Drinking Water State Revolving Fund Green Project Reserve

Business Case Examples

- A business case may have many formats. EPA does not endorse any specific format.
- These examples follow the essential components of EPA's June 22, 2009 guidance for GPR business cases (http://www.epa.gov/water/eparecovery/docs/2009_6_22_GPR_Q_A.pdf)
- Project level data for business cases may include annotated engineering reports, water or energy audit information, and/or results of water system tests that may exist in project files and be summarized and referenced in the business cases.

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Pipe Replacement

Summary

- Replacement of 24,000 feet of pre-1930s lead-jointed cast iron (CI) distribution pipe with new 8-inch to 16-inch ductile iron (DI) pipe to eliminate the loss of 115 million gallons of water per year (MGY), equal to 10% of total production and 52% of total system water loss.
- Loan amount = $2,500,000
- Water saving (green) portion of loan = 100%
- Annual water savings = 115 million gallons (MG)

Background

- The water system includes approximately 80 miles of CI and DI distribution pipe ranging from 6 to 16 inches in diameter. The treatment plant processes an average of 3 million gallons per day (MGD) or 1,095 million gallons per year (MGY).
- As part of a water loss management plan,[1] trends in distribution pipeline repairs from 2007 were evaluated to identify potential pipeline replacement projects. It was determined that the pre-1930s distribution pipe incurred the most repairs.
- The pre-1930s pipe account for 17% (13.6 miles) of the 80 miles of distribution pipe. This project will replace 24,000 feet of pipe with 8-inch to 16-inch DI pipe.

Results

- 175 pipeline repairs were made during 2007; the highest frequency of repairs was in the pre-1930s pipes and equally distributed among all sizes.[2]
- The system asset management plan shows the distribution system and the schedule of pipe replacement as well as the pipe break distribution frequency by the age of pipe.[3]
- Avg. 8.36 leaks per mile by the length of pipe.
- Avg. leak volume is 3.1 million gallons (1,067 GPM using Greeley's formula).

Calculated Water Loss

- 37 leaks * 3.1 million gallons per leak = 115 MGY from the leaking from pipes scheduled for replacement.
- To calculate overall water loss, subtract the water billed/consumed: 1,095 MGY - 876 MGY = 219 MGY of water pumped is lost (20%).
- The estimated 115 MGY of water loss from the pre-1930s pipe is 52% of the overall water loss of the system: 115 / 219 = 52%.

Conclusion

- By replacing the 24,000 feet of pipe the system anticipates conserving 115 MGY (52% of overall water loss). The cost to pump/treat water is $1.53 per 1,000 gallons. Cost savings from reduced leaks are estimated at $175,950 (115,000 gallons * $1.53).
- Additional benefits include reductions in unnecessary pumping and operation and maintenance expenditures, and eliminating potential health hazards associated with waterborne pathogens entering the water distribution system.

1 Water Loss Management Plan for the Hypothetical Drinking Water System. February 2008.
2 Water Loss Management Plan for the Hypothetical Drinking Water System. February 2008.
3 Asset Management Plan for the Hypothetical Drinking Water System. Updated August 2008.

Existing Water Meter Replacement

Summary

- Replacement of all water meters to eliminate 514 million gallons of water loss per year (MGY).
- Loan amount = $750,000
- Water saving (green) portion of loan = 100%
- Annual water savings = 514 million gallons (MG)

Background

- The water system serves 800,000 people and has approximately 320,000 residential connections. Total annual water use is 51,388 million gallons or 141 millions gallons per day (MGD).
- Water meters were installed at all connections in 1982, and the manufacturer specified that the meters' useful life would be approximately 25 years. The meters were due for replacement in 2007.
- Increased water loss, due to leaks and inaccurate readings, are attributed to the old meters.[1]

Results

- Based on the manufacturer's statement a 25-year-old meter is estimated to be 99% accurate (down from 99.9% at installation) and a 30-year old meter is estimated to be 82% accurate.[2] Therefore, the annual water loss attributed to meters is estimated at 514 million gallons (1% of annual production) and is expected to worsen over time.
- It takes 1.50 kilowatt hours (kWh) of electricity to treat 1,000 gallons of water. At a cost of 10 cents per kWh, the water loss costs the system at least $77,000 annually from the electricity required for treatment and pumping.[3]
- The estimated cost of the meter replacement project is $750,000; the project will pay for itself in less than 10 years.

Other Benefits

- Replacing the old, leaking meters will increase water efficiency by decreasing the amount of water lost and by providing more accurate water-use information to customers and the system.

Conclusion

- A savings of $77,000 in annual electricity costs will be realized as a result of reducing water lost from malfunctioning meters by 514 MG.
- Accurate metering of water consumption is an important conservation measure because inaccurate metering provides customers with misleading information regarding water consumption. Providing more accurate water bills will send a stronger price signal to customers and will result in more efficient consumption.
- Water leakage and inaccuracy increases with water meter age; therefore, an investment in water meters today will lead to additional water and dollar savings over time. Also, the water savings from the meter replacement will extend the life of the water supply and delay capital expansion projects.

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1 Water Audit Summary Report for Hypothetical Water System. Updated August 2008.
2 User's Manual for Hypothetical Brand Residential Meters. January 1982.
3 Calculations based on electricity bills and total annual water use for 2008.

Storage Tank Replacement

Summary

- Replacement of water storage Tank A will improve water efficiency of the system by eliminating 7.2 million gallons of annual water loss and provide additional water storage capacity.
- Loan amount = $510,000
- Water savings (green) portion of loan = 100%
- Annual water savings = 7.2 million gallons (MG)

Background

- Tank A is 150 feet below Tank B. This configuration prevents water from flowing out of Tank A when Tank B is at normal operating levels (pressure difference of 65 pounds per square inch).
- Due to the current configuration, the water in Tank A stagnates and loses its residual chlorine. The tank must be emptied and refilled weekly to ensure that potable water is available.
- Approximately 7,200,000 gallons of water (5.9% of current use) is drained annually from the 150,000-gallon Tank A.

Results

- Replacing Tank A with a larger storage tank at the same elevation as Tank B will enable both tanks to drop and fill at similar levels, thus reducing the 7,200,000 gallons of stagnant water that must be discarded annually.
- The annual water savings are calculated at $55,000. The simple payback period on this investment is less than 10 years.[1]

Conclusion

- Construction of a new water storage tank is the most cost-effective and sustainable solution.[2] The new storage tank will save 7,200,000 gallons of water each year and reduce the system's treatment costs.
- With a capacity of 340,000 gallons, the new tank will decrease water waste, improve service pressure, and increase the reliability of the system's infrastructure.
- Implementing the project will delay the need for plant expansions and will reduce the amount of water taken from the source water body, which is important for maintaining the quality of its habitat, especially during droughts.

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1 Preliminary Engineering Report for the Storage Tank Replacement Project. March 2009.
2 Preliminary Engineering Report for the Storage Tank Replacement Project. March 2009.

Treatment Process Selection

Summary

- An innovative approach of blending groundwater with treated surface water will be used to conserve water resources, reduce system costs, reduce disinfection byproducts (DBP) concentrations, and address non-compliance issues.
- Loan amount = $4,200,000
- Water savings (green) portion of loan = 100%
- Annual water savings = 620 million gallons (MG)

Background

- 19.1 billion gallons per year (BGY) is withdrawn from the only surface water source in the area: a river in an arid region of the Southwest, which contains significant levels of organic matter. Total organic carbon (TOC) in the surface water is 10 parts per million (ppm).
- DBPs are created during the treatment process (conventional treatment and chlorine disinfection) and their resultant annual average concentration exceeds EPA's new regulatory standards; therefore, something has to be done to meet the regulations.[1]
- There are rights to groundwater that contains less than 0.1 ppm TOC.

Results

- A feasibility study conducted identified two potential treatment options to reduce the DBP concentrations: Granular Activated Carbon (GAC) and groundwater blending.[2]
- A GAC system was the first treatment option evaluated.[3]
  - This treatment option includes adding a GAC filter to the end of the treatment process where treated water would be filtered prior to pumping to the storage tank. The concrete filter basin would be 4 feet high with an 8,100 square feet surface area for an initial cost of $8.5 million including installation.
  - Since the average pressure of the water passing through the GAC would drop, the water system will incur increased pumping costs. Additionally, the filter requires daily backwashing which will result in an additional 620 million gallons of water per year (MGY) being used for treatment. The increased water consumption is estimated to result in an additional $108,500 in annual electric costs.[4]
- Groundwater blending was the second treatment option evaluated.[5]
  - This treatment option consists of diluting the treated surface water at the finished water storage tank with groundwater (i.e. 23% groundwater to 77% treated water blend) to lower the DBP concentrations in the finished water. Based on modeling, during a peak day, 37 million gallons of treated surface water would be mixed with 11 million gallons of groundwater withdrawn from the aquifer to provide 48 million gallons of water that meets all water quality standards.
  - Prior to blending, 23% of the treated surface water in the storage tank will be diverted to injection wells to recharge the aquifer and replace the groundwater withdrawn. Total project cost is $4.2 million.
  - Groundwater wells will be located at least 1 kilometer from the injection wells to maintain steady-state aquifer level change of about 17 feet from the high point where the treated surface water is injected to the low point where it is recovered. Because the aquifer is normally at saturated depth of 130 feet, the injections and withdrawals should not significantly disturb the aquifer.

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1 1st and 2nd Qtr 2008 Water Quality Data for Hypothetical Water System.
2 Feasibility Study for Disinfection Byproduct (DBPs) Treatment Options. December 2008.
3 Feasibility Study for Disinfection Byproduct (DBPs) Treatment Options. December 2008.
4 Calculations based on electricity bills and submeter electric data for 2008.
5 Feasibility Study for Disinfection Byproduct (DBPs) Treatment Options. December 2008.

Treatment Process Selection, Continued

Benefits

- With limited water resources and the need to conserve the water supply, the water system selected the groundwater blending option since it will not increase overall water consumption.
- Another benefit of the groundwater blending is that the vadose zone of the aquifer is a desirable mixture of sand and unconsolidated clay that will naturally filter out much of the TOC and DBPs in the treated surface (recharge) water.
- An additional benefit is that incorporating groundwater into the potable water supply may improve its taste.

Conclusion

- The groundwater blending technique was chosen over a GAC filter because the GAC system was determined not feasible due to backwash water waste, additional energy consumption, the life-cycle costs of the system, and the size of the filter required.
- The installation and operation and maintenance total life cycle costs for the blending treatment option selected is $31.14 million versus $87.2 million for a GAC treatment system.[6]
- Blending groundwater instead of using a GAC system will avoid the withdrawal of 620 million gallons each year from the surface source, save $108,500 in energy costs, and will help maintain the riparian habitat of endangered wildlife. It will also avoid the purchase of GAC equipment and its associated operation and maintenance costs.

6 Life Cycle Cost Analysis for DBP treatment options. December 2008.

Pump and Motor Replacement

Summary

- Large-scale pipe replacement project includes replacement of high-service pump station with two large pumps and motors.
- Estimated loan amount = $2,800,000
  - o $2,600,000 pipe replacement
  - o $200,000 pump and motor replacement
- Estimated energy efficiency (green) portion of loan = 8% ($200,000)
- Estimated annual energy savings range from 22.9% to 24% or up to $2,934 per year.

Background

- The high-service pump station equipment is about 30 years old. The existing pumps are rated at 600gpm at 154 feet with a manufacturer-rated efficiency of 77%. Existing motors were rated at 85%. The actual operating efficiency probably is lower because of the age of the pump system.
- Estimated energy consumed by existing pumps is 116,400 kW annually.[1]

Results

- The proposed new pumps will have a rated efficiency of 89%.[2]
- The proposed new motors will have a rated efficiency of 93.5%.[3]

Calculated Energy Efficiency Improvements

- Standard pumps on the market have average efficiency ratings of 72.5%.
- Standard motors on the market have average efficiency ratings of 89%.[4]
- The efficiency (wire-to-water) of standard pumps and motors = 72.5% * 89% = 64.5% (pump efficiency times motor efficiency).
- The efficiency of proposed pumps and motors = 89% * 93.5% = 83.2%
- To compare the efficiency of proposed pumps and motors with standard pumps and motors, divide the total efficiency of the proposed components by the efficiency of the standard components: 83.2% / 64.5% = 1.29
- Thus, the increased wire to water efficiency is 29%. This level of efficiency exceeds the 20% recommended minimum for pumps and motors.

Conclusion

- By replacing the pumps and motors in the high-service pump station, the system will reduce energy use by 22.9% (for maximum day operation) to 24.0% (for average day operation) or 26,664 to 27,945 kW annually.[5]
- At 10.5 cents per kW, energy reductions from the new pumps and motors will save up to $2,934 per year.[6]

1 Calculations based on electricity bills and submeter electric data for 2008.
2 Hypothetical Manufacturer Pump Specifications. Fall 2008.
3 Hypothetical Manufacturer Motor Specifications. Spring 2009.
4 U.S. Department of Energy, 2005. When to Purchase NEMA Premium™ Efficiency Motors. Motor Systems Tip Sheet #1. DOE/GO-102005-2019.
5 Energy reductions results based calculation using an average of 600gpm, 154 TDH and operation of pumps for 12 hours a day.
6 Calculations based on electricity bills and submeter electric data for 2008 and estimated energy savings.