Green Project Reserve Business Case

Energy Efficiency and Water Efficiency for the Genesee Water and Sanitation District Water System Improvements

to accompany the State Revolving Fund Loan Application

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BACKGROUND

Genesee is located in the foothills west of Denver, and southwest of Golden. Primary water uses include residential and commercial water use, minimal landscape irrigation and water supply for fire protection purposes. The Genesee water system serves a residential population of approximately 3,700 customers and approximately 30 commercial users. The water distribution system includes intake facilities from Bear Creek including a raw water pump station, a raw water storage reservoir, a conventional water treatment plant, six pump stations that distribute potable water into the distribution system, four water storage tanks and nine pressure reducing stations (PRS). Major components of the distribution system were constructed in the mid 1970's to early 1980's. Some of these components of the system are inefficient in terms of their energy and water use, and are approaching the end of their useful life.

The Genesee Water and Sanitation District (Genesee or District) has submitted a Loan Application to the State Revolving Fund (SRF) to fund significant improvements to their water treatment, transmission and distribution system. The loan application states that the SRF Loan will be used to pay for the following improvements to the Genesee water system:

- Construction of a new water treatment plant, referred to in this document as the Genesee Advanced Water Treatment Facility (WTF)
- Renovations to transmission/distribution system Pump Stations, this includes the replacement of the Bitterroot Pump Station and the renovation/upgrades of the Base and Larkspur Pump Stations
- Replacement of PRS, the District is planning to replace four vaults
- Replacement of approximately 75% of the customer water meters with new water meters that contain remote automatic meter reading (AMR) capability, and the addition of AMR capability to the other customer water meters that are not being replaced.

This Business Case evaluation was prepared in accordance with "Attachment 2 – 2012 Clean Water State Revolving Fund 10% Green project Reserve: Guidance for Determining Project Eligibility:" of the EPA document titled "Procedures for Implementing Certain Provisions of EPA's Fiscal Year 2012 Appropriations Affecting the Clean Water and Drinking Water State Revolving Fund Programs". These projects result in significant gains in energy efficiency as well as water conservation, as well as gains in operator efficiency to operate the system.

ENERGY EFFICIENCY

Significant improvements to energy efficiency will be achieved through renovation of the three main pump stations that currently move and deliver treated water into the Genesee distribution system.

Project Component 1- Replacement / Renovation of Three Distribution System Pump Stations

A series of three pump stations are used to transfer water from the existing water treatment plant located on Bear Creek into the District's water distribution system. These pump stations are further discussed below.

1. Base Pump Station: the Base Pump Station is located at the site of the existing conventional Water Treatment Plant (WTP) and is used to pump water from the plant to an intermediary storage tank (the Solitude Tank), where it then flows by gravity down to the Bitterroot Pump Station and the site of the new Genesee Advanced WTF. While this pump station currently serves as one in a series of pump stations that delivers treated potable water into the distribution system, it will be upgraded and converted to pump raw water from Bear Creek or the Genesee raw water

reservoir to the new Genesee Advanced WTF in the future. The pump station is currently designed with five pumps to deliver the desired range of flows into the distribution system.

2. Bitterroort Pump Station: the Bitterroot Pump Station is located at the site of the District's Office Building and Wastewater Treatment Plant, which is also the general location of the future Genesee Advanced WTF. This pump station is used to boost treated potable water from the Solitude Tank to the Larkspur Pump Station clearwell. The pump station is currently designed with three pumps to deliver the desired range of flows into the distribution system.

3. Larkspur Pump Station: the Larkspur Pump Station is the final pump station along the main transmission system that pumps water from the clearwell located underneath it into the uppermost and main pressure zone of the Genesee distribution system. The hydraulic grade of this main pressure zone is established by the water level in the District's two major water storage tanks, the Choke Cherry and Chimney Creek storage tanks, each with a storage volume of 600,000 gallons. The pump station is currently designed with five pumps to deliver the desired range of flows into the distribution system.

All three pump stations are approximately 40 years old and contain the original pumps, electrical gear and motor control centers. Several pumps have failed, while other pumps show signs of nearing the end of their useful service life. The pumps in all three pump stations are currently operated as across the line start constant speed pumps, which results in high intermittent electrical demands and pumps often operating at inefficient points on their respective curves.

Calculated Energy Savings

Equipment cut sheets for the existing pumps are not available; however current energy use was determined from Xcel utility bills. Projected future energy use following the proposed upgrades was determined using standard equations with an estimated 95% efficiency for premium efficiency motors, and pump efficiencies ranging from 78-83% for the various pump stations based on preliminary pump selections. Calculations are shown on the attached sheet titled "Genesee Water Distribution system Improvements- Base, Bitterroot, and Larkspur Pump Stations". Gains in energy efficiency are expected due to higher efficiency motors, the use of VFDs that will allow the pumps to operate nearer their best efficiency points, and the ability to operate at reduced pumping rates thereby reducing friction head.

Table 1- Calculated Energy Savings for the Pump Station Upgrades

Pump Station	Current Energy Use (2014) [(a)] (KWH)	Projected Future Energy Use [(b)] (KWH)	Reduction	
Base	379,890	237,800	142,090	37.4%
Bitterroot [(c)]	161,370	186,690	(25,320)	(15.7%)
Larkspur	293,400	209,070	84,330	28.7%
TOTAL	**834,660**	**633,560**	**201,100**	**24.1%**

(a) Based on 2014 Xcel utility bills
(b) Based on standard energy calculations using preliminary equipment/pump selections
(c) Current energy use for Bitterroot based on estimated portion of the water meter (also serves the WWTP)

Calculated Cost Savings

Current utility bills were determined from Xcel utility bills. Projected future utility bills following the upgrades were estimated using the energy use information from Table 1 and the current year 2015 Xcel utility bill format. Energy savings are expected to result from lower demand charges due to reduced peak energy use, as well as lower overall energy use due to more efficient equipment and operation.

Table 2- Calculated Utility Bill Savings for the Pump Station Upgrades

Pump Station	Current Bill (2014) [(a)]	Projected Future Bill [(b)]	Reduction	
Base	$63,575	$37,406	$26,168	41.2%
Bitterroot [(c)]	$25,237	$21,937	$3,300	13.1%
Larkspur	$45,886	$26,159	$19,727	43.0%
TOTAL	**$134,698**	**$85,502**	**$49,195**	**36.5%**

(a) Based on 2014 Xcel utility bills
(b) Based on standard energy calculations from Table 1 and Xcel utility billing format from year 2015 bills
(c) Current energy bill for Bitterroot based on estimated portion of the water meter (also serves the WWTP)

Results and Analysis

- The upgrades will result in a significant reduction in energy use as demonstrated in Table 1 above (an approximate 24.1% reduction).
- The upgrades will result in significant cost savings, as demonstrated in Table 2 above (an approximate 36.5% reduction).
- Better system functionality where the pumps can deliver a range of flows into the distributions system automatically without operators having to adjust which pumps are in use and adjust valve positions.
- Will allow the PLC, control and SCADA systems for the new Genesee Advanced WTF to be coordinated with the distribution system's key pump stations so that water production rates may be matched with plant production and so that the entire system may be effectively monitored from a central location.
- Replacing aging pumps and electrical gear that is approaching the end of its useful life with new equipment that is more reliable.
- The upgrades will reduce operator time for operating and maintaining the system.
- The Opinion of Probable Cost for the Pump Station upgrades is $1,389,000; however, the upgrades will save an estimated $1,476,000 of O&M over the 30 year life of the facility.

Business Case and Eligibility

- Section 3.2-2 of the CWSRF Technical Guidance notes that any project that achieves a 20% reduction in energy use is a categorical project. The pump station upgrades meet this requirement.
- Section 3.4-1 of the CWSRF Technical Guidance notes that a project must identify energy savings and a payback period on capital that does not exceed the useful life of the asset. The pump station upgrades meet this requirement.

WATER CONSERVATION

Project Component 2- Providing a Water Treatment System with Higher Water Recovery

The existing Genesee water system uses a conventional water treatment system to produce potable water. The plant was originally designed to meet a less stringent filter performance requirement than the current standard. It has several physical limitations including somewhat shallow media depth of approximately 38-inches as compared to modern standards, and an antiquated filter under drain system. The plant has a hydraulic flocculation system with little detention time which is not as effective as current standard designs that use mechanical systems.

Description

The new Advanced WTF will include a more robust flocculation/sedimentation system, followed by a microfiltration treatment system that will allow 100% of the backwash water to be recycled. The microfiltration treatment system will use approximately 5% of treated water for backwashes, thereby significantly reducing the backwash volume that must be recycled. The more robust treatment processes will allow the backwash water to be recycled directly to the raw water flow stream coming into the plant. While the current Genesee WTP recycles backwash water to the raw water reservoir, the District is expecting to stop this practice and return the backwash volume to Bear Creek since the practice is causing a deterioration in raw water quality in the reservoir, making the water more challenging to treat and meet regulations.

In addition, the waste streams from the new Advanced WTF will be discharged to the sewer system directly and flow to the District's Wastewater Treatment Plant for solids handling instead of being discharged to a backwash pond where the solids then have to be removed by a vacuum sludge truck. Therefore, water used to slurry the solids for waste disposal will no longer be required.

Results and Analysis

- Water use for the existing WTP related to backwash water and residuals management for years 2013 and 2014 are shown in Table 3 below. The table shows that water used for these functions were 18.1% and 15.7%, respectively. With raw water quality in the reservoir slowly deteriorating over time, this percentage is expected to increase. By constructing the new Advanced WTF, the backwash stream will be reduced and 100% of the volume used will be recovered, while water used to manage the waste stream (slurry water) will be eliminated.
- The treatment system upgrades will reduce energy and chemicals used to treat water that is then used for backwash of the filters, since the microfiltration system will only use approximately 5% for backwash while the existing system uses from 15.7-18.1% based on historical data.
- The treatment system upgrades will reduce energy and chemicals used to treat water that is then used to slurry the backwash waste.
- By providing a treatment system that will use less treated water for backwash and less water for managing waste streams, less treated water needs to be produced. This reduces water that is lost through solids hauling, and reduces water that is lost in the current earthen backwash pond.
- The treatment system upgrades will reduce operator time required to manage disposal of waste streams.

Table 3- Historical Process Water Used with Conventional Water Treatment Facility

Year	Backwash Volume [(a)] (gal)	Sludge Management [(b)] (gal)	Total Process Water Wasted (gal)	Net Production [(a)] (gal)	Percent
2013	21,374,725	72,000	21,446,725	118,197,575	18.1
2014	17,125,534	72,000	17,197,534	109,484,186	15.7

(a) Based on water production and backwash data from the Genesee WTP operating records
(b) Estimated volumes based on cleaning the basin three times a year, and typical flow rate and operating duration

Business Case and Eligibility

- Section 2.4 of the CWSRF Technical Guidance notes the following. The proposed project meets all criteria stated in Section 2.4:

  2.4 Decision Criteria for Business Cases

  2.4-1 Water efficiency can be accomplished through water saving elements or reducing water consumption. This will reduce the amount of water taken out of rivers, lakes, streams, groundwater, or from other sources.

  2.4-2 Water efficiency projects should deliver equal or better services with less net water use as compared to traditional or standard technologies and practices

  2.4-3 Efficient water use often has the added benefit of reducing the amount of energy required by a POTW, since less water would need to be collected and treated; therefore, there are also energy and financial savings.

<u>Project Component 3- Replacement of Water Meters</u>

The Genesee water system serves approximately 3,700 customers and 1,323 taps including residential, commercial and other uses. Many water meters have been replaced over the last ten to fifteen years, however many meters are over 15 years old. None of the water meters currently have automatic or remote reading capability.

Description

Genesee has standardized on Badger model 35 water meters. Genesee will replace approximately 75% of the older customer water meters with new water meters that include remote automatic meter reading (AMR), and place AMR technology on the remaining customer water meters that are not being replaced.

Results and Analysis

- Water industry standard suggest that water meters should be replaced every fifteen years to guarantee that the units are operating properly and accurately measuring flow (reference AWWA M6- Water Meters- Selection, Installation, Testing and Maintenance).
- It is anticipated that water meters that are greater than 15 years old are likely under recording water usage by 3-5%. By providing new meters that accurately record water usage, Genesee will recover water revenue that is currently being lost.
- Some customer are anticipated to use less water once they are paying for the full cost of their water, and have a better understanding of how much water they are using. Accurate metering

of customer water usage is important both to individual customers and to the water utility to understand water usage, and to assist with identifying inefficient water usage and lost water.

- The addition of remote AMR will significantly reduce staff time needed to read meters, currently performed on a bi-monthly basis. By installing remote AMR, Genesee will be able to read and issue monthly water bills thereby improving cash flow.
- The installation of remote AMR will reduce costs and carbon footprint by reducing vehicle fuel used to perform bi-monthly meter reading.

Business Case and Eligibility

- Section 2.2-3 of the CWSRF Technical Guidance notes that replacing existing broken/malfunctioning water meters, or upgrading existing meters with meters AMR technology is a categorical project.
- Section 2.2-4 of the CWSRF Technical Guidance notes that retrofitting/adding AMR capabilities or leak detection capabilities to existing meters is a categorical project.

SUMMARY OF CAPITAL COSTS AND PERCENT OF PROJECT

The SRF Loan being requested is in the amount of $10.3 million, which matches the total project costs. Per the State of Colorado's SRF program, at least 20% of the project costs must be comprised of GPR eligible project components to be eligible for GPR financing. To meet this threshold, $2.06 million of the project costs must be attributable to components of the project that are GPR eligible.

Opinion of Probable Costs for the project components described in this document are shown in the following table. The Opinion of Probable Project Cost is based on cost data developed from previous projects, vendor quotes and recently bid construction projects. Bid climates can vary over time based on overall economic conditions and the availability of Contractors. The costs presented are in terms of year 2015 dollars and no attempt has been made to escalate these costs to a future date.

The American Association of Cost Engineers (AACE) has defined different classes of Opinions of Probable Project Cost in an effort to establish the expected accuracy range for various types of cost estimates. The appropriate class is based on the projects status and level of development. The Opinion of Probable Project Cost presented in this report is considered a Class 4 estimate, with an expected accuracy of +20% to –10%; this range has been used in the Opinion of Probable Project Cost.

Project Component	**Opinion of Probable Cost**
Replacement/Renovation of Pump Stations	
Base Pump Station	$580,000
Bitterroot Pump Station (1)	$225,000
Larkspur Pump Station	$584,000
Use of Higher Recovery Water Treatment Equipment (2)	$681,000
Replacement of Customer Water Meters (3)	$400,000
TOTAL	**$2,470,000**

(1) Includes cost for the pumps, VFDs and control/SCADA only
(2) Equipment cost for the microfiltration system package
(3) Based on Genesee's budget for this phase of the project

As shown, the GPR eligible components of the project total $2,470,000 million and meet the benchmark amount of $2,060,000 million.

CONCLUSIONS

Three components of the SRF Loan Application have been identified that meet the criteria for the GPR. The components address both energy and water efficiency per the CWSRF Technical Guidance, and provide significant operational and financial improvements to the District.

GENESEE WATER DISTRIBUTION SYSTEM IMPROVEMENTS
Base, Bitterroot and Larkspur Pump Stations

Energy Efficiency

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total
Water Pumping for 2014, gpm	7,583,000	7,440,000	7,506,000	7,456,000	9,570,000	12,483,000	13,945,000	11,946,000	10,125,000	8,376,000	7,189,000	7,725,000	111,344,000

Current Energy Use from Utility Bills (2014)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total
Base Pump Station	31,058	31,247	30,048	28,785	27,712	35,350	38,696	37,496	35,981	32,068	24,429	27,018	379,886
Bitterroot Pump Station (a)	12,980	11,660	11,770	10,780	13,640	16,390	19,470	17,710	15,510	11,550	9,570	10,340	161,370
Larkspur Pump Station	23,600	21,200	21,400	19,600	24,800	29,800	35,400	32,200	28,200	21,000	17,400	18,800	293,400
TOTAL	67,638	64,107	63,218	59,165	66,152	81,540	93,566	87,406	79,691	64,618	51,399	56,158	834,656

Future Energy Use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Production Pumping Rate, gpm	500	500	500	500	500	500	500	500	500	500	500	500
Typical Operating Head, ft (b)												
Raw Water Pump (c)	135	135	135	135	135	135	135	135	135	135	135	135
Base Pump Station	505	505	505	505	505	505	505	505	505	505	505	505
Bitterroot Pump Station	385	385	385	385	385	385	385	385	385	385	385	385
Larkspur Pump Station	450	450	450	450	450	450	450	450	450	450	450	450
Motor Efficiency	95.0%											
Pump Efficiency @ Production Rate												
Base Pump Station	83.0%											
Advanced WTF Finished Water PS	78.0%											
Larkspur Pump Station	81.0%											

Energy Usage (kw-Hr)													Total
Base Pump Station	18,862	17,127	16,530	14,708	16,334	23,181	27,579	24,821	24,297	19,754	16,498	18,110	237,800
Bitterroot Pump Station	13,496	13,269	12,001	12,123	15,608	18,718	22,749	20,469	17,533	14,114	12,287	14,326	186,693
Larkspur Pump Station	17,651	15,149	16,164	14,104	17,650	21,210	24,922	22,781	20,190	14,767	12,015	12,468	209,072
TOTAL	50,010	45,545	44,695	40,935	49,592	63,110	75,249	68,071	62,020	48,634	40,800	44,904	633,565

(a) Calculated as 55% of Larkspur Pump Station based on relative pumping head (385 feet of head - 60 psi feed pressure, compared to 450 ft)
(b) Operating head from system curves at 500 gpm
(c) Calculated as a Bear Creek water level of 7053 and Reservoir water level of 7188

Utility Bill

Current Utility Bills (2014)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total
Base Pump Station	$5,285.19	$6,168.43	$5,286.87	$5,403.21	$5,286.16	$5,799.76	$5,960.15	$6,208.77	$5,706.56	$5,790.78	$3,430.15	$3,248.90	$63,574.93
Bitterroot Pump Station (d)	$1,829.11	$2,119.76	$1,805.78	$2,151.08	$2,336.82	$2,726.23	$2,721.68	$2,659.56	$2,497.64	$1,733.49	$1,021.83	$1,634.08	$25,237.07
Larkspur Pump Station	$3,325.66	$3,854.10	$3,283.24	$3,911.06	$4,248.77	$4,956.78	$4,948.50	$4,835.57	$4,541.17	$3,151.80	$1,857.88	$2,971.05	$45,885.58
TOTAL	$10,439.96	$12,142.29	$10,375.89	$11,465.35	$11,871.75	$13,482.77	$13,630.33	$13,703.90	$12,745.37	$10,676.07	$6,309.86	$7,854.03	$134,697.58

Future Utility Bills (e)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total
Base Pump Station	$3,074.71	$3,010.46	$2,975.48	$2,893.12	$2,944.18	$3,283.14	$3,484.92	$3,367.54	$3,332.11	$3,118.99	$2,916.97	$3,004.82	$37,406.43
Bitterroot Pump Station (d)	$1,741.05	$1,732.36	$1,684.03	$1,688.70	$1,821.57	$1,940.16	$2,093.84	$2,006.92	$1,996.27	$1,764.59	$1,694.95	$1,772.67	$21,937.13
Larkspur Pump Station	$2,188.59	$2,093.20	$2,131.89	$2,053.34	$2,188.55	$2,324.30	$2,465.83	$2,384.20	$2,285.40	$2,078.61	$1,973.71	$1,990.97	$26,158.60
TOTAL	$7,004.35	$6,836.02	$6,791.40	$6,635.16	$6,954.30	$7,547.60	$8,044.59	$7,758.66	$7,613.78	$6,962.19	$6,585.63	$6,768.46	$85,502.15

(d) Current energy bill for Bitterroot based on estimated portion of the water meter (also serves the WWTP)
(e) Based on standard energy calculations from Energy Efficiency tables and Xcel billing format from year 2015 bills