Clean Water State Revolving Fund Green Project Reserve

- Interim -

City of Blackfoot WWTP Upgrade Project

SRF Loan #WW1703: FY2020 Amendment #2 (pop. 12,233)

$2,500,000

Interim Green Project Reserve Justification

Categorical GPR Documentation

1. INSTALL NEW FINE BUBBLE DIFFUSERS AND AIR DISTRIBUTION SYSTEM (Energy Efficiency). Categorical GPR per Section 3.2-2: *projects that achieve a 20% reduction in energy consumption.* ($217,236).

2. INSTALL NEW ENERGY-EFFICIENT GRIT REMOVAL SYSTEM (Energy Efficiency). Categorical per GPR 3.2-2: *projects that achieve a 20% reduction in energy consumption* ($283,939).

Business Case GPR Documentation

3. INSTALL SCADA SYSTEM (Energy Efficiency). Business Case GPR per 3.5-8: *SCADA systems can be justified based on substantial energy savings.* ($11,112).

Categorical

1. TREATMENT PROCESS: AERATION SYSTEM[1]

Summary

- Large-scale wastewater system improvement project includes upgrades to the aeration system. This portion of the project will replace leaking underground air distribution lines with overhead lines to each of three aeration basins and replace existing diffusers with new energy-efficient fine bubble diffusers in Aeration Basins 1, 2, and 3.
- Total Loan Amendment #2 = $2,500,000
- Estimated Categorical energy efficient (green) portion of loan = 8.7% ($217,236) (by proportionate distribution).
- Annual Energy savings = 35%

Background[2]

- The existing underground air distribution lines to the aeration basins are leaking, which impacts the air transfer efficiency to the basins, results in energy losses, and causes deleterious impacts on oxygen levels for BOD reduction and basin nitrification (diminishing treatment capacity). The amount of air loss is unknown but assumed at approximately 10%.
- Current BOD loads (during the facility plan) are effectively at or above projected 2034 loads because of significant industrial loading. The industrial loading has been reduced since the facility plan through pretreatment agreements with the industries, which permits additional residential growth over the planning period.
- The aeration basins are limited at peak loads, with DO levels often falling below 0.5 mg/L.
- Additionally, with increased organic loading, the SRT will be reduced and nitrification may be impeded, especially in the winter months.
- Based on vendor information obtained during detailed design, it is believed that the existing aeration basins consist of ceramic diffusers which have likely fouled beyond recovery. Additionally, during design it was discovered that the diffusers in Aeration Basin 1 are set lower than the diffusers in Aeration Basins 2 and 3 causing aeration distribution imbalance and further affecting dissolved oxygen in the biological system.

Upgrades

Air Distribution System:

- The City will replace the old leaking air distribution system ductile iron piping in the treatment plant with the following – new 304 Stainless Steel piping: ±230LF of 16" Ø Sch 10s to Aeration Basin No. 1; ±230LF of 14" Ø to Aeration Basin No. 2; ±120LF of 14" Ø to Aeration Basin No.3.

Aeration Basins

- All of the existing diffusers will be replaced with high-efficiency fine bubble diffusers in Aeration Basins 1, 2, and 3, greatly enhancing the oxygen transfer efficiency of the aeration process.
- The diffusers will be set at the same side water depth, thereby providing more consistent distribution of airflow to the aeration basins under varying airflow conditions.

[1] City of Blackfoot, Idaho Wastewater Treatment Facility Plan, Final, April 2014; JUB Engineers
[2] City of Blackfoot, Idaho Wastewater Treatment Facility Plan, Final, April 2014; JUB Engineers

Energy-Efficiency Improvements

- It is estimated the leaking ductile iron piping results in a 10% loss to the aeration basins, which will be eliminated with the new piping.
- Based on site conditions, the fine bubble diffusers result in a decreased actual oxygen requirement (AOR) to standard oxygen requirement (SOR) ratio of 0.33 compared to 0.24 for the existing, fouled diffusers. [3]

Fine Bubble Diffuser

- Final design calculations (included in Appendix A) indicate that an airflow of approximately 4,260 scfm is required with the new diffused aeration system at design average day conditions and a DO level of 2.0 mg/L. With an estimated 10% loss due to leaking distribution piping and additional diffuser fouling, the blower output must be increased to approximately 6,560 scfm. Assuming the reduction in energy usage corresponds with air output, the overall savings is estimated at 35%.

Conclusion

- By replacing old leaking air supply lines to the aeration basins and installing a fine bubble diffused aeration system in Aeration Basins 1, 2, and 3, the City reduces the required air demand of the aeration system by approximately 35% percent.

- **GPR Costs:**

Equipment Name	Cost
Fine Bubble Diffusers + DO Distribution System Replacement =	$1,051,300
With Amendment #2 =	$217,236
Total	$1,268,536

- **GPR Justification:** Categorically GPR-eligible (Energy Efficiency) per Section 3.2-2[4]: *projects that achieve a 20% reduction in energy consumption*.

[3] See attached supporting calculations; Sanitaire Diffused Aeration Design Guide reports typical values of 0.33 for fine bubble diffusers.

[4] Attachment 2. April 2011 EPA Guidance for Determining Project Eligibility.

Categorical

2. New Pumps and Motors

Summary

- In the headworks the existing inefficient aerated grit chamber will be replaced with an energy-efficient Vortex grit chamber.
- Total Amendment #2 amount = $2,500,000
- Estimated Categorical energy efficient (green) portion of loan = 11.4% ($283,939) (proportionate distribution)
- Annual Energy savings = 52%


Headworks

Background

The headworks consists of the following items associated with grit removal:

- An aerated grit chamber with a 7.5-hp positive displacement blower to induce grit settling (operating continuously);
- Wemco 5-hp centrifugal pump that conveys grit to a classifier (both of which operate continuously).

Energy Efficiency Improvements[5]

- The existing arrangement is inefficient from an energy and solids capture standpoint. The Vortex grit chamber proposed for the project will have a 1.0-hp mixer and a 5-hp energy-efficient pump, resulting in a reduction of connected energy load of approximately 52 % (from 12.5 to 6.0 hp). Additionally, the new grit removal system will operate intermittently, rather than continuously, providing even further reduction in energy usage.
- Grit removal will also be improved, resulting in less downtime for downstream processes for cleaning, less abrasion on pumping systems (resulting in extended equipment life), and less labor associated with cleaning and maintenance activities.


Vortex Grit Chamber

Conclusion

- By replacing the existing aerated grit chamber and standard efficiency centrifugal pump with a high efficiency Vortex grit chamber, there is a corresponding reduction in connected energy load of approximately 52%, with further reduction realized due to intermittent operation rather than continuous operation. Additional savings (not quantified) will be realized due to improved grit capture and reduced impact to downstream processes and equipment.
- **GPR Costs:** Vortex grit chamber (including associated site, yard piping, relative portion of the building and electrical costs) = $1,374,100 + $283,938 = $1,658,035
- **GPR Justification:** Categorically GPR-eligible (Energy Efficiency) per Section 3.2-2[6]: *"projects that achieve a 20% reduction in energy consumption."*

[5] City of Blackfoot, Idaho Wastewater Treatment Facility Plan, Final, April 2014; JUB Engineers

[6] Attachment 2. April 2011 EPA Guidance for Determining Project Eligibility.

3. SCADA CONTROL TECHNOLOGY

Summary

- A plant-wide SCADA system will be installed within the next three to five years. Energy efficiency results from the remote electronic sensing and control of the treatment plant.
- Total Amendment #2 amount = $2,500,000
- Estimated energy efficiency (green) portion of loan ≅ 0.5% ($11,112) (proportionate)
- Estimated annual energy and labor savings $8,000 per year.

Background/ Results

- The City has begun integrating the entire facility with a plant-wide SCADA system and is working with a subconsultant to complete a step-wise upgrade of the facility to full SCADA with the next three to five years. In Phase 1 (construction to be completed mid-2017), the primary PLC and communications network were established and integrated with the Intermediate Pump Station and secondary clarifiers.
- Continued development of the SCADA system is part of this project. The budget will include SCADA programming and some related components for the new Headworks, aeration system, and UV disinfection system. The SCADA improvements will reduce labor and energy costs[7].

Energy Efficiency Improvements

- Based on operations staff feedback, plant-wide and remote SCADA control would reduce labor costs (1 person an average of 1.5 call-outs per week at 2 hours per call-out = $7,800 per year in labor costs) and travel costs (5 miles per call out at $0.51 per mile = $200 per year). The total savings is estimated at $8,000/yr.

Conclusion

- Total SCADA savings are estimated at approximately $8,000 per year in energy and labor, costs = payback of 6 to 7 years; therefore, SCADA system costs are GPR-eligible by 3.5-8.
- **GPR Costs:** SCADA = $53,778 + $11,112 = $64,890
- **GPR Justification:** SCADA system costs are GPR-eligible by a Business Case per 3.5-8[8]: *SCADA systems can be justified based on substantial energy savings.*

[7] City of Blackfoot, Idaho Wastewater Treatment Facility Plan, Final, April 2014; JUB Engineers
[8] Attachment 2. April 21, 2011 EPA Guidance for Determining Project Eligibility.