Worthington, David (DEQ)

From:	Jeff Pugh <jpugh@fveng.com>
Sent:	Wednesday, April 22, 2015 4:26 PM
To:	Worthington, David (DEQ)
Cc:	Meyer, Cheri (DEQ); kanderson@dowagiac.org; Jerry J. Powell; Joe Benjamin
Subject:	RE: Dowagiac SRF 5604-01
Attachments:	FW: Dowagiac 5604-01 final plans & specs

David,

We are recommending Alternate A for Segment 2 but may entertain Alternate B instead if the contractor's offering can be better defined so that all costs can be identified.

As it currently stands, Alternate B appears to be $9,000.00 less but changes to the design would be required including a taller and longer platform, additional stairs and handrails, additional piping and fittings, larger concrete housekeeping pads, changes to the filter feed pumps duty point and other details. In our judgment, the potential costs of providing all of these modification could exceed the potential savings of going with Alternate B. We do not have the information required at this time to fully evaluate Alternate B but we may receive it in time to adjust our recommendation before award of contract.

The green components do add up to $1,169,500; our estimate of the GPR amount was $966,200. A GPR summary table based on the low bid appears below.

Thank you for getting back with us,

Jeff

Green Project Reserve Summary

Bid Form Item #	Segment	Alternate	Bid Total
12	1	N/A	$ 597,000.00
13	1	N/A	$ 15,500.00
4	2	Base-Bid	$ 389,000.00
5	2	Base-Bid	$ 166,000.00
4	2	A	$ 391,000.00
5	2	A	$ 166,000.00
4	2	B	$ 382,000.00
5	2	B	$ 166,000.00

Segment 1 GPR Total:	$ 612,500.00
Segment 2 GPR Total:	$ 557,000.00

GPR Total For Project:	$ 1,169,500.00

From: Worthington, David (DEQ) [mailto:WORTHINGTOND@michigan.gov]
Sent: Wednesday, April 22, 2015 3:41 PM
To: Jeff Pugh

Kevin and Jeff,

I have accepted another position within the DEQ. Starting April 27th, David Worthington will be your new project manager. David can be reached at worthingtond@michigan.gov 517-284-5423.

It has been a pleasure working with you and I wish you the best of luck on your project!

Cheri

Cheri Meyer, Project Manager
Revolving Loan Section
Office of Drinking Water and Municipal Assistance
Department of Environmental Quality
Phone: 517-284-5413
Fax: 517-373-4797

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SUMMARY

Following is a presentation of portions of the City of Dowagiac SRF Project Plan (with the May 22, 2013 Amendment) for Green Project Reserve (GPR) funding. Provisions of the Environmental Protection Agency's (EPA)'s GPR guidance document indicate that a number of the components in the Dowagiac Wastewater Treatment Plant (WWTP) Improvements project are eligible for "principal forgiveness", or a reduction in the loan capital amount.

As discussed in the May 22, 2013 Amendment, two of the Selected Alternatives in the SRF Project Plan are proposed as part of the 2014 SRF Project. The first Selected Alternative, entitled *Alternative WWTP-C-2 – Secondary Treatment, Optimum Performance of Existing Facilities*, outlines upgrades to the existing aeration system at the WWTP. The energy savings projected with this Alternative are in excess of 70% at current conditions and 50% at design flows and loadings as compared to the current system. The proposed improvements are being submitted under paragraph 3.2-2 of the Environmental Protection Agency's (EPA)'s GPR guidance document as a categorically eligible project that achieves at least a 20% reduction in energy consumption. As such, a business case is not required.

The second Selected Alternative, *WWTP-D-3 – Installation of Disc Filters*, upgrades the inefficient multimedia gravity filters to more efficient disc filters. The existing filtration system requires a great deal of backwash water and uses antiquated, inefficient feed pumps. The proposed filtration system would reduce the amount of backwash water needed by approximately 94% and reduce the electrical energy usage by approximately 36%. Due to these projected energy savings, the Disc Filter upgrade is also categorically eligible for GPR funding.

BACKGROUND

The aeration system improvements are discussed in detail as Alternative WWTP-C-2 in the *City of Dowagiac Wastewater System Project Plan for State Revolving Fund* project plan, dated May 2012, as modified by the May 22, 2013 Amendment. The tertiary filter improvements are presented as Alternative WWTP-D-3, as amended.

The Dowagiac WWTP serves the City of Dowagiac, the Cassopolis Area Utility Authority, the Sister Lakes Area Utility Authority, and Indian Lake. The plant has a peak rated capacity of 4.0 million gallons per day (MGD) and a design average capacity of 2.5 MGD. Plant processes include grit removal, comminution, primary clarification, complete mix activated sludge aeration with phosphorous removal, secondary clarification, tertiary filtration, and chlorination and dechlorination. Solids processes include aerobic sludge digestion and a rotary sludge press dewatering, followed by landfilling of the dewatered solids.

CLASSIFICATION

The proposed improvements to the secondary treatment facilities qualify for Categorical GPR principal forgiveness under Section 3.2-2 (Energy Efficient Categorical Projects) of the Environmental Protection Agency (EPA) *Procedures for Implementing Certain Provisions of EPA's Fiscal Year 2012 Appropriations Affecting the Clean Water and Drinking Water State Revolving Fund Programs* document. This categorical qualification is based on electrical energy savings in excess of 20% as a result of the project.

Similarly, the recommended tertiary filter alternative qualifies based on electrical energy savings greater than 20% and a reduction in backwash water generation.

CONFIRMATION

As previously mentioned, portions of the proposed improvements qualify for categorical GPR principal forgiveness based on energy savings. Following is a discussion for each project alternative, detailing the energy savings as a result of completing these alternatives:

Secondary Treatment Facilities

The plant currently has three aerated treatment basins. Two of the basins are used year round with the third basin typically used through the warmer months of the year to provide additional aeration capacity for ammonia-nitrogen removal (known as nitrification). Each of the aeration basins is equipped with a coarse bubble diffusion system. Coarse bubble diffusers, while relatively maintenance free, are inefficient at transferring oxygen from the supplied air into the wastewater when compared with currently available air diffusion technologies.

Air is supplied to the aeration basins by three existing Spencer centrifugal blowers, each rated at 3,250 cubic feet per minute (with an average blower efficiency of approximately 59%) and powered by a 150 horsepower motor. Two of the blowers are powered by original 1970's motors with a motor efficiency of approximately 80%. The third blower has been upgraded with an aftermarket premium efficiency motor with an efficiency of approximately 95%. The blowers are not equipped with inlet throttling valves so, when called to run, they operate at 100% capacity even when a smaller air volume would be sufficient.

The WWTP currently has no online monitoring system for the dissolved oxygen (D.O.) concentration in the aeration basins. WWTP operators periodically use a portable D.O. meter to monitor the D.O. concentration. This mode of operation results in excessively high D.O. concentrations. A review of the WWTP Monthly Operating Reports (MORs) from January 2011 through January 2013 shows an average aeration basin D.O. concentration of 5.8 mg/L (as opposed to the recommended minimum level of 2.0 mg/L), as well as significant day to day variations in the aeration basin D.O. concentrations.

Throughout the winter, a single blower is needed to meet the D.O. requirements of the aeration basins. However, during the warm summer months, a second blower is required at times to supply enough air. The increased air requirement is due to nitrification requirements and reduced oxygen transfer efficiency from the blower air into the wastewater. Due to the operational limitations of the existing system (lack of online D.O. monitoring and no automated control of the blowers), once the second blower is required (usually sometime in May), two blowers are run continuously (each at 100% capacity) through September. According to the WWTP personnel, with a single blower running, the blower amperage draw averages 175 Amps (112.6 hp). With two blowers running, the average amperage draw is 155 Amps (99.7 hp) per blower. Based on the second blower being required from May 15 through September 30, the energy costs associated with the current system operation are:

Fall/Winter/Spring:
1 blower X 112.6 hp X 0.7457 kW/hp X 24 hr/day X 226 day/yr = 455,431 kW-hr/yr

Summer:
2 blowers X 99.7 hp X 0.7457 kW/hp X 24 hr/day X 139 day/yr = 496,038 kW-hr/yr

Total of Existing Aeration Energy Usage:
Energy used = 455,431 kW-hr/yr + 496,038 kW-hr/yr = 951,469 kW-hr/yr
Energy cost = 1,352,998 kW-hr/yr X $0.10 per kW-hr = $95,147 per year

The proposed improvements to the aeration facilities include new variable speed blowers, rated at 1,150 standard cubic feet of air per minute (scfm) at full speed and capable of being slowed to supply lower air flow rates at reduced energy consumption. The new blowers will have an average blower efficiency of approximately 70% and will be powered by 75 horsepower premium efficiency motors with an efficiency of 95%. A D.O. monitoring system will also be added to the aeration basins. The D.O. monitors will be tied into the plant Supervisory Control and Data Acquisition (SCADA) system. The SCADA system will then be able to control the speed of the blowers to increase or decrease the amount of air being supplied in order to maintain a D.O concentration of 2.0 mg/L in the aeration basins. Additionally, the aeration basin diffuser system will be converted from coarse bubble diffusers to a fine bubble diffusion system. Fine bubble diffusers will provide increased oxygen transfer efficiency from the supplied air into the wastewater as compared to the existing coarse bubble diffusers and will result in the need for much smaller blowers.

Calculation of the amount of air needed requires knowledge of the organic and nutrient loadings to the aeration basins. Review of the WWTP MORs from January 2011 through January 2013 indicates that the current organic and nutrient concentrations in the influent to the aeration basins through the summer months average approximately 146 mg/L of BOD_5 and 16 mg/L of ammonia respectively. Through the winter months, the organic loading averages 168 mg/L of BOD_5 and ammonia concentrations are not measured since nitrification is not required.

At these organic and nutrient concentrations and at the current summer average day flow of 1.12 MGD, 68,000 pounds of air are required per day during the summer using the proposed aeration system (as opposed to 245,000 pounds of air delivered using the current aeration system). Through the winter months, when the average day flow drops to 1.07 MGD, 50,000 pounds of air are required per day using the proposed aeration system (as opposed to 209,000 pounds of air delivered using the current aeration system). The air calculations translate to an average air flow of 630 scfm through the summer and 463 scfm through the winter for the proposed aeration system. This means that, on average, 55% of current blower capacity is required to be in operation to supply the required air through the summer months and 40% of current blower capacity is required to be in operation to supply the required air through the winter months.

At current average flow and organic and nutrient concentrations, the energy required for the proposed aeration system is:

Fall/Winter/Spring:
0.40 blowers X 75 hp X 0.7457 kW/hp X 24 hr/day X 226 day/yr = 122,132 kW-hr/yr

Summer:
0.55 blowers X 75 hp X 0.7457 kW/hp X 24 hr/day X 139 day/yr = 102,210 kW-hr/yr

Total of Existing Aeration Energy Usage:
Energy used = 122,132 kW-hr/yr + 102,210 kW-hr/yr = 224,342 kW-hr/yr
Energy cost = 224,342 kW-hr/yr X $0.10 per kW-hr = $22,434 per year

The design average flow for the WWTP is 2.5 MGD and the peak flow is 4.0 MGD. Based on current average organic and nutrient concentrations, design concentrations of 150 mg/L for BOD_5 and 20 mg/L for ammonia were assumed for summer average day loadings and 120 mg/L for BOD_5 and 15 mg/L for ammonia were assumed for summer peak loadings. Based on these flow rates and concentrations, the proposed aeration system will require 160,000 pounds of air per day for the design average day flow and 196,000 pounds of air per day for the peak flow. These air requirements translate to air flows of 1,481 scfm and 1,815 scfm and will require 1.29 blowers and 1.58 blowers, respectively (based on proposed blower capacity). For the purpose of energy calculations, it is assumed that the current aeration system is sufficient to meet the design average and peak flows as currently operated (i.e. 2 blowers at full speed).

At design average and peak flows for summer organic and nutrient concentrations, the energy required for the proposed aeration system is:

Design Average:

Energy used = 1.29 blowers X 75 hp X 0.7457 kW/hp X 24 hr/day = 1,729 kW-hr/day
Energy cost = 1,729 kW-hr/day X $0.10 per kW-hr = $173

Peak Flow:

Energy used = 0.55 blowers X 75 hp X 0.7457 kW/hp X 24 hr/day = 2,118 kW-hr/day
Energy cost = 2,118 kW-hr/day X $0.10 per kW-hr = $212

At design average and peak flows for summer organic and nutrient concentrations, the energy required for the existing aeration system is:

Design Average and Peak Flow:

Energy used = 2 blowers X 99.7 hp X 0.7457 kW/hp X 24 hr/day = 3,569 kW-hr/day
Energy cost = 3,569 kW-hr/day X $0.10 per kW-hr = $357

Comparing the existing aeration system to the proposed aeration system, the energy and cost savings can be summarized as follows:

At Current Average Flow and Loading:

((951,469 kW-hr/yr - 224,342 kW-hr/yr)/951,469 kW-hr/yr) X 100% = 76% energy savings
(951,469 kW-hr/yr - 224,342 kW-hr/yr) X $0.10/kW-hr = $72,700 per year savings

At Design Average Flow and Loading:

((3,569 kW-hr/day - 1,729 kW-hr/day)/3,569 kW-hr/day) X 100% = 52% energy savings
(3,569 kW-hr/day - 1,729 kW-hr/day) X $0.10/kW-hr = $184 per day savings

At Peak Flow and Loading:

((3,569 kW-hr/day - 2,118 kW-hr/day)/3,569 kW-hr/day) X 100% = 41% energy savings
(3,569 kW-hr/day - 2,118 kW-hr/day) X $0.10/kW-hr = $145 per day savings

The energy savings resulting from the proposed improvements to the aeration system at all design conditions exceeds the 20% guidance. As such, the energy savings qualify the project as categorically eligible.

Tertiary Filtration

The second Selected Alternative, *WWTP-D-3 – Installation of Disc Filters*, upgrades the inefficient multimedia gravity filters to more efficient fabric disc filters. The existing filtration system was designed to handle average influent flows of 2.5 MGD and peak flows up to 4.0 MGD; however the existing system is not currently achieving these loading rates. The City evaluated optimizing the existing filter system and also replacing the existing system with a more efficient technology.

The Recommended Alternative includes replacement of the existing multimedia (gravel/sand/anthracite) gravity filters with fabric disc filters, a newer, more efficient filter technology. The proposed disc filters have a much lower headloss than the existing filters, allowing for much smaller filter pump motors. The new filter feed pump motors will also be more efficient than the existing pump motors. In addition, because the proposed filters require less backwash water, the 30 hp backwash pumps would be replaced with 7.5 hp pumps.

The annual electrical usage for the existing tertiary filtration process is estimated at 258,455 kWh. Table 1 presents the motor loads, approximate runtimes, and electrical usage for the existing tertiary filters.

Table 1 - Electrical Usage Estimate, Existing Process

	Motor (hp)	No. of Motors	Total Motor (hp)	Est. BHP	Motor Efficiency	Est. Runtime (hrs/day)	Est. Runtime (hrs/yr)	Elec. Usage (kWh/yr)	Annual Cost ($/yr)
Air wash blowers	20	2	40	20	85%	0.8	292	5,119	$ 512
Filter feed pumps (C, C)	40	2	80	66	85%	12	3942	228,033	$ 22,803
Filter feed pump (D)	30	1	30	25	85%	8	2602	57,008	$ 5,701
Backwash feed pumps	30	2	60	30	85%	1.3	487	12,796	$ 1,280
Backwash return pumps	2	1	2	2	85%	1.3	487	853	$ 85
TOTAL								**303,810**	**$ 30,381**

The annual electrical usage for the proposed disc filter process is estimated at 193,222 kWh. Table 2 presents the motor loads, approximate runtimes, and electrical usage for the proposed filtration process.

Table 2 - Electrical Usage Estimate, Proposed Process

	Motor (hp)	No. of Motors	Total Motor (hp)	Est. BHP	Motor Efficiency	Est. Runtime (hrs/day)	Est. Runtime (hrs/yr)	Elec. Usage (kWh/yr)	Annual Cost ($/yr)
Filter feed pumps	25	2	50	46	88%	12	4380	169,088	$ 16,909
Backwash feed pumps	7.5	2	15	15	88%	0.41	149	1,886	$ 189
Filter drive	3	1	3	3	88%	24	8760	22,248	$ 2,225
TOTAL								**193,222**	**$ 19,322**

The difference in the electrical usage between the existing filtration process and the proposed filtration process is 110,588 kW-h per year, or approximately 36%.

In addition to the electrical savings, the proposed filters offer an additional environmental benefit. The backwash water required will be reduced by 94%. The existing filters must be backwashed at a rate of 15 gallons per minute per square foot of filter media surface area. The filters are backwashed at a frequency dependent on the loading and solids content, but typically averaging twice per day for 10 minutes. This equates to approximately 98 million gallons per year or 19% of the influent flow rate. The proposed filters utilize approximately 1% of the influent flow rate for backwashing. This backwash water reduction significantly reduces the amount of backwash water routed back through the WWTP for additional treatment.

CONCLUSION

Significant energy and cost savings can be realized by converting the secondary treatment process into a fine bubble activated sludge process and installing new, higher efficiency, variable speed aeration blowers. The pre-design budgetary cost estimate of the improvements to the secondary treatment facilities is $1,309,050, most of which should qualify for GPR principal forgiveness.

Similarly, the proposed disc filter system would substantially reduce the electrical usage due to smaller and more efficient filter feed pump and backwash pump motors, and elimination of the air wash blowers. In addition, the proposed filter system requires only a small fraction of the backwash water compared to the water volume necessary for the existing system. The pre-design budgetary cost estimate for the tertiary filter improvements is $554,800, all of which should qualify for GPR principal forgiveness.

Dowagiac SRF Project Plan
Summary of GPR Components
Alternative WWTP-C-2
Revised November 19, 2013

Item No.	Description	Est. Qty	Unit	Unit Price	Amount	GPR Components
1	Mobilization, Bonds & Insurance	1	ls	$ 80,000	$ 80,000	$ -
2	High efficiency aeration blowers	3	ea	$ 55,000	$ 165,000	$ 165,000
3	Fine bubble diffusers	810	ea	$ 155	$ 125,550	$ 125,550
4	Exterior aeration piping	1	ls	$ 45,000	$ 45,000	$ 45,000
5	Interior blower piping & ducts	1	ls	$ 8,000	$ 8,000	$ 8,000
6	Demolition of defunct polymer system	1	ls	$ 1,500	$ 1,500	$ -
7	Demolition of existing blowers & air piping	1	ls	$ 2,500	$ 2,500	$ -
8	Replace existing air flow meters	3	ea	$ 2,500	$ 7,500	$ 7,500
9	New WAS/RAS piping	1	ls	$ 5,500	$ 5,500	$ -
10	New WAS/RAS pumps & VFDs	2	ea	$ 7,500	$ 15,000	$ 11,250
11	D.O. analyzers & blower controls	3	ea	$ 25,000	$ 75,000	$ 75,000
12	Electrical & controls	1	ls	$ 85,000	$ 85,000	$ 85,000
13	Blower Building improvements	1	ls	$ 8,500	$ 8,500	$ -
14	Ferric chloride feed pumps & controls	2	ea	$ 2,800	$ 5,600	$ -
15	Aeration tank repairs	3	ea	$ 8,000	$ 24,000	$ -
16	Aeration tank fiberglass weirs	110	ft	$ 80	$ 8,800	$ -
17	Final clarifier baffles, drives, weirs	2	ea	$ 143,750	$ 287,500	$ -
18	Final clarifier tank repairs	2	ea	$ 7,500	$ 15,000	$ -
				Subtotal	**$ 964,950**	**$ 522,300**
				Contingencies @ 15.0%	$ 144,700	$ 78,300
				Total Construction Cost	**$ 1,109,650**	**$ 600,600**
				Design Engineering Services @ 9.0%	$ 99,800	$ 54,100
				Construction Engineering Services @ 6.0%	$ 66,600	$ 36,000
				Administrative & Legal @ 3.0%	$ 33,300	$ -
				Total Project Cost	**$ 1,309,350**	**$ 690,700**

Dowagiac SRF Project Plan
Summary of GPR Components
Alternative WWTP-D-3
Revised November 19, 2013

Item No.	Description	Est. Qty	Unit	Unit Price	Amount	GPR Components
1	Mobilization, Bonds & Insurance	1	ls	$ 35,000	$ 35,000	$ -
2	Filter Piping Improvements	1	ea	$ 12,000	$ 12,000	$ -
3	Valve Replacement	4	ea	$ 2,500	$ 10,000	$ -
4	Replacement of filter feed pumps & VFDs	4	ls	$ 12,000	$ 48,000	$ 36,000
5	Demolition of existing feed pumps & piping	1	ls	$ 3,500	$ 3,500	$ -
6	Electrical & controls	1	ls	$ 10,000	$ 10,000	$ -
7	Filter Building improvements	1	ls	$ 8,500	$ 8,500	$ -
8	Cloth discfilter	2	ea	$ 140,950	$ 281,900	$ 281,900
				Subtotal	**$ 408,900**	**$ 317,900**
				Contingencies @ 15.0%	$ 61,300	$ 47,700
				Total Construction Cost	**$ 470,200**	**$ 365,600**
				Design Engineering Services @ 9.0%	$ 42,300	$ 32,900
				Construction Engineering Services @ 6.0%	$ 28,200	$ 21,900
				Administrative & Legal @ 3.0%	$ 14,100	$ -
				Total Project Cost	**$ 554,800**	**$ 420,400**