City of Gooding Wastewater Project SRF Loan #WW1804
$9,000,000 (pop. 3,545)

Preliminary Green Project Reserve Justification

Business Case GPR Documentation

1. **INSTALL NEW ENERGY-EFFICIENT GRIT REMOVAL SYSTEM** (Energy Efficiency). Business & Categorical per GPR 3.2-2: *projects that achieve a 20% reduction in energy consumption* ($720,000).

2. **INSTALLS SCADA FOR REMOTE MONITORING & CONTROL** (Energy Efficiency). GPR Business Case per GPR 3.5-8: *SCADA systems can be justified based on substantial energy savings* ($175,000).

3. **TERTIARY FILTER REDUCES UV ENERGY OUTPUT REQUIREMENTS** (Energy Efficiency). Categorically GPR-eligible per Section 3.2-2: *greater than 20% reduction in energy use*; also GPR-eligible per Section 3.4-1: *cost effective as cost is recovered over the useful life of the process* ($700,000).

4. **INSTALLS ADVANCED FLUORESCENT LIGHTING** (Energy Efficiency). Business Case GPR per 3.5-7: *Upgrade of lighting to energy efficient sources such as ...compact fluorescent lighting;* ($3,000).

Innovative & Categorical GPR Documentation

5. **LOW PRESSURE HIGH INTENSITY UV DISINFECTION SYSTEM** (Innovative + Energy Efficiency). Environmentally Innovative GPR-eligible per Section 4.5-5a: *Projects that significantly reduce or eliminate the use of chemicals in wastewater treatment*; Categorically GPR-eligible per Section 3.2-2: *projects that achieve a 20% reduction in energy consumption* ($202,000).

Innovative GPR Documentation

6. **INSTALL INNOVATIVE MULTI-STAGE ACTIVATED BIOLOGICAL PROCESS FOR BIOLOGICAL NUTRIENT REMOVAL** (Innovative). Environmentally Innovative GPR-eligible per Section 4.5-5a: *Projects that significantly reduce or eliminate the use of chemicals in wastewater treatment*; 4.5-5b: *...significantly reduce the volume of residuals, or lower the amount of chemicals in the residuals.* ($4,700,000).

State of Idaho SRF Loan Program
June 2018

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1 All Costs are Preliminary Estimates and will be update in the GPR Technical Memorandum
1. **NEW ENERGY-EFFICIENT GRIT CHAMBER** (PRELIMINARY)

**Summary**
- The Gooding wastewater treatment plant headworks upgrade includes replacement of the existing inefficient aerated grit chamber with an energy-efficient Vortex grit chamber.
- Total Loan amount = $9,000,000
- Estimated Categorical energy efficient (green) portion of loan = xxx% ($720,000) (Planning-Level cost opinion).
- Annual Energy savings = 52%

**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**
- 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.

**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, building, and electrical costs) = $720,000
- **GPR Justification:** Categorically GPR-eligible (Energy Efficiency) per Section 3.2-2:\[3\]: “projects that achieve a 20% reduction in energy consumption.”

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\[2\] City of Gooding, Idaho Wastewater Treatment Facility Plan, December 2017, Keller Associates
### 2. SCADA CONTROL TECHNOLOGY (PRELIMINARY)

#### 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 loan amount = $9,000,00
- Estimated energy efficiency (green) portion of loan ≅ 0.5% ($53,778) (Preliminary costs)
- Estimated annual energy and labor savings $8,000 per year.

#### Background/ Results
- The City will integrate the entire facility with a plant-wide SCADA system.
- 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.

#### 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
- **GPR Justification:** SCADA system costs are GPR-eligible by a Business Case per 3.5-8<sup>4</sup>: *SCADA systems can be justified based on substantial energy savings.*

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**Summary**

The project incorporates tertiary filtration for increased removal of suspended solids prior to UV disinfection, resulting in greater UV disinfection capacity at much lower power.

- Energy efficiency (green) portion of loan = 4.8% ($700,000) [Planning level Estimate]
- Estimated annual power savings = 16,381 kWh (30%) = $1,638 per year

**Background**

- The addition of the tertiary filter reduces the average TSS concentration flowing into the UV vessels from 15 mg/L to 5 mg/L or less. This allows the design UV transmissivity (or the ease at which UV light can pass through the water) to increase from 60% to 70%.
- As UVT improves, more UV light would be able to reach the disinfection target; the UV sensor would read this and adjust the lamps’ output down accordingly therefore decreasing the power consumption.
- The energy savings is not completely linear, but UV disinfection suppliers indicate the increase in transmissivity would significantly reduce energy consumption.
- The Wedeco lamps for the UV disinfection are guaranteed for 14,000 hours; this accounts for 100% operation, all the time. Operating capacity does not have as large an effect on lamp life as number of on/off cycles.

**Calculated Energy Efficiency Improvements**

- Without the tertiary filter the average power draw per UV chamber = 6.31 kW; annual power draw = 55,276 kWh = Annual Energy Costs (@$0.10/kWh) = $5,528.
- With the filter the average power draw = 4.44 kW; annual power draw = 38,894 kWh = Annual Energy Costs (@$0.10/kWh) = $3,889.
- Therefore, with the tertiary filter, the UV disinfection unit uses only 70% of the power required without the filter = 38,894 kWh / 55,276 kWh = .70, resulting in an annual cost saving = $1,639.
- Thus, with the tertiary filter, the UV system is more energy-efficient resulting in an annual power savings of 16,382 kWh.

**Conclusion**

- At 10 cents per kW, UV energy reductions from the tertiary filter saves up to $1,639 per year.

- **GPR Costs**: Tertiary filter = $700,000

- **GPR Justification**: Categorically GPR-eligible per Section 3.2-2^2 Error! Bookmark not defined.: greater than 20% reduction in energy use.
Summary

- Energy efficiency from the installation of advanced fluorescent lighting in the interior of the Facility and exterior LED lighting.
- Total Loan amount = $9,000,000
- Categorical energy efficient (green) portion of loan = 0.3% ($22,557) (Final Costs)

Energy Efficiency Improvements

- Energy efficient T-8 magnetic fluorescent lighting is approximately 28 percent more energy efficient than standard T-12 magnetic fluorescent lighting for relatively the same light output. ⁶
- LED lighting is approximately 58 percent more energy efficient that typical high pressure sodium lighting for relatively the same light output. ⁷

Conclusion

- GPR Costs:

<table>
<thead>
<tr>
<th>Equipment Name</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluorescent Lighting</td>
<td>$13,100</td>
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<tr>
<td>LED Lighting</td>
<td>$12,300</td>
</tr>
<tr>
<td>FY13 + FY14 (Amendment1) Total</td>
<td>$25,400</td>
</tr>
</tbody>
</table>

\[\therefore FY13 \text{ Total} = 25,400 - 2,843 = 22,557\]

- GPR Justification: Advanced fluorescent lighting is GPR-eligible by a Business Case per 3.5-7⁸:
  Upgrade of POTW lighting to energy efficient sources such as compact fluorescent.

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⁶ National Lighting Product Information Program, Lighting Answers, Volume 1 Issue 1, April 1993.
Summary

- The Low Pressure High Intensity UV system specified for the Gooding project is 3X more efficient than medium pressure lamps and 5X higher UV-C output than conventional low pressure lamps. The system specified for the Gooding project is more expensive than conventional lamps and would be comparative in price to the medium pressure option.

- Total Loan amount = $9,000,000
- Categorical energy efficient (green) portion of loan = 2.4% ($202,000) [Planning Level Estimate]
- Annual Energy savings = 66%

Background

- The City of Gooding will install two UV disinfection systems with low-pressure high-intensity lamps.
- A common alternative to low-pressure high-intensity style UV systems are medium-pressure UV systems. In comparison to medium pressure technology, low-pressure high-output technology consumes 2-4 times less power.  
- The typical electrical to germicidal UV conversion efficiency rates of medium pressure UV systems is 10 – 20%; whereas, this efficiency for low-pressure high-intensity systems is 30 – 35%.  
- The specific lamp installed at the Gooding WWTP is the WEDECO Spektrotherm UV lamp which has a light yield to energy expenditure 3 times higher in comparison to medium pressure lamps.

Results

- The maximum power consumption of the low-pressure high-intensity UV system (lamps and ballasts only) installed is 7.56 kW per UV unit. The wastewater flow at the WWTP will be constant, meaning the disinfection system is operating at all times.
- With one unit running 24 hours a day for every day of the year, the annual energy consumed by the system is 66,226 kWh/yr.
- Elimination of chlorine residuals and need for de-chlorination chemicals (sulfur dioxide).

Energy Efficiency Improvements

- The approximate energy consumption by medium pressure UV system for this application = 66,226 kW-hr x 3 = 198,677 kW-hr.
- The energy reduction achieved by using a low-pressure high-intensity system versus a medium-pressure high-intensity system = 1 - (66,226 kW-hr / 198,677 kW-hr) = 66%
- The annual energy cost savings associated with using a low-pressure high-intensity system instead of a medium-pressure high-intensity system (@$0.10/kWh) = (198,677 – 66,226)kWh x $0.10/kWh = $13,245/yr

Conclusion

- By selecting a low-pressure high-intensity UV disinfection system the power consumption will be 66% lower than the common alternative medium-pressure high-intensity disinfection system.

- **GPR Costs**: Low-pressure high intensity UV disinfection system: $202,000
- **GPR Justification**: Categorically GPR-eligible (Energy Efficiency) per Section 3.2.2, projects that achieve a 20% reduction in energy consumption; also Innovative GPR-eligible per Section 4.5-5a: Projects that significantly reduce or eliminate the use of chemicals in wastewater treatment.

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9 Correspondence from Katie Cook, Senior Applications Engineer for Xylem Inc.-WEDECO UV products.
10 Metcalf and Eddy-Wastewater Engineering; Tchobanoglous, Burton, & Stensel, 2003; Table 12-25
11 Table 2.1 from the USEPA’s UV Disinfection Guidance Manual (UVDGM 2006).
12 Wedeco LBX series UV disinfection system brochure.
Innovative

6. POTW UNIT PROCESS: BIOLOGICAL NUTRIENT REDUCTION

Summary
- An innovative biological nutrient reduction (BNR) system has been incorporated into the treatment process that will significantly reduce the amount of chemicals used to remove phosphorus and to buffer pH.
- Total Loan amount = $9,000,000
- Estimated Categorical energy efficient (green) portion of loan = 21% ($5,744,000)

Background
- It is anticipated that the City of Gooding’s NPDES permit will have phosphorus effluent limits.
- BNR is a proven innovative technology that significantly reduces the amount of chemicals used to treat wastewater; BNR also significantly reduces the amount of residuals produced, as well as the amount of chemicals in the residuals.
- The secondary treatment system will be configured to provide BNR of phosphorus and non-biological nitrogen (i.e. nitrate, NO3-N). The reduction of nitrate will improve the BNR of phosphorus and will recover alkalinity.
- Anaerobic and anoxic tanks will be incorporated as part of the secondary treatment process to perform the BNR.

Treatment Description
- In BNR return activated sludge from the secondary clarifiers is brought into contact with the influent wastewater in the anaerobic tanks. The anaerobic conditions promote the growth of organisms used to biologically remove phosphorus. BNR without chemical addition is capable of lowering the phosphorus concentration to 1.5 mg/L.
- Nitrified water is recirculated through the anoxic tanks to be denitrified. The removal of nitrate improves the performance of the biological phosphorus removal process by removing an alternate oxygen source.
- Efficient solids separation, necessary to maintain the low phosphorus, is provided via modern clarifiers.

Innovative Process Justification
- The GPR-eligibility of BNR was established by comparison to a Baseline Standard Practice (BSP). The BSP was derived from an analysis of viable and relevant treatment technologies.
- The BSP for Gooding is phosphorus removal by chemical precipitation using alum and providing supplemental alkalinity by chemical addition using magnesium hydroxide.
- Compared to the BSP over the design period for the project, BNR eliminates the use of alum, uses 2062 tons less magnesium hydroxide and generates no alum sludge. Overall, BNR uses 19,560 tons less chemical than the BSP. The estimated quantities of chemicals used, sludge generated and the savings BNR will create are summarized in the table.

<table>
<thead>
<tr>
<th></th>
<th>BSP</th>
<th>BNR</th>
<th>Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alum used</td>
<td>6,494 tons</td>
<td>0 tons</td>
<td>6,494 tons</td>
</tr>
<tr>
<td>Magnesium Hydroxide used</td>
<td>2,721 tons</td>
<td>659 tons</td>
<td>2,062 tons</td>
</tr>
<tr>
<td>Chemical sludge generated</td>
<td>11,004 tons</td>
<td>0 tons</td>
<td>11,004 tons</td>
</tr>
<tr>
<td>Total</td>
<td>20,219 tons</td>
<td>659</td>
<td>19,560 tons</td>
</tr>
</tbody>
</table>

- Compared to the BSP over the design period for the project, BNR will save more than $4 million in chemicals and sludge disposal cost. The estimated cost of chemicals used, cost to dispose of sludge and the savings BNR will create are summarized in the table below.

<table>
<thead>
<tr>
<th></th>
<th>BSP</th>
<th>BNR</th>
<th>Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of Alum</td>
<td>$2,597,543</td>
<td>$ 0</td>
<td>$2,597,543</td>
</tr>
<tr>
<td>Cost of Magnesium Hydroxide</td>
<td>$1,536,319</td>
<td>$372,090</td>
<td>$1,164,230</td>
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<tr>
<td>Cost of Chemical Sludge Disposal</td>
<td>$495,189</td>
<td>$ 0</td>
<td>$495,189</td>
</tr>
<tr>
<td>Total</td>
<td>$4,629,052</td>
<td>$372,090</td>
<td>$4,256,962</td>
</tr>
</tbody>
</table>

Conclusion
- BNR is GPR-eligible as it is an innovative process that eliminates the use of alum for phosphorus reduction, eliminates the generation of alum sludge, and significantly reduces the use of magnesium hydroxide for pH control.
- GPR Costs: Biological nutrient removal system = $5,744,000 (Planning level estimate)
- GPR Justification: The process is GPR-eligible per Section 4.5-5a: Projects that significantly reduce or eliminate the use of chemicals in wastewater treatment; 4.5-5b: ...significantly reduce the volume of residuals, or lower the amount of chemicals in the residuals.

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13 Wastewater Treatment Facility Plan, December 2017, Keller Associates