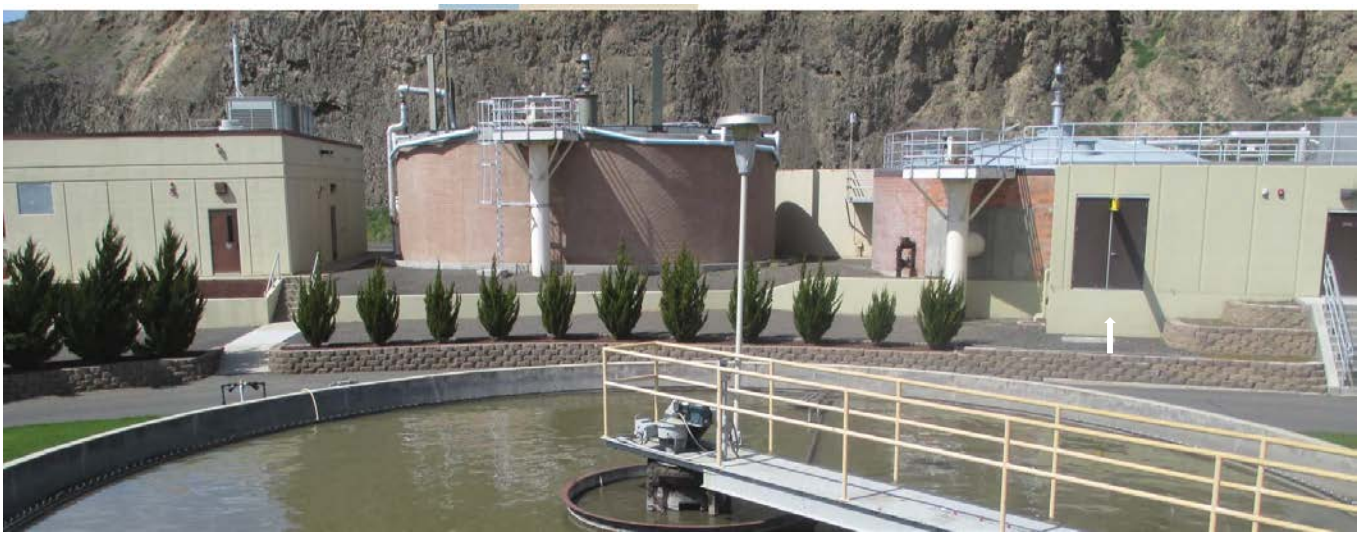
Clean Water State Revolving Fund Green Project Reserve

- Interim -



City of Lewiston WWTP Upgrade Project: Priority 1 Upgrades

SRF Loan #WW2001: $29,181,000 (pop 33,900)

Interim Green Project Reserve Justification

Business Case GPR Documentation

1. PREMIUM ENERGY EFFICIENT MOTORS AND VFDS (Energy Efficiency). Premium energy efficient motors and VFDs will be installed as part of the Wastewater System Upgrade project. GPR Business Case per Section 3.2-2: *Use of premium efficiency motors and VFD pumps in a new project to achieve 20% reduction in energy consumption.* ($1,059,000).
2. INSTALL SCADA SYSTEM (Energy Efficiency). Business Case GPR per 3.5-8: *SCADA systems can be justified based on substantial energy savings.* ($300,000)

Categorical GPR

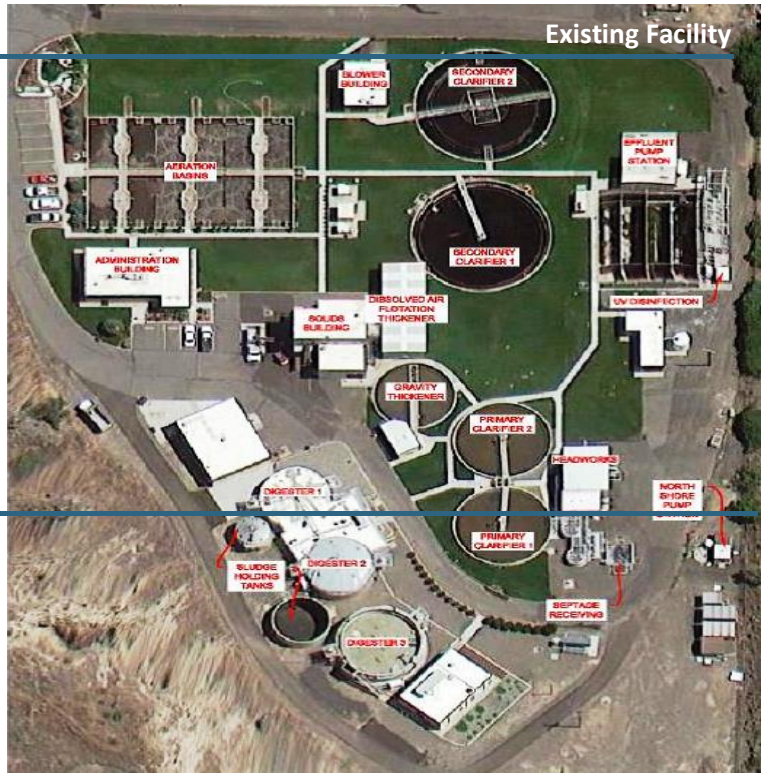
3. INSTALL NEW FINE BUBBLE DIFFUSED AERATION SYSTEM WITH HIGH SPEED SCREW COMPRESSORS (Energy Efficiency). Categorical GPR per Section 3.2-2: *projects that achieve a 20% reduction in energy consumption; retrofits to compare existing system to that proposed…New POTW projects or capacity expansion projects should be designed to maximize energy efficiency and should select high efficiency premium motors and equipment where cost effective."* ($1,520,000).
4. LOW PRESSURE HIGH INTENSITY UV DISINFECTION SYSTEM (Energy Efficiency). Categorically GPR-eligible per Section 3.2-2: *projects that achieve a 20% reduction in energy consumption; and* 4.5-5a: *Projects that significantly reduce or eliminate the use of chemicals in wastewater treatment* ($335,000).

Categorical

1. Premium Efficiency Pumps & VFDs[1]

Summary

- The City of Lewiston is upgrading their wastewater treatment plant, funded with a FY20 SRF Loan. The upgraded system includes pumps with premium motors, and Variable Frequency Drives (VFDs).
- Loan amount = $29,181,000
- GPR-eligible Pumps/VFDs = $1,059,000 [Design estimate]
- Green portion of loan = 3.6 %



Description

- The existing treatment process consists of pretreatment, primary settling, activated sludge secondary treatment, secondary clarifiers and low pressure UV disinfection.
- Energy efficient items installed in the Lewiston WWTP upgrade include:

Equipment[2]	Type	Quantity	HP (ea)	Annual Run Time (hrs/yr)	Total Cost
RAS Pumps	Horizontal Screw Centrifugal	3 Duty, 1 stby	25	8,760	$91,000
Effluent Pumps	Centrifugal	2 Duty, 1 stby	100	8,760	$311,000
Mixing System Pumps	Compressed Gas	2 Duty, 1 stby	20	8,760	$457,000
VFDs[3]	Allen Bradley	All equipment	-	-	$200,000

GPR Justification

To calculate the savings from using premium energy-efficient equipment, the Baseline Standard Practice (BSP) for comparison is a standard Epact motor that is not controlled by a VFD[4].

- Motor/VFD efficiency data were calculated using the WEG VFD Energy Savings Calculator[5].
- The estimated combined annual energy savings for utilizing premium energy-efficient pumps and VFDs (compared to the BSP) is summarized in the table below for each of the different pieces of equipment. The corresponding cost savings are estimated using an energy cost of 0.1$/kWh.

[1] Equipment specification provided by J. King P.E., Keller Engineers – K McNeill P.E. IDEQ email Dec 6, 2019
[2] All rotating equipment controlled by VFDs
[3] All pumps and blowers indicated are VFD controlled. The only item listed that is not is the Compressed Gas Mixing system which uses shuts off at high pressure.
[4] NYS Energy Research and Development Authority, Energy Evaluation Memorandum, Village of Greenport WWTP Upgrade 8-2009
[5] WEG Energy Savings Tool

Equipment	Energy Savings (kWh/yr per pump/VFD system)	Cost Savings ($ per pump/VFD)	Payback period (years) per item
RAS Pumps + VFD	90,307	$9,031	2.5
Effluent Pumps + VFD	353,895	$35,389	2.9
Mixing System Pumps	72,800	$7,280	20.0

Conclusion

- The use of premium energy-efficient pumps and VFDs are GPR-eligible as they are cost effective.


Vertical Turbine Pumps at Effluent Pump Station

- **GRP Costs Identified**[i]
  - RAS Pumps $ 91,000
  - Effluent Pumps $311,000
  - Mixing System Pumps $457,000
  - VFDs $200,000

  Total $1,059,000

- **GPR Justification**: The Pump/VFD systems are both Categorically and Business-Case GPR eligible (Energy Efficiency) per Section 3.2-2 page 9[6]: *Use of premium efficiency motors and VFD pumps … where they are cost effective and achieve a 20% reduction in energy consumption*. Section 3.5-9 also states: *Variable Frequency Drives can be justified based upon substantial cost savings.*

[6] 2012 Clean Water State Revolving Fund 10% Green Project Reserve: Guidance for Determining Project Eligibility

2. SCADA CONTROL TECHNOLOGY

Summary

- SCADA Control Technology is installed for on-site control of the treatment plant in order to minimize power costs and optimize treatment effectiveness.
- Estimated loan amount = $29,181,000
- Energy efficiency (green) portion of loan = 1.0% ($300,000) [Design estimate]
- Estimated annual savings $60,000 per year[7].

Background / Results

- The SCADA system is part of the project upgrade at the plant.
- SCADA will be installed to control treatment plant operations.
- ACTIVATED SLUDGE BASINS: The aeration system is tied to the dissolved oxygen levels in the oxidation ditches and air compressors/blowers through PLC's; these control air flow and blower VFDs. Thus, SCADA monitors and controls oxygen levels in aerobic processes and secondarily by ammonia levels.

- UV DISINFECTION: The SCADA system controls the UV system through flow and transmissivity PLC monitoring. A UV intensity sensor in each UV vessel monitors the transmissivity. The PLC receives inputs from the UV sensor and flow meter and automatically adjusts the received UV Dose to maintain the required levels under all operation conditions. The dose-pacing of the system has the ability to power the lamps between 50-100% of their maximum output in addition to being turn them on and off when needed.
- OPERATOR TIME SAVED ANNUALLY: 2,080 hrs per year. Would otherwise require a dedicated person to collect samples, adjust valves, blower speed etc.
- ANNUAL COST SAVINGS: $60,000

Conclusion

- The system results in a cost savings of $60,000 per year in energy and labor costs = payback of 5 years.
- **GPR Costs:** SCADA = $300,000 (Engineering design estimate)
- **GPR Justification:** The SCADA is GPR-eligible per Section 3.5-8: *SCADA systems can be justified based on substantial energy savings*.

[7] 12-21-2019 Email Jason King P.E. Keller Engineers to K McNeill P.E. IDEQ

Categorical

3. AERATION IMPROVEMENTS

Summary

- The project includes energy-efficient aeration system upgrades, such as premium blowers and fine bubble diffusion.
- Loan amount = $29,181,000
- GPR-eligible blowers + fine bubble diffusion = $1,520,000
- Green portion of loan = 5.2 %

Upgrades

Aeration Improvements:

- High efficiency Rotary Helical Screw Compressor Blowers, three duty, one standby, 200 HP ea; Total Cost = $1,100,000; Annual run times = 8,760 hrs per year.
- Fine bubble Flexible Membrane Plate Diffusers; Cost = $420,000.
- Fine bubble diffusers provide for a decreased actual oxygen requirement (AOR) to standard oxygen requirement (SOR) ratio of 0.33 compared to 0.50 for coarse bubble diffusers. [8]
- Fine bubble diffusers provide an oxygen transfer efficiency (OTE) of 2 percent per foot of submergence compared to 0.75 percent for coarse bubble diffusers. [2]
- Screw compressor blowers operate with an increased wire to air efficiency of approximately 90 percent compared to positive displacement blowers which operate with a wire to air efficiency of approximately 70 percent.[9]
- The dissolved oxygen control system allows for precise control of the air flow to match the diurnal dissolved oxygen demand which substantially decreases the power demand of the new system.

Conclusion

- By using a fine bubble diffused aeration system, screw compressor blowers, VFDs, and flow metering, the City reduces the required air demand of the aeration system by approximately 30 percent.
- **GPR Costs:**

Equipment Name	Cost
Fine Bubble Diffusers	$420,000
Screw Compressor Blowers	$1,100,000
Total	**$1,520,00**

- **GPR Justification:** Categorically GPR-eligible (Energy Efficiency) per Section 3.2-2[10]: *projects that achieve a 20% reduction in energy consumption.*

[8] Sanitaire Diffused Aeration Design Guide.
[9] Refer FY13 City of Fruitland GPR.
[10] Attachment 2. April 2011 EPA Guidance for Determining Project Eligibility.

4. Low Pressure High Intensity UV Disinfection System

Summary

- The City of Lewiston will install a more energy-efficient UV disinfection system with low-pressure high-intensity lamps.
- Total Loan amount = $29,181,000
- Categorical energy efficient (green) portion of loan = 2.4% ($335,000) [Design Estimate]
- Annual Energy savings = 66%

Background

- The new system includes fewer lamps due to higher wattage and is dose-paced based on flow, thereby conserving energy.
- The existing in-channel, vertical lamp, Low Pressure High output UV system (Aquaray 40) will be replaced with a Wedeco Duron UV system with an in-channel, 45-degree, vertically inclined 600 W lamps. UV-C output is important when considering UV disinfection systems because the UV-C range is the germicidal portion of the UV radiation band.

- A common alternative to low-pressure high-intensity style UV systems low-pressure high-output technology consumes 2-4 times less power. [11]
- 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%.[12]
- The specific lamp to be installed is the WEDECO Duron UV lamp which has a light yield to energy expenditure 3 times higher in comparison to medium pressure lamps.[13]

Results

- 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 per year

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: $335,000 (Design Estimate)
- **GPR Justification:** Categorically GPR-eligible (Energy Efficiency) per Section 3.2-2: *projects that achieve a 20% reduction in energy consumption; and* 4.5-5a: *Projects that significantly reduce or eliminate the use of chemicals in wastewater treatment.*

[11] Metcalf and Eddy-Wastewater Engineering; Tchobanoglous, Burton, & Stensel, 2003; Table 12-25
[12] Table 2.1 from the USEPA's UV Disinfection Guidance Manual (UVDGM 2006).
[13] Wedeco UV disinfection system brochure.