Coeur D'Alene WWTP Upgrade Project Phase 5C.1

SRF Loan #WW1307 (FY13) (pop. 46,146)

$7,700,000

Final Green Project Reserve Justification

Categorical GPR Documentation

- INSTALL NEW FINE BUBBLE DIFFUSED AERATION SYSTEM WITH HIGH SPEED TURBO BLOWERS (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."* ($213,584).
- INSTALLS INSTALL NEW ENERGY-EFFICIENT VFDS AND PREMIUM EFFICIENCY MOTORS ON PROCESS PUMPS AND AIR SCOUR BLOWERS (Energy Efficiency). Categorical per GPR 3.2-2: *projects that achieve a 20% reduction in energy consumption* ($81,881).

Business Case GPR Documentation

- 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;* ($22,557).

Categorical

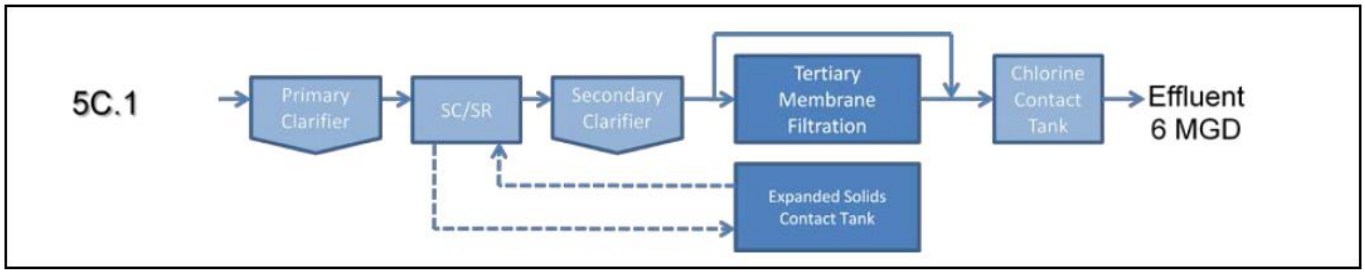
1. Treatment Process – Fine Bubble Aeration System

Summary

- Large-scale wastewater plant improvement project includes up to 1 mgd of tertiary membrane filtration (TMF) of secondary effluent from the existing secondary wastewater treatment plant.
- Total Loan amount = $7,700,000
- Categorical energy efficient (green) portion of loan = 2.77% ($213,584) (Installed cost)
- Annual Energy savings = 71%

Background[1]

- The City of Coeur d'Alene's Waste Water Treatment Plant currently services approximately 45,000 people and includes 13,915 resident and 1,716 commercial connections as of fiscal year 2011.
- The City of Coeur d'Alene faces changing effluent discharge conditions in the Spokane River and new regulatory requirements driven by water quality impairment in the Spokane River and downstream Lake Spokane (Long Lake reservoir).
- Current treatment processes include screening, grit removal, primary clarification, trickling filter/solids contact, secondary clarification, and disinfection.
- The Phase 5C.1 improvements will include up to 1 mgd of tertiary membrane filtration of secondary effluent from the TF/SC plant. Secondary effluent will be pumped from the secondary clarifiers to the chemical mixing tank and through the membrane tanks. The TMF permeate will be blended with secondary effluent, disinfected, and discharged to the river. A process schematic is shown below.



- Increased nitrification capacity is added in a combination of improvements including the chemical mixing tank, the expanded solids contact tank, and by seeding of nitrifying bacteria from solids wasting from the membrane tank.
- During Phase 5C.1, one of three chemical mixing tanks will be used in conjunction with the membrane filtration process. The other two chemical mixing tanks will be used for addition expanded solids contact tank volume to increase the ammonia reduction capacity of the treatment plant. During future phases, all three mixing tanks will serve the membrane filtration syste

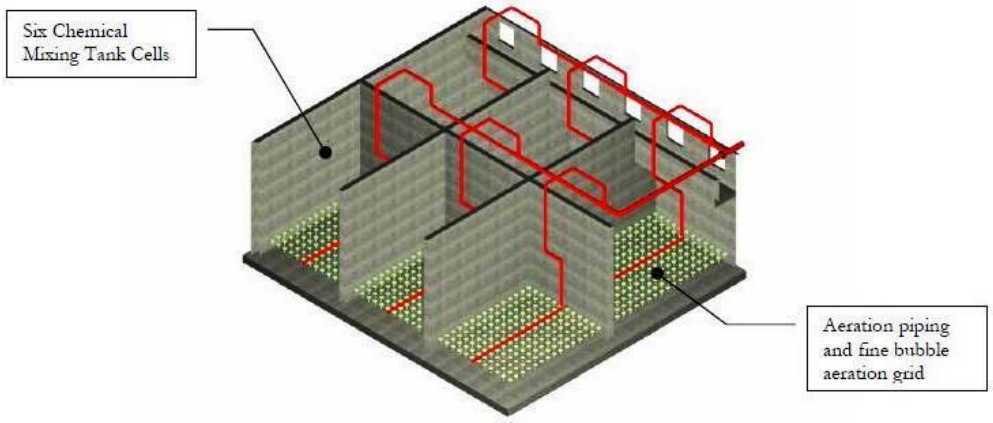


Figure 4-1: Chemical Mixing Tank Layout

- All three of the chemical mixing tanks are equipped with fine bubble diffusers supplied with air from high-speed turbo aeration blowers. Each of the tanks is equipped with dissolved oxygen control system

[1] 2012 Update to the 2009 Facility Plan, City of Coeur D'Alene, HDR Engineering Inc. February 2012

FINE BUBBLE AERATION SYSTEM (CONT.)

including dissolved oxygen probes, air flow control valves, and air flow meters. Each high-speed turbo blower is equipped with an internal variable frequency drive.

Results

- The horsepower (HP) requirement of the new high-speed turbo blowers is 125 HP for each blower.
- The estimated energy consumed by the proposed system will be 230,000 kW-hr per year

Energy Efficiency Improvements

- 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. [2]
- 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. [3]
- High-speed turbo blowers operate with an increased wire to air efficiency of approximately 73 percent compared to multi-stage centrifugal blowers which operate with a wire to air efficiency of approximately 60 percent.[4]
- The dissolved oxygen control system allows for precise control of the air flow to match the diurnal dissolved oxygen demand which will substantially decrease the power demand of the new system.

Conclusion

- By using a fine bubble diffused aeration system, the City will reduce the required air demand by approximately 43 percent.
- By using high-speed turbo blowers, the City will reduce the power demand by approximately 18 percent.
- By using a combination of fine bubble aeration, high speed turbo blowers, and dissolved oxygen control system, the City will reduce power demand by approximately 71 percent.
- **GPR Costs:**

Equipment Name	Cost
Fine Bubble Diffusers	$30,600
High-speed Turbo Blowers	$190,400
Dissolved Oxygen Control System	$19,500
FY13 + FY14 (Amendment1) Total	**$240,500**
∴ FY13 Total = $240,500 – 26,916 = $213,584	

- **GPR Justification:** Categorically GPR-eligible (Energy Efficiency) per Section 3.2-2[5]: *projects that achieve a 20% reduction in energy consumption*.

[2] Sanitaire Diffused Aeration Design Guide.
[3] Ditto.
[4] *City of Coeur d'Alene Advanced Water Reclamation Facility (AWRF) Phase 5 Expansion Preliminary Design Report*, Section 8 - Blower Building, May 2009.
[5] Attachment 2. April 2010 EPA Guidance for Determining Project Eligibility.

2. New Pumps and Motors[6] (preliminary)

Summary

- All pumps and blowers are new and are to be equipped with variable frequency drives (VFDs) and premium efficiency motors to conserve energy and enhance the operability of the treatment process
- Total Loan amount = $7,700,000
- Categorical energy efficient (green) portion of loan = 1.1% ($81,881) (Final Costs)
- Annual Energy savings = 36%

Background

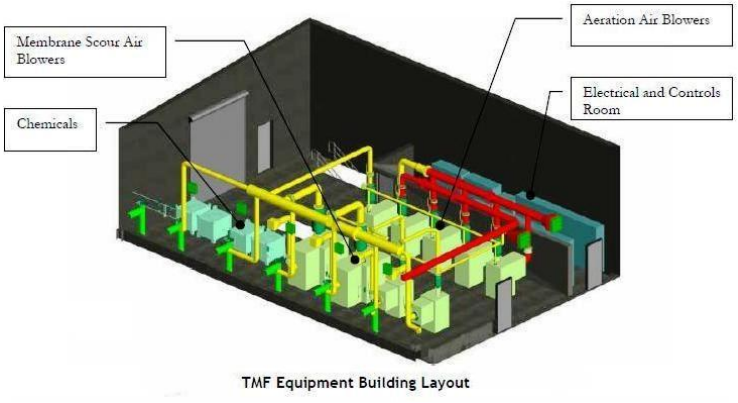
- See summary in Section 1. Fine Bubble Aeration System.
- Premium efficiency motors save on average 3-7% over standard efficiency motors.
- Variable frequency drives greatly add to the efficiency of the process by allowing process equipment to operate at speeds that match the demands rather than operate at full speed all of the time.

Results

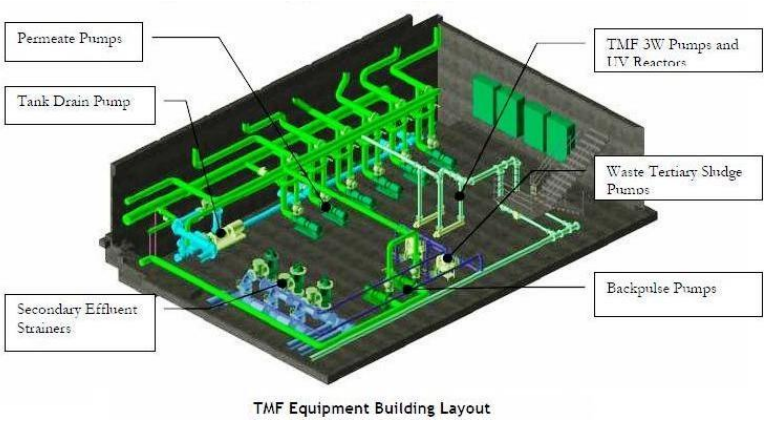
- Equipment that will have premium efficiency motors and/or will be controlled by VFDs is listed in the table below.

Equipment Name	HP
Return Secondary Sludge Transfer Pump	15
Secondary Effluent Transfer Pump 1	20
Secondary Effluent Transfer Pump 2	20
Trickling Filter Effluent Transfer Pump	15
Overhead Rolling Door	1.5
Exhaust Fan	6
Sump Pump 1	5
Sump Pump 2	5
Supply Fan	10
Membrane Tank 1 Slide Gate	1
Membrane Tank 2 Slide Gate	1
Secondary Effluent Strainer Drain Pump	7.5
Secondary Effluent Strainer 1	1
Secondary Effluent Strainer 2	1
Permeate Pump 1	10

Equipment Name	HP
Permeate Pump 2	10
Backpulse/CIP Pump 1	7.5
Backpulse/CIP Pump 2	7.5
Return Tertiary Sludge Pump 1	40
Return Tertiary Sludge Pump 2	40
Flash Mixing Pump 1	3
Flash Mixing Pump 2	3
RTS Channel Scum Skimmer	1
Flash Mixing Tank Scum Skimmer	1
Waste Tertiary Sludge Pump 1	3
Waste Tertiary Sludge Pump 2	3
Tank Drain Pump 1	15
Tank Drain Pump 2	15
Blower 5 - Scour Air	40
Blower 6 - Scour Air	40



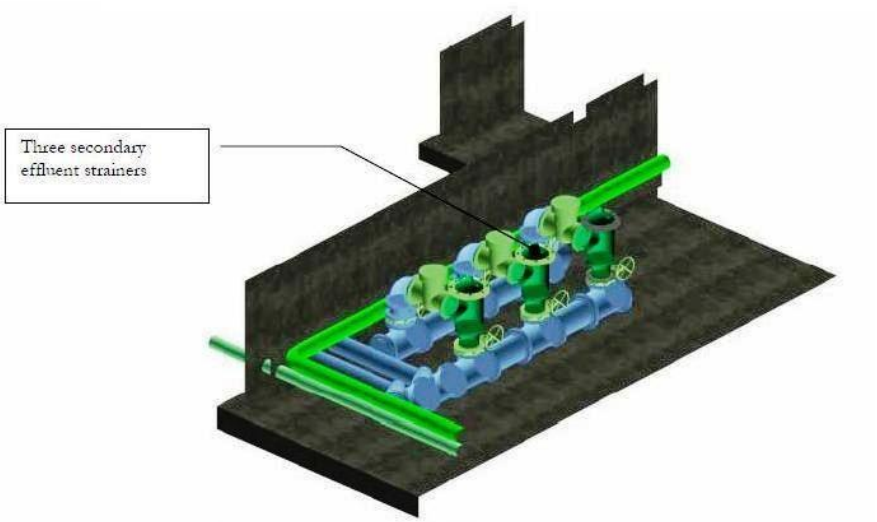
TMF Equipment Building Layout



TMF Equipment Building Layout

[6] NOTE: Analysis is preliminary and will be completed when project has been awarded and pump & motor schedules are available

NEW PUMPS AND MOTORS (CONT.)



Secondary Effluent Strainers Layout

Energy Efficiency Improvements

- Equipment without premium energy-efficiency motors and VFDs result in a power usage of 1,124,000 kW-hr per year at an annual power cost of $73,100.
- Equipment powered by premium efficiency motors with VFDs result in a power usage of 829,000 kW-hr per year at an annual power cost of $53,900.
- The use of premium energy-efficiency motors and VFDs results in a power savings of 295,000 kW-hr per year and an annual cost savings of $19,200.

Conclusion

- By using VFDs and providing premium efficiency motors, the City will reduce their power needs by approximately 295,000 kW-hr per year and annual power costs by approximately $19,200 each year – a 36% overall savings in energy and costs.
- The equipment is GPR-eligible due to the 36% reduction in energy consumption and the payback on the investment (< 5 years) which is substantially less than the useful life of the equipment.
- **GPR Costs**:

Equipment Name	Cost
Variable Frequency Drivers	$52,100
Premium Efficiency Motors	$40,100
FY13 + FY14 (Amendment1) Total	**$92,200**
∴ FY13 Total = 92,200 – 10,319 = $81,881	

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

3. FLUORESCENT LIGHTING

Summary

- Energy efficiency from the installation of advanced fluorescent lighting in the interior of the Tertiary Membrane Filtration (TMF) Facility and exterior LED lighting.
- Total Loan amount = $7,700,000
- 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. [7]
- LED lighting is approximately 58 percent more energy efficient that typical high pressure sodium lighting for relatively the same light output.[8]

Conclusion

- **GPR Costs**:

Equipment Name	Cost
Fluorescent Lighting	$13,100
LED Lighting	$12,300
FY13 + FY14 (Amendment1) Total	**$25,400**
∴ FY13 Total = 25,400 - $2,843 = $22,557	

- **GPR Justification**: Advanced fluorescent lighting is GPR-eligible by a Business Case per 3.5-7[9]: *Upgrade of POTW lighting to energy efficient sources such as …compact fluorescent.*

[7] National Lighting Product Information Program, *Lighting Answers*, Volume 1 Issue 1, April 1993.
[8] Global Green Energy, *ROI Analysis - 250W high pressure sodium vs. EcoBright 120W LED street light*, accessed via http://www.gg-energy.com/
[9] Attachment 2. April 21, 2010 EPA Guidance for Determining Project Eligibility. Page 10.