MISSOURI
DEPARTMENT OF
NATURAL RESOURCES

City of Cape Girardeau
I. Wastewater Treatment Plant Upgrade
And
II. Inflow and Infiltration Rehabilitation

Clean Water State Revolving Fund
Green Project Reserve
Business Case

State Fiscal Year 2013 Intended Use Plan
Project Numbers C295531-01, -02, and -03

Loan Closing Date	Loan Amount	Total Green Amount
June 19, 2012	$31,000,000	WWTP $8,852,000
June 18, 2013	$ 3,250,000	I/I $ 555,739
June 18, 2013	$35,750,000	

I. WASTEWATER TREATMENT PLANT UPGRADE

Summary

- Construction of a new Sequencing Batch Reactor (SBR) wastewater treatment plant (WWTP) to replace the existing trickling filter WWTP.
- Total Loan amount = $70,000,000
- Estimated green portion of loan = 12.6% ($8,852,000)

Background

The original trickling filter wastewater treatment facility was built in 1962, expanded in 1977, and upgraded in 1994 and 2002. The Missouri State Operating Permit MO-0050580 was renewed with more stringent effluent limits, which required an upgrade of the facility. In addition, the existing treatment facility site is located in an area of karst topography where numerous nearby sink holes have recently developed. This project relocated the city's wastewater treatment facility to a new location that will satisfy the wastewater treatment needs for the projected growth of the city, eliminate wet weather bypasses, and reduce the threat of karst features developing around the existing treatment facility.

The new treatment facility consists of a headworks facility, a sequencing batch reactor activated sludge system, an ultraviolet disinfection system, and a biosolids processing and handling system designed to treat an average design flow of 11 million gallons per day.

Green Component Justification

1. Three 225 horsepower (HP) high-speed turbo blowers with variable frequency drive (VFD) motors for the SBR.
    - The turbo blowers are being installed for the new sequencing batch reactor which will help increase efficiency and lower energy costs compared to conventional blowers.
    - Units are of high efficiency design with precise control of output based on oxygen demand and mixing requirements. Units are anticipated to result in a 20% to 40% reduction in energy consumption compared to traditional blowers.
    - Categorically GPR-eligible per Section 3.2-2, "*Projects that achieve a 20% reduction in energy consumption are categorically eligible for GPR*".

2. Three 60 HP positive displacement blowers with variable frequency drive motors for the waste activated sludge (WAS) tanks.
    - The VFD motors are being installed on the blowers for the new WAS tanks which will help increase efficiency and lower energy costs compared to conventional blowers without VFDs.
    - It is estimated that the use of VFDs for the three blowers will reduce overall power consumption when compared with full voltage operation of the pumps. This power savings result primarily, from a reduction in the inrush current associated with multiple blower starts, as well as an ability to control blower operating speed and capacity within an efficient operating range.
    - Business Case GPR-eligible per Section 3.5-9, "*Variable Frequency Drive can be justified based upon substantial energy savings*".

3. Six 215 HP submersible pumps with VFDs for the influent pumping station.
    - The VFDs provide a uniform flow through the process, with a minimum of starts and stops, reducing starting amperage, and optimizing pumping efficiency.
    - It is estimated that the use of VFDs for the six pumps will reduce overall power consumption by approximately ten percent when compared with full voltage operation of the pumps. This power savings result primarily, from a reduction in the inrush current associated with multiple pump starts, as well as an ability to control pump operating speed and capacity within an efficient operating range.
    - Business Case GPR-eligible per Section 3.5-9, "*Variable Frequency Drive can be justified based upon substantial energy savings*".

4. Three 50 HP vertical turbine pump with VFD motors for the service water pumping in ultraviolet disinfection and service water pumping station.
    - The VFDs provide a uniform flow through the process, with a minimum of starts and stops, reducing starting amperage, and optimizing pumping efficiency.
    - The use of VFDs for the three pumps will reduce overall power consumption when compared with full voltage operation of the pumps. This power savings result primarily, from a reduction in the inrush current associated with multiple pump starts, as well as an ability to control pump operating speed and capacity within an efficient operating range.
    - Business Case GPR-eligible per Section 3.5-9, "*Variable Frequency Drive can be justified based upon substantial energy savings*".

5. Fine bubble diffusers in the sequencing batch reactor.
    - The high efficiency fine bubble diffusers provide more mass transfer of oxygen than coarse bubble diffusers given the same air volume.

- The use of fine bubble diffusers will provide more mass transfer of oxygen and use less energy than coarse bubble diffusers.
- Business Case GPR-eligible per Section 3.5-1, "*POTW projects or unit process projects that achieve less than a 20% energy efficiency improvement*".

6. Fine bubble diffusers in the WAS tanks.
    - The high efficiency fine bubble diffusers provide more mass transfer of oxygen than coarse bubble diffusers given the same air volume.
    - The use of fine bubble diffusers will provide more mass transfer of oxygen and use less energy than coarse bubble diffusers.
    - Business Case GPR-eligible per Section 3.5-1, "*POTW projects or unit process projects that achieve less than a 20% energy efficiency improvement*".

7. Construction of a new dewatering and drying facility in order to stop land applying liquid sludge and create a dried Class A biosolid product.
    - The city of Cape Girardeau currently trucks its liquid sludge to be either land applied or taken to the landfill. The city wants to be able to create Class A biosolids to reduce fuel costs as well as increase final disposal and reuse options of their biosolids product. The project will consist of the installation of centrifuges, a biosolids drier system, and all necessary appurtenances necessary to make a biosolids facility capable of producing Class A biosolids.
    - Reduction of the volume of liquid sludge land application in the Cape Girardeau area.
    - Energy savings in fuel for hauling a dry compacted material versus liquid sludge.
    - Finished product will be a categorized Class A biosolid, a high quality organic nitrogen source, reducing total fertilizer need in the area.
    - Business Case GPR-eligible per Section 4.5-5b, "*Treatment technologies or approaches that significantly reduce the volume of residuals, minimize the generation of residuals, or lower the amount of chemicals in the residuals*".
    - Business Case GPR-eligible Per Section 4.5-5b(i), "*Includes composting, class A and other sustainable biosolids management approaches*".

8. Three 15 HP recessed impeller pumps for grit slurry pumping, two 2.5 HP submersible mixers for the influent pumping station, two 3 HP submersible pumps in new pump station at the existing treatment plant, two 6 HP submersible pre-rotation pumps for the scum pump station, four 3 HP waste sludge pumps for the sequencing batch reactor, two 5 HP bar screen motors for the headworks, two 5 HP compactor motors for the headworks, and one 5 HP grinder motor for the septage receiving grinders.

- Each of the motors listed above is designated as National Electrical Manufacturers Association (NEMA) Premium® motors. Premium efficiency motors operate in the most efficient manner possible to help reduce electrical power consumption, costs, and improve system reliability.
- The premium efficiency motors will reduce the amount of energy usage compared to standard motors.
- Business Case GPR-eligible per Section 3.5-1, "*POTW projects or unit process projects that achieve less than a 20% energy efficiency improvement*".

9. Heating, ventilation, and air conditioning (HVAC) systems installed in the administration building variant refrigerant system, the headworks building ventilation system, and the biosolids processing building system.
    - The city considered ways to reduce energy usage and natural gas consumption throughout their HVAC systems in the three new buildings. This would help offset some of the daily costs of operating such a large facility.
    - The administration building variant refrigerant system with a dedicated outdoor air unit uses a plant effluent loop to reject or reclaim heat from the water for energy efficiency.
    - The headworks building ventilation system uses a custom energy recovery unit utilizing a heat-pipe heat exchanger allowing a 50% reduction in natural gas consumption. Heat from the blowers is used to heat the building.
    - The biosolids processing building ventilation system uses a custom energy recovery unit utilizing a heat-pipe heat exchanger allowing a 50% reduction in natural gas consumption. Heat from the blowers is used to heat the building.
    - Business Case GPR-eligible per Section 3.5-1, "*POTW projects or unit process projects that achieve less than a 20% energy efficiency improvement*".
    - Categorically GPR-eligible per Section 3.2-2, "*Projects that achieve a 20% reduction in energy consumption are categorically eligible for GPR*".

Conclusion

The SBR WWTP and biosolids project is the most cost effective alternative. Energy efficiency was at the core of the design of the facility. VFDs, high efficiency motors, high oxygen transfer efficiency fine bubble diffusers, energy efficient HVAC systems, and a biosolids treatment system that will possibly eliminate all trips to land apply the biosolids as most, if not all of it, will be sold as Class A biosolids for fertilizer demonstrates that the project is energy efficient.

II. INFLOW AND INFILTRATION REHABILITATION

Summary

- Rehabilitate the city of Cape Girardeau's wastewater collection system to reduce excessive inflow and infiltration (I/I).
- Total Loan amount = $70,000,000 (Included in total loan for both projects.)
- Estimated energy efficient (green) portion of loan = 0.79% ($555,739)

Background

Wet weather flows have caused backups and sanitary sewer overflows (SSOs) in some areas of the city of Cape Girardeau. The city performed an I/I analysis for the sanitary sewer collection system. Public and private sector defects were identified within the study area. An estimated six million gallons of rain related flow enters the system during a rain event representing the one year, 30 minute event which is a close approximation of the 90th percentile rain event for the area. Specific areas have been identified that will be rehabilitated. The city's sewer collection system has approximately 265 miles of sewer piping with approximately 5,700 manholes and 30 lift stations. This project consists of the rehabilitation of portions of the city's sewer system. It will correct cross connections, repair pipe segments using cured-in-place pipe (CIPP), and rehabilitate defective manholes by repairing or replacing the frames and covers where necessary, and provide a cementitious coating to the inside walls and benches.

Energy Efficiency Justification

The collection system rehabilitation improvements consist of CIPP lining of a total of approximately 25,300 linear feet of 8, 10, 12, 15, and 24-inch sewer pipe. It will also consist of the replacement of approximately 110 linear feet of 8-inch sewer pipe and the construction of four new manholes. In addition, 1,588 manholes have been identified as in need of repair. Repairs will include cementitious lining, replacing frames, and/or covers. The collection rehabilitation will be used to reduce the amount of I/I entering the collection system. This will reduce the energy consumption of the lift stations and the wastewater treatment facility, because the amount of water to be pumped and treated is reduced.

Conclusion

- The use of CIPP lining of the sanitary sewer system is the most cost effective method, as is the lining and rehabilitation of the manholes.
- Per Section 3.5-4, *"Infiltration/Inflow (I/I) correction projects that save energy from pumping and reduced treatment costs are cost effective."*

References

- Attachment 2. 2012 Clean Water State Revolving Fund 10% Green Project Reserve: Guidance for Determining Project Eligibility.
- Jacobs Engineering Group, Inc. facility plan "Wastewater Treatment Plant" for the city of Cape Girardeau, Missouri sealed June 13, 2011.
- Jacobs Engineering Group Inc. Bidding and Contract Documents for the city of Cape Girardeau, Missouri sealed April 16, 2012.
- Excel Spreadsheet Listing Energy Efficiency Items.
- City of Cape Girardeau Sanitary Sewer Collection System facility plan Amendment, sealed January 22, 2013.
- City of Cape Girardeau Work Specification for I&I Flow Reduction Program, sealed October 11, 2013.