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Catherine B. Templeton, Director
Promoting and protecting the health of the public and the environment

July 25, 2013

Mr. Bill Yetman, P.E., City Engineer
City of Rock Hill
P.O. Box 11706
Rock Hill, SC 29731-1706

RE: Green Project Reserve Eligibility Determination
City of Rock Hill High Service Pumping Improvements
SRF No. 4610002-06
York County

Dear Mr. Yetman:

The Green Project Reserve (GPR) Business Case that was submitted on July 24th by e-mail from Wiedeman and Singleton, Inc., for your State Revolving Fund (SRF) Drinking Water project has been reviewed and is approved as presented. This approval is based on the decision criteria provided in the U.S. EPA's Technical Guidance. The project reviewed for GPR eligibility is summarized below:

> The project will provide various energy efficiency improvements at the City of Rock Hill's Water Treatment Plant. Improvements include: Two (2) new premium efficiency pumps with Variable Frequency Drives (VFD's) at High Service Pump Station (HSPS) #3, two (2) new VFD's for existing pumps at HSPS #2, medium voltage electrical gear for all pumps, high-efficiency lighting for the new electrical building, and a "smart" HVAC system for the electrical building that maximizes use of outdoor air for cooling and waste heat from electrical equipment for heating.
>
> Type of Green Project: Energy Efficiency
> Estimated Green Cost: $ 1,622,682
> Estimated SRF Loan: $ 4,021,028

At present the estimated SRF loan amount that can be covered by the green rate, based on your project estimate, is $1,622,682. The final amount eligible for the green rate will be determined once bids are opened and approved.

Thank you for incorporating green principles into the design of this SRF-eligible project. Should you have any questions, you may contact me at (803) 898-8178 or via e-mail at mccainjm@dhec.sc.gov.

July 25, 2013

Sincerely,

John M. McCain

John M. McCain, P.E., Project Manager
State Revolving Fund Section
Water Facilities Permitting Division
Bureau of Water

JMM/jmm

Enclosure (approved business case)

cc: Trish Comp, Budget and Control Board
Troy Began, P.E., Wiedeman and Singleton, Inc.
SRF Project File

APPROVED - SCDHEC
WATER FACILITIES PERMITTING DIVISION
SRF NO. 4610002-06 DATE 7-25-2013
PROJECT City of Rock Hill HSPS Imp.
PROJECT ENGR. John M. McCain

South Carolina Drinking Water State Revolving Fund – Revised 7/24/13
Green Project Reserve Business Case Documentation
City of Rock Hill, South Carolina

Rock Hill Water Plant High-Service Pumping Modifications and Expansion

Energy Efficiency

Summary

- Expansion of the high service pumping capacity of the City of Rock Hill Water Treatment Plant (WTP) from 30 MGD to at least 36 MGD; and better operational control of system pressures and energy savings by installing medium voltage VFDs and high efficiency pumps and motors.
- SRF loan amount (including 0.25% loan closing fee) = $4,021,028
- Green portion of loan = $1,622,682 or 40% of the total loan.
- Minimum estimated annual energy savings = 744,647 kWh
- Minimum estimated annual cost savings = $69,995 and onetime cost savings of $100,000 to install medium voltage VFDs (i.e., conductor costs savings - less copper wire)

Background

The City of Rock Hill Water Treatment Plant (WTP) is currently designed and permitted by the South Carolina Department of Health and Environmental Control (SCDHEC) to treat a maximum daily flow of 36 million gallons per day (MGD), and has been master planned for expansion in the future to at least 48 MGD and potentially 60 MGD. Currently, the maximum daily high-service pumping capacity available is estimated to be approximately 30 MGD. The purpose of this project is twofold; to modify and expand Rock Hill's existing high-service pumping arrangement to at least 36 MGD with easy expansion of the high-service pumping capacity in the future, as the plant site is built-out, to at least 48 MGD and possibly 60 MGD; and to provide better operational control of system pressures and energy savings by installing medium voltage VFDs and high efficiency pumps and motors. The project will consist of the following improvements.

- New High Service Pump Station #3, including two new high service pumps and variable frequency drives.
- New Electrical Building.
- Installation of two variable frequency drives for existing high service pump #4 and #6.
- Associated piping and appurtenances.

Energy Efficient Components

The *Consolidated Appropriations Act, 2012* allows State Drinking Water SRFs to use funds made available by the Act to address green infrastructure, water or energy efficiency improvements, or other environmentally innovative activities. South Carolina has chosen to continue to fund projects or portions of Drinking Water projects that qualify as "green" using the previously published EPA Guidance for DWSRF Green Project Reserve. The components of the City of Rock Hill High Service Pumping and Expansion Project that fall under "Energy Efficiency" eligible projects are listed below and require the development of a business case:

1. VFDs - High Service Pump Station #2 and High Service Pump Station #3: VFDs will be installed for existing high service pump #4 and #6 and for the two new pumps that will be installed at High Service Pump Station #3. The VFDs enable the pumps to accommodate fluctuating demand by running at lower speeds and pumping less flow; thereby, enabling these pumps, which have more efficient pumps and motors, to be used more frequently.

Currently, existing high service pump #1 (2 MGD), #2 (6 MGD) and #3 (3 MGD) are used in combination with the other high service pumps to meet fluctuating demand throughout the day.

Power and cost savings would be realized by increasing the frequency of operation of the existing high service pumps at HSPS #2 or by operating the new high service pumps. Refer to Table 1 through Table 4 attached. The analysis is based on a "typical" operating data on November 8, 2007. According to the analysis, the annual estimated power savings, at current flows of 13.91 MGD, is approximately 686,900 kWh, which is an estimated cost savings of approximately $61,821 per year. Note, this analysis doesn't include the power and cost savings associated with reducing over-pumping into the system at increased discharge pressures.

The VFDs will also help maintain discharge pressure at the WTP below 105 psi, which reduces stress on the water system and eliminates leaks (i.e., 105 psi is maximum pressure to prevent leaks in the Rock Hill distribution system). Bypass starters will not be installed and the Owner's personnel will be provided with a minimum of 8 hours of on-site instruction on VFD operation to ensure that they have adequate training to operate the equipment. The auto-start feature is a standard option with the VFDs and the VFDs will be current limiting. The auto-start feature allows for automatic restart in the event of specific faults (i.e., overcurrent, overheat, motor overload, etc). This option can be turned on/turned off and due to the size/voltage of the VFDs, this option will be kept OFF and the operator will be required to manually reset the fault prior to restart.

2. High Service Pump Station #3. Two new high service pumps are being installed at HSPS #3 to expand the high service pumping at the WTP to at least 36 MGD. The new pumps will be equipped with variable frequency drives, which will better match high service pumping flow with actual system demands and will enable the City to maintain a more constant discharge pressure. The new pumps will also be more efficient than the existing pumps and will have premium efficiency motors. The new more efficient pumps and motors will result in an estimated energy savings of 974,909 kWh per year and an annual cost savings of $87,742 per year. The actual energy and cost savings will probably be greater because the actual efficiency of the existing pumps and motors is lower due to the age of the pumps and motors. Refer to Table 5.

   Assuming the cost to purchase and install the pumps and motors is $465,000, then the simply payback = $465,000/$87,742 per year = approximately 5.5 years.

3. Energy Efficient Lighting - The light-emitting diode (LED) is one of today's most energy-efficient and rapidly-developing lighting technologies. Quality LED light bulbs last longer, are more durable and offer comparable or better light quality than other types of traditional lighting options. The true cost of the bulb is the cost of replacement bulbs and the labor expense and time needed to replace the bulb as well as the efficiency of the bulb. The estimated annual energy savings using LED lights is 274 kWh per wall pack and the estimated cost savings resulting from the reduced maintenance and the electrical power savings over a 15 year period (life expectancy of LED light packs) is approximately $397 per light or a total of $3,174 (based on installation of eight wall packs). Refer to Table 6.

4. Medium Voltage Electrical Gear – The high service pumps (new and existing) will operate at 4,160V. The higher voltages (compared to 480V) require less current. Lower current means smaller or fewer conductors to distribute power. Using smaller or fewer conductors decreases the amount of copper (conservation of natural resources) and therefore reduces cost. Conduit and installation costs are also lower. Medium-voltage also helps

to minimize voltage drop. In medium-voltage systems, the load current is smaller, resulting in less voltage drop. This smaller voltage drop eliminates the need to oversize conductors and makes the overall system more efficient.

The medium voltage (4,160V) VFDs cost approximately $54,000 more than their counterpart 480V VFDs but the cost savings in the wire, conduit and installation is estimated to be approximately $64,000 per pump, which is a onetime cost savings of approximately $10,000 for each new pump at High Service PS#3. The onetime cost savings to operate the existing pumps at 4,160V is approximately $40,000 per pump. Refer to Table 7 and Table 8.

Also, a power monitoring system will be included with the Medium Voltage Switchgear. Power monitors will be installed on each of the main fused switches in the new main-tie-main switchgear. The power monitor will measure power, amps, etc. and will be connected to Rock Hill's SCADA system and provide a valuable means for monitoring and tracking the pumping system over the long term.

5. HVAC –To avoid recirculating and cooling hot exhaust air that discharges from each VFD, at approximately 115 degrees F, an alternative air conditioning system will be installed at the new electrical building. The proposed system is a more energy efficient alternative that uses 100% outdoor air to maintain indoor temperature at 85 degrees F or less. The packaged outside air conditioning units are rated in terms of Energy Efficiency Ratio (EER) in lieu of Seasonal Energy Efficiency Ratio (SEER). The EER rating of the outside air conditioning units proposed for Rock Hill is 12.2. The approximate equivalent SEER for this unit is 13.94. The current national standard is 13.0. A system description follows:

   - Whenever the outside air temperature is 75 degrees F or less, the proposed system would discharge hot VFD exhaust air directly outdoors and replace it with cooler ventilation air that is unconditioned.
   - When outdoor air temperature rises above 75 degrees F, air conditioning capacity would be activated in small increments that would be adequate to reduce outside air supply temperature to just below 75 degrees F. (Conditioning outdoor air at 95 degrees F is more cost-effective than attempting to condition 115 degree F air that discharges from the VFDs.)
   - When outdoor temperature drops below 50 degrees F, hot exhaust air from the VFD's will be recirculated in the VFD Room to defer use of electric unit heat.

   Using this arrangement, the energy cost for the outside air conditioning system will be approximately 50% of the cost for operating a conventional system and results in an annual cost savings of approximately $5,000 per year over a conventional system (i.e., annual estimated cooling cost to operate a conventional system is $10,000 and the "outside" air conditioning is $5,000). To help ensure increased energy efficiency, the electrical building will be insulated.

Conclusion

Expansion of the high service pumping capacity at the City of Rock Hill WTP will modify and expand Rock Hill's existing high-service pumping arrangement to at least 36 MGD with easy expansion of the high-service pumping capacity in the future to at least 48 MGD and possibly 60 MGD and will provide better operational control of system pressures and energy savings. The energy savings include reductions in pumping costs. Additionally, the new

electrical building will include energy efficient building lighting and "outside" air condition both of which will result in increased energy savings over their "conventional" counterparts.

The total opinion of probable cost for the Rock Hill Water Plant High-Service Pumping Modifications and Expansion is $4,021,028. The business case discusses various components of the project which are eligible under the Green Project Reserve. Therefore, funding for these components, should be covered by the Green Rate, and is estimated to be $1,622,682 as follows:

1. Two 800 hp medium Voltage VFDs for High Service PS#3 = $320,000 (equipment costs) + $32,000 (installation costs) = $352,000
2. One 800 hp and one 400 hp medium voltage VFD for High Service PS#2 = $320,000 (equipment costs) + $32,000 (installation costs) = $352,000
3. Two new vertical turbine pumps and motors for High Service PS#3 = $445,000 (equipment costs) + $20,000 (installation costs) = $465,000
4. Medium Voltage Electrical Gear = $120,000 (equipment costs) + $12,000 (installation costs) = $132,000
5. HVAC for High Service PS#3 = $40,000 (equipment costs) + $5,000 (installation costs) = $45,000
6. Eight LED Light Packs for High Service PS#3 and the Electrical Building = $3,200

SUB-TOTAL – ITEMS 1-6 ABOVE = $1,349,200

7. Mobilization, Bonds and Insurance (5.70% of construction cost) = $76,904
8. Legal and Appraisal Fees (0.85% of construction cost) = $11,468
9. Construction Engineering (3.42% of construction cost) = $46,143
10. Contingency for Construction (10% of construction cost) = $134,920
11. Loan Closing Fee (0.25% of total costs) = $4,047

TOTAL ESTIMATED PROJECT GREEN COSTS = $1,622,682

TABLE 1

Estimated Operation Cost - New/Existing High Service Pumps with Variable Speed Drives

City of Rock Hill Water Treatment Plant

	Existing High Service Pump Operation		New Pumps
	Without VFDs	With VFDs	With VFDs
Total Flow Pumped, MGD (Average Day)	15.75	15.75	15.75
Total KWH Required/Day	15,186	13,612	12,498
Cost/Day @ $0.09/KWH	$ 1,367	$ 1,225	$ 1,125
Cost/MGD @ $0.09/KWH	$ 87	$ 78	$ 71
2012 Average Day Flow (MGD)	13.91	13.91	13.91
2012 Pumping Cost/Year	$ 440,574	$ 394,909	$ 362,596
Pump Run Time (% of Time)	100%	50%	50%
Total Estimated Operating Cost	$ 440,574	$ 197,455	$ 181,298
Estimated Operating Cost Savings/Year	$ (61,821)		

TABLE 2

Estimated Operation Cost - Existing High Service Pumps - Constant Speed

City of Rock Hill Water Treatment Plant

Electrical Cost/KWH: $ 0.090

Daily Flow Demand Cycle						Primary Pump						Secondary Pump						
						Full-Spd Curve Data			Power Req'd					Full-Spd Curve Data		Power Req'd		
Time	Flow	Flow	TDH	Primary	Secondary	At Given Head		Motor	Constant Speed		Additional	Select Existing Pump		At Given Head		Constant Speed		Total
(Hr)	(gpm)[a]	(MGD)	(Feet)	Pump#	Pump#	GPM	Eff.	Eff.	HP	KW	Pumping Req'd, GPM	Pump #	Motor Eff.	GPM	Eff.	HP	KW	KWH Req'd
0	11800	16.99																
1	11800	16.99	206.6	4	2	6468	75%	85%	530	395	5332	2	85%	5010	76%	405	302	697
2	9200	13.25	202.2	4	1	6468	75%	85%	518	387	2732	1	85%	2431	76%	192	143	530
3	9400	13.54	202.5	4	3	6468	75%	85%	519	387	2932	3	85%	3175	76%	252	188	575
4	9200	13.25	202.2	4	1	6468	75%	85%	518	387	2732	1	85%	2431	76%	192	143	530
5	9500	13.68	202.6	4	3	6468	75%	85%	520	388	3032	3	85%	3175	76%	252	188	575
6	9600	13.82	202.8	4	3	6468	75%	85%	520	388	3132	3	85%	3175	76%	252	188	576
7	9800	14.11	203.1	4	3	6558	75%	85%	528	394	3242	3	85%	3163	76%	251	187	581
8	9800	14.11	203.1	4	3	6558	75%	85%	528	394	3242	3	85%	3163	76%	251	187	581
9	9800	14.11	203.1	4	3	6558	75%	85%	528	394	3242	3	85%	3163	76%	251	187	581
10	9800	14.11	203.1	4	3	6558	75%	85%	528	394	3242	3	85%	3163	76%	251	187	581
11	9800	14.11	203.1	4	3	6558	75%	85%	528	394	3242	3	85%	3163	76%	251	187	581
12	12200	17.57	207.4	5		12367	83%	85%	919	686	-167							686
13	12000	17.28	207.0	5		12367	83%	85%	917	684	-367							684
14	12000	17.28	207.0	5		12367	83%	85%	917	684	-367							684
15	12000	17.28	207.0	5		12367	83%	85%	917	684	-367							684
16	12200	17.57	207.4	5		12367	83%	85%	919	686	-167							686
17	12000	17.28	207.0	5		12367	83%	85%	917	684	-367							684
18	12000	17.28	207.0	5		12367	83%	85%	917	684	-367							684
19	12200	17.57	207.4	5		12367	83%	85%	919	686	-167							686
20	12200	17.57	207.4	5		12367	83%	85%	919	686	-167							686
21	12200	17.57	207.4	5		12367	83%	85%	919	686	-167							686
22	12200	17.57	207.4	5		12367	83%	85%	919	686	-167							686
23	12000	17.28	207.0	5		12367	83%	85%	917	684	-367							684
24	9600	13.82	202.8	4	3	6468	75%	85%	520	388	3132	3	85%	3175	76%	252	188	576
	15.75 MGD																KWH/Day:	15,186
																	Electric Cost/Day:	$ 1,367

Notes

a. November 8, 2007 Calibration Day for Rock Hill Hydraulic Model (Water Distribution System Study, W&S, March 2008)

TABLE 3

Estimated Operation Cost - Existing High Service Pumps #4 & #6 with Variable Speed Drives

City of Rock Hill Water Treatment Plant

Electrical Cost/KWH: $ 0.090

Time	Flow	Flow	TDH	HSP #4 w/VFD			HSP #6 w/VFD			Total	High Service Pump #4 With VFD				High Service Pump #6 With VFD				Total KWH
(Hr)	(gpm)[a]	(MGD)	(Feet)[b]	RPM[b]	TDH	GPM	RPM*	TDH	GPM	GPM	Pump Eff	Motor Eff	HP	KW	Pump Eff	Motor Eff	HP	KW	Req'd
0	11800	16.992								0									
1	11800	16.992	206.5	1060	206.5	4770	975	206.5	7005	11775	84%	85%	349	260	82%	94%	474	354	614
2	9200	13.248	202.2	996	202.2	3596	928	202.2	5646	9242	84%	85%	257	192	82%	94%	374	279	471
3	9400	13.536	202.5	1003	202.5	3725	930	202.5	5700	9425	84%	85%	267	199	82%	94%	379	282	482
4	9200	13.248	202.2	996	202.2	3596	928	202.2	5646	9242	84%	85%	257	192	82%	94%	374	279	471
5	9500	13.68	202.7	1008	202.7	3811	931	202.7	5736	9547	84%	85%	273	204	82%	94%	381	284	488
6	9600	13.824	202.8	1010	202.8	3854	931	202.8	5754	9608	84%	85%	277	206	82%	94%	383	285	492
7	9800	14.112	203.1	1017	203.1	3983	933	203.1	5808	9791	84%	85%	286	214	82%	94%	387	289	502
8	9800	14.112	203.1	1017	203.1	3983	933	203.1	5808	9791	84%	85%	286	214	82%	94%	387	289	502
9	9800	14.112	203.1	1017	203.1	3983	933	203.1	5808	9791	84%	85%	286	214	82%	94%	387	289	502
10	9800	14.112	203.1	1017	203.1	3983	933	203.1	5808	9791	84%	85%	286	214	82%	94%	387	289	502
11	9800	14.112	203.1	1017	203.1	3983	933	203.1	5808	9791	84%	85%	286	214	82%	94%	387	289	502
12	12200	17.568	207.3	1062	207.3	4754	971	207.3	7461	12215	84%	85%	349	260	82%	94%	507	378	639
13	12000	17.28	206.9	1062	206.9	4762	966	206.9	7233	11995	84%	85%	349	260	82%	94%	491	366	626
14	12000	17.28	206.9	1062	206.9	4762	966	206.9	7233	11995	84%	85%	349	260	82%	94%	491	366	626
15	12000	17.28	206.9	1062	206.9	4762	966	206.9	7233	11995	84%	85%	349	260	82%	94%	491	366	626
16	12200	17.568	207.3	1062	207.3	4754	971	207.3	7461	12215	84%	85%	349	260	82%	94%	507	378	639
17	12000	17.28	206.9	1062	206.9	4762	966	206.9	7233	11995	84%	85%	349	260	82%	94%	491	366	626
18	12000	17.28	206.9	1062	206.9	4762	966	206.9	7233	11995	84%	85%	349	260	82%	94%	491	366	626
19	12200	17.568	207.3	1062	207.3	4754	971	207.3	7461	12215	84%	85%	349	260	82%	94%	507	378	639
20	12200	17.568	207.3	1062	207.3	4754	971	207.3	7461	12215	84%	85%	349	260	82%	94%	507	378	639
21	12200	17.568	207.3	1062	207.3	4754	971	207.3	7461	12215	84%	85%	349	260	82%	94%	507	378	639
22	12200	17.568	207.3	1062	207.3	4754	971	207.3	7461	12215	84%	85%	349	260	82%	94%	507	378	639
23	12000	17.28	206.9	1062	206.9	4762	966	206.9	7233	11995	84%	85%	349	260	82%	94%	491	366	626
24	9600	13.824	202.8	1010	202.8	3854	931	202.8	5754	9608	84%	85%	277	206	82%	94%	383	285	492

KWH/Day: 13,612

Electric Cost/Day: $ 1,225

Notes

a. November 8, 2007 Calibration Day for Rock Hill Hydraulic Model (Water Distribution System Study, W&S, March 2008)

b. RPM estimated from interpolated data

TABLE 4

Estimated Operation Cost - New High Service Pumps with Variable Speed Drives

City of Rock Hill Water Treatment Plant

New High Service Pumps - VFDs *800 HP, each* *Electrical Cost/KWH: $ 0.090*

Daily Flow Demand Cycle				Pump Runs Based on Demand Cycle						Power Consumption Based on Demand Cycle									
Time	Flow	Flow	TDH	One (1) New HSP w/VFD			TWO (2) New HSP w/VFD[c]			Pump Eff	Motor Eff	Run Time	Percent of	No. of Pumps	Theoretical Power		Water to Wire	Power Req'd With VFDs	
(Hr)	(gpm)[a]	(MGD)	(Feet)	RPM[b]	TDH	GPM	RPM[a]	TDH	GPM	(%)[d]	(%)[e]	(hr)	Full Speed	Running	Usage	Water HP	Eff.	HP	KW
0	11800	16.992																	
1	11800	16.992	206.7				984	206.7	11818	87%	94%	1	56%	2	17.8%	617.5	81%	758	565
2	9200	13.248	202.1	1145	202.1	9215			**	87%	94%	1	65%	1	28.0%	470.8	81%	578	431
3	9400	13.536	202.4	1156	202.4	9410			**	87%	94%	1	66%	1	28.8%	481.4	81%	591	441
4	9200	13.248	202.1	1145	202.1	9215			**	87%	94%	1	65%	1	28.0%	470.8	81%	578	431
5	9500	13.68	202.5	1160	202.5	9475			**	87%	94%	1	66%	1	29.1%	485.0	81%	595	444
6	9600	13.824	202.7	1168	202.7	9605			**	87%	94%	1	67%	1	29.7%	492.1	81%	604	450
7	9800	14.112	203	1180	203	9800			**	87%	94%	1	67%	1	30.7%	502.9	81%	617	460
8	9800	14.112	203	1180	203	9800			**	87%	94%	1	67%	1	30.7%	502.9	81%	617	460
9	9800	14.112	203	1180	203	9800			**	87%	94%	1	67%	1	30.7%	502.9	81%	617	460
10	9800	14.112	203	1180	203	9800			**	87%	94%	1	67%	1	30.7%	502.9	81%	617	460
11	9800	14.112	203	1180	203	9800			**	87%	94%	1	67%	1	30.7%	502.9	81%	617	460
12	12200	17.568	207.5				994	207.5	12238	87%	94%	1	57%	2	18.3%	641.9	81%	788	588
13	12000	17.28	207.1				989	207.1	12028	87%	94%	1	57%	2	18.0%	629.7	81%	773	576
14	12000	17.28	207.1				989	207.1	12028	87%	94%	1	57%	2	18.0%	629.7	81%	773	576
15	12000	17.28	207.1				989	207.1	12028	87%	94%	1	57%	2	18.0%	629.7	81%	773	576
16	12200	17.568	207.5				994	207.5	12238	87%	94%	1	57%	2	18.3%	641.9	81%	788	588
17	12000	17.28	207.1				989	207.1	12028	87%	94%	1	57%	2	18.0%	629.7	81%	773	576
18	12000	17.28	207.1				989	207.1	12028	87%	94%	1	57%	2	18.0%	629.7	81%	773	576
19	12200	17.568	207.5				994	207.5	12238	87%	94%	1	57%	2	18.3%	641.9	81%	788	588
20	12200	17.568	207.5				994	207.5	12238	87%	94%	1	57%	2	18.3%	641.9	81%	788	588
21	12200	17.568	207.5				994	207.5	12238	87%	94%	1	57%	2	18.3%	641.9	81%	788	588
22	12200	17.568	207.5				994	207.5	12238	87%	94%	1	57%	2	18.3%	641.9	81%	788	588
23	12000	17.28	207.1				989	207.1	12028	87%	94%	1	57%	2	18.0%	629.7	81%	773	576
24	9600	13.824	202.7	1168	202.7	9605			**	87%	94%	1	67%	1	29.7%	492.1	81%	604	450

KWH/Day: 12,498

Electric Cost/Day: $ 1,125

Notes

a. November 8, 2007 Calibration Day for Rock Hill Hydraulic Model (Water Distribution System Study, W&S, March 2008)

b. RPM esimated from interpolated data

c. Use of two (2) pumps for demand flows below 9800 GPM not recommended.

TABLE 5
Estimated Annual Power Consumption and Costs
New High Service Pumps - VFDs

Description	Flow (MGD)	TDH (Feet)[a]	Power (Hp)[b]	Pump Eff (%)[c]	Motor Eff (%)[d]	Wire to Water Eff (%)	Run Time (hr)[e]	Yearly Consumption (kWh)[f.]	Estimated Yearly Total Cost Savings ($)
Existing Pumps	13.91	219	534	84	82	68.88	8760	5,068,312	$456,148
New Pumps	13.91	210	512	87	94	81.78	8760	4,093,404	$368,406
								974,909	$87,742

a. TDH = Average of existing operating range of 85 psi to 105 psi (existing), 91 psi delivery to York County (new pumps)
b. Power (Hp) = flow rate (Q) * TDH/3960
c. Average efficiency of three proposed pump manufacturers (new pumps), average efficiency of all six existing pumps at rated design point (existing pumps)
d. Assumed value for premium efficiency motor (new pumps), assumed value for existing motors
e. Runtime assumes 365 days per year, 24 hours per day
f. Hourly consumption (kWh) = Q * TDH * 0.746/(3960 * wire to water efficiency)
g. Electricity Rate = $0.09 kw/H

TABLE 6
City of Rock Hill, SC
Estimated Cost Savings
100W High Pressure Sodium vs. Stonco LP32 (32W) Fixture
Wall Packs

Assumptions		
Average Lighting	3650.00	hours per year
Electricity Rate	0.09	per kwh
100W HPS	200.00	HPS Wall Pack Purchase Price
32W LED	400.00	LED Wall Pack Purchase Price
HPS Relamping Cost	30.00	Material ($10) and Labor ($20)

Electricity		
	HPS	LED
Power Factor	0.83	0.95
Actual Watts	125	50
Annual Electricity (kwh)	456.25	182.5
Annual Electricity Cost	40.296	16.1184
Average Product Life (Years)	2	15

Cost of Ownership			
Year	HPS	LED	Notes
1	$240	$416	
2	$281	$432	
3	$351	$448	Relamp HPS
4	$391	$464	
5	$461	$481	Relamp HPS
6	$502	$497	
7	$572	$513	Relamp HPS
8	$612	$529	
9	$683	$545	Relamp HPS
10	$723	$561	
11	$793	$577	Relamp HPS
12	$834	$593	
13	$904	$610	Relamp HPS
14	$944	$626	
15	$1,014	$642	Relamp HPS
16	$1,055	$658	

Table 7
City of Rock Hill, SC
Estimated Cost Savings
Existing High Service Electrical Gear Comparison - 4160V to 480V

		Existing 800HP Motor at 4160V	Unit	Qty	Cost		Source
1	VFD	4160V, 800HP, 99 FLA, N-1, No Bypass	Each	1	$159,000	$159,000	
2	CABLE	3 #2 5KV, 133%, Copper, XLP Shielded	Feet	900	$5	$4,590	RS Means 26 05 13.16-0100
3	CONDUIT	4" RGS	Feet	300	$61	$18,150	RS Means 26 05 33.05-1970
4	TERM	5KV Cable Termination	Each	6	$145	$870	RS Means 26 05 13.10-0100
		Total				$182,610	

		Existing 800HP Motor at 480V	Unit	Qty	Cost		Source
1	VFD	480V, 800HP, 960 FLA, N-1, No Bypass, 18 Pulse with Auto-Transformer	Each	1	$105,000	$105,000	Vendor
2	CABLE	4 Runs of 3 #350kcmil, 600V, XHHW, Copper	Feet	3600	$13	$45,000	RS Means 26 05 19.90-3280
3	CONDUIT	4" RGS	Feet	1200	$61	$72,600	RS Means 26 05 33.05-1970
4	TERM	480V Cable Terminations, Terminal Lugs	Each	24	$89	$2,136	RS Means 26 05 19.35-0400
		Total				$224,736	

	Savings at 4160V	**$42,126**	

Note: the cost savings doesn't include the cost for a new transformer and rewinding the existing pumps motors. This is estimated to be an additional $54,000.

TABLE 8
City of Rock Hill, SC
Estimated Cost Savings
New High Service Electrical Gear Comparison - 4160V to 480V

		Existing 800HP Motor at 4160V	Unit	Qty	Cost		Source
1	VFD	4160V, 800HP, 99 FLA, N-1, No Bypass	Each	1	$159,000	$159,000	
2	CABLE	3 #2 SKV, 133%, Copper, XLP Shielded	Feet	225	$5	$1,148	RS Means 26 05 13.16-0100
3	CONDUIT	4" RGS	Feet	75	$61	$4,538	RS Means 26 05 33.05-1970
4	TERM	5KV Cable Termination	Each	6	$145	$870	RS Means 26 05 13.10-0100
						$165,555	

		Existing 800HP Motor at 480V	Unit	Qty	Cost		
1	VFD	480V, 800HP, 960 FLA, N-1, No Bypass, 18 Pulse with Auto-Transformer	Each	1	$105,000	$105,000	Vendor
2	CABLE	4 Runs of 3 #500kcmil, 600V, XHHW, Copper	Feet	900	$13	$11,250	RS Means 26 05 19.90-3280
3	CONDUIT	4" RGS	Feet	300	$61	$18,150	RS Means 26 05 33.05-1970
4	TERM	480V Cable Terminiations, Terminal Lugs	Each	24	$89	$2,136	RS Means 26 05 19.35-0400
5	XFMR	4160V to 480V Transformer (1000KVA)	Each	1	$39,000	$39,000	RS Means 26 12 19.20-0300
						$175,536	

Savings at 4160V	**$9,981**

WIEDEMAN AND SINGLETON, INC.
CIVIL AND ENVIRONMENTAL ENGINEERS

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July 24, 2013

Mr. John M. McCain
State Revolving Fund Section
Division of Water Facilities Permitting
Bureau of Water
Columbia, SC 29201

Re: Rock Hill Water Plant High-Service Pumping Modifications and Expansion
Green Business Case
Rock Hill, South Carolina
W&S No: 056-13-140

Dear Mr. McCain:

Enclosed for your review and approval are three (3) copies of the business case that was developed in support of the City of Rock Hill's request to obtain Green Project Reserve financing for components of the Rock Hill Water Plant High-Service Pumping Modifications and Expansion in Rock Hill, South Carolina. The business case was revised to reflect SCDHEC comments related to the installation of the VFDs and the HVAC system at the electrical building.

If you have any questions or comments or we can be of further assistance, please do not hesitate to call.

Sincerely,

WIEDEMAN AND SINGLETON, INC.

Troy A. Began, P.E.

Cc: Mr. Bill Yetman
Mr. Peter Johns

Rock Hill\056-13-140\Business Case_Cover Ltr Revised.doc

South Carolina Drinking Water State Revolving Fund – Revised 7/24/13
Green Project Reserve Business Case Documentation
City of Rock Hill, South Carolina

Rock Hill Water Plant High-Service Pumping Modifications and Expansion **Energy Efficiency**

Summary

- Expansion of the high service pumping capacity of the City of Rock Hill Water Treatment Plant (WTP) from 30 MGD to at least 36 MGD; and better operational control of system pressures and energy savings by installing medium voltage VFDs and high efficiency pumps and motors.
- SRF loan amount (including 0.25% loan closing fee) = $4,021,028
- Green portion of loan = $1,622,682 or 40% of the total loan.
- Minimum estimated annual energy savings = 744,647 kWh
- Minimum estimated annual cost savings = $69,995 and onetime cost savings of $100,000 to install medium voltage VFDs (i.e., conductor costs savings - less copper wire)

Background

The City of Rock Hill Water Treatment Plant (WTP) is currently designed and permitted by the South Carolina Department of Health and Environmental Control (SCDHEC) to treat a maximum daily flow of 36 million gallons per day (MGD), and has been master planned for expansion in the future to at least 48 MGD and potentially 60 MGD. Currently, the maximum daily high-service pumping capacity available is estimated to be approximately 30 MGD. The purpose of this project is twofold; to modify and expand Rock Hill's existing high-service pumping arrangement to at least 36 MGD with easy expansion of the high-service pumping capacity in the future, as the plant site is built-out, to at least 48 MGD and possibly 60 MGD; and to provide better operational control of system pressures and energy savings by installing medium voltage VFDs and high efficiency pumps and motors. The project will consist of the following improvements.

- New High Service Pump Station #3, including two new high service pumps and variable frequency drives.
- New Electrical Building.
- Installation of two variable frequency drives for existing high service pump #4 and #6.
- Associated piping and appurtenances.

Energy Efficient Components

The *Consolidated Appropriations Act, 2012* allows State Drinking Water SRFs to use funds made available by the Act to address green infrastructure, water or energy efficiency improvements, or other environmentally innovative activities. South Carolina has chosen to continue to fund projects or portions of Drinking Water projects that qualify as "green" using the previously published EPA Guidance for DWSRF Green Project Reserve. The components of the City of Rock Hill High Service Pumping and Expansion Project that fall under "Energy Efficiency" eligible projects are listed below and require the development of a business case:

1. VFDs - High Service Pump Station #2 and High Service Pump Station #3: VFDs will be installed for existing high service pump #4 and #6 and for the two new pumps that will be installed at High Service Pump Station #3. The VFDs enable the pumps to accommodate fluctuating demand by running at lower speeds and pumping less flow; thereby, enabling these pumps, which have more efficient pumps and motors, to be used more frequently.

Currently, existing high service pump #1 (2 MGD), #2 (6 MGD) and #3 (3 MGD) are used in combination with the other high service pumps to meet fluctuating demand throughout the day.

Power and cost savings would be realized by increasing the frequency of operation of the existing high service pumps at HSPS #2 or by operating the new high service pumps. Refer to Table 1 through Table 4 attached. The analysis is based on a "typical" operating data on November 8, 2007. According to the analysis, the annual estimated power savings, at current flows of 13.91 MGD, is approximately 686,900 kWh, which is an estimated cost savings of approximately $61,821 per year. Note, this analysis doesn't include the power and cost savings associated with reducing over-pumping into the system at increased discharge pressures.

The VFDs will also help maintain discharge pressure at the WTP below 105 psi, which reduces stress on the water system and eliminates leaks (i.e., 105 psi is maximum pressure to prevent leaks in the Rock Hill distribution system). Bypass starters will not be installed and the Owner's personnel will be provided with a minimum of 8 hours of on-site instruction on VFD operation to ensure that they have adequate training to operate the equipment. The auto-start feature is a standard option with the VFDs and the VFDs will be current limiting. The auto-start feature allows for automatic restart in the event of specific faults (i.e., overcurrent, overheat, motor overload, etc). This option can be turned on/turned off and due to the size/voltage of the VFDs, this option will be kept OFF and the operator will be required to manually reset the fault prior to restart.

2. High Service Pump Station #3. Two new high service pumps are being installed at HSPS #3 to expand the high service pumping at the WTP to at least 36 MGD. The new pumps will be equipped with variable frequency drives, which will better match high service pumping flow with actual system demands and will enable the City to maintain a more constant discharge pressure. The new pumps will also be more efficient than the existing pumps and will have premium efficiency motors. The new more efficient pumps and motors will result in an estimated energy savings of 974,909 kWh per year and an annual cost savings of $87,742 per year. The actual energy and cost savings will probably be greater because the actual efficiency of the existing pumps and motors is lower due to the age of the pumps and motors. Refer to Table 5.

   Assuming the cost to purchase and install the pumps and motors is $465,000, then the simply payback = $465,000/$87,742 per year = approximately 5.5 years.

3. Energy Efficient Lighting - The light-emitting diode (LED) is one of today's most energy-efficient and rapidly-developing lighting technologies. Quality LED light bulbs last longer, are more durable and offer comparable or better light quality than other types of traditional lighting options. The true cost of the bulb is the cost of replacement bulbs and the labor expense and time needed to replace the bulb as well as the efficiency of the bulb. The estimated annual energy savings using LED lights is 274 kWh per wall pack and the estimated cost savings resulting from the reduced maintenance and the electrical power savings over a 15 year period (life expectancy of LED light packs) is approximately $397 per light or a total of $3,174 (based on installation of eight wall packs). Refer to Table 6.

4. Medium Voltage Electrical Gear – The high service pumps (new and existing) will operate at 4,160V. The higher voltages (compared to 480V) require less current. Lower current means smaller or fewer conductors to distribute power. Using smaller or fewer conductors decreases the amount of copper (conservation of natural resources) and therefore reduces cost. Conduit and installation costs are also lower. Medium-voltage also helps

to minimize voltage drop. In medium-voltage systems, the load current is smaller, resulting in less voltage drop. This smaller voltage drop eliminates the need to oversize conductors and makes the overall system more efficient.

The medium voltage (4,160V) VFDs cost approximately $54,000 more than their counterpart 480V VFDs but the cost savings in the wire, conduit and installation is estimated to be approximately $64,000 per pump, which is a onetime cost savings of approximately $10,000 for each new pump at High Service PS#3. The onetime cost savings to operate the existing pumps at 4,160V is approximately $40,000 per pump. Refer to Table 7 and Table 8.

Also, a power monitoring system will be included with the Medium Voltage Switchgear. Power monitors will be installed on each of the main fused switches in the new main-tie-main switchgear. The power monitor will measure power, amps, etc. and will be connected to Rock Hill's SCADA system and provide a valuable means for monitoring and tracking the pumping system over the long term.

5. HVAC –To avoid recirculating and cooling hot exhaust air that discharges from each VFD, at approximately 115 degrees F, an alternative air conditioning system will be installed at the new electrical building. The proposed system is a more energy efficient alternative that uses 100% outdoor air to maintain indoor temperature at 85 degrees F or less. The packaged outside air conditioning units are rated in terms of Energy Efficiency Ratio (EER) in lieu of Seasonal Energy Efficiency Ratio (SEER). The EER rating of the outside air conditioning units proposed for Rock Hill is 12.2. The approximate equivalent SEER for this unit is 13.94. The current national standard is 13.0. A system description follows:

   - Whenever the outside air temperature is 75 degrees F or less, the proposed system would discharge hot VFD exhaust air directly outdoors and replace it with cooler ventilation air that is unconditioned.
   - When outdoor air temperature rises above 75 degrees F, air conditioning capacity would be activated in small increments that would be adequate to reduce outside air supply temperature to just below 75 degrees F. (Conditioning outdoor air at 95 degrees F is more cost-effective than attempting to condition 115 degree F air that discharges from the VFDs.)
   - When outdoor temperature drops below 50 degrees F, hot exhaust air from the VFD's will be recirculated in the VFD Room to defer use of electric unit heat.

   Using this arrangement, the energy cost for the outside air conditioning system will be approximately 50% of the cost for operating a conventional system and results in an annual cost savings of approximately $5,000 per year over a conventional system (i.e., annual estimated cooling cost to operate a conventional system is $10,000 and the "outside" air conditioning is $5,000). To help ensure increased energy efficiency, the electrical building will be insulated.

Conclusion

Expansion of the high service pumping capacity at the City of Rock Hill WTP will modify and expand Rock Hill's existing high-service pumping arrangement to at least 36 MGD with easy expansion of the high-service pumping capacity in the future to at least 48 MGD and possibly 60 MGD and will provide better operational control of system pressures and energy savings. The energy savings include reductions in pumping costs. Additionally, the new

electrical building will include energy efficient building lighting and "outside" air condition both of which will result in increased energy savings over their "conventional" counterparts.

The total opinion of probable cost for the Rock Hill Water Plant High-Service Pumping Modifications and Expansion is $4,021,028. The business case discusses various components of the project which are eligible under the Green Project Reserve. Therefore, funding for these components, should be covered by the Green Rate, and is estimated to be $1,622,682 as follows:

1. Two 800 hp medium Voltage VFDs for High Service PS#3 = $320,000 (equipment costs) + $32,000 (installation costs) = $352,000
2. One 800 hp and one 400 hp medium voltage VFD for High Service PS#2 = $320,000 (equipment costs) + $32,000 (installation costs) = $352,000
3. Two new vertical turbine pumps and motors for High Service PS#3 = $445,000 (equipment costs) + $20,000 (installation costs) = $465,000
4. Medium Voltage Electrical Gear = $120,000 (equipment costs) + $12,000 (installation costs) = $132,000
5. HVAC for High Service PS#3 = $40,000 (equipment costs) + $5,000 (installation costs) = $45,000
6. Eight LED Light Packs for High Service PS#3 and the Electrical Building = $3,200

SUB-TOTAL – ITEMS 1-6 ABOVE = $1,349,200

7. Mobilization, Bonds and Insurance (5.70% of construction cost) = $76,904
8. Legal and Appraisal Fees (0.85% of construction cost) = $11,468
9. Construction Engineering (3.42% of construction cost) = $46,143
10. Contingency for Construction (10% of construction cost) = $134,920
11. Loan Closing Fee (0.25% of total costs) = $4,047

TOTAL ESTIMATED PROJECT GREEN COSTS = $1,622,682

TABLE 1

Estimated Operation Cost - New/Existing High Service Pumps with Variable Speed Drives

City of Rock Hill Water Treatment Plant

	Existing High Service Pump Operation		New Pumps
	Without VFDs	With VFDs	With VFDs
Total Flow Pumped, MGD (Average Day)	15.75	15.75	15.75
Total KWH Required/Day	15,186	13,612	12,498
Cost/Day @ $0.09/KWH	$ 1,367	$ 1,225	$ 1,125
Cost/MGD @ $0.09/KWH	$ 87	$ 78	$ 71
2012 Average Day Flow (MGD)	13.91	13.91	13.91
2012 Pumping Cost/Year	$ 440,574	$ 394,909	$ 362,596
Pump Run Time (% of Time)	100%	50%	50%
Total Estimated Operating Cost	$ 440,574	$ 197,455	$ 181,298
Estimated Operating Cost Savings/Year	$ (61,821)		

TABLE 2

Estimated Operation Cost - Existing High Service Pumps - Constant Speed

City of Rock Hill Water Treatment Plant

Electrical Cost/KWH: $ 0.090

Daily Flow Demand Cycle						Primary Pump						Secondary Pump						
						Full-Spd Curve Data			Power Req'd					Full-Spd Curve Data		Power Req'd		
Time	Flow	Flow	TDH	Primary	Secondary	At Given Head		Motor	Constant Speed		Additional Pumping	Select Existing Pump		At Given Head		Constant Speed		Total KWH
(Hr)	(gpm)[a]	(MGD)	(Feet)	Pump#	Pump#	GPM	Eff.	Eff.	HP	KW	Req'd, GPM	Pump #	Motor Eff.	GPM	Eff.	HP	KW	Req'd
0	11800	16.99																
1	11800	16.99	206.6	4	2	6468	75%	85%	530	395	5332	2	85%	5010	76%	405	302	697
2	9200	13.25	202.2	4	1	6468	75%	85%	518	387	2732	1	85%	2431	76%	192	143	530
3	9400	13.54	202.5	4	3	6468	75%	85%	519	387	2932	3	85%	3175	76%	252	188	575
4	9200	13.25	202.2	4	1	6468	75%	85%	518	387	2732	1	85%	2431	76%	192	143	530
5	9500	13.68	202.6	4	3	6468	75%	85%	520	388	3032	3	85%	3175	76%	252	188	575
6	9600	13.82	202.8	4	3	6468	75%	85%	520	388	3132	3	85%	3175	76%	252	188	576
7	9800	14.11	203.1	4	3	6558	75%	85%	528	394	3242	3	85%	3163	76%	251	187	581
8	9800	14.11	203.1	4	3	6558	75%	85%	528	394	3242	3	85%	3163	76%	251	187	581
9	9800	14.11	203.1	4	3	6558	75%	85%	528	394	3242	3	85%	3163	76%	251	187	581
10	9800	14.11	203.1	4	3	6558	75%	85%	528	394	3242	3	85%	3163	76%	251	187	581
11	9800	14.11	203.1	4	3	6558	75%	85%	528	394	3242	3	85%	3163	76%	251	187	581
12	12200	17.57	207.4	5		12367	83%	85%	919	686	-167							686
13	12000	17.28	207.0	5		12367	83%	85%	917	684	-367							684
14	12000	17.28	207.0	5		12367	83%	85%	917	684	-367							684
15	12000	17.28	207.0	5		12367	83%	85%	917	684	-367							684
16	12200	17.57	207.4	5		12367	83%	85%	919	686	-167							686
17	12000	17.28	207.0	5		12367	83%	85%	917	684	-367							684
18	12000	17.28	207.0	5		12367	83%	85%	917	684	-367							684
19	12200	17.57	207.4	5		12367	83%	85%	919	686	-167							686
20	12200	17.57	207.4	5		12367	83%	85%	919	686	-167							686
21	12200	17.57	207.4	5		12367	83%	85%	919	686	-167							686
22	12200	17.57	207.4	5		12367	83%	85%	919	686	-167							686
23	12000	17.28	207.0	5		12367	83%	85%	917	684	-367							684
24	9600	13.82	202.8	4	3	6468	75%	85%	520	388	3132	3	85%	3175	76%	252	188	576
	15.75 MGD																KWH/Day:	15,186
																	Electric Cost/Day:	$ 1,367

Notes

a. November 8, 2007 Calibration Day for Rock Hill Hydraulic Model (Water Distribution System Study, W&S, March 2008)

TABLE 3

Estimated Operation Cost - Existing High Service Pumps #4 & #6 with Variable Speed Drives

City of Rock Hill Water Treatment Plant

Electrical Cost/KWH: $ 0.090

Time	Flow	Flow	TDH	HSP #4 w/VFD			HSP #6 w/VFD			Total	High Service Pump #4 With VFD				High Service Pump #6 With VFD				Total KWH
(Hr)	(gpm)[a]	(MGD)	(Feet)[b]	RPM[b]	TDH	GPM	RPM*	TDH	GPM	GPM	Pump Eff	Motor Eff	HP	KW	Pump Eff	Motor Eff	HP	KW	Req'd
0	11800	16.992								0									
1	11800	16.992	206.5	1060	206.5	4770	975	206.5	7005	11775	84%	85%	349	260	82%	94%	474	354	614
2	9200	13.248	202.2	996	202.2	3596	928	202.2	5646	9242	84%	85%	257	192	82%	94%	374	279	471
3	9400	13.536	202.5	1003	202.5	3725	930	202.5	5700	9425	84%	85%	267	199	82%	94%	379	282	482
4	9200	13.248	202.2	996	202.2	3596	928	202.2	5646	9242	84%	85%	257	192	82%	94%	374	279	471
5	9500	13.68	202.7	1008	202.7	3811	931	202.7	5736	9547	84%	85%	273	204	82%	94%	381	284	488
6	9600	13.824	202.8	1010	202.8	3854	931	202.8	5754	9608	84%	85%	277	206	82%	94%	383	285	492
7	9800	14.112	203.1	1017	203.1	3983	933	203.1	5808	9791	84%	85%	286	214	82%	94%	387	289	502
8	9800	14.112	203.1	1017	203.1	3983	933	203.1	5808	9791	84%	85%	286	214	82%	94%	387	289	502
9	9800	14.112	203.1	1017	203.1	3983	933	203.1	5808	9791	84%	85%	286	214	82%	94%	387	289	502
10	9800	14.112	203.1	1017	203.1	3983	933	203.1	5808	9791	84%	85%	286	214	82%	94%	387	289	502
11	9800	14.112	203.1	1017	203.1	3983	933	203.1	5808	9791	84%	85%	286	214	82%	94%	387	289	502
12	12200	17.568	207.3	1062	207.3	4754	971	207.3	7461	12215	84%	85%	349	260	82%	94%	507	378	639
13	12000	17.28	206.9	1062	206.9	4762	966	206.9	7233	11995	84%	85%	349	260	82%	94%	491	366	626
14	12000	17.28	206.9	1062	206.9	4762	966	206.9	7233	11995	84%	85%	349	260	82%	94%	491	366	626
15	12000	17.28	206.9	1062	206.9	4762	966	206.9	7233	11995	84%	85%	349	260	82%	94%	491	366	626
16	12200	17.568	207.3	1062	207.3	4754	971	207.3	7461	12215	84%	85%	349	260	82%	94%	507	378	639
17	12000	17.28	206.9	1062	206.9	4762	966	206.9	7233	11995	84%	85%	349	260	82%	94%	491	366	626
18	12000	17.28	206.9	1062	206.9	4762	966	206.9	7233	11995	84%	85%	349	260	82%	94%	491	366	626
19	12200	17.568	207.3	1062	207.3	4754	971	207.3	7461	12215	84%	85%	349	260	82%	94%	507	378	639
20	12200	17.568	207.3	1062	207.3	4754	971	207.3	7461	12215	84%	85%	349	260	82%	94%	507	378	639
21	12200	17.568	207.3	1062	207.3	4754	971	207.3	7461	12215	84%	85%	349	260	82%	94%	507	378	639
22	12200	17.568	207.3	1062	207.3	4754	971	207.3	7461	12215	84%	85%	349	260	82%	94%	507	378	639
23	12000	17.28	206.9	1062	206.9	4762	966	206.9	7233	11995	84%	85%	349	260	82%	94%	491	366	626
24	9600	13.824	202.8	1010	202.8	3854	931	202.8	5754	9608	84%	85%	277	206	82%	94%	383	285	492

KWH/Day: 13,612

Electric Cost/Day: $ 1,225

Notes

a. November 8, 2007 Calibration Day for Rock Hill Hydraulic Model (Water Distribution System Study, W&S, March 2008)

b. RPM esimated from interpolated data

TABLE 4

Estimated Operation Cost - New High Service Pumps with Variable Speed Drives

City of Rock Hill Water Treatment Plant

New High Service Pumps - VFDs *800 HP, each* *Electrical Cost/KWH: $ 0.090*

Daily Flow Demand Cycle				Pump Runs Based on Demand Cycle						Power Consumption Based on Demand Cycle									
Time	Flow	Flow	TDH	One (1) New HSP w/VFD			TWO (2) New HSP w/VFD[c]			Pump Eff	Motor Eff	Run Time	Percent of	No. of Pumps	Theoretical Power		Water to Wire	Power Req'd With VFDs	
(Hr)	(gpm)[a]	(MGD)	(Feet)	RPM[b]	TDH	GPM	RPM*	TDH	GPM	(%)[d]	(%)[e]	(hr)	Full Speed	Running	Usage	Water HP	Eff.	HP	KW
0	11800	16.992																	
1	11800	16.992	206.7				984	206.7	11818	87%	94%	1	56%	2	17.8%	617.5	81%	758	565
2	9200	13.248	202.1	1145	202.1	9215			**	87%	94%	1	65%	1	28.0%	470.8	81%	578	431
3	9400	13.536	202.4	1156	202.4	9410			**	87%	94%	1	66%	1	28.8%	481.4	81%	591	441
4	9200	13.248	202.1	1145	202.1	9215			**	87%	94%	1	65%	1	28.0%	470.8	81%	578	431
5	9500	13.68	202.5	1160	202.5	9475			**	87%	94%	1	66%	1	29.1%	485.0	81%	595	444
6	9600	13.824	202.7	1168	202.7	9605			**	87%	94%	1	67%	1	29.7%	492.1	81%	604	450
7	9800	14.112	203	1180	203	9800			**	87%	94%	1	67%	1	30.7%	502.9	81%	617	460
8	9800	14.112	203	1180	203	9800			**	87%	94%	1	67%	1	30.7%	502.9	81%	617	460
9	9800	14.112	203	1180	203	9800			**	87%	94%	1	67%	1	30.7%	502.9	81%	617	460
10	9800	14.112	203	1180	203	9800			**	87%	94%	1	67%	1	30.7%	502.9	81%	617	460
11	9800	14.112	203	1180	203	9800			**	87%	94%	1	67%	1	30.7%	502.9	81%	617	460
12	12200	17.568	207.5				994	207.5	12238	87%	94%	1	57%	2	18.3%	641.9	81%	788	588
13	12000	17.28	207.1				989	207.1	12028	87%	94%	1	57%	2	18.0%	629.7	81%	773	576
14	12000	17.28	207.1				989	207.1	12028	87%	94%	1	57%	2	18.0%	629.7	81%	773	576
15	12000	17.28	207.1				989	207.1	12028	87%	94%	1	57%	2	18.0%	629.7	81%	773	576
16	12200	17.568	207.5				994	207.5	12238	87%	94%	1	57%	2	18.3%	641.9	81%	788	588
17	12000	17.28	207.1				989	207.1	12028	87%	94%	1	57%	2	18.0%	629.7	81%	773	576
18	12000	17.28	207.1				989	207.1	12028	87%	94%	1	57%	2	18.0%	629.7	81%	773	576
19	12200	17.568	207.5				994	207.5	12238	87%	94%	1	57%	2	18.3%	641.9	81%	788	588
20	12200	17.568	207.5				994	207.5	12238	87%	94%	1	57%	2	18.3%	641.9	81%	788	588
21	12200	17.568	207.5				994	207.5	12238	87%	94%	1	57%	2	18.3%	641.9	81%	788	588
22	12200	17.568	207.5				994	207.5	12238	87%	94%	1	57%	2	18.3%	641.9	81%	788	588
23	12000	17.28	207.1				989	207.1	12028	87%	94%	1	57%	2	18.0%	629.7	81%	773	576
24	9600	13.824	202.7	1168	202.7	9605			**	87%	94%	1	67%	1	29.7%	492.1	81%	604	450

KWH/Day: 12,498

Electric Cost/Day: $ 1,125

Notes

a. November 8, 2007 Calibration Day for Rock Hill Hydraulic Model (Water Distribution System Study, W&S, March 2008)

b. RPM esimated from interpolated data

c. Use of two (2) pumps for demand flows below 9800 GPM not recommended.

TABLE 5
Estimated Annual Power Consumption and Costs
New High Service Pumps - VFDs

Description	Flow (MGD)	TDH (Feet)[a]	Power (Hp)[b]	Pump Eff (%)[c]	Motor Eff (%)[d]	Wire to Water Eff (%)	Run Time (hr)[e]	Yearly Consumption (kWh)[f.]	Estimated Yearly Total Cost Savings ($)
Existing Pumps	13.91	219	534	84	82	68.88	8760	5,068,312	$456,148
New Pumps	13.91	210	512	87	94	81.78	8760	4,093,404	$368,406
								974,909	$87,742

a. TDH = Average of existing operating range of 85 psi to 105 psi (existing), 91 psi delivery to York County (new pumps)
b. Power (Hp) = flow rate (Q) * TDH/3960
c. Average efficiency of three proposed pump manufacturers (new pumps), average efficiency of all six existing pumps at rated design point (existing pumps)
d. Assumed value for premium efficiency motor (new pumps), assumed value for existing motors
e. Runtime assumes 365 days per year, 24 hours per day
f. Hourly consumption (kWh) = Q * TDH * 0.746/(3960 * wire to water efficiency)
g. Electricity Rate = $0.09 kw/H

TABLE 6
City of Rock Hill, SC
Estimated Cost Savings
100W High Pressure Sodium vs. Stonco LP32 (32W) Fixture
Wall Packs

Assumptions		
Average Lighting	3650.00	hours per year
Electricity Rate	0.09	per kwh
100W HPS	200.00	HPS Wall Pack Purchase Price
32W LED	400.00	LED Wall Pack Purchase Price
HPS Relamping Cost	30.00	Material ($10) and Labor ($20)

Electricity		
	HPS	LED
Power Factor	0.83	0.95
Actual Watts	125	50
Annual Electricity (kwh)	456.25	182.5
Annual Electricity Cost	40.296	16.1184
Average Product Life (Years)	2	15

Cost of Ownership			
Year	HPS	LED	Notes
1	$240	$416	
2	$281	$432	
3	$351	$448	Relamp HPS
4	$391	$464	
5	$461	$481	Relamp HPS
6	$502	$497	
7	$572	$513	Relamp HPS
8	$612	$529	
9	$683	$545	Relamp HPS
10	$723	$561	
11	$793	$577	Relamp HPS
12	$834	$593	
13	$904	$610	Relamp HPS
14	$944	$626	
15	$1,014	$642	Relamp HPS
16	$1,055	$658	

Table 7
City of Rock Hill, SC
Estimated Cost Savings
Existing High Service Electrical Gear Comparison - 4160V to 480V

		Existing 800HP Motor at 4160V	Unit	Qty	Cost		Source
1	VFD	4160V, 800HP, 99 FLA, N-1, No Bypass	Each	1	$159,000	$159,000	
2	CABLE	3 #2 5KV, 133%, Copper, XLP Shielded	Feet	900	$5	$4,590	RS Means 26 05 13.16-0100
3	CONDUIT	4" RGS	Feet	300	$61	$18,150	RS Means 26 05 33.05-1970
4	TERM	5KV Cable Termination	Each	6	$145	$870	RS Means 26 05 13.10-0100
		Total				$182,610	
		Existing 800HP Motor at 480V	Unit	Qty	Cost		
1	VFD	480V, 800HP, 960 FLA, N-1, No Bypass, 18 Pulse with Auto-Transformer	Each	1	$105,000	$105,000	Vendor
2	CABLE	4 Runs of 3 #350kcmil, 600V, XHHW, Copper	Feet	3600	$13	$45,000	RS Means 26 05 19.90-3280
3	CONDUIT	4" RGS	Feet	1200	$61	$72,600	RS Means 26 05 33.05-1970
4	TERM	480V Cable Terminations, Terminal Lugs	Each	24	$89	$2,136	RS Means 26 05 19.35-0400
		Total				$224,736	
		Savings at 4160V	**$42,126**				

Note: the cost savings doesn't include the cost for a new transformer and rewinding the existing pumps motors. This is estimated to be an additional $54,000.

TABLE 8
City of Rock Hill, SC
Estimated Cost Savings
New High Service Electrical Gear Comparison - 4160V to 480V

		Existing 800HP Motor at 4160V	Unit	Qty	Cost		Source
1	VFD	4160V, 800HP, 99 FLA, N-1, No Bypass	Each	1	$159,000	$159,000	
2	CABLE	3 #2 5KV, 133%, Copper, XLP Shielded	Feet	225	$5	$1,148	RS Means 26 05 13.16-0100
3	CONDUIT	4" RGS	Feet	75	$61	$4,538	RS Means 26 05 33.05-1970
4	TERM	5KV Cable Termination	Each	6	$145	$870	RS Means 26 05 13.10-0100
						$165,555	

		Existing 800HP Motor at 480V	Unit	Qty	Cost		
1	VFD	480V, 800HP, 960 FLA, N-1, No Bypass, 18 Pulse with Auto-Transformer	Each	1	$105,000	$105,000	Vendor
2	CABLE	4 Runs of 3 #500kcmil, 600V, XHHW, Copper	Feet	900	$13	$11,250	RS Means 26 05 19.90-3280
3	CONDUIT	4" RGS	Feet	300	$61	$18,150	RS Means 26 05 33.05-1970
4	TERM	480V Cable Terminiations, Terminal Lugs	Each	24	$89	$2,136	RS Means 26 05 19.35-0400
5	XFMR	4160V to 480V Transformer (1000KVA)	Each	1	$39,000	$39,000	RS Means 26 12 19.20-0300
						$175,536	

Savings at 4160V	**$9,981**