CH2M HILL
135 S. 84th Street
Suite 400
Milwaukee, WI
53214
Tel 414.272.2426
Fax 414.272.4408

RECEIVED
MAR 03 2014
DNR BUREAU OF COMMUNITY
FINANCIAL ASSISTANCE

February 27, 2014

Maureen Hubeler
Bureau of Community Financial Assistance
Wisconsin Department of Natural Resources
P.O. Box 7921
101 S. Webster Street
Madison, WI 53707

Subject: City of Oshkosh Wastewater Treatment Plant Control System, Influent Pumping & Aeration Blowers Upgrade Project, CWFP No. 4130-14
Financial Assistance Application Green Project Reserve

Dear Ms Hubeler:

Last week the City of Oshkosh submitted its CWFP Financial Assistance Application for the subject project. The Green Project Reserve Form and supporting documentation was not submitted with the Application and is enclosed in for your records.

Please contact me at (414) 847-0205 or Linda.Mohr@CH2M.com if you have any questions about this submission.

Sincerely,
CH2M HILL

Linda Mohr

Linda Mohr, P.E.
Project Manager

cc: Steve Brand, City of Oshkosh
Kevin Sorge, City of Oshkosh
Ed Nokes, City of Oshkosh
Tara Wendt, City of Oshkosh
David Patek, City of Oshkosh
Mark Stanek, Wisconsin Department of Natural Resources

State of Wisconsin
Department of Natural Resources
Bureau of Community Financial Assistance – CF/2
101 S. Webster St., P.O. Box 7921
Madison, WI 53707-7921
Phone No. (608) 266-7555, FAX (608) 267-0496

RECEIVED
MAR 03 2014
DNR BUREAU OF COMMUNITY FINANCIAL ASSISTANCE

Applicants must complete and submit this form for each Clean Water Fund Program (CWFP) and Safe Drinking Water Loan Program (SDWLP) project for which they submit a Financial Assistance Application.

Municipality		EIF Project No.
City of Oshkosh	☒ CWFP ☐ SDWLP	4130-14

Does this project include any "green" elements as described below?

☒ YES (If yes, complete and return page 1 **and** appropriate page(s) with green category information)

☐ NO (If no, complete and return only page 1)

Name and Title of Person Completing This Form (Type or Print)	Phone No.	Email Address
Linda Mohr	414-847-0205	lmohr@ch2m.com
Signature of Person Completing This Form Linda Mohr		Date Signed 02/27/2014

Green projects fall into four separate categories: green infrastructure, water efficiency, energy efficiency, and environmentally innovative projects. Please read the definitions below and refer to the guidance document ***Green Project Reserve: Guidance for Determining Project Eligibility***, dated April 21, 2010, (available on the web at http://dnr.wi.gov/org/caer/cfa/EL/Section/news.html). This document explains the types of projects eligible for funding under the Green Project Reserve and details which types of projects are considered categorically eligible and which types of projects require a business case. **Applicants must submit all required business cases prior to loan closing.** DNR is required to post the business cases on the web.

When completing this form, include only those costs you intend to request from the Environmental Improvement Fund.

SUMMARY OF GREEN PROJECT RESERVE COSTS

GREEN CATEGORY	EIF-FUNDED GREEN PROJECT COSTS
Green Infrastructure	$
Water Efficiency	$
Energy Efficiency	$ 2,447,000
Environmentally Innovative	$
TOTAL	$ 2,447,000

FOR DNR USE ONLY	
Signature of GPR Specialist Becky Scott	Date Review Completed 3/20/14

Energy Efficiency definition: Energy Efficiency projects include the use of improved technologies and practices to reduce the energy consumption of water quality projects, use energy in a more efficient way, and/or produce/utilize renewable energy.

This project is categorically an Energy Efficiency project Yes

Indicate Categorical Project number from *GPR: Guidance for Determining Project Eligibility* and estimated cost (i.e. 3.2-3 for $175,000):

Categorical Project Number: 3.2-~~3~~2 Estimated Cost: $ 547,000

Categorical Project Number: _____ Estimated Cost: $_____

Other: _____ Estimated Cost: $_____

Or

This project requires a business case ___

Indicate Business Case Project number from *GPR: Guidance for Determining Project Eligibility* and estimated cost (i.e. 3.5-1 for $23,000):

Business Case Project Number: 3.5-1, -6 Estimated Cost: $ 1,900,000

Business Case Project Number: _____ Estimated Cost: $_____

Other: _____ Estimated Cost: $_____

The **TOTAL** estimated cost of this Energy Efficiency project or project components $ 2, 447,000

Please provide a **detailed** description of your Energy Efficiency project or project components below. Please include any pertinent calculations of energy savings in both kilowatt hours and percentage of overall energy usage. Attach a separate sheet if necessary.

See attached technical memorandum

Clean Water Fund Program Project #4130-14 Parallel Cost Estimate

PREPARED FOR:	Wisconsin Department of Natural Resources
COPY TO:	City of Oshkosh
PREPARED BY:	CH2M HILL
DATE:	February 16, 2014
PROJECT NUMBER:	481462.02.21.57

Purpose

The purpose of this technical memorandum is to provide a detailed description of the Energy Efficiency components of the City of Oshkosh (City) Wastewater Treatment Plant (WWTP) Control System, Influent Pumping, and Aeration Blower Upgrade Project, Clean Water Fund Program (CWFP) Project #4130-14, as defined by *Green Project Reserve: Guidance for Determining Project Eligibility* (U.S. Environmental Protection Agency [USEPA] 2010).

The primary sources of information for this technical memorandum are located in Appendix A—100 percent construction cost estimate and Appendix B—*Wastewater Treatment Plant Control System, Influent Pumping & Aeration Blower Upgrade Project Engineer's Report* (CH2M HILL, 2013).

Project Background

The WWTP Control System, Influent Pumping, and Aeration Blower Upgrade Project (Project) is being implemented to address the WWTP control system communication network deficiencies, improve operational reliability, and reduce the energy used for aeration and influent pumping.

The Project includes replacement of equipment that is at or near the end of its useful life, replacement of old equipment that is no longer supported by its manufacturer, and replacement of old equipment with similar equipment that can be operated with lower energy costs. The aeration blowers and the influent pumps use energy in a more efficient way.

Aeration Blowers

The aeration basins blower system consists of five constant-speed, 300-horsepower (hp), multistage, constant speed centrifugal blowers; associated valves; piping; and instrumentation and controls. The blowers have a capacity of 5,000 standard cubic feet per minute (scfm) each. Four of the blowers were installed in 1989, the fifth in 1995. Blower output is adjusted to match treatment process demand with modulating inlet butterfly valves and a 20-year-old control system. The blowers are energy-intensive, and there are opportunities to reduce energy and operating costs by improving the aeration blowers' control system and changing the type, size, or number of blowers in service.

To improve the operating efficiency of the aeration system, the City is replacing two of the five 5,000-scfm blowers with two, 5,000-scfm high-speed turbo blowers with adjustable frequency drives. The economic analysis that supported this decision is comprehensively documented in the Engineers Report and summarized in Table 1.

TABLE 1
Present Worth and Payback Analyses of HSI High Speed Turbo Blowers

	Existing Blower					
Flow Condition	Avg. Total Aeration Air Required (scfm)	Existing Blower Approx. scfm/kW at this flow	Existing Blower Average kW	Existing Blower Annual kWh	Annual Cost at Current Avg. Electric Cost[c]	Annual Cost at Estimated Avg. Electric Cost[d]
Initial average[a]	4,600	18.3	251	2,201,967	$121,108	$159,441
Midpoint between initial and 20-year design	5,250	17.4	302	2,647,668	$145,622	$191,713
20-year design average[a, b]	5,900	17.6	335	2,936,591	$161,513	$212,633

	New HST Blower					
Flow Condition	Average Total Aeration Air Required (scfm)	New HST Blower Approx. scfm/kW at this flow	New HST Blower Avg. kW	New Blower Annual kWh	Annual Cost at Current Avg. Electric Cost[c]	Annual Cost at Estimated Avg. Electric Cost[d]
Initial average[a]	4,600	30.2	152	1,333,282	$73,331	$96,541
Midpoint of initial and design	5,250	29.5	178	1,559,205	$85,756	$112,899
20-year design average[a, b]	5,900	28.4	208	1,822,513	$100,238	$131,965

	Annual and 20-Year Present Worth Savings of Electricity with Two New HST Blowers			
Flow Condition	Annual Savings at Current Average Electric Cost[c]	Annual Savings at Estimated Average Electric Cost[d]	20-yr Present Worth of Electrical Savings at Current Average Electric Cost[c]	20-yr Present Worth of Electrical Savings at Estimated Average Electric Cost[d]
Initial average[a]	$47,778	$62,900	$851,419	$1,120,905
Midpoint of initial and design	$59,865	$78,814	$1,066,830	$1,404,496
20-year design average[a, b]	$61,274	$80,668	$1,091,935	$1,437,548

	Capital Cost of Two New HST Blowers		
	New HST Equipment Cost Per 6,400 scfm Blower	New HST Equipment Cost For Two New HST Blowers	Estimated HST Equipment Installed Cost
Cost	$119,500	$239,000	$526,652

	20-Year Present Worth and Payback with Two New HST Blowers			
	20-yr total Present Worth at Current Average Electric Cost[c]	20-yr Total Present Worth at Estimated Average Electric Cost[d]	Payback v. Existing at $0.055/kWh (yr)	Payback v. Existing at $0.072/kWh (yr)
Initial average[a]	$324,767	$594,253	**11.8**	**8.8**
Midpoint of initial and design	$540,178	$877,844	**9.3**	**7**

Note: Wisconsin Department of Natural Resources discount rate: 4.125 percent; inflation rate: 3 percent

[a] Estimated using 2010 through September 2011 average influent basis of design (BOD), total suspended solids (TSS), and ammonia loads in combination with diurnal variation October 10 to 24, 2011.

[b] Based on 2010 through September 2011 influent BOD, TSS, and ammonia loads escalated 22 percent. The 22 percent was calculated using 1.327 millions of gallons per day (mgd) additional average residential plus 1.55 mgd additional commercial/industrial for a total additional flow of 2.877 mgd according to East Central Wisconsin Regional Planning Commission (ECWRPC) Table 4, Year 2030 Flow Projections, which corresponds to a 22 percent increase.

[c] Current average electricity cost is in dollars per kilowatt hours ($/kWh): $0.055

[d] Electricity cost escalated 8 percent for expected rate increase next year per Wisconsin Public Service (WPS) due to air regulations and then at 2 percent above inflation rate to midpoint of 20-year planning period for approx. 20-year average ($/kWh): $0.072

The Green Project Reserve statistics are as follows:

- Estimated annual energy savings, 20-year design average, are 1,114,078 kilowatt hours (kWh)
- Energy savings of 37 percent over current blower energy usage
- Estimated construction cost of the new blower installation is $547,000

Influent Raw Sewage Pumping

The existing raw sewage influent pump station consists of five, 25-million gallon per day (mgd) pumps. Four of the pumps were installed in 1973 and one pump in 1994. The 1994 pump was retrofit with an adjustable frequency drive (AFD) in 2008. Two of the 1973 pumps have 4,160-volt constant-speed motors and two have 4,160-volt motors with adjustable speed drives (ASDs), eddy current type for variable flow. Table 2 summarizes this pump information and the nominal efficiency.

TABLE 2
Oshkosh WWTP Influent Pumps

Pump	Drive Type	Drive Nominal Full Load Efficiency (%)	Motor Voltage (volts)
1V-A201P	ASD magnetic	96	4,160
2V-A203P	ASD magnetic	96	4,160
3V-A205P	AFD	96	480
1C-A204P	None	NA	4,160
2C-A206P	None	NA	4,160

Notes:
Pumps are ITT, model 24 MNV, 25.2-mgd, 86 percent efficient, 300-hp, 52-foot head, 600 RPM; installed in 1973

ASD magnetic: Ampli Speed (eddy current type)

AFD: Rockwell Automation KHSM 12-R

Average daily influent flow ranges from 10 to 15 mgd. Consequently, during normal operation, the City operates one 25-mgd pump. Most the time, the City operates the 1994 pump with the AFD because it can be controlled to match average flow conditions. During wet weather events, the City may operate all five pumps. With all five pumps in service, the peak output of the pump station is roughly 115 mgd.

During normal operating conditions, one of the new 15-mgd pumps will be operated. To improve pumping system efficiency, the City is replacing one 25-mgd pump with a new 15-mgd pump and replacing the motors on the other four existing pumps. With two 15-mgd pumps, the City has greater redundancy under average flow conditions. In addition, all pump motors will be equipped with new AFDs. Replacing constant speed and eddy current drives with AFDs allows the City to allocate pump run hours more uniformly across all pumping units. Replacing the existing 4,160-volt electrical service with 480-volt service allows the City to standardize voltage across the WWTP and utilize more readily available electrical equipment.

Influent Pumping Energy Use Evaluation

The potential energy savings associated with replacing the existing magnetic driven pumps (Pump 1V-A201P and 2V-A203P) with variable frequency drives (VFDs) was investigated. With the pumps running at the duty point of 25 mgd and full speed, the efficiencies of the magnetic drive and the VFD are the same. When operating a full speed, VFDs don't offer much energy savings over the existing eddy-current magnetic drive pumps. However, as the load decreases, the magnetic drive is less efficient than a VFD and VFDs offer greater energy efficiency.

Review of the WWTP electrical billing information from 2009 and 2010, indicates the average electrical rate was $0.055 per kWh. An escalation cost of $0.72 per kWh is used for the evaluation. This is equivalent to

approximately $1.30 per day per hp. At an average flow of 12 mgd, the magnetic drive efficiency drops to approximately 80 percent and consumes 20 hp more compared to the VFD, which is still at a nominal 96 percent efficiency. The energy cost for the magnetic drive loss is approximately $10,000 per year. With only one pump normally running at reduced load, potential energy savings are limited and alone do not justify the purchase of new equipment.

The evaluation of the energy use for influent pumping revealed the City is operating its 25-mgd pump with the AFD as much as possible. For an average daily influent flow of 13 mgd, the difference between operating a 25-mgd pump with an AFD and a 15-mgd pump with an AFD is roughly 10 hp, or 7.5 kW.

The Green Project Reserve statistics are as follows:

- Four pre-Energy Policy Action of 1992, 300-hp motors will be replaced
- Estimated annual energy savings are 10,800 kWh
- Energy savings of 7 percent over current influent pumping energy usage
- Estimated construction cost of influent pumping upgrades is $1,900,000