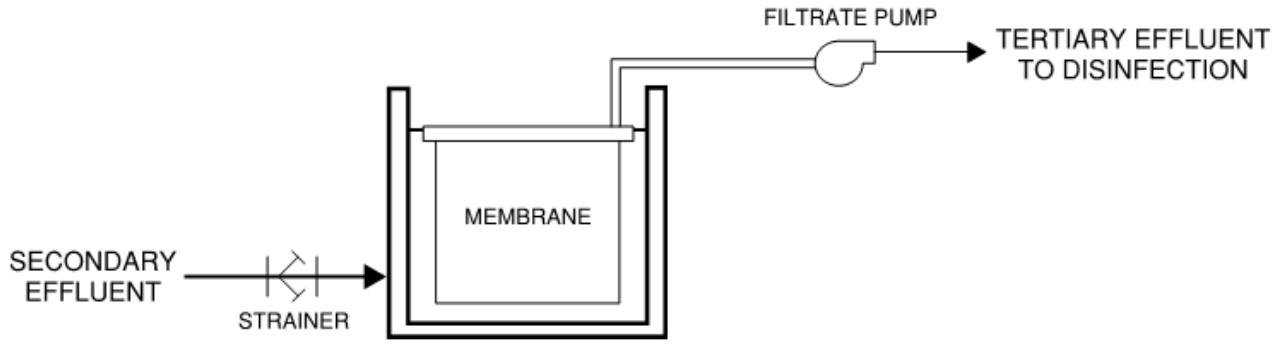

Figure 3. Alternative 1: Tertiary membrane (submerged system) process flow diagram

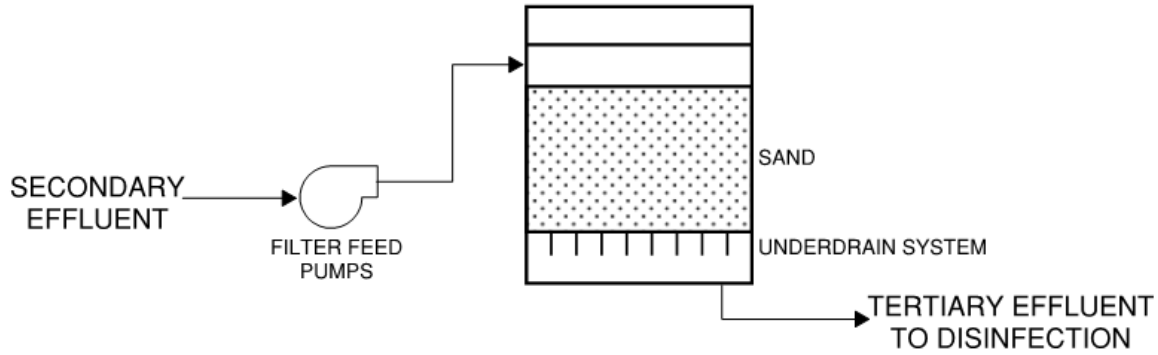

Figure 4. Alternative 2: Downflow sand filter process flow diagram. Alternative 2B is the same technology but involves 2-stages instead of single-stage filters.

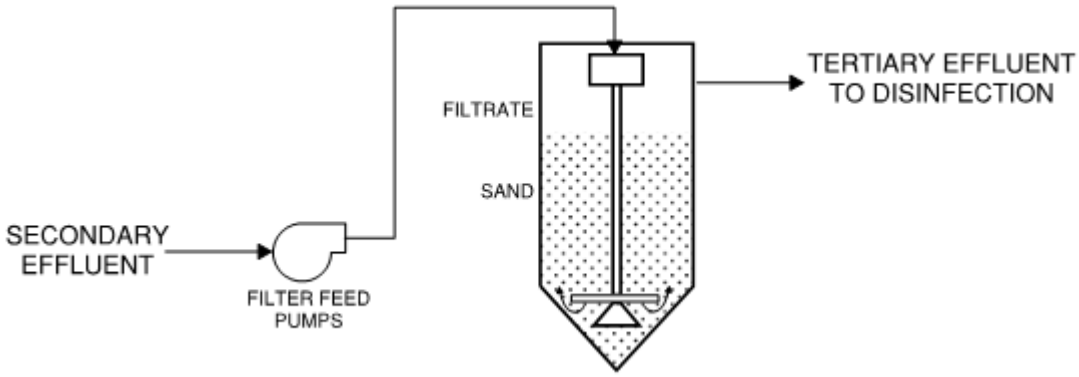

Figure 5. Alternative 3: Upflow sand filter process flow diagram. Alternative 3B is the same technology but involves 2-stages instead of single-stage filters.

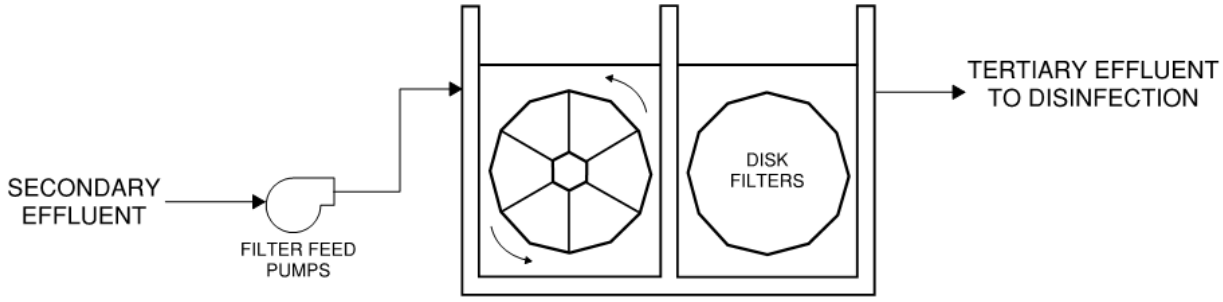

Figure 6. Alternative 4: Cloth disk filter process flow diagram