Ohio | Public Utilities Commission

Application to Commit Energy Efficiency/Peak Demand Reduction Programs (Mercantile Customers Only)

Case No.: 14-937-EL-EEC

Mercantile Customer: **MSDGC Metropolitan Sewer District of Greater Cincinnati**

Electric Utility: **Duke Energy**

Program Title or Description: **Blower Control Upgrades at Little Miami and Muddy Creek**

Rule 4901:1-39-05(F), Ohio Administrative Code (O.A.C.), permits a mercantile customer to file, either individually or jointly with an electric utility, an application to commit the customer's existing demand reduction, demand response, and energy efficiency programs for integration with the electric utility's programs. The following application form is to be used by mercantile customers, either individually or jointly with their electric utility, to apply for commitment of such programs in accordance with the Commission's pilot program established in Case No. 10-834-EL-POR

Completed applications requesting the cash rebate reasonable arrangement option (Option 1) in lieu of an exemption from the electric utility's energy efficiency and demand reduction (EEDR) rider will be automatically approved on the sixty-first calendar day after filing, unless the Commission, or an attorney examiner, suspends or denies the application prior to that time. Completed applications requesting the exemption from the EEDR rider (Option 2) will also qualify for the 60-day automatic approval so long as the exemption period does not exceed 24 months. Rider exemptions for periods of more than 24 months will be reviewed by the Commission Staff and are only approved up the issuance of a Commission order.

Complete a separate application for each customer program. Projects undertaken by a customer as a single program at a single location or at various locations within the same service territory should be submitted together as a single program filing, when possible. Check all boxes that are applicable to your program. For each box checked, be sure to complete all subparts of the question, and provide all requested additional information. Submittal of incomplete applications may result in a suspension of the automatic approval process or denial of the application.

Any confidential or trade secret information may be submitted to Staff on disc or via email at ee-pdr@puc.state.oh.us.

Section 1: Mercantile Customer Information

Name: **MSDGC Metropolitan Sewer District of Greater Cincinnati**

Principal address: **1600 Gest Street, Cincinnati, Ohio 45204**

Address of facility for which this energy efficiency program applies:

6125 River Road , Cincinnati, Ohio 45233

225 Wilmer Ave. Cincinnati, Ohio 45226

Name and telephone number for responses to questions:

Megan Fox, (5153)287-3367

Electricity use by the customer (check the box(es) that apply):

- ✓ The customer uses more than seven hundred thousand kilowatt hours per year at the above facility. (**Refer to Appendix A for documentation**.)
- □ The customer is part of a national account involving multiple facilities in one or more states. (Please attach documentation.)

Section 2: Application Information

A) The customer is filing this application (choose which applies):

- □ Individually, without electric utility participation.
- ✓ **Jointly with the electric utility.**

B) The electric utility is: **Duke Energy**

C) The customer is offering to commit (check any that apply):

- □ Energy savings from the customer's energy efficiency program. (Complete Sections 3, 5, 6, and 7.)
- □ Capacity savings from the customer's demand response/demand reduction program. (Complete Sections 4, 5, 6, and 7.)
- ✓ **Both the energy savings and the capacity savings from the customer's energy efficiency program. (Complete all sections of the Application.)**

Section 3: Energy Efficiency Programs

A) The customer's energy efficiency program involves (check those that apply):

✓ Early replacement of fully functioning equipment with new equipment. (Provide the date on which the customer replaced fully functioning equipment, and the date on which the customer would have replaced such equipment if it had not been replaced early. Please include a brief explanation for how the customer determined this future replacement date (or, if not known, please explain why this is not known)).

Customer completed replacement of existing process air blower at two treatment plants with high efficiency blowers. One of the plants also had the diffusers replaced with high efficiency air diffusers also. Muddy Creek was completed in April 2012. Little Miami was completed in April 2013.

□ Installation of new equipment to replace equipment that needed to be replaced The customer installed new equipment on the following date(s): _____.

□ Installation of new equipment for new construction or facility expansion. The customer installed new equipment on the following date(s): _____.

□ Behavioral or operational improvement.

B) Energy savings achieved/to be achieved by the energy efficiency program:

1) If you checked the box indicating that the project involves the early replacement of fully functioning equipment replaced with new equipment, then calculate the annual savings [(kWh used by the original equipment) – (kWh used by new equipment) = (kWh per year saved)]. Please attach your calculations and record the results below:

Annual savings: 4,095,931 kWh
Refer to Appendix B for calculations and supporting document

2) If you checked the box indicating that the customer installed new equipment to replace equipment that needed to be replaced, then calculate the annual savings [(kWh used by less efficient new equipment) – (kWh used by the higher efficiency new equipment) = (kWh per year saved)]. Please attach your calculations and record the results below:

Annual savings: _____kWh

Please describe any less efficient new equipment that was rejected in favor of the more efficient new equipment.

3) If you checked the box indicating that the project involves equipment for new construction or facility expansion, then calculate the annual savings [(kWh used by less efficient new equipment) – (kWh used by higher efficiency new equipment) = (kWh per year saved)]. Please attach your calculations and record the results below:

Annual savings: _____kWh

Please describe the less efficient new equipment that was rejected in favor of the more efficient new equipment.

4) If you checked the box indicating that the project involves behavioral or operational improvements, provide a description of how the annual savings were determined.

Annual savings: _____kWh

Section 4: Demand Reduction/Demand Response Programs

A) The customer's program involves (check the one that applies):

✓ **Coincident peak-demand savings from the customer's energy efficiency program.**

□ Actual peak-demand reduction. (Attach a description and documentation of the peak-demand reduction.)

□ Potential peak-demand reduction (check the one that applies):

□ The customer's peak-demand reduction program meets the requirements to be counted as a capacity resource under a tariff of a regional transmission organization (RTO) approved by the Federal Energy Regulatory Commission.

□ The customer's peak-demand reduction program meets the requirements to be counted as a capacity resource under a program that is equivalent to an RTO program, which has been approved by the Public Utilities Commission of Ohio.

B) On what date did the customer initiate its demand reduction program?

Sample - The new equipment was installed in April 2012

C) What is the peak demand reduction achieved or capable of being achieved (show calculations through which this was determined):

467 kW
Refer to Appendix B for calculations and supporting documentation.

Section 5: Request for Cash Rebate Reasonable Arrangement (Option 1) or Exemption from Rider (Option 2)

Under this section, check the box that applies and fill in all blanks relating to that choice.

Note: If Option 2 is selected, the application will not qualify for the 60-day automatic approval. All applications, however, will be considered on a timely basis by the Commission.

A) The customer is applying for:

✓ **Option 1: A cash rebate reasonable arrangement.**

OR

□ Option 2: An exemption from the energy efficiency cost recovery mechanism implemented by the electric utility.

OR

□ Commitment payment

B) The value of the option that the customer is seeking is:

Option 1: A cash rebate reasonable arrangement, which is the lesser of (show both amounts):

✓ A cash rebate of **$133,000. Refer to Appendix C for documentation.** (Rebate shall not exceed 50% project cost.

Option 2: An exemption from payment of the electric utility's energy efficiency/peak demand reduction rider.

□ An exemption from payment of the electric utility's energy efficiency/peak demand reduction rider for ____ months (not to exceed 24 months). (Attach calculations showing how this time period was determined.)

OR

□ A commitment payment valued at no more than $_____. (Attach documentation and

calculations showing how this payment amount was determined.)

OR

□ Ongoing exemption from payment of the electric utility's energy efficiency/peak demand reduction rider for an initial period of 24 months because this program is part of the customer's ongoing efficiency program. (Attach documentation that establishes the ongoing nature of the program.) In order to continue the exemption beyond the initial 24 month period, the customer will need to provide a future application establishing additional energy savings and the continuance of the organization's energy efficiency program.)

Section 6: Cost Effectiveness

The program is cost effective because it has a benefit/cost ratio greater than 1 using the (choose which applies):

□ Total Resource Cost (TRC) Test. The calculated TRC value is: _____ (Continue to Subsection 1, then skip Subsection 2)

✓ Utility Cost Test (UCT) . The calculated UCT values were **12.77(Little Miami)** **12.75 (Muddy Creek)** (Skip to Subsection 2.) **Refer to Appendix D for calculations and supporting documents.**

Subsection 1: TRC Test Used (please fill in all blanks).

The TRC value of the program is calculated by dividing the value of our avoided supply costs (generation capacity, energy, and any transmission or distribution) by the sum of our program overhead and installation costs and any incremental measure costs paid by either the customer or the electric utility.

The electric utility's avoided supply costs were _____.

Our program costs were _____.

The incremental measure costs were _____.

Subsection 2: UCT Used (please fill in all blanks).

We calculated the UCT value of our program by dividing the value of our avoided supply costs (capacity and energy) by the costs to our electric utility (including administrative costs and incentives paid or rider exemption costs) to obtain our commitment.

Our avoided supply costs were **$4,078,404.**

The utility's program costs were **$186,818.**

The utility's incentive costs/rebate costs were **$133,000.**

Refer to Appendix D for calculations and supporting documents.

Section 7: Additional Information

Please attach the following supporting documentation to this application:

Narrative description of the program including, but not limited to, make, model, and year of any installed and replaced equipment.

A copy of the formal declaration or agreement that commits the program or measure to the electric utility, including:

1) any confidentiality requirements associated with the agreement;
2) a description of any consequences of noncompliance with the terms of the commitment;
3) a description of coordination requirements between the customer and the electric utility with regard to peak demand reduction;
4) permission by the customer to the electric utility and Commission staff and consultants to measure and verify energy savings and/or peak-demand reductions resulting from your program; and,
5) a commitment by the customer to provide an annual report on your energy savings and electric utility peak-demand reductions achieved.

Refer to Offer Letter following this application

A description of all methodologies, protocols, and practices used or proposed to be used in measuring and verifying program results. Additionally, identify and explain all deviations from any program measurement and verification guidelines that may be published by the Commission.

Ohio | Public Utilities Commission

Application to Commit Energy Efficiency/Peak Demand Reduction Programs (Mercantile Customers Only)

Case No.: ____-____-EL-EEC 14-937-EL-EEC

State of OHIO :

DAVID CASTELLINI, Affiant, being duly sworn according to law, deposes and says that:

1. I am the duly authorized representative of:

   METROPOLITAN SEWER DISTRICT OF GREATER CINCINNATI

   [insert customer or EDU company name and any applicable name(s) doing business as]

2. I have personally examined all the information contained in the foregoing application, including any exhibits and attachments. Based upon my examination and inquiry of those persons immediately responsible for obtaining the information contained in the application, I believe that the information is true, accurate and complete.

3. I am aware of fines and penalties which may be imposed under Ohio Revised Code Sections 2921.11, 2921.31, 4903.02, 4903.03, and 4903.99 for submitting false information.

David A Castelli

Signature of Affiant & Title

Sworn and subscribed before me this 14th day of May, 2014 Month/Year

Signature of official administering oath

CHARLES A. DICK

Print Name and Title

My commission expires on Oct 20, 2016

NOTARY PUBLIC STATE OF OHIO

CHARLES A. DICK
Notary Public, State of Ohio
My Commission Expires
October 20, 2016

Please indicate your response to this rebate offer within 30 days of receipt.

☒ Rebate is accepted. ☐ Rebate is declined.

By accepting this rebate, Jeff Dean affirms its intention to commit and integrate the energy efficiency projects listed on the following pages into Duke Energy's peak demand reduction, demand response and/or energy efficiency programs.

Additionally, Jeff Dean also agrees to serve as joint applicant in any future filings necessary to secure approval of this arrangement as required by PUCO and to comply with any information and reporting requirements imposed by rule or as part of that approval.

Finally, Jeff Dean affirms that all application information submitted to Duke Energy pursuant to this rebate offer is true and accurate. Information in question would include, but not be limited to, project scope, equipment specifications, equipment operational details, project costs, project completion dates, and the quantity of energy conservation measures installed.

If rebate is accepted, will you use the monies to fund future energy efficiency and/or demand reduction projects?

☒ YES ☐ NO

If rebate is declined, please indicate reason (optional):

DAVID A. CASTELLINI 4/14/2014

Customer Signature Printed Name Date

Proposed Rebate Amounts

Measure ID	Energy Conservation Measure (ECM)	Proposed Rebate Amount
ECM-1	Little Miami HE Blowers	$94,000
ECM-2	Muddy Creek HE Blowers	$39,000
Total		$133,000

52200740 01

METRO SEWER DIST-LMTP

225 WILMER

CINCINNATI, OH 45226

Date	Days	Actual KWH
12/20/2013	30	823315
11/20/2013	30	845381
10/21/2013	31	760373
9/20/2013	30	646569
8/21/2013	29	521880
7/23/2013	32	635634
6/21/2013	30	677357
5/22/2013	29	420336
4/23/2013	32	352781
3/22/2013	29	569074
2/21/2013	9	139478
1/23/2013	34	578477
12/20/2012	31	472123
11/19/2012	31	449837
10/19/2012	29	717,408
9/20/2012	30	977,434
8/21/2012	29	734,247
7/23/2012	32	748,057
6/21/2012	30	629,160
5/22/2012	29	982,565
4/23/2012	32	1,057,018
3/22/2012	29	1,253,328
2/22/2012	29	1,506,172
1/24/2012	34	932,035
12/21/2011	30	985,579
11/21/2011	31	566,808
Total		**11,089,811**

Appendix B - Metro Sewer Dist Energy Savings Achieved

	Baseline Used			Post Project Actual				Savings	
	Description	Annual kWh	Summer Coincident kW	Description	Annual kWh	Summer Coincident kW	Hours of Operation	Annual kWh	Summer Coincident kW
ECM - 1	Manual controls on blowers at Little Miami	4,762,457	544	Installed controls on blowers to automate needed inflow	2,050,675	234	8,760	2,711,782	309.6
ECM - 2	course bubble diffusers and manual controls on blowers at Muddy Creek	2,251,533	271	Installed controls on blowers to automate needed inflow as well as replaced diffusers to fine bubble diffusers	1,129,932	129	8,500	1,121,601	142.3

Notes: Energy consumption baseline, demand baseline and post project energy consumption basis are outlined in the following pages.

After consideration of line losses, total energy savings are **4,095,931 kWh** and **467 summer coincident kW**. These values may also reflect minor DSMore modeling software rounding error.

Appendix C -Cash Rebate Calculation

Metropolitan Sewer District Blowers (2 locations)

Measure	Quantity	Cash Rebate Rate	Cash Rebate
OH_ SD Custom - MSDGC - Little Miami HE Blowers	1	50% of incentive that would be offered by the Smart $aver Custom program	$ 94,000
OH_ SD Custom - MSDGC - Muddy Creek HE Blowers	1	50% of incentive that would be offered by the Smart $aver Custom program	$ 39,000
			$133,000

Appendix D -UCT Value

Metro Sewer Dist Blowers (2 locations)

Measure	Total Avoided Cost	Program Cost	Incentive	Quantity	Measure UCT
OH_ SD Custom - MSDGC - Little Miami HE Blowers	**2,885,112.77**	**$ 132,157.08**	**$ 94,000.00**	**1**	**12.77**
OH_ SD Custom - MSDGC - Muddy Creek HE Blowers	$1,193,291	$54,661	$39,000	1	**12.75**
Totals	**$4,078,404**	**$186,818**	**$133,000**	**2**	

Total Avoided Supply Costs	$4,078,404	***Aggregate Application UCT***	***12.75***
Total Program Costs	$186,818		
Total Incentive	$133,000		

Mercantile Self Direct
Nonresidential Custom Rebate Application
PART 1

Ohio Mercantile Self Direct Program

Application Guide & Cover Sheet

Questions? Call 1-866-380-9580 or visit www.duke-energy.com.

Email this form along with completed Mercantile Self Direct Prescriptive or Custom applications, proof of payment, energy savings calculations and spec sheets to SelfDirect@Duke-Energy.com. You may also fax to 1-513-629-5572.

Mercantile customers, defined as using at least 700,000 kWh annually or having an account in multiple locations are eligible for the Mercantile Self Direct program. Indicate which applies:

- [x] a single Duke Energy Ohio account with 700,000 kWh annual usage
- [ ] an account with multiple locations

Please list Duke Energy account numbers below (attach listing of multiple accounts and/or billing history for other utilities as required):

Account Number	Annual Usage	Account Number	Annual Usage
4540-0682	4,600,000 Kw/hr	5220-0740	19,600,000 Kw/hr

Self Direct rebates are available for completed Custom projects that have not previously received a Duke Energy Smart $aver® Custom Incentive. Self Direct rebates are applicable to Prescriptive measures that were installed more than 90 days prior to submission to Duke Energy and have not previously received a Duke Energy Prescriptive rebate.

Self Direct Program rules allow for, though do not require, certain projects that are Prescriptive in nature under the Smart $aver program to be evaluated using the Custom process in the Self Direct program. Use the list on page two as a guide to determine which Self Direct program best fits your project(s). Apply for Self Direct projects using the appropriate application forms in conjunction with this cover sheet.

Self Direct Program rules also allow for behaviorally based and/or no cost and low cost projects to receive rebates.

Please check each box to indicate completion/inclusion of the following program requirements:

[x] All sections of appropriate application(s) are completed	[x] Proof of payment.*	[x] Manufacturer's Spec sheets	[x] Energy model/calculations and detailed inputs for Custom applications

*If a single payment record is intended to demonstrate the costs of both Prescriptive & Custom projects, please include an additional document with an estimated breakout of costs for each Prescriptive and Custom energy conservation measure.

**Behavioral energy efficiency and demand reduction projects must be both measurable and verifiable. Provide justification with your application. Rebates for such projects may be small in magnitude.

Mercantile Self Direct
Nonresidential Custom Rebate Application
PART 1

DUKE ENERGY

1. Contact Information (Required)

Duke Energy Customer Contact Information					
Company Name	MSDGC METROPOLITAN SEWER DISTRICT OF GREATER CINCINNATI				
Address	1600 WEST STREET				
City	CINCINNATI	State	OHIO	Zip Code	45204
Project Contact	JEFF DEAN				
Title	SENIOR ENGINEER				
Office Phone	244-1364(513)	Mobile Phone		Fax	
E-mail Address	JEFFREY.DEAN@CINCINNATI-OH.GOV				

Equipment Vendor / Contractor / Architect / Engineer Contact Information					
Company Name	BROWN AND CALDWELL				
Address	144 MERCHANT ST. SUITE 225				
City	CINCINNATI	State	OHIO	Zip Code	45246
Project Contact	☒ Mr. ☐ Ms	BRIAN MUMY			
Title	PROJECT ENGINEER				
Office Phone	513-719-6100	Mobile Phone		Fax	
E-mail Address	BMUMY@BRWNCALD.COM				

Who is the primary point of contact for technical questions?[1]	BRIAN MUMY

Payment Information	
If an incentive is awarded, who should receive payment?[2] ☒ Customer ☐ Vendor (Customer must sign below)	
I hereby authorize payment of incentive directly to the vendor: Customer Signature [signature] Date 12/12/2013 (mm/dd/yyyy)	
Tax ID Number for Payee Provide W-9 for Payee	316000064

[1] Note that if the vendor is the primary point of contact, the customer will still be copied on all application correspondence. If the customer does not wish to be copied, the customer must provide a signed waiver indicating an entity acting as agent for the customer. Duke Energy does not act as agent.
[2] If payment is to be made to an entity other than the Duke Energy account holder or the vendor, a payment waiver is required and will be provided for customer signature.

Mercantile Self Direct
Nonresidential Custom Rebate Application
PART 1

DUKE ENERGY.

2. Project Information (Required)

A. Please indicate project type:
- ☐ New Construction
- ☐ Expansion at an existing facility (existing Duke Energy account number)
- ☐ Replacing equipment due to equipment failure
- ☒ Replacing equipment that is estimated to have remaining useful life of 2 years or less
- ☐ Replacing equipment that is estimated to have remaining useful life of more than 2 years
- ☐ Behavioral, operational and/or procedural programs/projects

B. Please describe your project, or attach a detailed project description that describes the project. REPLACEMENT OF EXISTING PROCESS AIR BLOWER AT TWO WW TREATMENTS WITH HIGH EFFICIENCY BLOWERS. ONE OF THE PLANTS ALSO HAD THE DIFFUSORS REPLACED WITH HIGHER EFFICIENT AIR DIFFUSORS AS WELL.

C. When did you start and complete implementation?

	Start date / (mm/yyyy)	End date / (mm/yyyy)
Muddy Creek	6/2010	4/2012
Lime Mini	10/2010	4/2013

D. Are you also applying for Self-Direct Prescriptive rebates and, if so, which one(s)[3]?

NO

E. Please indicate which worksheet(s) you are submitting for this application (check all that apply):
- ☐ Lighting
- ☐ Variable Frequency Drive (VFD)
- ☐ Compressed Air
- ☐ Energy Management System (EMS)
- ☒ General (for projects not easily submitted using one of the above worksheets)

F. List all assumptions about the baseline and proposed equipment energy use and operation schedule, or attach a document listing that information. Attach specification sheets for all proposed new equipment.

G. Attach a supplier or contractor estimate, engineer's cost estimate, and/or other equivalent information documenting the Implementation Cost for each project listed in your application. Does the Implementation Cost include any internal labor[4]? If yes, please specify which costs are internal labor.

3. Signature

[3] If your project involves some equipment that is eligible for prescriptive rebates and some equipment that is likely eligible for custom rebates, and if it is feasible to separate the equipment for the energy analysis, then the equipment will be evaluated separately. If it is not feasible to separate the equipment for analysis, then the equipment will be evaluated together in the custom application.
[4] Internal labor costs cannot be counted in the Incremental Project Cost for purposes of analysis.

Mercantile Self Direct
Nonresidential Custom Rebate Application
PART 1

DUKE ENERGY.

(Required – must be signed by Duke Energy customer)

Customer Consent to Release of Personal Information

I, (insert name) David Castrellini do hereby consent to Duke Energy disclosing my Duke Energy Ohio, Inc Account Number and Federal Tax ID Number to its subcontractors solely for the purpose of administering Duke Energy Ohio's Mercantile Self-Direct Program. I understand that such subcontractors are contractually bound to otherwise maintain my Duke Energy Ohio, Inc Account Number and Federal Tax ID Number in the strictest of confidence.

I realize that under the rules and regulations of the public utilities commission, I may refuse to allow Duke Energy Ohio, Inc to release the information set forth above. By my signature, I freely give Duke Energy Ohio, Inc permission to release the information designated above.

Application Signature

I certify that I meet the eligibility requirements of the Duke Energy Ohio, Inc Mercantile Self Direct Custom Rebates Program and that all information provided within this application is correct to the best of my knowledge. I agree to the terms and conditions set forth for this program. I certify that the numbers, energy savings, and responses shown on this form are correct. Further, I certify that the taxpayer identification number is current and correct. I am not subject to backup withholding because: (a) I am exempt from backup withholding; or (b) I have not been notified by the IRS that I am subject to backup withholding as a result of a failure to report all interest or dividends; or (c) the IRS has notified me that I am no longer subject to backup withholding. I am a U.S. citizen (includes a U.S. resident alien).

David A Castrellini

Duke Energy Ohio, Inc Customer Signature

Print Name David A. Castrellini

Date 12/22/2013

Checklist for completing the Application

INCOMPLETE APPLICATIONS WILL RESULT IN DELAYS IN DUKE ENERGY PROCESSING YOUR APPLICATION AND NOTIFYING YOU CONCERNING AY REBATES. Before submitting the application and the required supplementary information, use the following checklist to ensure that your application is complete and the information in the application is accurate. (Note: this checklist is for your use only – do not submit this checklist with your application)

Section No. & Title	Have You:
1. Contact Information	☐ Completed the contact information for the Duke Energy customer? ☐ Completed the contact information for the equipment vendor / project engineer that can answer questions about the technical aspects of the project, if that is a different person than above?
2. Project Information	☐ Answered the questions A-G, including providing a description of your project. ☐ Completed and attached the lighting, compressed air, VFD, EMS and/or General worksheet(s)? ☐ Attached a supplier or contractor estimate, engineer's cost estimate, and/or other equivalent information documenting the Implementation Cost for **each** project listed in your application? (Note: self-install costs cannot be included in the Implementation Cost)
3. Signature	☒ Signed your name? ☐ Printed your name? ☐ Entered the date?
Supplementary information (Required)	☒ (If submitting the General Worksheet) attached calculations documenting the energy usage and energy savings for **each** project listed in your application?

If you have any questions concerning how to complete any portion of the application or what supplementary information is required, please contact:

- your Duke Energy account manager
  or,
- the Duke Energy Self Direct team at 1-866-380-9580.

Submit your completed, signed application with attachments via email or fax:

Email: SelfDirect@duke-energy.com
Fax: 1-513-629-5572.

The General Worksheet is part 2 of the application. Do not submit this file without submitting a completed Part1 Custom Application document file, which can be found at www.duke-energy.com. This worksheet is for all projects that are not easily submitted through one of the other worksheets

Before you complete this application, please note the following important criteria:

- Submitting this application does not guarantee an rebate will be approved.
- Rebates already decided to proceed.
- Electric demand and/or energy reductions must be well documented with auditable calculations.
- Incomplete applications will not be reviewed; all fields are required.

Refer to the complete list of Instructions and Disclaimers, found in the Mercantile Self Direct Custom Application Part 1 document.

Please enter your information and data into the cells that are shaded.
Cells in white are locked and cannot be written over.

Duke Energy Customer Contact Information (Match the information in Application Part 1):

Name	Jeff Dean
Company	Metropolitan Sewer District

Equipment Vendor / Project Engineer Contact Information

Name	Brian Mumy
Company	Brown and Caldwell

Before proceeding with the custom application, please verify that your project is not on the Self-Direct Prescriptive application.
The prescriptive rebate applications can be found at:
http://www.duke-energy.com/ohio-large-business/smart-saver/mercantile-self-direct.asp
Prescriptive rebate amounts are pre-approved.

List of Sites (Required)

App No.	
Rev.	

Provide a list of sites addressed by this custom rebate application

Site ID (see note 1)	Duke Energy Electric Account Number(s) (see note 2)	Facility Address	List of Proposed Projects at each site	Annual Hours of Operation	Gross Square Footage	Conditioned Square Footage	Facility Age (years)
225	*12345678 01*	*Example: 123 Main Street, Anywhere USA 12345*	*Project Name(s)*	*5,840*	*42,000*	*38,000*	*12*
muctp	*4540-0682*	*6125 River Road , Cincinnati, Ohio 45233*	*blower upgrade*	*8,760*	*6,000*	*1,000*	*54*
lmtp	*5220-0740*	*225 Wilmer Av. Cincinnati, Ohio 45226*	*blower upgrade*	*8,760*		*1,000*	*62*

1 Site ID
Can be a store number, building name or other way to identify the location. If there is only one site involved in this application, then a Site ID is not necessary.

2 Account Numbers
Must match the facility of the proposed project(s). If there are multiple meters at a site, only include the meters that pertain to the project(s).

App No.	0
Rev.	0

For each project, answer the following questions (use one worksheet per project)

Project Name: **blower efficency upgrade**

How would you classify this project? (Place an x in all boxes that apply.)

Lighting		**Heating/Cooling**		**Air Compressor**	x	**Energy Management System**	x
VFD		**Motors/Pumps**		**Process Equipment**		**Other, describe below:**	x

Brief Project Description

Describe the Baseline (see note 3) **Equipment/System**	**Describe the Proposed High Efficiency Project**
Account # 4540-0682 Older blowers with out controls but newer fine bubble diffusers	**New high Eff. Blowers and air controls and new piping**

If Existing Equipment is the Baseline, how many years of useful life remain or how many years until scheduled replacement? 0

Detailed Project Description Attached? Yes (Required)

Operating Hours (see note 4)

	Weekday		Saturday		Sunday		Weeks of Use in Year (see note 5)	Total Annual Hours of Use
24 x 7	**Start Hour**	**End Hour**	**Start Hour**	**End Hour**	**Start Hour**	**End Hour**		
Yes							***52***	***8,760***

Energy Savings

	Baseline (see Note 3)	**Proposed**	**Savings**	**Describe how energy numbers were calculated**
Annual Electric Energy	2,540,000 kWh	###########	992,000 kWh	Electric readings were found from internal/sub meters
Electric Demand	295 kW	178 kW	117 kW	
Calculations attached	Yes	Yes	(Required)	

Simple Payback

Average electric rate ($/kWh) on the applicable accounts (see note 6)			$0.07
Estimated annual electric savings			$69,440
Other annual savings in addition to electric savings, such as operations, maintenance, other fuels			$0.00
Incremental cost to implement the project (equipment & installation) (see note 7)			##########
Copy of vendor proposal is attached (see note 8)			Yes
Simple Electric Payback in years (see note 9)	18.04435484	**Total Payback in years**	18.04435484

3 Baseline
Retrofit projects: the existing equipment is the baseline.
New construction projects: the baseline is the standard option in today's market, taking into account any applicable organizational, local, state or federal codes or standards currently in effect.

4 Operating Hours
Describe when the equipment is typically used. If the project is proposed for more than one site, provide any variations in operating hours between the sites on a separate sheet.

5 Weeks of Use in Year
If the equipment is not in use 52 weeks during the year (for example, during holiday or summer break), provide an explanation of when usage is not expected and why:

6 Average electric rate ($/kWh)
If you do not know your average electric rate, use $0.10/kWh.

7 Incremental cost to implement the project
Costs exclude self installation costs. Retrofit projects, incremental cost is the total cost of the proposed project. New construction or where the existing equipment must be replaced anyway, then incremental cost is the premium of the proposed high efficiency project over baseline.

8 Copy of vendor invoice is attached
Vendor invoices detailing costs of the project are always required.
New construction projects or where the existing equipment must be replaced anyway, vendor proposal of baseline must also be attached.

9 Simple Electric Payback
If the simple electric payback is less than 1 year, the rebate structure is affected. Double check average electric rate for correct payback.

The General Worksheet is part 2 of the application. Do not submit this file without submitting a completed Part1 Custom Application document file, which can be found at www.duke-energy.com. This worksheet is for all projects that are not easily submitted through one of the other worksheets

Before you complete this application, please note the following important criteria:

- Submitting this application does not guarantee an rebate will be approved.
- Rebates already decided to proceed.
- Electric demand and/or energy reductions must be well documented with auditable calculations.
- Incomplete applications will not be reviewed; all fields are required.

Refer to the complete list of Instructions and Disclaimers, found in the Mercantile Self Direct Custom Application Part 1 document.

Please enter your information and data into the cells that are shaded.
Cells in white are locked and cannot be written over.

Duke Energy Customer Contact Information (Match the information in Application Part 1):

Name	Jeff DEAN
Company	Metropolitan Sewer District

Equipment Vendor / Project Engineer Contact Information

Name	Brian Mumy
Company	Brown and Caldwell

Before proceeding with the custom application, please verify that your project is not on the Self-Direct Prescriptive application.
The prescriptive rebate applications can be found at:
http://www.duke-energy.com/ohio-large-business/smart-saver/mercantile-self-direct.asp
Prescriptive rebate amounts are pre-approved.

List of Sites (Required)

App No.	
Rev.	

Provide a list of sites addressed by this custom rebate application

Site ID (see note 1)	Duke Energy Electric Account Number(s) (see note 2)	Facility Address	List of Proposed Projects at each site	Annual Hours of Operation	Gross Square Footage	Conditioned Square Footage	Facility Age (years)
225	*12345678 01*	*Example: 123 Main Street, Anywhere USA 12345*	*Project Name(s)*	*5,840*	*42,000*	*38,000*	*12*
	4540-0682	*6125 River Road , Cincinnati, Ohio 4522*	*blower upgrade*	*8,760*	*6,000*	*1,000*	*62*
	5220-0740	*225 Wilmer Ave. Cincinnati, Ohio 45226*	*blower upgrade*	*8,760*	*25,000*	*1,000*	*54*

1 **Site ID**
Can be a store number, building name or other way to identify the location. If there is only one site involved in this application, then a Site ID is not necessary.

2 **Account Numbers**
Must match the facility of the proposed project(s). If there are multiple meters at a site, only include the meters that pertain to the project(s).

App No.	0
Rev.	0

For each project, answer the following questions (use one worksheet per project)

Project Name: **Process Blower Upgrade**

How would you classify this project? (Place an x in all boxes that apply.)

Lighting		**Heating/Cooling**		**Air Compressor**	x	**Energy Management System**	
VFD		**Motors/Pumps**		**Process Equipment**		**Other, describe below:**	x
						install of higher eff. Blowers and diffusers	

Brief Project Description

Describe the Baseline (see note 3) **Equipment/System**	**Describe the Proposed High Efficiency Project**
account 5220-0740 had less eff process blowers and course bubble air diffusers	**the upgrade project had new higher eff. Blowers, fine bubble higher eff. Diffusers and new piping installed and controls**

If Existing Equipment is the Baseline, how many years of useful life remain or how many years until scheduled replacement? 3

Detailed Project Description Attached? Yes (Required)

Operating Hours (see note 4)

	Weekday		Saturday		Sunday		Weeks of Use in Year (see note 5)	Total Annual Hours of Use
24 x 7	**Start Hour**	**End Hour**	**Start Hour**	**End Hour**	**Start Hour**	**End Hour**		
Yes							***52***	***8,760***

Energy Savings

	Baseline (see Note 3)	**Proposed**	**Savings**	**Describe how energy numbers were calculated**
Annual Electric Energy	4,810,000 kWh	###########	2,620,000 kWh	
Electric Demand	550 kW	250 kW	300 kW	
Calculations attached	Yes	Yes	(Required)	ers / demand numbers were taken from the submeters in the building that the blower

Simple Payback

Average electric rate ($/kWh) on the applicable accounts (see note 6)			$0.07
Estimated annual electric savings			$183,400
Other annual savings in addition to electric savings, such as operations, maintenance, other fuels			
Incremental cost to implement the project (equipment & installation) (see note 7)			##########
Copy of vendor proposal is attached (see note 8)			Yes
Simple Electric Payback in years (see note 9)	20.17448201	**Total Payback in years**	20.17448201

3 Baseline
Retrofit projects: the existing equipment is the baseline.
New construction projects: the baseline is the standard option in today's market, taking into account any applicable organizational, local, state or federal codes or standards currently in effect.

4 Operating Hours
Describe when the equipment is typically used. If the project is proposed for more than one site, provide any variations in operating hours between the sites on a separate sheet.

5 Weeks of Use in Year
If the equipment is not in use 52 weeks during the year (for example, during holiday or summer break), provide an explanation of when usage is not expected and why:

6 Average electric rate ($/kWh)
If you do not know your average electric rate, use $0.10/kWh.

7 Incremental cost to implement the project
Costs exclude self installation costs. Retrofit projects, incremental cost is the total cost of the proposed project. New construction or where the existing equipment must be replaced anyway, then incremental cost is the premium of the proposed high efficiency project over baseline.

8 Copy of vendor invoice is attached
Vendor invoices detailing costs of the project are always required.
New construction projects or where the existing equipment must be replaced anyway, vendor proposal of baseline must also be attached.

9 Simple Electric Payback
If the simple electric payback is less than 1 year, the rebate structure is affected. Double check average electric rate for correct payback.

135 Merchant Street
Suite 240
Cincinnati, OH 45246

Tel: (513) 719-6100
Fax: (513) 719-6105

BROWN AND CALDWELL

December 7, 2010

Mr. Jeffrey Dean, P.E.
Project Manager
MSD of Greater Cincinnati
1600 Gest Street
Cincinnati, Ohio 45204

Subject: LMTP & MuCTP Blower Energy Efficiency Upgrade
MSD ID: 10200002
Bid Evaluation and Recommendation of Award

Dear Mr. Dean:

Bids were received for the above-referenced project on November 30, 2010. The bids were based on a lump sum and unit price contract.

The bids have been reviewed and a Bid Tabulation Summary has been compiled. A copy of the Bid Tabulation Summary, which was provided by the Metropolitan Sewer District of Greater Cincinnati for all bidders, is enclosed for reference. The total amounts for the three lowest bids received are as follows:

Part 1 - General:

	Total Bid Amount
Dugan & Meyers	$6,073,668.00
Ulliman Schutte Construction, LLC	$6,567,000.00
Building Crafts, Inc.	$6,870,574.00

Part 2 - Electrical:

	Total Bid Amount
Lake Erie Electric, Inc.	$1,629,500.00

Combination:

	Total Bid Amount
Dugan & Meyers	$7,764,415.00
Ulliman Schutte Construction, LLC	$8,240,000.00
Reynolds, Inc.	$8,673,000.00

The total amounts for all Bidders can be found on the Bid Tabulation Summary.

Based on the above summary, the lowest Part 1(General) Bid Amount was received from Dugan & Meyers in the amount of $6,073,668.00 and the lowest Part 2 (Electrical) Bid Amount was received from Lake Erie Electric, Inc. in the amount of $1,629,500.00. The lowest Combination Bid Amount was received from Dugan & Meyers in the amount of $7,767,415.00. The lowest overall Bid Amount is the combination of each of the lowest Bid Amounts for Part 1 and 2 (General: Dugan & Meyers, Electrical: Lake Erie Electric, Inc.) in the amount of $7,703,168.00.

During the process of evaluating the three lowest bidders, each Bid was evaluated for submission of required technical Pre-Submittals. We then compared each of the bidder's costs for each bid item with the minimum, average and maximum bid costs for each individual bid item. Each of the three lowest bidders were then compared to each other. These evaluations did not identify any anomalies in the prices of the three lowest bidders. Based upon this review we recommend that Part 1 (General) of the referenced project be awarded to Dugan & Meyers for the amount of $6,073,668.00 and Part 2 (Electrical) to Lake Erie Electric, Inc. in the amount of $1,629,500.00.

The scope of this bid recommendation includes analysis of bid tabulation and submission of required technical Pre-Submittals only. Contract and bid compliance and conformance to MSDGC SBE requirements by others.

If you have any questions regarding this information, please contact me at (513) 719-6100.

Very truly yours,

BROWN AND CALDWELL

Brian J. Mumy, P.E.
Project Manager

Enclosures

Summary of Bids Received For
LMTP & MuCTP Blower Energy Efficiency Upgrade

MSD ID: 10200002

Trade: **General**

Firm Name	Bid Total $
Dugan & Meyers	6,073,668.00
Ulliman Schutte Construction, LLC	6,567,000.00
Building Crafts, Inc.	6,870,574.00
Reynolds Inc.	6,880,000.00
Kokosing Construction Company, Inc.	6,920,000.00
PAE & Associates	8,023,000.00

	Bid Item	Quantity	Unit	Bidders *Firm*	*Labor (UP) $*	*Materials (UP) $*	*Combined Unit $*	*Bid Item Total $*
1	**General Construction**	**1**	**LS**					
				Ulliman Schutte Construction, LLC	400,000.00	1,967,000.00	2,367,000.00	2,367,000.00
				Building Crafts, Inc.	450,000.00	1,942,374.00	2,392,374.00	2,392,374.00
				Reynolds Inc.	700,000.00	2,194,200.00	2,894,200.00	2,894,200.00
				Dugan & Meyers	883,084.00	1,079,324.00	1,962,408.00	1,962,408.00
				Kokosing Construction Company, Inc.	940,000.00	1,633,000.00	2,573,000.00	2,573,000.00
				PAE & Associates	1,250,000.00	2,063,000.00	3,313,000.00	3,313,000.00
2	**Performance Bond**	**1**	**LS**					
				Ulliman Schutte Construction, LLC	0.00	38,000.00	38,000.00	38,000.00
				Kokosing Construction Company, Inc.	0.00	43,000.00	43,000.00	43,000.00
				Dugan & Meyers	0.00	44,260.00	44,260.00	44,260.00
				Reynolds Inc.	0.00	60,000.00	60,000.00	60,000.00
				Building Crafts, Inc.	0.00	64,000.00	64,000.00	64,000.00
				PAE & Associates	0.00	75,000.00	75,000.00	75,000.00
3	**Grit Removal, Dewatering, and Disposal**	**1,200**	**TON**					
				Reynolds Inc.	13.00	21.00	34.00	40,800.00
				Ulliman Schutte Construction, LLC	57.00	228.00	285.00	342,000.00
				Kokosing Construction Company, Inc.	60.00	25.00	85.00	102,000.00
				Dugan & Meyers	100.00	205.00	305.00	366,000.00
				PAE & Associates	180.00	120.00	300.00	360,000.00
				Building Crafts, Inc.	246.00	85.00	331.00	397,200.00
4	**Neuros, Blowers - Base Bid**	**1**	**LS**					
				Building Crafts, Inc.	15,000.00	2,312,000.00	2,327,000.00	2,327,000.00

				Ulliman Schutte Construction, LLC	20,000.00	2,000,000.00	2,020,000.00	2,020,000.00
				Dugan & Meyers	20,000.00	2,111,000.00	2,131,000.00	2,131,000.00
				PAE & Associates	25,000.00	2,450,000.00	2,475,000.00	2,475,000.00
				Reynolds Inc.	30,000.00	2,115,000.00	2,145,000.00	2,145,000.00
				Kokosing Construction Company, Inc.	35,000.00	2,376,000.00	2,411,000.00	2,411,000.00
5	**OTT Diffusers - Base Bid**	**1**	**LS**					
				Dugan & Meyers	70,000.00	1,500,000.00	1,570,000.00	1,570,000.00
				PAE & Associates	70,000.00	1,730,000.00	1,800,000.00	1,800,000.00
				Building Crafts, Inc.	76,000.00	1,614,000.00	1,690,000.00	1,690,000.00
				Kokosing Construction Company, Inc.	160,000.00	1,631,000.00	1,791,000.00	1,791,000.00
				Reynolds Inc.	240,000.00	1,500,000.00	1,740,000.00	1,740,000.00
				Ulliman Schutte Construction, LLC	300,000.00	1,500,000.00	1,800,000.00	1,800,000.00

Summary of Bids Received For
LMTP & MuCTP Blower Energy Efficiency Upgrade

MSD ID: 10200002

Trade: **General Alternative**

Firm Name	Bid Total $
Dugan & Meyers	**920,000.00**
Building Crafts, Inc.	**953,000.00**
PAE & Associates	**1,200,000.00**
Reynolds Inc.	**1,340,000.00**
Ulliman Schutte Construction, LLC	**1,400,000.00**
Kokosing Construction Company, Inc.	**1,500,000.00**

	Bid Item	Quantity	Unit	Bidders *Firm*	*Labor (UP) $*	*Materials (UP) $*	*Combined Unit $*	*Bid Item Total $*
5A	**Fine Bubble Diffusion Equipment - Alternative**	**1**	**LS**					
				Dugan & Meyers	70,000.00	850,000.00	920,000.00	920,000.00
				PAE & Associates	70,000.00	1,130,000.00	1,200,000.00	1,200,000.00
				Building Crafts, Inc.	145,000.00	808,000.00	953,000.00	953,000.00
				Kokosing Construction Company, Inc.	160,000.00	1,340,000.00	1,500,000.00	1,500,000.00
				Reynolds Inc.	240,000.00	1,100,000.00	1,340,000.00	1,340,000.00
				Ulliman Schutte Construction, LLC	300,000.00	1,100,000.00	1,400,000.00	1,400,000.00

Summary of Bids Received For
LMTP & MuCTP Blower Energy Efficiency Upgrade

MSD ID: 10200002

Trade: **Electrical**

Firm Name	Bid Total $
Lake Erie Electric, Inc.	**1,629,500.00**

	Bid Item	Quantity	Unit	Bidders *Firm*	*Labor (UP) $*	*Materials (UP) $*	*Combined Unit $*	*Bid Item Total $*
1	**Electrical Work**	**1**	**LS**					
				Lake Erie Electric, Inc.	253,000.00	1,324,500.00	1,577,500.00	1,577,500.00
2	**Performance Bond**	**1**	**LS**					
				Lake Erie Electric, Inc.	0.00	12,000.00	12,000.00	12,000.00
3	**Network Equipment Allowance**	**40,000**	**LS**					
				Lake Erie Electric, Inc.	0.00	1.00	1.00	40,000.00

Summary of Bids Received For
LMTP & MuCTP Blower Energy Efficiency Upgrade

MSD ID: 10200002

Trade: **Mandatory Alternati**

Firm Name	Bid Total $
Reynolds Inc.	3,045,000.00
Dugan & Meyers	3,060,000.00
Building Crafts, Inc.	3,112,000.00
Ulliman Schutte Construction, LLC	3,112,450.00
Kokosing Construction Company, Inc.	3,168,000.00
PAE & Associates	3,255,000.00

	Bid Item	Quantity	Unit	Bidders *Firm*	*Labor (UP) $*	*Materials (UP) $*	*Combined Unit $*	*Bid Item Total $*
4A	**K-Turbo Blowers - Mandatory Alternative**	**1**	**LS**					
				Building Crafts, Inc.	15,000.00	2,167,000.00	2,182,000.00	2,182,000.00
				Ulliman Schutte Construction, LLC	20,000.00	2,100,000.00	2,120,000.00	2,120,000.00
				Dugan & Meyers	20,000.00	2,125,000.00	2,145,000.00	2,145,000.00
				PAE & Associates	25,000.00	2,325,000.00	2,350,000.00	2,350,000.00
				Reynolds Inc.	30,000.00	2,060,000.00	2,090,000.00	2,090,000.00
				Kokosing Construction Company, Inc.	35,000.00	2,235,000.00	2,270,000.00	2,270,000.00
4B	**Warranty Extension - Neuros - Mandatory Alternative**	**1**	**LS**					
				Kokosing Construction Company, Inc.	0.00	442,000.00	442,000.00	442,000.00
				PAE & Associates	0.00	445,000.00	445,000.00	445,000.00
				Dugan & Meyers	0.00	450,000.00	450,000.00	450,000.00
				Building Crafts, Inc.	0.00	458,000.00	458,000.00	458,000.00
				Reynolds Inc.	0.00	470,000.00	470,000.00	470,000.00
				Ulliman Schutte Construction, LLC	0.00	488,750.00	488,750.00	488,750.00
4C	**Warranty Extension - K - Turbo - Mandatory Alternative**	**1**	**LS**					
				Kokosing Construction Company, Inc.	0.00	456,000.00	456,000.00	456,000.00
				PAE & Associates	0.00	460,000.00	460,000.00	460,000.00
				Dugan & Meyers	0.00	465,000.00	465,000.00	465,000.00
				Building Crafts, Inc.	0.00	472,000.00	472,000.00	472,000.00
				Reynolds Inc.	0.00	485,000.00	485,000.00	485,000.00
				Ulliman Schutte Construction, LLC	0.00	503,700.00	503,700.00	503,700.00

From:	Dean, Jeffrey
To:	MSD Document Control
Subject:	FW: 10200002 Little Miami and Muddy Creek Treatment Plant Blower Energy Efficiency Upgrade
Date:	Thursday, June 30, 2011 11:29:08 AM
Attachments:	Blower_Bid_Recommendation.pdf

-----Original Message-----
From: Dean, Jeffrey
Sent: Thursday, June 30, 2011 9:43 AM
To: 'Mbah, Valentine'
Cc: Walkenspaw, Amy; Burri, Christina; Wooton, Billy J; Brown, Frank
Subject: RE: Little Miami and Muddy Creek Treatment Plant Blower Energy Efficiency Upgrade

Valentine:
I understand that Bill Wooton has explained the DBE (Item 7). Item 6 (debarment) is being addressed in the proposed change order, which will include the Davis-Bacon. Our contracting department has not supplied item 8 (resolution awarding contract), I hope that the executed contract can suffice. Attached is item 4 (bid evaluation).

Thank you for your understanding.
Jeff

-----Original Message-----
From: Mbah, Valentine [mailto:Valentine.Mbah@epa.state.oh.us]
Sent: Wednesday, June 29, 2011 10:55 AM
To: Dean, Jeffrey
Cc: Wooton, Billy J; Walkenspaw, Amy; Burri, Christina
Subject: Little Miami and Muddy Creek Treatment Plant Blower Energy Efficiency Upgrade

Hi Jeff,

A review of the contract documents and specifications - Volume 1, bid booklet shows that some items are missing from the booklet. For this project to be funded through our loan program (WPCLF), items not marked (see attachment) should be addressed with a change order (you have already opened bids and can only enforce a change through a change order process). The items that are paramount are as follows:

- Davis-Bacon wage rate requirements
- Certification regarding debarment and suspension
- Violating facilities clause
- DBE requirements and DBE data sheets I, II, III

On the executed contracts, items 4, 6, 7 and 8 (see attachment-circled items) should also be addressed.

If you have any question(s), please let me know. Thanks

Valentine Mbah
614-644-3668

OHIO WATER DEVELOPMENT AUTHORITY

CONTRACTOR'S ESTIMATE

TO OWNER:
Cincinnati Metropolitan Sewer District
1600 Gest St.
Cincinnati, Ohio 45204

APPLICATION NO: 5
PERIOD TO: 12/9/11 - 1/12/11
OWDA LOAN NO: 5964

FROM CONTRACTOR:
Dugan & Meyers Construction Co.
11110 Kenwood Road.
Cincinnati, Ohio 45242

FOR OWDA OFFICE USE ONLY
Fund: _____
Voucher: _____
OWDA Pay: _____
Date: _____

PROJECT: #10200002
Little Miami & Muddy Creek WWTPs
Blower Upgrade

1	ORIGINAL CONTRACT PRICE		$6,073,668.00
2	Net change by CHANGE ORDER		$16,013.00
3	CURRENT CONTRACT PRICE (Line 1 + 2)		$6,089,681.00
4	TOTAL COMPLETED & STORED TO DATE		$1,313,813.00
5	RETAINAGE		
a.	8 % of completed work	$105,105.04	
b.	% of stored work		
	Total Retainage (Line 5a + 5b)		$105,105.04
6	TOTAL EARNED LESS RETAINAGE (Line 4 less Line 5 total)		$1,208,707.96
7	LESS PREVIOUS PAYMENTS (Line 6 from prior certificate)		$395,779.40
8	CURRENT PAYMENT DUE		$812,928.56

CHANGE ORDER SUMMARY	ADDITIONS	DEDUCTIONS
Approved Change Orders through Change Order No: 1	$16,013.00	
	NET CHANGES by Change Order	$16,013.00

CONTRACTOR'S CERTIFICATE

I hereby certify that the above materials and services have been furnished and performed in accordance with the conditions of the contract for the above work, and that payment has not been recevied and therefore is due and to be paid on said contract

CONTRACTOR:

BY: DATE:

ENGINEER: _____ By: _____ Date: _____

OWNER: _____ By: _____ Date: _____

OWDA: _____

Chief Engineer Executive Director

TO OWNER: Cincinnati MSD

FROM CONTRACTOR: Dugan & Meyers Construction

APPPLICATION NO: 5
PERIOD TO: 12/9/11 - 1/12/11
OWDA LOAN NO: 5964
EPA LOAN NO:

PROJECT: 10200002 - LMTP & MuCTP Blower Upgrade

A	B	C	D	E	F	G	H	I	J	K	L
	DESCRIPTION OF WORK	SCHEDULED COST		Work Completed		Work In Place		Stored Materials	Total Completed		% Complete
				Previous Application		This Application		Not in Column F or H	& Stored To Date		
		Labor	Material/Equipment	Labor	Material/Equipment	Labor	Material/Equipment		Labor	Material/Equipment	
	REFERENCE ITEM #1										
	Overhead/General Conditions	$143,000	$95,408	$ 52,440.00	$ 35,201.00	$ 5,960.00	$ 4,030.00	$ -	$ 58,400.00	$ 39,231.00	41%
	Muddy Creek										
	Demolition										
	Mobilization	$2,000	$8,000	$ 2,000.00	$ 8,000.00			$ -	$ 2,000.00	$ 8,000.00	100%
	Demo/Excavate at AEB's	$2,000	$2,000	$ 1,500.00	$ 1,500.00	$ 500.00	$ 500.00	$ -	$ 2,000.00	$ 2,000.00	100%
	Demo Boiler & HVAC Equipment	$16,500	$3,500	$ 14,500.00	$ 3,500.00			$ -	$ 14,500.00	$ 3,500.00	90%
	Demo Blowers #3 & #4	$5,000	$1,000	$ -	$ -			$ -	$ -	$ -	0%
	Demo Air Pipe to AEB#2	$16,500	$8,500	$ 3,000.00	$ 1,500.00	$ 10,500.00	$ 4,000.00	$ -	$ 13,500.00	$ 5,500.00	86%
	Demo Blowers #1 & #2	$5,000	$1,000	$ 5,000.00	$ 1,000.00			$ -	$ 5,000.00	$ 1,000.00	100%
	Demo Air Pipe to AEB#1	$15,500	$6,500	$ 15,500.00	$ 6,500.00			$ -	$ 15,500.00	$ 6,500.00	100%
	Installation										
	Install Temp Air Pipe at AEB's	$13,500	$24,500	$ 13,500.00	$ 24,500.00			$ -	$ 13,500.00	$ 24,500.00	100%
	F/P/F Equipment Pads	$5,250	$3,750	$ 3,125.00	$ 1,800.00			$ -	$ 3,125.00	$ 1,800.00	49%
	Install AEB#2 Air Pipe to Blower #3/#4	$14,000	$198,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0%
	Insulate Air Pipe to AEB#2	$8,000	$14,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0%
	Install New Air Intake Louvers	$2,000	$3,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0%
	Install AEB#1 Air Pipe to Blower #1/#2	$14,000	$198,500	$ -	$ -	$ 10,000.00	$ 141,750.00	$ -	$ 10,000.00	$ 141,750.00	71%
	Insulate Air Pipe to AEB#1	$8,000	$14,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0%
	Terazzo Flooring	$18,000	$12,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0%
	Final Cleaning	$20,000	$5,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0%
	Felker - Stored MAT. - See Attached				$ 69,270.00		$ (16,460)		$ -	$ 52,810	
	Pratt Valves - Stored MAT. - See Attached				$ 41,004.00		$ (17,936)			$ 23,068	
	FM Stainless - Stored MAT. - See Attached				$ 4,009.00		$ (1,530)			$ 2,479	
	Jiffy Fastening - Stored MAT. - See Attached				$ 4,657.00		$ (1,457)			$ 3,200	
	Pratt Valves - Stored MAT. - See Attached				$ 65,996.00		$ -			$ 65,996	
	Little Miami										
	Demolition										
	Mobilization	$2,000	$8,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0%
	Demo Blowers #1 & #2	$4,000	$1,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0%
	Demo Diffusers AEB's 4/5	$11,000	$4,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0%
	Demo Air Pipe to AEB's 4/5	$20,500	$7,500	$ 1,500.00	$ 400.00			$ -	$ 1,500.00	$ 400.00	7%
	Demo Diffusers AEB's 6/7	$11,000	$4,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0%
	Demo Air Pipe to AEB's 6/7	$20,500	$7,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0%
	Demo Blowers #3 & #4	$4,000	$1,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0%
	Demo Diffusers AEB's 2/3	$11,000	$4,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0%
	Demo Air Pipe to AEB's 2/3	$20,500	$7,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0%

Demo Diffusers AEB's 1/8	$11,000	$4,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0%
Demo Air Pipe to AEB's 1/8	$20,500	$7,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0%
Installation										
F/P/F Equipment Deck/Pads Blower #1/#2	$8,500	$4,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0%
Install Air Pipe #1 to AEB's 4/5	$18,000	$148,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0%
Insulate Air Pipe to AEB 4/5	$7,000	$13,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0%
Install Air Pipe #2 to AEB's 6/7	$18,000	$148,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0%
Insulate Air Pipe to AEB 6/7	$7,000	$13,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0%
F/P/F Equipment Deck/Pads Blower #3/#4	$8,500	$4,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0%
Install Air Pipe #3 to AEB's 2/3	$18,000	$148,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0%
Insulate Air Pipe to AEB 2/3	$7,000	$13,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0%
Install Air Pipe #4 to AEB's 1/8	$18,000	$148,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0%
Insulate Air Pipe to AEB 1/8	$7,000	$13,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0%
Terazzo Flooring	$34,000	$16,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0%
Final Cleaning	$38,000	$7,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0%
REFERENCE ITEM #2										
Performance Bond		$44,260	$ -	$ 44,260.00	$ -	$ -	$ -	$ -	$ 44,260.00	100%
REFERENCE ITEM #3										
Grit Removal/Dewatering/Disposal	$126,000	$240,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0%
REFERENCE ITEM #4										
High Speed Blower - Neuros										
LMTP Blower #1	$2,500	$339,669	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0%
LMTP Blower #2	$2,500	$339,669	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0%
LMTP Blower #3	$2,500	$339,669	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0%
LMTP Blower #4	$2,500	$339,669	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0%
MuCTP Blower #1 & #2	$5,000	$376,162	$ -	$ -	$ 3,500.00	$ 371,000.00	$ -	$ 3,500.00	$ 371,000.00	98%
MuCTP Blower #3 & #4	$5,000	$376,162	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0%
MuCTP Blowers - Stored MAT - See Attached		**$737,921**				$ 368,961.00			$ 368,961.00	
LMTP Blowers - Stored MAT - See Attached		**$1,339,674**							$ -	
REFERENCE ITEM #5										
Fine Bubble Diffusion - OTT										
LMTP AEB's 4/5	$17,500	$375,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0%
LMTP AEB's 6/7	$17,500	$375,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0%
LMTP AEB's 2/3	$17,500	$375,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0%
LMTP AEB's 1/8	$17,500	$375,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0%
Change Orders										
CO#1 - OWDA Loan	$12,780	$3,233	$ 1,800.00	$ 3,233.00	$ 300.00		$ -	$ 2,100.00	$ 3,233.00	33%
TOTALS	$862,030	$5,227,551	$113,865.00	$316,330.00	$30,760.00	$852,858.00	$0.00	$144,625.00	$1,169,188.00	17%
	Total	**$6,089,581**	**Total**	**$430,195.00**	**Total**	**$883,618.00**		**Total**	**$1,313,813.00**	

STORED MATERIALS

APP. NO.	VENDOR/INV. NO.	DESCRIPTION	TOTAL TASK	TOTAL STRD	INVOICE AMT.
2	Felker #141849-00	MuC Air Piping	$69,270	$52,810	$69,270
3	Pratt #2285893	Manual Valves	$41,004	$23,068	$41,004
3	FM Stainless #39908	Supports	$4,009	$2,479	$4,009
3	Jiffy Fastening #5048842	Bolts/Studs/Nuts	$4,657	$3,200	$4,657
4	Pratt #2313733	Auto Valves	$65,996	$65,996	$65,996
5	APG-Neuros #335	MuC Blwoers	$737,921	$368,961	$737,921

euros **APGN INC.**
1270 Michele-Bohec
Blainville, Qc J7C 5S4
Phone # 450-939-0799
Fax # 450-939-2115

E-mail
info@apg-neuros.com
Web Site
www.apg-neuros.com

Invoice

Date	Invoice #
12/29/2011	335

Invoice To

Jason M. Fisher
Dugan & Meyers Construction Co.
11,110 Kenwood Road
Cincinnati, OH 45242-1863

VAT Reg ID :

Ship To

Cincinnati Muddy Creek WWTF
6125 River Road
Cincinnati, OH 45233

P.O. No.	Terms	Rep	Ship	Via	F.O.B.	Project
11-4-811-001	Net 30	BissN	12/29/2011		Destination	

Qty	Item	Description	Price Each	Amount	Tax
1	NX300 - Sales	First invoice for delivery of 4 Neuros Turbo Blowers for Muddy Creek and Little Miami	737,921.00	737,921.00	E
-1	Withholding	10% withholding	73,792.10	-73,792.10	E
		NOTE: Credit for expansion joints to be applied on final retention amount. (33,180.00)			
			Subtotal	$664,128.90	

Project #11-0008
Cincinnati - Muddy Creek

Payment by wire transfer to account :
National Bank of Canada
206, Boul. Cure Labelle
Ste-Therese, Quebec J7E 2X7 Canada
Beneficiary : APGN inc.
Transit & Beneficiary account :
10421-006-0055469
SWIFT BNDCCAMMINT
Payment by Credit Card is now accepted.
VISA or MASTER CARD

Sales Tax Summary

Total Tax 0.00

Total $664,128.90

Currency : US

Authorized by :

Omar Hammoud, President

GST/HST No. 854566452 QST No. 1215444089

OTT North America, LLC
1000 Peachtree Industrial Blvd., Suite 6266
Suwanee, GA 30024
David R. Rubin, Chief Executive Officer
Office: 770-476-1492 or Cell: 770-377-0300
Fax: 678-302-9962
rubin@ott-group.com
www.ott-system.com

OTT GROUP
OTT North America LLC

Jason Fisher
DUGAN & MEYERS Construction Co., Inc.
11110 Kenwood Road
Cincinnati, OH 45242-1863

INVOICE
Number: 12-014-1 Page 1/1
Date: June 1, 2012
Customer PO No.: 11-4-811-005
Date of dispatch: May 18, 2012
Delivery terms: Net 30 days
OTT Project No.: 11-0007
Project: LMTP & MUCTP Blower Energy Upgrade

Thank you for your order.
.

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	**Piping**	1	LS		$ 200,000.00
2	**Supports and hardware**	1	LS		$ 200,000.00
3	**Couplings**	1	LS		$ 80,000.00
	Total				$ 480,000.00
	10% hold back				$ 48,000.00
	Due this invoice				$ 432,000.00

OTT North America, LLC
1000 Peachtree Industrial Blvd., Suite 6266
Suwanee, GA 30024
David R. Rubin, Chief Executive Officer
Office: 770-476-1492 or Cell: 770-377-0300
Fax: 678-302-9962
rubin@ott-group.com
www.ott-system.com

OTT GROUP
OTT North America LLC

Jason Fisher
DUGAN & MEYERS Construction Co., Inc.
11110 Kenwood Road
Cincinnati, OH 45242-1863

INVOICE
Number: 12-014-3 Page 1/1
Date: October 31, 2012
Customer PO No.: 11-4-811-005
Date of dispatch: May 18, 2012
Delivery terms: Net 30 days
OTT Project No.: 11-0007
Project: LMTP & MUCTP Blower Energy Upgrade

Thank you for your order.
.

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	**Diffusers**	**Balance**	**LS**		**222,309.41**
					-
					-
					-
					-
	10% hold back				**22,230.94**
	Due this invoice				**200,078.47**

Greater Cincinnati
Metropolitan Sewer District

Business Case Evaluation

Little Miami WWTP Blower Energy Efficiency Upgrade

MSD ID No. 10200002

Prepared By: Tim Koch, P.E., Brown and Caldwell
Under the direction of: Jeff Dean, P.E.
November 18, 2010

Table of Contents

List of Tables

Section 1

Executive Summary

The Little Miami WWTP Secondary Treatment process includes blowers and diffusers to deliver the air required for the eight (8) activated sludge Aeration Tanks. The system consists of four (4) 1000 HP Roots Multistage Centrifugal Compressors and coarse bubble diffusers.

Under current influent loadings, only one (1) blower is required to provide the necessary air to the Secondary Aeration Tanks, with a second blower being turned on rarely during high influent BOD loading.

According to the MSDGC Useful Life of Capital Assets Report, the useful life for a blower is 30 years and the useful life of aeration equipment is 20 years. The blowers and diffusers at Little Miami were installed in 1977. Having exceeded their useful life, the blowers and diffusers will be replaced.

Two replacement options were evaluated. Both options include replacing the blowers and coarse bubble diffusers with new blowers and fine bubble diffusers. For both options, the new blowers will be smaller capacity than the existing blowers due to reduced projected influent loadings and lower air requirements due to high efficiency fine bubble diffusers.

The first replacement option is to replace the existing system with new multistage centrifugal blowers similar to the existing blowers and fine bubble diffusers.

The second replacement option is to replace the existing system with new high speed turbo blowers and fine bubble diffusers.

Based on the alternatives analysis the recommendation is to install new high speed turbo blowers with fine bubble diffusers. The new high speed turbo blowers are recommended due to lower capital, operation and maintenance, and energy costs.

Section 2
The Problem

2.1 Problem Statement

The Secondary Treatment process aeration system at Little Miami WWTP has exceeded its useful life. According to the MSDGC Useful Life of Capital Assets Report, the useful life for a blower is 30 years and the useful life of aeration equipment is 20 years. The blowers and diffusers at Little Miami were installed in 1977. Having exceeded their useful life, the blowers and diffusers will be replaced.

The purpose of the report is to document the formulation and screening of the alternatives (Alternatives Development) for the Little Miami WWTP Blower Energy Efficiency Upgrade Project located in the eastern portion of Hamilton County.

2.2 Condition Assessment

The Little Miami WWTP is designed for an average daily flow of 55 MGD. Secondary Treatment is provided by eight aeration tanks with coarse bubble diffusers. Air is supplied to the aeration tanks by four multistage centrifugal air compressors (blowers).

A. Blowers
   1. Number: 4
   2. Type: Multistage Centrifugal
   3. Stages: 3
   4. Rated Capacity: 21,500 scfm
   5. Discharge Pressure: 8.0 psig
   6. Horsepower: 1,000
   7. Age: Installed in 1977

B. Diffusers
   1. Stainless Steel Coarse Bubble Diffusers
   2. Age: Installed in 1977

The blowers and diffusers have exceeded their useful life and must be replaced according to the MSDGC Useful Life of Capital Assets Report. While the blowers remain in operation, their continued use will result in higher operating and maintenance costs over time.

2.3 Problem Diagnosis

The MSDGC Useful Life of Capital Assets Report requires replacement of the existing blowers and diffusers at the Little Miami WWTP. Although the blowers are currently still functional, continued use will result in higher operating and maintenance costs due to part failures as well as normal wear and tear of the equipment. The blowers and diffusers should be replaced to ensure operational reliability and efficiency.

2.4 Boundary of the Analysis

The project area was confined to the Secondary Treatment aeration process only. No other plant processes or areas were investigated. The remainder of the Secondary Treatment process should be evaluated in a separate report.

Section 3
Strategies

3.1 Initial Screening of Strategies

Two strategies for replacing the blowers and diffusers in the Little Miami WWTP Secondary Treatment process were reviewed:

1. Replace existing blowers with new multistage centrifugal blowers and fine bubble diffusers
2. Replace existing blowers with new high speed turbo blowers and fine bubble diffusers

The first strategy is to replace the existing blowers and diffusers with new multistage centrifugal blowers and fine bubble diffusers sized to deliver air at revised demand rates. The fine bubble diffusers allow for a greater amount of oxygen to be transferred into the water for a given amount of air. The maintenance requirements of new multistage centrifugal blowers would be similar to the maintenance requirements of the existing blowers. Regularly scheduled maintenance includes filter changes and oil changes.

The second strategy is to replace the existing blowers and diffusers with new high speed turbo blowers and fine bubble diffusers. With increased efficiency the new blowers would require less energy to operate. The fine bubble diffusers also allow for a greater amount of oxygen to be transferred into the water for a given amount of air. The maintenance requirements of new high speed turbo blowers would be less than for the existing blowers. Regularly scheduled maintenance includes pre-filter and fine-filter changes. High speed turbo blowers do not require lubrication.

Section 4
Development of Alternatives

4.1 Design Conditions

Process modeling was performed to determine aeration requirements. Table 4-1 summarizes the conditions that the new blowers and diffusers will be designed for. The existing conditions are current flows and loading and future are the projected flows and loadings.

Table 4-1. Summary of Aeration Requirements for Existing and Future Conditions

Parameters	Units	Existing	Future
Influent Flow			
Annual average	mgd	30	35
Maximum month	mgd	38.5	45
Influent $cBOD_5$/COD			
Annual average	lb/d	33,800/69,350	39,500/80,900
Maximum month	lb/d	45,500/93,160	52,600/107,870
Dissolved Oxygen			
Annual average	mg/L	3	3
Maximum Month	mg/L	3	3
Peak Hour	mg/L	1	1
Actual Oxygen Requirements			
Annual average	lb/d O_2	35,400	48,300
Maximum month	lb/d O_2	48,350	66,600
Airflow - Total			
Minimum	scfm	6,100	7,000
Annual average	scfm	12,100	14,000
Maximum month	scfm	18,100	21,100
Peak Hour	scfm	21,500	24,500

Based on the aeration requirements described in Table 4-1, the design conditions for future conditions are:

1. Number of Blowers: 4
2. Rated Capacity: 8,185 scfm
3. Discharge Pressure: 10.0 psig

4.2 Alternative No. 1: New Multistage Centrifugal Blowers and Fine Bubble Diffusers

The advantage to this alternative is the plant operators' familiarity with the blower units. By replacing the blowers with similar units, the training requirements will be reduced. The technology has been proven by its continued use at the plant along with other MSDGC facilities. The fine bubble diffusers allow for a greater amount of oxygen to be transferred into the water for a given amount of air. The disadvantages for Alternative No. 1 include higher maintenance costs for the blower units in addition to an increased use of electricity compared to Alternative No. 2. The disadvantages for both alternatives also include the need to replace aeration piping with new stainless steel piping to prevent rust and corrosion from plugging the diffusers.

The Net Present Value (NPV) analysis in Appendix A shows the NPV of costs over a 30 year period to be $23,248,710. The values used to determine this NPV are based on capital and annual costs. The Maintenance costs were determined from an average of the Maintenance costs on all four existing blowers from 2008 to present day. It is assumed that maintenance costs for new multistage centrifugal blowers will be similar. The cost of filters was added to the maintenance costs to provide the annual Maintenance and Filter costs as seen in Appendix A. The annual Electric Costs were based on a rate of $0.073 per KW/hr with two units running at 358 HP (267 KW).

4.3 Alternative No. 2: New High Speed Turbo Blowers and Fine Bubble Diffusers

The advantage to this alternative is a lower capital cost in addition to reduced maintenance and operating costs. The high speed turbo blowers are delivered as a package, further simplifying construction. The fine bubble diffusers allow for a greater amount of oxygen to be transferred into the water for a given amount of air. The disadvantages for Alternative No. 2 (and Alternative No. 1) include the need to replace aeration piping with new stainless steel piping to prevent rust and corrosion issues from plugging the diffusers.

The NPV analysis in Appendix B shows the NPV of costs over a 30 year period to be $17,817,189. The values used to determine this NPV are based on capital, annual and non-annual costs. The non-annual costs were provided by K-Turbo for their high speed turbo blowers. The annual cost of filters was based on replacement of the prefilter and fine filter. The annual Electric Costs were based on a rate of $0.073 per KW/hr with two units running at 335 HP (262 KW).

4.4 Recommendation

The recommended solution to the secondary treatment aeration problem is Alternative No. 2. The advantages of Alternative No. 2 over Alternative No. 1 are as follows:

1. Lower capital cost.
2. Lower operation and maintenance costs.
3. Lower energy costs.
4. Lower NPV.

Section 5

Execution Plan

Based on the recommendations, the existing blowers will be replaced with four new high speed turbo blowers, the existing diffusers will be replaced with new tube membrane type fine bubble diffusers, and the aeration piping will be replaced with new stainless steel piping to prevent rust and corrosion issues from plugging the diffusers. The project will bid and be awarded to the Contractor in December 2010. The construction period will be 24 months.

Section 6

Limitations

This document was prepared solely for MSDGC in accordance with professional standards at the time the services were performed and in accordance with the contract between MSDGC and Brown and Caldwell dated August 30, 2010. This document is governed by the specific scope of work authorized by MSDGC; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by MSDGC and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

This document sets forth the results of certain services performed by Brown and Caldwell with respect to the property or facilities described therein (the Property). MSDGC recognizes and acknowledges that these services were designed and performed within various limitations, including budget and time constraints. These services were not designed or intended to determine the existence and nature of all possible environmental risks (which term shall include the presence or suspected or potential presence of any hazardous waste or hazardous substance, as defined under any applicable law or regulation, or any other actual or potential environmental problems or liabilities) affecting the Property. The nature of environmental risks is such that no amount of additional inspection and testing could determine as a matter of certainty that all environmental risks affecting the Property had been identified. Accordingly, THIS DOCUMENT DOES NOT PURPORT TO DESCRIBE ALL ENVIRONMENTAL RISKS AFFECTING THE PROPERTY, NOR WILL ANY ADDITIONAL TESTING OR INSPECTION RECOMMENDED OR OTHERWISE REFERRED TO IN THIS DOCUMENT NECESSARILY IDENTIFY ALL ENVIRONMENTAL RISKS AFFECTING THE PROPERTY.

Further, Brown and Caldwell makes no warranties, express or implied, with respect to this document, except for those, if any, contained in the agreement pursuant to which the document was prepared. All data, drawings, documents, or information contained this report have been prepared exclusively for the person or entity to whom it was addressed and may not be relied upon by any other person or entity without the prior written consent of Brown and Caldwell unless otherwise provided by the Agreement pursuant to which these services were provided.

References

MSDGC Useful Life of Capital Assets Report.

Black and Veatch, Burgess & Niple, *Little Miami Treatment Plant Liquid/Solid Rehabilitation and Upgrade Study*, MSDGC, 2006.

Appendix A: Alternative No. 1

New Multistage Centrifugal Blowers and Fine Bubble Diffusers

LCCAParameters

Business Case Triple Bottom Line Evaluation: **MSDGC - Little Miami Blower Energy Efficiency Upgrade**

Inflation				3.00%	
Escalation Rate				3.50%	
Cost of capital (Discount Rate)				5.00%	
Year of Capital Investment	2011		Current Year	2010	

				Yr of Placement
	Capital Asset Initial Investment			
	Multistage Centrifugal Blowers Installed Cost	1	15285400	2011
				2011
	Capital Asset Cyclic Investment			
			0	2011

	Residual Values	Year				Salvage
				2011		
				2011		
				2011		
				2011		
				2011		
				2011		
				2011		
				2011		
				2011		
				2011		

	Non Annual Costs	Yearly Cycle		
			0	2011
			0	2011
			0	2011
			0	2011
			0	2011
			0	2011
			0	2011
			0	2011
			0	2011
			0	2011
	Startup Costs	Year Ending		
				2011
				2011
				2011
				2011
				2011
				2011
				2011
				2011
				2011
				2011
	Annual Costs	Annual		
	Maintenance and Filters	1	9700	2011
	Electric Costs	1	341482	2011
				2011
				2011
				2011
				2011
				2011
				2011
				2011
				2011

	Taxes, Incentives,Finance Charges, Grants, Rebates, Revenue, and Discounts	Year		
				2011
				2011
				2011
				2011
				2011
				2011
				2011
				2011
				2011
				2011

LCCACalculations

		1	2	3	4	5	6	7	8	9	10	11	12	13	14
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Capital Asset Initial Investment															
Multistage Centrifugal Blowers Installed Cost	$15,285,400.00														
	$0.00														
Capital Asset Cyclic Investment															
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Residual Values															
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Operation, Maintenance and Repair Costs															
Non Annual Costs															
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Startup Costs															
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Costs															
Maintenance and Filters		$10,290.73	$10,599.45	$10,917.44	$11,244.96	$11,582.31	$11,929.78	$12,287.67	$12,656.30	$13,035.99	$13,427.07	$13,829.88	$14,244.78	$14,672.12	$15,112.28
Electric Costs		$362,278.25	$373,146.60	$384,341.00	$395,871.23	$407,747.37	$419,979.79	$432,579.18	$445,556.56	$458,923.25	$472,690.95	$486,871.68	$501,477.83	$516,522.16	$532,017.83
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
Taxes, Incentives,Finance Charges, Grants, Rebates, Revenue, and Discounts															
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Capital Asset Initial Investment	$15,285,400.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total Capital Investment Cyclic Investment	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total Residual Costs	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total Non Annual Costs	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total Startup Costs	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total Annual Costs	$0.00	$372,568.98	$383,746.05	$395,258.43	$407,116.19	$419,329.67	$431,909.56	$444,866.85	$458,212.86	$471,959.24	$486,118.02	$500,701.56	$515,722.61	$531,194.28	$547,130.11
Total Taxes, Incentives,Finance Charges, Grants, Rebates, Revenue, and Discounts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total All Cash Flows	$15,285,400.00	$372,568.98	$383,746.05	$395,258.43	$407,116.19	$419,329.67	$431,909.56	$444,866.85	$458,212.86	$471,959.24	$486,118.02	$500,701.56	$515,722.61	$531,194.28	$547,130.11
Total Operating Costs	$0.00	$372,568.98	$383,746.05	$395,258.43	$407,116.19	$419,329.67	$431,909.56	$444,866.85	$458,212.86	$471,959.24	$486,118.02	$500,701.56	$515,722.61	$531,194.28	$547,130.11
NPV of Costs	$23,248,709.58														

15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
$15,565.65	$16,032.62	$16,513.60	$17,009.01	$17,519.28	$18,044.86	$18,586.20	$19,143.79	$19,718.10	$20,309.65	$20,918.94	$21,546.50	$22,192.90	$22,858.69	$23,544.45	$24,250.78
$547,978.36	$564,417.72	$581,350.25	$598,790.75	$616,754.48	$635,257.11	$654,314.82	$673,944.27	$694,162.60	$714,987.47	$736,437.10	$758,530.21	$781,286.12	$804,724.70	$828,866.44	$853,732.44
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
$563,544.02	$580,450.34	$597,863.85	$615,799.76	$634,273.76	$653,301.97	$672,901.03	$693,088.06	$713,880.70	$735,297.12	$757,356.03	$780,076.72	$803,479.02	$827,583.39	$852,410.89	$877,983.22
$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
$563,544.02	$580,450.34	$597,863.85	$615,799.76	$634,273.76	$653,301.97	$672,901.03	$693,088.06	$713,880.70	$735,297.12	$757,356.03	$780,076.72	$803,479.02	$827,583.39	$852,410.89	$877,983.22
$563,544.02	$580,450.34	$597,863.85	$615,799.76	$634,273.76	$653,301.97	$672,901.03	$693,088.06	$713,880.70	$735,297.12	$757,356.03	$780,076.72	$803,479.02	$827,583.39	$852,410.89	$877,983.22

Appendix B: Alternative No. 2

New High Speed Turbo Blowers and Fine Bubble Diffusers

LCCAParameters

Business Case Triple Bottom Line Evaluation: **MSDGC - Little Miami Blower Energy Efficiency Upgrade**

Inflation				3.00%	
Escalation Rate				3.50%	
Cost of capital (Discount Rate)				5.00%	
Year of Capital Investment	2011		Current Year	2010	

				Yr of Placement	
	Capital Asset Initial Investment				
	High Speed Turbo Blowers - Installed	1	10133900	2011	
				2011	
	Capital Asset Cyclic Investment				
			0	2011	
	Residual Values	Year			Salvage
				2011	
				2011	
				2011	
				2011	
				2011	
				2011	
				2011	
				2011	
				2011	
				2011	
	Non Annual Costs	Yearly Cycle			
	Service Impeller and Bearing Check	3	2000	2011	
	Capacitor Change	5	2000	2011	
	Motor Overhaul	10	5000	2011	
			0	2011	
			0	2011	
			0	2011	
			0	2011	
			0	2011	
			0	2011	
			0	2011	
	Startup Costs	Year Ending			
				2011	
				2011	
				2011	
				2011	
				2011	
				2011	
				2011	
				2011	
				2011	
				2011	
				2011	
	Annual Costs	Annual			
	Filters	1	2440	2011	
	Electric Costs	1	335088	2011	
				2011	
				2011	
				2011	
				2011	
				2011	
				2011	
				2011	
				2011	
				2011	
	Taxes, Incentives,Finance Charges, Grants, Rebates, Revenue, and Discounts	Year			
				2011	
				2011	
				2011	
				2011	
				2011	
				2011	
				2011	
				2011	
				2011	
				2011	

LCCACalculations

		1	2	3	4	5	6	7	8	9	10	11	12	13	14
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Capital Asset Initial Investment															
High Speed Turbo Blowers - Installed	$10,133,900.00														
	$0.00														
Capital Asset Cyclic Investment															
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Residual Values															
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Operation, Maintenance and Repair Costs															
Non Annual Costs															
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Service Impeller and Bearing Check	$0.00	0	0	$2,251.02	0	0	$2,459.75	0	0	$2,687.83	0	0	$2,937.07	0	0
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Capacitor Change	$0.00	0	0	0	0	$2,388.10	0	0	0	0	$2,768.47	0	0	0	0
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Motor Overhaul	$0.00	0	0	0	0	0	0	0	0	0	$6,921.17	0	0	0	0
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Startup Costs															
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Costs															
Filters		$2,588.60	$2,666.25	$2,746.24	$2,828.63	$2,913.49	$3,000.89	$3,090.92	$3,183.65	$3,279.16	$3,377.53	$3,478.86	$3,583.22	$3,690.72	$3,801.44
Electric Costs		$355,494.86	$366,159.70	$377,144.50	$388,458.83	$400,112.60	$412,115.97	$424,479.45	$437,213.84	$450,330.25	$463,840.16	$477,755.36	$492,088.02	$506,850.67	$522,056.19
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
Taxes, Incentives,Finance Charges, Grants, Rebates, Revenue, and Discounts															
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Capital Asset Initial Investment	$10,133,900.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total Capital Investment Cyclic Investment	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total Residual Costs	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total Non Annual Costs	$0.00	$0.00	$0.00	$2,251.02	$0.00	$2,388.10	$2,459.75	$0.00	$0.00	$2,687.83	$9,689.64	$0.00	$2,937.07	$0.00	$0.00
Total Startup Costs	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total Annual Costs	$0.00	$358,083.46	$368,825.96	$379,890.74	$391,287.46	$403,026.08	$415,116.87	$427,570.37	$440,397.48	$453,609.41	$467,217.69	$481,234.22	$495,671.25	$510,541.38	$525,857.63
Total Taxes, Incentives,Finance Charges, Grants, Rebates, Revenue, and Discounts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total All Cash Flows	$10,133,900.00	$358,083.46	$368,825.96	$382,141.76	$391,287.46	$405,414.19	$417,576.61	$427,570.37	$440,397.48	$456,297.24	$476,907.33	$481,234.22	$498,608.31	$510,541.38	$525,857.63
Total Operating Costs	$0.00	$358,083.46	$368,825.96	$382,141.76	$391,287.46	$405,414.19	$417,576.61	$427,570.37	$440,397.48	$456,297.24	$476,907.33	$481,234.22	$498,608.31	$510,541.38	$525,857.63
NPV of Costs	$17,817,188.91														

LCCACalculations

15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
$3,209.41	0	0	$3,507.01	0	0	$3,832.21	0	0	$4,187.56	0	0	$4,575.86	0	0	$5,000.16
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
$3,209.41	0	0	0	0	$3,720.59	0	0	0	0	$4,313.18	0	0	0	0	$5,000.16
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
0	0	0	0	0	$9,301.47	0	0	0	0	0	0	0	0	0	$12,500.40
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
$3,915.48	$4,032.95	$4,153.94	$4,278.55	$4,406.91	$4,539.12	$4,675.29	$4,815.55	$4,960.02	$5,108.82	$5,262.08	$5,4´9.95	$5,582.54	$5,750.02	$5,922.52	$6,100.20
$537,717.87	$553,849.41	$570,464.89	$587,578.84	$605,206.20	$623,362.39	$642,063.26	$661,325.16	$681,164.91	$701,599.86	$722,647.85	$744,327.29	$766,657.11	$789,656.82	$813,346.53	$837,746.92
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
$6,418.83	$0.00	$0.00	$3,507.01	$0.00	$13,022.06	$3,832.21	$0.00	$0.00	$4,187.56	$4,313.18	$0.00	$4,575.86	$0.00	$0.00	$22,500.72
$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
$541,633.35	$557,882.36	$574,618.83	$591,857.39	$609,613.11	$627,901.51	$646,738.55	$666,140.71	$686,124.93	$706,708.68	$727,909.94	$749,747.24	$772,239.65	$795,406.84	$819,269.05	$843,847.12
$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
$548,052.18	$557,882.36	$574,618.83	$595,364.40	$609,613.11	$640,923.57	$650,570.76	$666,140.71	$686,124.93	$710,896.23	$732,223.12	$749,747.24	$776,815.51	$795,406.84	$819,269.05	$866,347.84
$548,052.18	$557,882.36	$574,618.83	$595,364.40	$609,613.11	$640,923.57	$650,570.76	$666,140.71	$686,124.93	$710,896.23	$732,223.12	$749,747.24	$776,815.51	$795,406.84	$819,269.05	$866,347.84

Greater Cincinnati
Metropolitan Sewer District

Business Case Evaluation

Muddy Creek WWTP Blower Energy Efficiency Upgrade

MSD ID No. 10200002

Prepared By: Tim Koch, P.E., Brown and Caldwell
Under the direction of: Jeff Dean, P.E.
November 22, 2010

Table of Contents

List of Tables

Section 1

Executive Summary

The Muddy Creek WWTP Secondary Treatment process utilizes blowers to deliver the air required for the two (2) activated sludge Aeration Tanks. The system consists of four (4) 200 HP Roots Positive Displacement Blowers.

Under current influent loadings, only two (2) blowers are required to provide the necessary air to the Aeration Tanks. Typically one blower is operated at full speed, while the second blower is operated between 50% full speed during low biological loading periods and 100% during high biological load periods.

According to the MSDGC Useful Life of Capital Assets Report, the useful life for a blower is 30 years. The blowers at Muddy Creek were installed in 1972. Having exceeded their useful life, the blowers will be replaced.

Two replacement options were evaluated. Both options include replacing the blowers with new blowers. For both options, the new blowers will be slightly larger capacity than the existing blowers due to increased wet weather capacity and higher operating pressures..

The first replacement option is to replace the existing system with new positive displacement blowers similar to the existing blowers.

The second replacement option is to replace the existing system with new high speed turbo blowers.

Based on the alternatives analysis the recommendation is to procure new high speed turbo blowers. The new high speed turbo blowers are recommended due to lower capital, operation and maintenance, and energy costs in addition to their ease of construction.

Section 2
The Problem

2.1 Problem Statement

The Muddy Creek WWTP in recent years has exceeded the useful life of their blowers in the Secondary Treatment process. According to the MSDGC Useful Life of Capital Assets Report, the useful life for a blower is 30 years. The blowers at Muddy Creek were installed in 1972. Having exceeded their useful life, the blowers will be replaced.

The purpose of the report is to document the formulation and screening of the alternatives (Alternatives Development) for the Muddy Creek WWTP Blower Energy Efficiency Upgrade Project located in the south western portion of Hamilton County.

The Muddy Creek WWTP Secondary Aeration system consists of four blowers whose discharge piping combines to deliver air through headers and diffusers into each of the two aeration tanks.

2.2 Condition Assessment

The Muddy Creek WWTP is designed for a peak hourly wet weather flow of 35 MGD. Secondary Treatment is provided by two aeration tanks with fine bubble diffusers. Air is supplied to the aeration tanks by four positive displacement blowers:

A. Blowers
   1. Number: 4
   2. Type: Positive Displacement
   3. Stages: 3
   4. Rated Capacity: 4,650 scfm
   5. Discharge Pressure: 7.7 psig
   6. Horsepower: 200
   7. Age: Installed in 1972

B. Diffusers
   1. Sanitaire Ceramic Disc Fine Bubble Diffusers
   2. Age: Installed in 2008

The blowers have exceeded their useful life and must be replaced according to the MSDGC Useful Life of Capital Assets Report. While the blowers remain in operation, their continued use will result in higher operating and maintenance costs over time.

2.3 Problem Diagnosis

The MSDGC Useful Life of Capital Assets Report requires replacement of the existing blowers at the Muddy Creek WWTP. Although the blowers are currently still functional, continued use will result in higher operating and maintenance costs due to part failures as well as normal wear and tear of the equipment. The blowers should be replaced to ensure operational reliability and efficiency.

2.4 Boundary of the Analysis

The project area was confined to the Secondary Treatment aeration process only. No other plant processes or areas were investigated. The remainder of the Secondary Treatment process should be evaluated in a separate report.

Section 3
Strategies

3.1 Initial Screening of Strategies

There are two possible strategies for replacing the blowers in the Muddy Creek WWTP Secondary Treatment process.

1. Replace existing blowers with new positive displacement blowers
2. Replace existing blowers with new high speed turbo blowers

The first strategy is to replace the existing blowers with new positive displacement (PD) blowers sized to deliver air at the new demand rates. The new blowers would be slightly more efficient than the existing blowers due to the improved efficiency from new inlet guide vanes. The maintenance requirements of new PD blowers would be similar to the maintenance requirements of the existing blowers. Regularly scheduled maintenance includes filter changes and oil changes.

The second strategy is to replace the existing blowers with new high speed turbo blowers. With increased efficiency the new blowers would require less energy to operate. The maintenance requirements of new high speed turbo blowers would be less than the maintenance requirements for the existing blowers. Regularly scheduled maintenance includes pre-filter and fine-filter changes. High speed turbo blowers do not require lubrication.

Section 4
Development of Alternatives

4.1 Design Conditions

Process modeling was performed to determine aeration requirements. Table 4-1 summarizes the existing and future conditions that the new blowers will be designed for. Four options were evaluated during the process modeling. The options were:

1. Existing process operation to meet secondary $cBOD_5$ and TSS requirements
2. Full nitrification (effluent Ammonia-nitrogen less than 1 mg/L average)
3. Full nitrification and biological phosphorus removal
4. Nitrification and denitrification (effluent total nitrogen less than 10 mg/L average). Additional denitrification (denitrification filters or denitrifying biologically active filters) and phosphorus removal (chemical precipitation) are required to meet very low nutrient limits.

Full nitrification represented the highest future air requirements, and is included in Table 4-1 as the "Future" condition.

Table 4-1. Summary of Aeration Requirements for Existing and Future Conditions

Parameters	Units	Existing	Future
Influent Flow			
Annual average	mgd	15	15
Maximum month	mgd	20	20
Maximum day	mgd	35	35
Influent $cBOD_5$/COD			
Annual average	lb/d	10,600/24,100	10,600/24,100
Maximum month	lb/d	16,100/36,700	16,100/36,700
Dissolved Oxygen			
Annual average	mg/L	2	2
Maximum Month	mg/L	2	2
Peak Hour	mg/L	1	1
Actual Oxygen Requirements			
Annual average, both basins			
Pass 1	lb/d O_2	3,100	3,200
Pass 2	lb/d O_2	1,900	1,700
Pass 3	lb/d O_2	1,100	1,000
Maximum month			
Pass 1	lb/d O_2	4,600	5,400
Pass 2	lb/d O_2	2,300	2,200
Pass 3	lb/d O_2	1,300	1,500

Airflow - Total			
Minimum			
Pass 1	scfm	700	700
Pass 2	scfm	380	360
Pass 3	scfm	360	350
Total including channel air	scfm	3,200	3,200
Annual average			
Pass 1	scfm	1,700	1,500
Pass 2	scfm	900	760
Pass 3	scfm	440	390
Total including channel air	scfm	6,400	5,600
Maximum month			
Pass 1	scfm	2,800	2,900
Pass 2	scfm	1,200	1,000
Pass 3	scfm	570	640
Total including channel air	scfm	9,400	9,600
Peak Hour			
Pass 1	scfm	3,900	4,100
Pass 2	scfm	1,600	1,500
Pass 3	scfm	800	900
Total including channel air	scfm	13,000	13,200

Based on the aeration requirements described in Table 4-1, the design conditions for future conditions are:

1. Number of Blowers: 4
2. Rated Capacity: 4,770 scfm
3. Discharge Pressure: 8.3 psig

4.2 Alternative No. 1: New Positive Displacement Blowers

The advantage to this alternative is the plant operators' familiarity with the blower units. By replacing the blowers with similar units, the training requirements will be reduced. The technology has been proven by its continued use at the plant along with other MSDGC facilities. The disadvantages for Alternative No. 1 include higher maintenance costs for the blower units in addition to an increased use of electricity compared to Alternative No. 2. Both alternatives include replacing iron aeration piping with new stainless steel piping to prevent rust and corrosion from plugging the diffusers.

The Net Present Value (NPV) analysis in Appendix A shows the NPV of costs over a 30 year period to be $7,924,865. The values used to determine this NPV are based on capital, annual and non-annual costs. The Maintenance costs were determined from an average of the Maintenance costs on all four existing blowers from 2006 to present day. It is assumed that maintenance costs for new PD blowers will be similar. The cost of filters was added to the maintenance costs to provide the annual Maintenance and Filter costs as seen in Appendix A. The non-annual costs were based on replacing the VFD capacitor every five years. The annual Electric Costs were based on a rate of $0.073 per KW/hr with two units running at 182 HP (135 KW).

4.3 Alternative No. 2: New High Speed Turbo Blowers

The advantage to this alternative is a lower capital cost in addition to reduced maintenance and operating costs. The high speed turbo blowers are delivered as a package, further simplifying construction. Both alternatives include replacing iron aeration piping with new stainless steel piping to prevent rust and corrosion issues from plugging the diffusers.

The NPV analysis in Appendix B shows the NPV of costs over a 30 year period to be $6,096,012. The values used to determine this NPV are based on capital, annual and non-annual costs. The non-annual costs were provided by K-Turbo for their high speed turbo blowers. The annual cost of filters was based on replacement of the prefilter and fine filter. The annual Electric Costs were based on a rate of $0.073 per KW/hr with two units running at 133 HP (106 KW).

4.4 Recommendation

The recommended solution to the secondary treatment aeration problem is Alternative No. 2. The advantages of Alternative No. 2 over Alternative No. 1 are as follows:

1. Lower capital cost.
2. Lower operation and maintenance costs.
3. Lower energy costs.
4. Lower NPV.

Section 5

Execution Plan

Based on the recommendations, the existing blowers will be replaced with four new high speed turbo blowers and the iron aeration piping will be replaced with new stainless steel piping to prevent rust and corrosion issues from plugging the diffusers. The project will bid and be awarded to the Contractor in December 2010. The construction period will be 24 months.

Section 6

Limitations

This document was prepared solely for MSDGC in accordance with professional standards at the time the services were performed and in accordance with the contract between MSDGC and Brown and Caldwell dated August 30, 2010. This document is governed by the specific scope of work authorized by MSDGC; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by MSDGC and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

This document sets forth the results of certain services performed by Brown and Caldwell with respect to the property or facilities described therein (the Property). MSDGC recognizes and acknowledges that these services were designed and performed within various limitations, including budget and time constraints. These services were not designed or intended to determine the existence and nature of all possible environmental risks (which term shall include the presence or suspected or potential presence of any hazardous waste or hazardous substance, as defined under any applicable law or regulation, or any other actual or potential environmental problems or liabilities) affecting the Property. The nature of environmental risks is such that no amount of additional inspection and testing could determine as a matter of certainty that all environmental risks affecting the Property had been identified. Accordingly, THIS DOCUMENT DOES NOT PURPORT TO DESCRIBE ALL ENVIRONMENTAL RISKS AFFECTING THE PROPERTY, NOR WILL ANY ADDITIONAL TESTING OR INSPECTION RECOMMENDED OR OTHERWISE REFERRED TO IN THIS DOCUMENT NECESSARILY IDENTIFY ALL ENVIRONMENTAL RISKS AFFECTING THE PROPERTY.

Further, Brown and Caldwell makes no warranties, express or implied, with respect to this document, except for those, if any, contained in the agreement pursuant to which the document was prepared. All data, drawings, documents, or information contained this report have been prepared exclusively for the person or entity to whom it was addressed and may not be relied upon by any other person or entity without the prior written consent of Brown and Caldwell unless otherwise provided by the Agreement pursuant to which these services were provided.

References

MSDGC Useful Life of Capital Assets Report.

Appendix A: Alternative No. 1

New Positive Displacement Blowers

LCCAParameters

Business Case Triple Bottom Line Evaluation: **MSDGC - MuC WWTP Blower Energy Efficiency Upgrade**

Inflation				3.00%	
Escalation Rate				3.50%	
Cost of capital (Discount Rate)				5.00%	
Year of Capital Investment	2011		Current Year	2010	

				Yr of Placement	
	Capital Asset Initial Investment				
	Positive Displacement Blowers - Installed	1	3864840	2011	
				2011	
	Capital Asset Cyclic Investment				
			0	2011	
	Residual Values	Year			Salvage
				2011	
				2011	
				2011	
				2011	
				2011	
				2011	
				2011	
				2011	
				2011	
				2011	
	Non Annual Costs	Yearly Cycle			
	VFD Capacitor	5	4000	2011	
			0	2011	
			0	2011	
			0	2011	
			0	2011	
			0	2011	
			0	2011	
			0	2011	
	Startup Costs	Year Ending			
				2011	
				2011	
				2011	
				2011	
				2011	
				2011	
				2011	
				2011	
				2011	
				2011	
	Annual Costs	Annual			
	Maintenance and Filters	1	5700	2011	
	Electric Costs	1	172660	2011	
				2011	
				2011	
				2011	
				2011	
				2011	
				2011	
				2011	
				2011	
	Taxes, Incentives,Finance Charges, Grants, Rebates, Revenue, and Discounts	Year			
				2011	
				2011	
				2011	
				2011	
				2011	
				2011	
				2011	
				2011	
				2011	
				2011	

LCCACalculations

		1	2	3	4	5	6	7	8	9	10	11	12	13	14
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Capital Asset Initial Investment															
Positive Displacement Blowers - Installed	$3,864,840.00														
	$0.00														
Capital Asset Cyclic Investment															
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Residual Values															
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Operation, Maintenance and Repair Costs															
Non Annual Costs															
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
VFD Capacitor	$0.00	0	0	0	0	$4,776.21	0	0	0	0	$5,536.94	0	0	0	0
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Startup Costs															
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Costs															
Maintenance and Filters		$6,047.13	$6,228.54	$6,415.40	$6,607.86	$6,806.10	$7,010.28	$7,220.59	$7,437.21	$7,660.32	$7,890.13	$8,126.84	$8,370.64	$8,621.76	$8,880.41
Electric Costs		$183,174.99	$188,670.24	$194,330.35	$200,160.26	$206,165.07	$212,350.02	$218,720.52	$225,282.14	$232,040.60	$239,001.82	$246,171.87	$253,557.03	$261,163.74	$268,998.65
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
Taxes, Incentives,Finance Charges, Grants, Rebates, Revenue, and Discounts															
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Capital Asset Initial Investment	$3,864,840.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total Capital Investment Cyclic Investment	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total Residual Costs	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total Non Annual Costs	$0.00	$0.00	$0.00	$0.00	$0.00	$4,776.21	$0.00	$0.00	$0.00	$0.00	$5,536.94	$0.00	$0.00	$0.00	$0.00
Total Startup Costs	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total Annual Costs	$0.00	$189,222.12	$194,898.79	$200,745.75	$206,768.12	$212,971.17	$219,360.30	$225,941.11	$232,719.35	$239,700.93	$246,891.95	$254,298.71	$261,927.67	$269,785.50	$277,879.07
Total Taxes, Incentives,Finance Charges, Grants, Rebates, Revenue, and Discounts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total All Cash Flows	$3,864,840.00	$189,222.12	$194,898.79	$200,745.75	$206,768.12	$217,747.38	$219,360.30	$225,941.11	$232,719.35	$239,700.93	$252,428.89	$254,298.71	$261,927.67	$269,785.50	$277,879.07
Total Operating Costs	$0.00	$189,222.12	$194,898.79	$200,745.75	$206,768.12	$217,747.38	$219,360.30	$225,941.11	$232,719.35	$239,700.93	$252,428.89	$254,298.71	$261,927.67	$269,785.50	$277,879.07
NPV of Costs	$7,924,864.83														

LCCACalculations

15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
$6,418.83	0	0	0	0	$7,441.18	0	0	0	0	$8,626.37	0	0	0	0	$10,000.32
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
$9,146.83	$9,421.23	$9,703.87	$9,994.98	$10,294.83	$10,603.68	$10,921.79	$11,249.44	$11,586.93	$11,934.53	$12,292.57	$12,661.35	$13,041.19	$13,432.42	$13,835.40	$14,250.46
$277,068.61	$285,380.67	$293,942.09	$302,760.36	$311,843.17	$321,198.46	$330,834.41	$340,759.45	$350,982.23	$361,511.70	$372,357.05	$383,527.76	$395,033.59	$406,884.60	$419,091.14	$431,663.87
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
$6,418.83	$0.00	$0.00	$0.00	$0.00	$7,441.18	$0.00	$0.00	$0.00	$0.00	$8,626.37	$0.00	$0.00	$0.00	$0.00	$10,000.32
$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
$286,215.44	$294,801.90	$303,645.96	$312,755.34	$322,138.00	$331,802.14	$341,756.20	$352,008.89	$362,569.16	$373,446.23	$384,649.62	$396,189.11	$408,074.78	$420,317.02	$432,926.53	$445,914.33
$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
$292,634.27	$294,801.90	$303,645.96	$312,755.34	$322,138.00	$339,243.32	$341,756.20	$352,008.89	$362,569.16	$373,446.23	$393,275.98	$396,189.11	$408,074.78	$420,317.02	$432,926.53	$455,914.65
$292,634.27	$294,801.90	$303,645.96	$312,755.34	$322,138.00	$339,243.32	$341,756.20	$352,008.89	$362,569.16	$373,446.23	$393,275.98	$396,189.11	$408,074.78	$420,317.02	$432,926.53	$455,914.65

Appendix B: Alternative No. 2

New High Speed Turbo Blowers

LCCAParameters

Business Case Triple Bottom Line Evaluation: MSDGC - MuC WWTP Blower Energy Efficiency Upgrade

Inflation				3.00%	
Escalation Rate				3.50%	
Cost of capital (Discount Rate)				5.00%	
Year of Capital Investment	2011		Current Year	2010	

				Yr of Placement		
	Capital Asset Initial Investment					
	High Speed Turbo Blowers - Installed	1	2936940	2011		
				2011		
	Capital Asset Cyclic Investment					
			0	2011		
	Residual Values	Year				Salvage
				2011		
				2011		
				2011		
				2011		
				2011		
				2011		
				2011		
				2011		
				2011		
				2011		
	Non Annual Costs	Yearly Cycle				
	Service Impeller and Bearing Check	3	2000	2011		
	Capacitor Change	5	2000	2011		
	Motor Overhaul	10	5000	2011		
			0	2011		
			0	2011		
			0	2011		
			0	2011		
			0	2011		
			0	2011		
			0	2011		
	Startup Costs	Year Ending				
				2011		
				2011		
				2011		
				2011		
				2011		
				2011		
				2011		
				2011		
				2011		
				2011		
	Annual Costs	Annual				
	Filters	1	2440	2011		
	Electric Costs	1	135570	2011		
				2011		
				2011		
				2011		
				2011		
				2011		
				2011		
				2011		
				2011		
	Taxes, Incentives,Finance Charges, Grants, Rebates, Revenue, and Discounts	Year				
				2011		
				2011		
				2011		
				2011		
				2011		
				2011		
				2011		
				2011		
				2011		
				2011		

LCCACalculations

		1	2	3	4	5	6	7	8	9	10	11	12	13	14
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Capital Asset Initial Investment															
High Speed Turbo Blowers - Installed	$2,936,940.00														
	$0.00														
Capital Asset Cyclic Investment															
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Residual Values															
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Operation, Maintenance and Repair Costs															
Non Annual Costs															
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Service Impeller and Bearing Check	$0.00	0	0	$2,251.02	0	0	$2,459.75	0	0	$2,687.83	0	0	$2,937.07	0	0
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Capacitor Change	$0.00	0	0	0	0	$2,388.10	0	0	0	0	$2,768.47	0	0	0	0
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Motor Overhaul	$0.00	0	0	0	0	0	0	0	0	0	$6,921.17	0	0	0	0
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
	$0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Startup Costs															
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual Costs															
Filters		$2,588.60	$2,666.25	$2,746.24	$2,828.63	$2,913.49	$3,000.89	$3,090.92	$3,183.65	$3,279.16	$3,377.53	$3,478.86	$3,583.22	$3,690.72	$3,801.44
Electric Costs		$143,826.21	$148,141.00	$152,585.23	$157,162.79	$161,877.67	$166,734.00	$171,736.02	$176,888.10	$182,194.74	$187,660.59	$193,290.40	$199,089.12	$205,061.79	$211,213.64
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
Taxes, Incentives,Finance Charges, Grants, Rebates, Revenue, and Discounts															
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Capital Asset Initial Investment	$2,936,940.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total Capital Investment Cyclic Investment	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total Residual Costs	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total Non Annual Costs	$0.00	$0.00	$0.00	$2,251.02	$0.00	$2,388.10	$2,459.75	$0.00	$0.00	$2,687.83	$9,689.64	$0.00	$2,937.07	$0.00	$0.00
Total Startup Costs	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total Annual Costs	$0.00	$146,414.81	$150,807.25	$155,331.47	$159,991.41	$164,791.16	$169,734.89	$174,826.94	$180,071.75	$185,473.90	$191,038.12	$196,769.26	$202,672.34	$208,752.51	$215,015.08
Total Taxes, Incentives,Finance Charges, Grants, Rebates, Revenue, and Discounts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total All Cash Flows	$2,936,940.00	$146,414.81	$150,807.25	$157,582.49	$159,991.41	$167,179.26	$172,194.64	$174,826.94	$180,071.75	$188,161.73	$200,727.75	$196,769.26	$205,609.41	$208,752.51	$215,015.08
Total Operating Costs	$0.00	$146,414.81	$150,807.25	$157,582.49	$159,991.41	$167,179.26	$172,194.64	$174,826.94	$180,071.75	$188,161.73	$200,727.75	$196,769.26	$205,609.41	$208,752.51	$215,015.08
NPV of Costs	$6,096,011.83														

LCCACalculations

15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
$3,209.41	0	0	$3,507.01	0	0	$3,832.21	0	0	$4,187.56	0	0	$4,575.86	0	0	$5,000.16
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
$3,209.41	0	0	0	0	$3,720.59	0	0	0	0	$4,313.18	0	0	0	0	$5,000.16
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
0	0	0	0	0	$9,301.47	0	0	0	0	0	0	0	0	0	$12,500.40
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
$3,915.48	$4,032.95	$4,153.94	$4,278.55	$4,406.91	$4,539.12	$4,675.29	$4,815.55	$4,960.02	$5,108.82	$5,262.08	$5,419.95	$5,582.54	$5,750.02	$5,922.52	$6,100.20
$217,550.05	$224,076.55	$230,798.85	$237,722.82	$244,854.50	$252,200.14	$259,766.14	$267,559.12	$275,585.90	$283,853.47	$292,369.08	$301,140.15	$310,174.35	$319,479.59	$329,063.97	$338,935.89
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
$6,418.83	$0.00	$0.00	$3,507.01	$0.00	$13,022.06	$3,832.21	$0.00	$0.00	$4,187.56	$4,313.18	$0.00	$4,575.86	$0.00	$0.00	$22,500.72
$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
$221,465.54	$228,109.50	$234,952.79	$242,001.37	$249,261.41	$256,739.25	$264,441.43	$272,374.67	$280,545.91	$288,962.29	$297,631.16	$306,560.10	$315,756.90	$325,229.61	$334,986.49	$345,036.09
$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
$227,884.36	$228,109.50	$234,952.79	$245,508.38	$249,261.41	$269,761.32	$268,273.64	$272,374.67	$280,545.91	$293,149.85	$301,944.34	$306,560.10	$320,332.75	$325,229.61	$334,986.49	$367,536.81
$227,884.36	$228,109.50	$234,952.79	$245,508.38	$249,261.41	$269,761.32	$268,273.64	$272,374.67	$280,545.91	$293,149.85	$301,944.34	$306,560.10	$320,332.75	$325,229.61	$334,986.49	$367,536.81

SECTION 43 11 23

HIGH SPEED INTEGRAL MOTOR DRIVEN BLOWERS

PART 1—GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies self contained, electric, high speed, integral motor driven blowers, complete with control system, sound enclosures and appurtenances, for use in variable volume applications. The aeration blowers shall supply air to aeration basins at the Little Miami and Muddy Creek wastewater treatment facilities, Metropolitan Sewer District of Greater Cincinnati, Ohio. Airflow rates to the fine bubble diffuser system shall be varied to maintain the required air flow rate to achieve the desired mixed liquor dissolved oxygen (DO) concentration in the aeration basins.

B. TYPE:

Blowers provided under this section shall be of the self contained, high speed, high efficiency turbo type with integral direct connected motor. Included with the blower shall be the inlet filter/silencer housing, inlet filter, inlet silencer, blow-off valve, blow-off silencer, acoustic sound enclosure, drive motor, air foil bearing, variable frequency drive (VFD), local and master control panels, vibration detection system, surge control system, suction and discharge flexible couplings, check valves, and other appurtenances as described in this specification section. A master control panel (MCP) shall be furnished as a separate enclosure. The same supplier shall furnish the blowers, master control panels and appurtenances as a complete and fully integrated blower system.

C. DEFINITIONS:

1. STANDARD CUBIC FEET PER MINUTE (SCFM): The volumetric flow rate in cubic feet per minute at 68 degrees F, 14.70 pounds per square inch absolute pressure and 36-percent relative humidity.

2. ABSOLUTE PRESSURE (PSIA): The total pressure measured from an absolute vacuum is the absolute pressure. Units are pounds per square inch absolute (psia).

3. DISCHARGE PRESSURE (PSIG): The pressure at the blower discharge at site conditions. Units are pounds per square inch gauge (psig).

4. WIRE-TO-AIR EFFICIENCY. The ratio of the adiabatic power for compression of a perfect gas to the total input power to the blower system. Wire-to-air efficiency shall be calculated in accordance with ASME PTC-10 with k, the ratio of specific heats, taken as having a value of 1.40 for air.

Standard atmospheric conditions shall be taken as 68 degrees F, 14.7 psia, and 36 percent relative humidity.

D. EQUIPMENT LIST:

Little Miami

Item	Location Numbers*			
	Blower 1	Blower 2	Blower 3	Blower 4
Blower				
Inlet Air Filter				
Master Control Panel				

Muddy Creek

Item	Location Numbers*			
	Blower 1	Blower 2	Blower 3	Blower 4
Blower				
Inlet Air Filter				
Master Control Panel				

* Owner will provide Location Numbers to be used for equipment identification and tagging during construction.

E. OPERATING CONDITIONS:

The blowers will be operated in parallel with similar equipment to produce aeration air necessary to meet process requirements. Blowers will be operated at variable speed in response to process signals to maintain constant pressure in the discharge header.

The blowers will be installed in the equipment gallery which will be ventilated with outside air. Environmental conditions are listed below.

Description	Range of Conditions
Winter	Cool with frequent freezing
Summer	Mild; occasionally hot and humid
Relative humidity, percent	
Indoors	60 – 80%
Average outdoors	55 – 90%
Air temperature, degrees F	
Outdoors	-20 - 103

Indoors	50 - 90
Elevation	600 ft MSL
Barometric pressure, inches, mercury	29.3

F. PERFORMANCE AND DESIGN REQUIREMENTS:

The blowers provided under this section shall meet the following operating requirements:

Little Miami

	LM-Blower 1	LM-Blower 2	LM-Blower 3	LM-Blower 4
Condition A[1]				
Inlet pressure, psia[6]	14.2	14.2	14.2	14.2
Inlet temperature, degrees F	95	95	95	95
Relative humidity, percent	80	80	80	80
Discharge pressure, psig[7]	9.8	9.8	9.8	9.8
Discharge volume, scfm	8165	8165	8165	8165
Wire-to-air efficiency[5], percent, minimum	69	69	69	69
Condition B[2]				
Inlet pressure, psia[6]	14.2	14.2	14.2	14.2
Inlet temperature, degrees F	0	0	0	0
Relative humidity, percent	10	10	10	10
Discharge pressure, psig[7]	9.8	9.8	9.8	9.8
Discharge volume, scfm, minimum	8165	8165	8165	8165
Wire-to-air efficiency[5], percent, minimum	71	71	71	71
Condition C[4]				
Inlet pressure, psia[6]	14.36	14.36	14.36	14.36
Inlet temperature, degrees F	55	55	55	55
Relative humidity, percent	70	70	70	70
Discharge pressure, psig[7]	8.7	8.7	8.7	8.7
Discharge volume, scfm, minimum	4000	4000	4000	4000
Wire-to-air efficiency[5], percent, minimum	64	64	64	64

Muddy Creek

	MC-Blower 1	MC-Blower 2	MC-Blower 3	MC-Blower 4
Condition A[1]				
Inlet pressure, psia[6]	14.22	14.22	14.22	14.22
Inlet temperature, degrees F	95	95	95	95
Relative humidity, percent	80	80	80	80
Discharge pressure, psig[7]	8.3	8.3	8.3	8.3
Discharge volume, scfm	4770	4770	4770	4770
Wire-to-air efficiency[5], percent, minimum	69	69	69	69
Condition B[2]				
Inlet pressure, psia[6]	14.22	14.22	14.22	14.22
Inlet temperature, degrees F	0	0	0	0
Relative humidity, percent	10	10	10	10
Discharge pressure, psig[7]	8.3	8.3	8.3	8.3
Discharge volume, scfm, minimum	4770	4770	4770	4770
Wire-to-air efficiency[5], percent, minimum	67	67	67	67
Condition C[4]				
Inlet pressure, psia[6]	14.38	14.38	14.38	14.38
Inlet temperature, degrees F	55	55	55	55
Relative humidity, percent	70	70	70	70
Discharge pressure, psig[7]	8.3	8.3	8.3	8.3
Discharge volume, scfm, minimum	2800	2800	2800	2800
Wire-to-air efficiency[5], percent, minimum	64	64	64	64

See Notes below.

In addition, the following limitations shall apply to the motor:

	LM-Blower 1 - 4	MC-Blower 1 - 4
Motor horsepower, maximum[3]	500	250

NOTES: 1. Condition A shall be the blower's rated condition. This condition shall impose the greatest pressure requirement at the highest airflow through the machine. The blower's shaft efficiency at the rated condition shall be not less than that listed. The blower motor shall be selected to drive the

blower without overloading under this condition. The blower overload protection system shall ensure that the motor is never required to produce more than its nameplate rating. Use of the motor's service factor rating to meet this requirement will not be accepted.

2. Condition B is the estimated operating requirement for the blower under conditions which will impose the greatest mass flow through the machine. The blower motor shall be selected to drive the blower without overloading under this condition. The blower overload protection system shall ensure that the motor is never required to produce more than its nameplate rating. Use of the motor's service factor rating to meet this requirement will not be accepted.

3. Power requirements at all operating conditions must be non-overloading. Blowers with motor horsepower in excess of this number will not be allowed.

4. Condition C represents the maximum acceptable lowest volume operating point on the blower's pressure-capacity curve. Blower operation between this condition and all others listed in paragraph 43 11 23-1.01 F shall be free from surge without resorting to surge control measures of any kind.

5. Wire-to-air efficiency shall be at the best efficiency point along blower's pressure-volume curve for the specified discharge volume at a constant speed.

6. Inlet absolute pressure listed is atmospheric pressure minus any inlet pressure losses.

7. Discharge pressure excludes inlet losses (piping, filter, silencer, valves, etc) to the blower

The blower shall have, as a minimum, 0.75 psi pressure rise to surge from the rated discharge pressure under all operating conditions.

G. CONTROLS:

1. GENERAL: Each blower shall be provided with an integral control cabinet to contain the machine's start/stop, surge, and pressure/volume and speed controls as well as vibration monitoring and safety/shutdown systems. Unless otherwise specified, electrical control circuits shall operate on 120 volts AC, single phase.

2. START-UP/SHUTDOWN: The blower shall be capable of being manually started and stopped from a control station located on the face of the control cabinet, or automatically from the master control panel. Interlocks shall be provided to prevent start if the blow-off control valve is not fully opened by the surge control system. Once start has been initiated, no further operator intervention shall be required. The blower shall start automatically, with the surge control valve open. Once the machine has accelerated to operating

speed, the surge control valve shall close. On initiation of the shutdown sequence, the blow-off control valve shall open.

3. SURGE CONTROL: The surge control system shall function to modulate blower volume to prevent surge by venting a variable portion of the machine's output during start-up and shutdown or by varying the blowers output whenever the blower pressure/volume controls require process output less than the blower's surge limit. The surge control system shall incorporate the manufacturer's latest design standard, with primary surge monitoring elements interlocked with the safety shutdown controls. The surge control system shall also utilize the vibration monitoring system to assist in early detection of a surge condition.

1.02 QUALITY ASSURANCE

A. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ANSI H 35.1	Alloy and Temper Designation Systems for Aluminum
ANSI/IEEE 112	Standard Test Procedures for Polyphase Induction Motors and Generators
API 594	Check Valves: Flanged, Lug, Wafer, and Butt-Welding
API 617	Axial and Centrifugal Compressors and Expander-compressors for Petroleum, Chemical, and Gas Industry Services
ASME/ANSI B16.5	Pipe Flanges and Flanged Fittings
ASME PTC 10-1997	Performance Test Code on Compressors and Exhausters

Reference	Title
ASME PTC 19.5 - 2004	Flow Measurement
ASHRAE 52.2	Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size
ASTM A36/A36M	Carbon Structural Steel
ASTM A 48	Gray Iron Castings
ASTM A 276	Stainless Steel Bars and Shapes
IEEE 519	Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems
ISO 9001	Quality Management Systems -- Requirements
NEMA MG 1	Motors and Generators
NEMA MG 3	Sound Level Prediction for Installed Rotating Electrical Machines
NFPA 79	Electrical Standard for Industrial Machinery
IEEE 85	Test Procedure for Airborne Noise Measurements on Rotating Electric Machinery

B. FACTORY TESTS:

1. GENERAL:

Upon completion of the blower assembly, the blower system, blow off valves, discharge check valves, harmonic filters and signal conditioners, vibration monitor and control panel as a fully integrated and operational system shall be subject to factory and performance tests before shipment. The local control panel shall be connected to all enclosure instruments, electric valves, and appurtenances. All start / stop and running sequences and all safety alarm systems shall be tested. The blower system shall be tested with all doors closed and panels installed, and inlet filter/silencer installed to simulate the final installed condition. Testing the blower core removed from the sound enclosure is not allowed.

All test logs and plotted test results shall be provided and shall be certified correct under penalty of perjury by an officer of the manufacturing corporation. A written statement that the blower performance meets the specified performance requirements shall be included as a part of the submitted certified test report.

The Owner will require a witnessed test. Accordingly, the Contractor shall furnish the Engineer with at least six (6) weeks' written notification of the time and location of the test.

2. CERTIFIED FACTORY TESTS:

Blower manufacturer shall conduct testing on each blower system as outlined below. Blower manufacturer shall provide a registered professional engineer to witness all of the testing. The witnessing engineer shall sign and seal the test procedures and results, certifying that the assembled blowers, auxiliaries, blow off valves, discharge check valves, and control panel were tested together, as a system, in the blower manufacturer's facility. If the certified factory tests indicate noncompliance with the requirements of this Section, the blower shall be reworked and retested at the manufacturer's full expense until compliance with the requirements is attained. The test shall be sufficiently comprehensive to produce guaranteed performance characteristics.

Conduct performance testing and reporting in accordance with the above standards and as specified herein:

a. The capacity of the blower shall be defined as per Paragraph 4.26 of the ASME PTC 10 Power Test Code and ASME 19.5. Air flow shall be measured on the discharge side of the blower at zero percent negative tolerance.

b. All test equipment shall be calibrated and certified by an independent test agency no more than 12 months prior to the test date. Certificates shall show the stability of calibration over a period of at least one year per ISO 9001, Paragraph 4.11.

c. A calibrated wattmeter certified by the local power company shall measure the electrical shaft power input to the blower system. Measured power shall include wire to air and include all losses associated with electrical shaft power, including but not limited to the motor, inverter, job filter and cooling system.

d. The test data shall be employed to produce operating curves showing pressure-capacity, power-capacity, and efficiency capacity curves and surge points for each operating condition specified. The performance shall be shown in terms of SCFM, discharge pressure (psig), brake horsepower required at the input shaft of the blower, total input power (kW) and actual wire to air efficiency. Data showing performance at rated speed vs. discharge pressure from lowest system pressure to maximum pressure shall be provided with surge points indicated.

e. Net delivered flow rate and discharge pressure shall be guaranteed with no negative tolerance. There shall be no tolerances or measuring uncertainties used in the reporting of the test results (i.e., the test results report + or – zero percent tolerance using measured values).

f. Data showing performance at rated speed vs. discharge pressure from lowest system pressure to maximum pressure. The performance shall be shown in terms of standard cubic feet per minute and brake horsepower required at the input shaft of the blower. The data shall be for the inlet conditions specified in the Performance Requirements section of this specification and corresponding to operation at rated inlet conditions and maximum inlet density. Surge points shall be indicated.

g. Conduct performance tests at 6 test points on each blower as specified in 43 11 23-1.02 D. Two of these points shall bracket the rated point. The test shall be conducted at constant speed and shall extend from the surge point to not less than 110 percent of design volume at design pressure. The test shall be sufficiently comprehensive to confirm minimum turndown and produce guaranteed performance characteristics.

h. Measure actual wire to air values during the ASME PTC-10 factory test for all test points described above.

i. Provide a copy of certified efficiency data from 50% to 100% full load for the drive motor shall be furnished.

j. Prior to conducting the tests, submit the proposed test procedure for review.

3. CONTRACT PRICE ADJUSTMENT:

The guaranteed power values submitted under paragraph 43 11 23-1.03 shall be compared to the factory test results. If the factory test results demonstrate that the blower wire-to-air power requirements are greater than the submitted guaranteed power values, the contract price will be reduced by a penalty calculated as follows:

Penalty = \$100,000 [$P_{MINIMUM}$ + $P_{60\%}$ + $P_{70\%}$ + $P_{80\%}$ + $P_{90\%}$ + $P_{MAXIMUM}$] where:

$P_{MINIMUM}$ = The difference between actual and guaranteed power (kW) at condition point C times 0.29.

$P_{60\%}$ = The difference between actual and guaranteed power (kW) at 60%* times 0.29.
$P_{70\%}$ = The difference between actual and guaranteed power (kW) at 70%*times 0.58.
$P_{80\%}$ = The difference between actual and guaranteed power (kW) at 80%*times 0.81.
$P_{90\%}$ = The difference between actual and guaranteed power (kW) at 90%* times 0.31.
$P_{MAXIMUM}$ = The difference between actual and guaranteed power (kW) at condition point A times 0.13.

*-Refers to conditions as called for in paragraph 43 11 23 1.02 D.

All power figures will be adjusted for power losses in the motor operating at project altitude. The actual wire to air power at the specified operating points shall be derived per ASME PTC-10 and as described above from the wire to air power at the equivalent points during the factory test.

This adjustment will be calculated for each plant (Little Miami WWTP and Muddy Creek WWTP) seperately. For the purpose of determining the penalty, performance figures for the blowers provided for each plant under this section will be averaged prior to performing the above calculation. The sum thus calculated for each plant will be added together to determine the total adjustment. The total adjustment will be deducted from progress payments due to the Contractor.

4. MOTOR TEST:

The motor shall be subjected to a factory test which shall consist of:

a. No load current and speed
c. Winding resistance
d. Four-hour heat run
e. Winding and bearing temperature at end of heat run
f. Conformance test in accordance with NEMA MG1-20.47
g. Bearing inspection

The specified tests shall be performed in accordance with NEMA MG1-12 or MG1-20, as applicable. Copies of the results, plus the computer design calculation printout for efficiency and power factor (at 100 percent, 75 percent and 50 percent of full load) shall be provided.

D. POWER GUARANTEE:

The blower manufacturer shall submit a power guarantee table for each blower specified in this section. Power guarantee tables shall include values for guaranteed wire-to-air kW power, wire-to-air kW efficiency, flow rate, barometric and discharge pressures, inlet temperature, and

relative humidity at 6 operating points between and including the blower minimum capacity (Design Condition C) and the maximum blower capacity (Design Condition A). The 6 operating points shall include the following conditions in ascending order:

(1) Condition C
(2) 60% of discharge volume of Condition A, and same pressures and atmospheric conditions as Condition A
(3) 70% of discharge volume of Condition A, and same pressures and atmospheric conditions as Condition A
(4) 80% of discharge volume of Condition A, and same pressures and atmospheric conditions as Condition A
(5) 90% of discharge volume of Condition A, and same pressures and atmospheric conditions as Condition A
(6) Condition A

The completed table will be considered the basis of the Power Guarantee and contract price adjustment, and all related requirements as specified herein. The blower manufacturer shall reaffirm stated guarantee wire kW values for the blower unit in the final submittal and associated shop drawings. The guaranteed wire kW values must match what is presented in the bid and construction submittals. Failure to meet this requirement will result in immediate rejection.

E. SHIPMENT, PROTECTION AND STORAGE:

Equipment shipment, protection and storage shall conform to the requirements specified in Section 01 66 00.

F. WARRANTY:

In addition to the guarantee specified in the General Conditions, the blower manufacturer shall provide a written warranty to cover the blower package, including the motors, VFDs, and control components, against defects in workmanship and material for a period of ten years from the Contract Completion. The manufacturer’s warranty shall be issued in the Owner’s name.

G. MANUFACTURER'S EXPERIENCE:

Equipment furnished under this section shall be the product of a single manufacturer who shall be able to demonstrate not less than 3 years' continuous successful experience in not less than ten similar applications with equipment of similar sized. If the Contractor proposes a manufacturer with less than the required experience, the proposal shall be accompanied by a cash bond or irrevocable letter of credit drawn on a financial institution insured by the United States government in the amount of not less than $200,000. The bond or irrevocable letter of credit shall have a term of two years, beginning with substantial completion of this portion of the project. The instrument shall be in a form satisfactory to the Owner and surrenderable to the Owner upon the failure of the equipment, in the sole opinion of the Owner, to demonstrate continuous, reliable operation in the intended application.

1.03 SUBMITTALS

The following submittals shall be provided in accordance with Section 01 33 00:

A. BID SUBMITTAL

1. The blower manufacturers shall submit a preliminary submittal to assist in the Owner's selection of the turbo blower systems. The preliminary submittal shall include adequate information for a through evaluation of the proposed blower system. The system and final selection will be based on the successful demonstration of the following criteria and/or considerations:

    a. Manufacturer's Qualifications:

        1) Business Structure: Submittal shall identify the proposed manufacturer's current approach on the development and implementation of turbo blower technology in the North American market.

        2) Installation List: Include a comprehensive list of all installed units, with North American installations clearly identified. List must include equipment model and service application, including the aeration system installations where the Blower Manufacturer supplied aeration system controls and Master Control Panels of the same make and type specified in this Specification.

        3) Submittal shall identify the individual that will serve as the point-of-contact for the procurement, service, and warranty of the blower system.

        4) Manufacturer shall describe their current service network, by listing the nearest factory authorized service center and/or qualified service representative to the Owner's facility. Identify service technicians and include pertinent certifications to substantiate their knowledge and expertise.

        5) Manufacturers shall describe and demonstrate their approach to field start-up and training.

        6) Start-Up: Include a description and sample test procedure for field start-up.

        7) Factory Training: Include a description of the factory training facility and sample outline for typical factory training that will be available to the Owner. Identify the trainer and associated qualifications, including resume and/or training certifications.

8) Field Training: Include a description of the typical field training and sample outline that will be available to the Owner, as specified in this Section. Identify the trainer and associated qualifications, including resume and/or training certifications.

b. Quality of Construction:

1) Proof of UL or TUV Certification: Submit proof of certification on the same model and size proposed.

2) Statement of conformance letter stating conformance to the specifications with all exceptions noted. Statement of conformance must be signed original copy by an individual authorized to make such statements.

3) Bill of Materials: Complete bill of materials of all components and equipment supplied. Bill of materials shall include make and model number and replacement cost of the primary components including, but not limited to the following:

a) VFD

b) Control System

c) Sensors (temperature, pressure, vibration, etc)

4) Spare Parts: Include a list of spare parts and point of purchase. Include a statement of availability of all parts.

c. Power Guarantee:

1) The blower manufacturer shall guarantee the maximum wire-to-air ("wire") kW values, in accordance with tables in 43 11 23 Paragraph 1.02.D.

d. The blower manufacturer shall reaffirm stated guaranteed wire kW values for each blower unit in the Construction Submittal and associated Shop Drawings. The Guaranteed wire kW values must match what is presented in the Preliminary Submittal. Failure to meet this requirement may result in immediate rejection.

e. Warranty and Service Agreements: Submit a detailed description of the manufacturer's warranty and service agreement options.

1) Ten (10) Year Extended Warranty: Provide a ten-year warranty for all parts and labor at no additional cost. Include a detailed description of the manufacturer's extended warranty options.

2) Extended Routine Maintenance: Include a detailed description of the manufacturer's extended routine

maintenance options. Description shall include pricing structure.

3) Service Agreements: Include a detailed description of the manufacturer's service options. Description shall include pricing structure.

B. CONSTRUCTION SUBMITTAL

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. A check mark shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. *Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.*

2. A copy of the contract document control diagrams and process and instrumentation diagrams relating to the submitted equipment, with addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal. If no changes are required, the drawing or drawings shall be marked *"no changes required"*. Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.

3. Manufacturer's catalog data and shop drawings confirming dimensions, weight, construction, and installation details of blower and all associated equipment. Shop drawings shall include spatial requirements showing clearances required for maintenance purposes.

4. Predicted performance curves for the performance and design requirements specified under paragraph 43 11 23-1.02.D showing pressure-capacity, power-capacity, and efficiency-capacity curves, air to wire power and surge points for each operating condition specified. Operating curves shall show the flow rate and motor current range as a function of inlet temperature and that the blower is able to operate within without causing a surge condition shall be provided. Capacity shall be shown in discharge scfm.

All performance parameters shall reflect site conditions as listed in paragraph 43 11 23-1.02.D for each operating condition. Sample actual test condition inlet/specified condition acfm conversion calculations shall also be provided.

5. Operating noise levels shall be provided for the motor and blower combination. Noise shall be expressed as sound pressure levels (SPL) in decibels as read on the "A" weighting network of a standard sound level meter (dBa); all measurements shall be made in relation to a reference pressure of 0.0002 microbar.

6. Drawing and catalog information detailing all controls and control panel, including complete master wiring diagrams, elementary or control schematics, overall panel layout interconnection diagrams, and communication network diagrams.

7. Motor data Form 26 05 83-A.

8. Electrical and control wiring diagrams.

9. Control system configuration parameters to be read/written with register address, bit assignment, setting value (range of value) over plant process control network for SCADA system as specified.

10. Anchor bolt and seismic bracing calculations as specified in paragraph 43 11 23-2.03G.

11. A list of the manufacturer's recommended spare parts.

12. Power guarantee table in accordance with 43 11 23-1.02 D

PART 2--PRODUCTS

2.01 MANUFACTURERS

The Owner and Engineer believe the following candidate manufacturers are capable of producing equipment and/or products that will satisfy the requirements of this Section. This statement, however, shall not be construed as an endorsement of a particular manufacturer's products, nor shall it be construed that named manufacturers' standard equipment or products will comply with the requirements of this Section. Candidate manufacturers include: APG-Neuros, Inc and K-Turbo USA; Engineer knows of no equal.

2.02 MATERIALS

Materials shall be as follows:

Component	Material
Blower Casings and inlet inducer	High-strength aluminum alloy, A1Si7Mg-T6 (T6=Heat treatment stage)
Blower Shafts	420 stainless steel, titanium alloy
Blower and Motor Frame	Welded steel. ASTM A 36
Blower discharge spool and elbow	Steel, ASTM A 36
Blower impeller	Type 7075 Aluminum or Stainless steel Grade 630
Flexible joints	Type 316L Stainless steel braid/bellows, ASTM A276
Blow off silencer	Steel, ASTM A 36
Blow off valve	Steel, ASTM A 36
Discharge check valve	Stainless steel body and disc, Viton seat
Anchor Bolts	Type 316 Stainless steel

All elastomeric materials for couplings, valves, etc., shall be rated for minimum 250 °F.

Materials specified are considered the minimum acceptable for the purposes of durability, strength, and resistance to erosion and corrosion. The Contractor may propose alternative materials for the purpose of providing greater strength or to meet required stress limitations. However, alternative materials must provide at least the same qualities as those specified for the purpose.

2.03 EQUIPMENT

A. BLOWER:

1. Blowers shall be capable of variable speed operation with a minimum turndown of fifty percent (50%) of the blower's full capacity.
2. Blowers shall operate within specified vibration levels without overloading the drive motor, and without signs of distress when operating at specified operating point and including off design conditions. Blower manufacturer shall be responsible for attenuating noise and vibration in the blower package such that no special installation base shall be required nor shall any vibration from the blower package be transmitted to the base or the piping. A vibration monitor shall be supplied to confirm/measure operating vibration levels.

3. The blowers shall be designed such that no special foundations or reinforced equipment pads shall be required for installation.
4. Blowers shall be single-stage centrifugal design intended for heavy, continuous industrial service, shall not require oils or lubricants for adequate operation, and shall deliver oil-free air.
5. Each blower shall be labeled and listed as a complete unit by a nationally recognized electrical testing laboratory (as defined in OSHA Regulation 1910.7) for the application.
6. The blowers shall have a pressure-volume curve, which extends from the design system pressure to the upper system surge pressure with a continuously rising pressure characteristic, and shall not surge at or above flow rates corresponding to specified surge pressure. Each blower must be capable of the specified turndown shown above over the entire temperature range.
7. The impellers shall be shaped from a solid cast stainless steel alloy or a solid cast or forged piece of high-strength forged aluminum alloy on a numerical machining center using CAM technology. Impeller shall be of the backswept three dimensional high efficiency configuration designed using Computational Fluid Dynamics (CFD) with two stages in one (axial and centrifugal) and with first lateral critical speed at least 120% of the maximum allowable operating speed. Impeller shall be mounted directly to the motor shaft without a coupling or keyway and have a labyrinth and O-ring seal arrangement. Impeller shall be statically and dynamically balanced. Impellers shall be of standard design configuration and not specifically designed for a specific duty point.
8. The bearings shall be bump foil air bearing type and sized for a minimum of ten (10) years and a minimum of 75,000 hard stops expected between major overhauls.
9. Operator shall not be required to reach over any component of the blower package to perform maintenance.

B. MOTOR:

1. An air-cooled or closed system liquid cooled, variable-speed (inverter duty) compatible, high frequency electric motor designed for continuous duty, high-speed, variable torque service shall be provided. The motor shall be a high speed permanent magnet type with Class F winding insulation, soft start, thermal and moisture sensors, and thermal protection surveillance software built into the VFD. Nameplate shall be NEMA standard stainless steel and shall also include NEMA efficiency rating, bearing information, and number of starts per hour.
2. Provide a high temperature shutoff control circuit that shall include a high temperature shutoff tied to a temperature probe in the blower discharge connection. Two thermal protectors in the stator windings (one each end) shall be provided. Thermal protectors shall be rod and tube type or similar that is sensitive to rate of rise as well as temperature.

3. The motor shaft shall be either horizontally or vertically mounted and supported. The critical speed of the rotor must be a minimum of 20% above the operating design speed.
4. Motor shall be 460VAC, 60 Hz, 3-phase with a 1.15 service factor. The motor-blower unit shall be mounted to a welded steel base/frame with elastic mountings. The maximum input motor horsepower should not exceed the specified nameplate horsepower when operating at all design conditions.

C. VARIABLE FREQUENCY DRIVE:

1. A built-in variable frequency drive (VFD) customized to provide optimal blower efficiency at all operational conditions shall be provided to control the blower speed.
2. VFD software shall provide for blower control based on the signal from the supplied master control panel automation controls or the local control panel (keypad on the blower door).
3. A VFD shall control the blower operation according to the performance references set. These references can be from the local control panel (keypad on the blower door) or from the supplied master control panel controls via an Ethernet message.
4. The VFD shall be air or liquid cooled.
5. VFD shall conform to the testing requirements of Section 25 08 00.

D. HARMONIC FILTER:

1. Harmonic filtering shall be provided in conjunction with each blower. In addition to the requirements of IEEE-519, input filters to the VFDs shall reduce the Current Distortion (THID) to 5% or less. Refer to section 26 35 26.
2. Each blower shall have Running and Loaded (if applicable) Dry contacts connected to its Harmonic input filter so that capacitors can be switched while VFD is running as recommended by the Harmonic filter supplier. These signals are in addition to the Ethernet signals provided for the SCADA system so the blower manufacturer shall provide additional relays if needed. The dry contacts shall be rated 120VAC, 5A minimum.

E. SINE WAVE FILTER:

1. Provide a VFD output filter to limit peak voltages below 1400 volts.
2. Filter shall be compatible with output frequencies up to 600 hz.
3. Filter shall be compatible with VFD.

G. SOUND ENCLOSURE:

1. Each blower shall be supplied with a sound enclosure covering the entire blower package.
2. Noise emission from the blower package shall not exceed 85 dBa within +/- 2 dBa tolerance within 3 feet of the blower package.
3. The sound enclosure shall be designed for easy inspection and maintenance of all blower package components. Quick release panels, each less than 50 lbs, shall provide easy and quick access for routine maintenance of the blower and the package components. Should the panels be heavier than 50 lbs, hinged doors shall be supplied, with the appropriate frame, reinforcements and supporting elements.
4. Electrical components, instrumentation and instrument connections shall not be mounted or interface with moving panels of the sound enclosure except as required for the control cabinet section.
5. All intake ports used for enclosure ventilation air shall be provided with replaceable filters meeting the requirements specified for the inlet filter/silencers in Section 2.03
6. Sound enclosure shall bear the label specified in 43 11 23-2.03 A.5.

G. ACCESSORIES:

1. Blow-off Valve: The blow off valve shall be an integral part of the blower to protect it during start up and shut down conditions. It shall be an electric or electro-pneumatically controlled valve that is controlled by the blower control system. The blow off valve shall be mounted on the blower discharge manifold and be sufficiently sized to handle the flow and pressures seen during start up and shut down. Discharge from the blow-off valve shall be directed to an externally mounted silencer. Connection to the blow-off valve shall utilize a 150 lb bolted flange for connection to either the blow-off silencer or discharge piping.

2. Blow-off Silencer: Each blower shall be provided with a blow-off silencer suitable for installation as specified and adequately sized for airflows specified in paragraph 43 11 23-1.01F. The silencer shall be selected to limit pipeline noise to not more than 80 dBa 3 feet from the blow-off exhaust. Internal baffles, packed with sound absorbent material, shall direct air flow around four 90° turns in an annular flow configuration.

3. Discharge Check Valve: The blower shall be supplied with a discharge check valve suitable for use in the service specified and capable of providing an airtight seal upon closure with minimum pressure loss when open. The check valve shall meet API 594 standard and shall be of the double disc, center pivot, spring assisted type, specifically designed for installation in the orientation shown under the operating conditions and test pressures

specified. When necessary because of piping configuration or valve orientation, special light weight discs and/or special springs shall be provided to assure proper operation and sealing or to minimize loss. All components shall be suitable for use with air temperatures up to 300 degrees F. Valves shall be APCO series 9000, Crane Duo-Chek II, Tyco Gulf Valve Model MB, or approved equal, modified to meet specified requirements.

4. Expansion Joints: 316L stainless steel flexible metal bellows expansion joints shall be provided by the blower manufacturer at the discharge connections to the blower. Formed bellows type expansion joints shall be suitable for temperatures up to 800 degrees F shall have 300 series stainless steel multi-ply bellows rated for the specified design temperature and pressure. Each expansion joint shall be factory tested at the test pressure. Expansion joint design shall be determined by the amount and kind of movement specified (axial, lateral, angular). Unless otherwise specified, end connections shall be flanged with an ASME/ANSI B16.5, Class 150 bolt pattern and shall include control rods. Formed bellows type expansion joints shall be as manufactured by Hyspan Series 2500 laminated bellows, or equal.

5. Fittings and Connections: Adapters and connective fittings between the blower and the fixed piping shown on the Contract Drawings shall be provided by the manufacturer to accommodate increases and reduction in pipe diameter around the blower equipment. Connections to discharge piping shall be 150 lb flanged, with ANSI B16.5 bolt pattern.

6. Inlet Filter: Each blower shall be supplied with one combination inlet filter silencer. The filter media shall provide of two-stage filtration with an efficiency of 90% by weight per ASHRE 52.2 and a synthetic dust equivalent to separation > 95% @ 10 microns. The inlet filter silencer shall be suitable for outdoor installation and mounted directly to the inlet flange of the blower. Filter and silencer shall be adequately sized for the airflow rate of each blower specified and the performance losses shall be included by the blower vendor in the blower performance calculation. Maximum clean pressure loss across the filter shall be less than 0.12 psig. Each blower shall be supplied with one inlet silencer and shall include filter elements, filter housing, filter access door and filter adapter.

7. Cooling System: Blower and integral VFD shall not require any external cooling devices such as cooling fans or external water cooling. If required, internal cooling systems shall be sized to adequately cool the blower system at the operating conditions specified in paragraph 43 11 23-1.01E. Interlocks shall be provided to shut down the blower if the cooling system fails (e.g., high temperature or pump failure). Where air is used for cooling, the cooling system shall be designed to direct the rejected heat with either the blower discharge air or out of the blower enclosure.

Flanged or grooved pipe and fittings shall be provided to vent the rejected heat.

E. INSTRUMENTS:

1. Instruments used for point and continuous measurement (mechanically and/or electronic) shall be industrial grade, certified for the installation area classification, accuracy better than ±0.5 percent, meet specified environmental conditions and have listing/labeling/marking acceptable to the local, state, and federal electrical codes. These instruments shall be factory or field calibrated and field tested under actual operating conditions by the blower manufacturer.

2. Instruments used for regulation, conditioning, control, monitoring, alarming and data acquisition (electronic) shall be industrial grade, certified for the installation area classification, meet specified environmental conditions and have listing/labeling/marking acceptable to the local, state and federal electrical codes.

3. Instruments shall be mounted as recommended by the blower manufacturer and as specified in this section. Instruments mounted on the face of a panel shall meet the same NEMA rating as the associated panel.

4. Instruments shall be provided integral to the blower system as required for equipment protection/ performance optimization/ service/ maintenance and as required to meet the operations specified.

5. Instruments shall comply with the requirements of Division 25.

F. CONTROLS AND ELECTRICAL:

1. GENERAL: Control and electrical devices, systems and panels shall conform to the requirements of Divisions 25, 26, and 40.

2. CONTROL PANELS:

a. Panel(s) shall be provided with instruments used for regulation, conditioning, control, monitoring, alarming, and data acquisition. Control shall include blower(s) start/stop, emergency stop, pressure/volume regulation and safety/shutdown systems.

b. Panel(s) shall contain distribution components, power supplies and transformers, as required to derive power for all instruments and equipment provided as part of the blower package.

c. Panel(s) shall be provided with a power source as specified.

d. Panel(s) shall be NEMA 12 rated.

3. CONTROL SYSTEM:

a. All controls necessary for the manual and fully automatic operation shall be provided.

1) In manual, the blower shall operate as a separate unit with start/stop, pressure/volume regulation and safety/shutdown system.
2) In automatic, each blower shall operate under the command of the MCP to meet a pressure set point which is provided by the Plant SCADA along with system START and STOP over the specified communication network. The Plant SCADA controls the aeration drop-leg flow rates based on meeting dissolved oxygen requirements at various locations in the aeration basins by modulating valves. The MCP maintains a constant header pressure on the aeration blowers' discharge by changing the speed or motor current setpoint sent to each blower. The control system shall not allow the blower system to operate in a surge condition at any time. The control system shall allow the user to select the sequence which allows the blowers to be rotated into operation.

b. The control systems shall monitor the following as a minimum:
1) Motor bearing temperatures
2) Motor winding temperature
3) Inlet and discharge air temperatures
4) Blower Inlet and discharge pressure, psig
5) Vibration (RMS Value of entire spectrum)
6) Blow-off status
7) Control mode status
8) Running status
9) Speed
10) Output Power (Watts)
11) Output Current (Amps)
12) Runtime
13) Inlet Filter Differential pressure

In addition, the control systems shall include any other monitoring points recommended by the blower manufacturer. Monitoring points shown on the P&ID drawings shall be readable by the plant's SCADA.

c. The control systems shall provide the following alarm indications as a minimum:

1) High motor bearing temperature
2) High motor winding temperature
3) Excessive vibration
4) Motor overcurrent
5) Fault
6) Power Failure
7) High inlet filter differential pressure

In addition, the control systems shall include any other alarm points recommended by the blower manufacturer. All alarms shall be readable by the plant's SCADA.

d. The control systems OI displays shall follow NFPA 79 for color graphic interface devices, and be coordinated with Owner to provide a standardized appearance and interface with plant's SCADA system.

e. The control systems shall interface with the plant's SCADA system using 100 Mbps Ethernet and Rockwell's *Ethernet/IP protocol*. The control systems shall allow the plant's SCADA to read/write data over the Ethernet local area network (LAN) .

f. The control system shall be able to restart automatically after a power failure or power restoration. The plant's SCADA system shall serve as a master to sequence the plant equipment online after a power failure or power restoration. The plant's SCADA system shall provide a permissive over the Ethernet LAN which shall be used by the control systems to allow restart in manual or automatic.

g. The control system data for transfer over the plant's SCADA system shall be provided in READ and WRITE tables, packaged in consecutive words with clear description of function, on/off state, scale range, and measuring unit.

h. The control system's runtime and development software shall be non-propriety and shall be licensed to the Owner. The control system's application programming/graphics shall be provided to the Owner after commissioning.

i. Controllers used in the blower panels shall be PLCs or microcontrollers as required. All controllers shall have interfaces to communicate with Ethernet/IP protocol. At Little Miami, provide fiber-optic media converters to interface with the LAN.

Controllers used in the MCP shall be Allen-Bradley ControlLogix to match the owner's SCADA system; see section 40 94 43 for detailed PLC specifications.

4. BLOWER LOCAL CONTROL INTERFACE: Local blower control, status and annunciation shall be through the Blower Control Panel front panel. The front panel shall be mounted on the door of the Blower Control Panel, and shall contain a switch, a push-button, and a touch screen control panel. The blower local control interface shall provide at a minimum the following functions:

a. DISPLAY SCREENS FOR BLOWER OPERATION: The blower functions shall be monitored continuously during operation by means of the control panel default display. The basic display during monitoring shall show the following:

1) Discharge Flow Volume (SCFM)
2) Output pressure
3) Inlet pressure
4) Operating time in hours
5) Operating time in days
6) Power counter
7) Differential pressure at inlet air filter
8) Reference flow volume
9) Blower type
10) Program version
11) Current
12) Inverter temperature
13) Motor temperature
14) Inlet temperature
15) Vibration
16) Control mode status
17) Running status
18) Speed
19) Power

b. FAULT AND ALARM MESSAGES: If the control system detects a malfunction during blower operation, the blower shall stop and a fault message appears in the control panel display. If the fault does not require stopping the blower, an alarm is displayed until acknowledged or the reason for the alarm is corrected or cleared. The system shall automatically monitor the following minimum conditions:

1) Power Supply Status including:

- Over voltage in main supply
- Under voltage in main supply
- One phase missing
- Over/under voltage in auxiliary supply

2) Process Air Connections including:

- Blockage in the inlet or outlet air piping
- Overpressure
- Inlet air temperature too high (surge)

3) Cooling Air Connections including:

- Blockage in the inlet or outlet air piping
- Cooling air over temperature via motor/VFD over temperature monitoring.
- Motor temperature
- VFD temperature
- Magnetic bearing controller temperature

5. MASTER CONTROL PANEL: The Master Control Panel (MCP) shall be a standalone Allen Bradley ControlLogix PLC, conforming to the requirements of section 40 94 43, used to control the blowers feeding into the same pressure line. The MCP shall control the group of blowers to maintain their operation at optimal efficiency at varying process demands.

a. The MCP shall be compatible with the site SCADA/PLC network, have 4 point analog input card(s) that monitors pressure from two transmitters. A Panelview 300 shall be used to provide operator interface. The MCP shall receive a pressure setpoint signal from the SCADA/PLC network to control blower output. The MCP shall also use an Ethernet IP communications link to the SCADA/PLC network to monitor the blower status, reset alarms, and change set points.

b. The MCP, touch screen control panel, and marshalling for the I/O and communications will be assembled into a single NEMA 12 wall mounted enclosure approximately 3 feet wide by 1 foot deep. The closed network between the MCP and blowers shall be Ethernet IP communication protocol.

c. The MCP touch screen shall allow operations staff to view and change the blower sequencing (lead, lag, lag1, etc). It shall also offer a choice of which pressure transmitter, including the option of an average between the two.

d. An ethernet switch shall be supplied under this contract to enable Ethernet communications between the Blower controllers, the blower MCP and the Master Aeration PLC. See section 25 13 16 and the appropriate drawings showing the network architecture.

1) At Little Miami, the switch shall be provided in the Aeration Master PLC.

2) At Muddy Creek the switch shall be provided in the Blower MCP.

e. The MCP panel shall have a UPS (Uninterruptible Power Supply) that can supply the entire panel for 15 minutes or more. The UPS shall provide power to all PLCs, instruments, network devices and HMI displays. It does not need to power cabinet heaters or convenience lighting. A relay shall be wired so that in the event of a UPS failure, the PLC will be powered directly from the incoming line power – see drawings for an example of this relay wiring.

G. ANCHORAGE: The blower manufacturer shall be responsible for the design of the anchor bolting system for each separately mounted component furnished in this Section. Anchor bolts and connecting bolts for all assemblies supported as furnished under this Section shall be designed in accordance with Sections 05 05 23 and 01 90 00. Anchorage Bolts shall be stainless steel. Seismic calculations shall be provided by an Engineer who is a State of Ohio Licensed Structural Engineer.

2.04 COATINGS

A. Prime and finish coatings shall be applied in accordance with Section 09 90 00.

2.05 SPARE PARTS AND TOOLS

A. The following spare parts shall be provided:

1. One inlet filter of each type per each blower supplied.

Spare parts shall be tagged and stored as specified in 44 05 13.

B. Manufacturer shall furnish one set of special tools required for complete assembly or disassembly of blower system components for each type or size of blower specified, together with a neat metal box (or boxes) for the same. The tool kit shall be sufficiently complete to permit normal repair and maintenance of all equipment furnished under this project.

2.06 PRODUCT DATA

A. The following information shall be provided in accordance with Section 01 33 00:

1. Certified results of factory blower and motor tests including test logs as specified in paragraph 43 11 23-1.02C.

2. Instrument test results, as specified in paragraph 43 11 23-2.03E/1.

3. Certified performance curves for each unit based upon pressure-capacity, power-capacity, efficiency-capacity curves, and surge points.

4. Complete as-built schematic and wiring diagrams.

5. Operator and maintenance information as specified in Section 01 78 23.

6. Installation Certification Form 44 05 13-A specified in paragraph 43 11 23-3.01.

7. Manufacturer's Representative's installation report, as specified in paragraph 43 11 23-3.02E.

8. Certificate of Proper Installation, as specified in paragraph 43 11 23-3.02G.

9. Field test results, as specified in paragraph 3.03B.

8. Training details, as specified in paragraph 43 11 23-3.04A

11. Training Certification Form 44 05 13-B specified in paragraph 43 11 23-3.04A.

12. Provide fully annotated programmable controller (including microprocessors) application program code which achieves the functions specified along with a written control description that describes the application program code in non-technical terms using clear sentence structure that includes sequence of events, interlocks, action on fault conditions. Hard copy and electronic copy shall be provided in native program and PDF.

13. Provide OI terminal application program graphics/code which achieves the functions specified. Hard copy and electronic copy shall be provided in native program and PDF.

PART 3--EXECUTION

3.01 GENERAL

Furnish, install, finish, and place in service the blower and all appurtenances in accordance with the manufacturer's recommendations. The installation shall be certified on Form 44 05 13-A as specified in Section 01 33 19.

3.02 INSTALLATION

A. The blower supplier shall supply blower packages shipped completely pre-assembled. Only the electrical connections and pipe connections shall be performed on site by contractor.

B. Contractor shall be fully responsible for installing all equipment in this Section and conducting startup and testing in accordance with the blower manufacturer's written recommendations and/or requirements. The Contractor shall include in his costs all assistance required of the manufacturer to ensure proper installation, provide startup and testing assistance, and train the Owner's personnel.

C. Contractor shall, where required, install anchor bolts per the blower manufacturer's instructions and calculations.

E. Following installation but prior to startup or testing, the manufacturer shall send a representative to the job site to inspect the installation. Any deficiencies noted during the manufacturer's representative's inspection must be corrected prior to startup or testing. The manufacturer's representative shall note any findings in a written report to the Contractor, with a copy provided to the Engineer.

F. The Contractor shall remedy any deficiencies noted by the manufacturer's representative in the written report. The manufacturer's representative shall re-inspect the installation and this process shall be repeated until the manufacturer's representative finds the equipment to be installed in accordance with the manufacturer's recommendations and requirements.

G. Upon finding of satisfactory installation, and prior to startup or testing, the manufacturer's representative shall issue a Certificate of Proper Installation and provide a copy to the Engineer. Startup and testing may begin once the Engineer has received the Certificate of Proper Installation from the manufacturer.

3.03 START-UP AND COMMISIONING

A. The equipment provided under this section shall be started and tested only under the direction of personnel provided by the blower manufacturer. To that end, the Contractor shall cause the manufacturer to furnish start-up and testing specialists factory-trained in the proper procedures for initial installation, initial testing, and commissioning of the equipment. All such activities shall be performed under the

direction of these specialists. This provision, however, shall not be construed as relieving the Contractor of overall responsibility for this work.

B. Test procedures shall conform to the requirements of Section 01 75 01 and those specified in this Section. They shall contain the following features:
   1. Static tests of all control and protective circuits.
   2. Not less than two (2) cold starts.
   3. Not less than 24 hours of continuous operation at full load.
   4. Communications and network monitoring and control with plant's SCADA system.
   5. The contractor shall provide third party electrical harmonic mitigation testing of all VFD's associated with the blower system. The harmonic mitigation test shall be performed at the point of common coupling (PCC) as defined in Section 26 08 01. The third party testing shall:
      a. Demonstrate to the satisfaction of the Engineer that there is no harmonic distortion to the electrical system per IEEE 519.
      b. Be performed for each blower system for the duration of not less than 24 hours.
      c. Be repeated if necessary at no cost to the Owner or Engineer.

C. Commissioning shall conform to the requirements of Section 01 91 00. During commissioning, a qualified manufacturer's service representative shall be available to provide answers to service inquiries within eight (8) hours and onsite technical assistance within twenty-four (24) hours when required.

D. After the equipment has been placed into operation by the Owner for a minimum of forty-five (45) calendar days, the equipment manufacturer shall provide one (1) eight (8) hour day of equipment follow-up for equipment inspection and Owner review. This visit shall be coordinated with the Owner.

3.04 TRAINING

A. The manufacturer's representative shall be present at the job site for a minimum of four (4) 8-hour days, exclusive of travel time, to fully train the Owner's personnel in the proper operation and maintenance of the equipment. A minimum of four (4) 4-hour sessions of training conforming to the requirements of Section 01 79 00 shall be provided. Training details shall be submitted three (3) weeks prior to scheduled training. Training shall be certified on Form 44 05 13-B specified in Section 01 33 19.

END OF SECTION 43 11 23

THIS PAGE LEFT BLANK INTENTIONALLY

SECTION 46 51 00

FINE BUBBLE DIFFUSION EQUIPMENT

PART 1--GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section includes labor, materials, equipment, appurtenances, and incidentals required for fine bubble membrane diffusion systems for the distribution of aeration air to satisfy process oxygen requirements and maintain solids suspension in a municipal wastewater process. Work includes air drop pipes, manifolds, laterals, fine bubble diffusers, and pipe supports, complete with all accessories, connections, supports and controls necessary for a workable system. The fine bubble diffuser system is defined as starting from the point in each tank where the main air header tees into three sub headers, and proceeds through the interior of the aeration tank to the manifolds and individual diffusers.

One manufacturer shall be responsible for the materials associated with the work of this Section including drop pipes, manifolds, laterals, diffusers, and other accessories as indicated, but without altering or modifying the CONTRACTOR'S responsibilities under the Contract Documents.

B. DEFINITIONS:

Standard cubic feet per minute (SCFM) refers to air flow rate at standard conditions. Standard conditions shall be defined as 68 degrees F, 14.7 psia, and 36 percent relative humidity.

Effective diffuser area is defined as the total perforated membrane area passing air at the specified conditions and excluding non-perforated membrane material.

Dissolved oxygen (DO) is the oxygen dissolved in liquid, expressed in milligrams per liter (mg/L) or percent saturation.

Mixed liquor (MLQ) is a mixture of wastewater that has undergone primary sedimentation and secondary sludge. The mixture is contained in the aeration tanks in an activated sludge process. The mixed liquor may include waste solids, organic solids, animal fats, industrial solvents, emulsified oils and grease, and detergents.

Mixed liquor suspended solids (MLSS) is the concentration of suspended solids in activated sludge mixed liquor, expressed in milligrams per liter (mg/L).

Oxygen transfer efficiency (OTE) refers to the fraction of oxygen in an injected gas stream dissolved under given conditions of temperature, barometric pressure, gas rate, and dissolved oxygen concentration.

Oxygen transfer rate (OTR) refers to mass of oxygen per unit time dissolved in a volume of water by an oxygen transfer system operating under given conditions of temperature, barometric pressure, power, gas rate, and dissolved oxygen concentration.

Standard oxygen transfer rate (SOTR) is the rate of oxygen transferred to tap water, expressed in pounds of oxygen per hour, at standard conditions of 68 degrees F, 0.0 mg/L residual dissolved oxygen concentration, and a barometric pressure of 760 mm Hg (dry air).

Standard oxygen transfer efficiency (SOTE) is the percentage of oxygen transferred under standard conditions of 68 degrees F, 0.0 mg/L residual dissolved oxygen concentration, and a barometric pressure of 760 mm Hg (dry air).

C. TYPE:

The layout shown on the drawings for 8 aeration tanks is based on OTT Magnum 2000 Fine Bubble Diffusers with FlexSil® membranes. The OTT system shall be included in the Base Bid. Disc type diffusers shall not be permitted.

D. DESIGN REQUIREMENTS:

1. GENERAL: Equipment furnished under this section shall be designed to supply diffused air to effect the removal of carbonaceous biochemical oxygen demand from municipal wastewater in an activated sludge-type process. The diffused air system shall be suitable for continuous operation in mixed liquor and shall provide sufficient mixing to maintain solids in suspension for each specified operating condition.

2. DIFFUSION EQUIPMENT CONFIGURATION: The diffusion system shall consist of grids of diffusers with laterals, manifolds and associated supporting systems. A drop pipe at each grid shall supply air to the manifolds. The manifolds shall supply air to the laterals. The diffusers shall be attached to the laterals. Refer to Drawings for specific aeration equipment layout requirements for each tank.

The fine bubble aeration equipment shall be capable of maintaining its structural integrity and location with the aeration basin under a variety of process conditions including basin filling, dewatering, and a dewatered condition.

E. OPERATING REQUIREMENTS AND CHARACTERISTICS:

1. DIFFUSION EQUIPMENT OPERATING REQUIREMENTS: The fine bubble aeration diffusion equipment shall be designed for the following conditions:

Number of Aeration tanks	8
Centerline height of diffusers above floor of tank, ft	0.7

Minimum diffuser density (%)	25.3
Sidewater depth, ft	17.33
Water Surface Elevation	477.1
Alpha F	0.50
Beta	0.95
Maximum process air temperature, degrees F	180

Diffuser headloss shall include both the diffuser element and the control orifice. Piping headloss shall include all losses upstream of the control orifice to the top of the drop pipe.

2. AERATION SYSTEM CAPACITY: The fine bubble aeration equipment shall be capable of the following characteristics:

	Aeration System Capacity		
Tanks 1-8	Average	Maximum Month	Peak
DO (mg/L)	3	3	1
SOTR Lbs O_2/hr	5,416	7,620	9,672
SOTE (%)	42.80	34.40	37.90
Air Flow (scfm)	12,144	21,248	24,496

1.02 QUALITY ASSURANCE

A. REFERENCES:

This section references the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
General	ANSI, Standards of American National Standards Institute.

Reference	Title
	AWWA, Standards of American Water Works Association.
ASCE/EWRI 2-06	Standard for Measurement of Oxygen Transfer in Clean Water.
ASTM A380	Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment and Systems.
ASTM A240	Heat-Resistant Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels
SATM A774	As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Pressures
ASTM A778	Welded, Unannealed Austenitic Stainless Steel Tubular Products
ASTM D395 or DIN 53.505	Test Methods for Rubber Property – Compression Set
ASTM D412 ASTM D624B or DIN 53.504 SII	Test Methods for Rubber Properties in Tension

B. TESTS:

1. CLEAN WATER OXYGEN TRANSFER TEST

a. Test Requirements:

The fine bubble diffusion equipment shall be subjected to clean water oxygen transfer testing performed by an independent engineer. All costs for the clean water test shall be borne by the CONTRACTOR. The CONTRACTOR shall arrange to conduct this test through an independent testing laboratory approved by the Construction Manager, either at the manufacturer's manufacturing facility or at the premises of the independent testing laboratory. The CONTRACTOR shall supply all the necessary materials and labor to perform this test, including all the air diffusion assemblies, diffuser grid piping, expansion joints, pipe supports, source of air, sampling and testing equipment and test chemicals. Four copies of the test report shall be provided to the Construction Manager no later than 10 days after the completion of the test.

Tests shall be conducted for the operating condition specified and at the wastewater depths specified in paragraph 46 51 00-1.01 E. The type of the diffusers and all other accessories comprising the diffuser assembly shall be the same as that in the full-scale aeration basin. The test shall be a minimum size of 100 sq ft and the test diffuser grid spacing shall be the same as the diffuser density proposed for the Project. Confirm level of all diffusers to be within ± 1/8 inch.

The test shall be sufficiently comprehensive to produce guaranteed performance characteristics. The test data shall be employed to produce operating curves having standard oxygen transfer efficiency and standard oxygen transfer rate plotted against air flow rate in scfm. All test measurements shall be taken with instruments calibrated in accordance with the instrument manufacturers' recommendations. Calibrations shall be current in accordance with applicable standards.

Test logs and operating curves shall be certified correct under penalty of perjury by an officer of the test engineer's corporation. The test shall be successfully completed and accepted by the Construction Manager before any diffusers are shipped to the project site.

Clean water testing shall be performed under the direction of a qualified third party approved by the OWNER.

Testing shall be performed in accordance with the current ASCE Standard: Measurement of Oxygen Transfer in Clean Water, unless otherwise specified in this section. Results shall be normalized to 1000 mg/l TDS in conformance with the Voluntary Standard.

The Owner will require a witnessed test for all specified factory tests. Accordingly, the Contractor shall furnish the Construction Manager with at least 6 weeks prior written notification of the time and location of the test.

b. Instrumentation requirements for Standard Oxygen Transfer Efficiency (SOTE) Tests.

1) A minimum four dissolved oxygen (DO) probes geometrically distributed in the test tank. If the test tank exceeds 500,000 gallons, comply with ASCE/EWRI 2-06.
2) Instrumentation for dissolved oxygen vs. time measurement.
3) Two airflow measuring devices and temperature and pressure measurement upstream of each flow meter.
4) Thermometer in test tank to monitor water temperature.
5) Instruments for barometric pressure, ambient temperature and relative humidity.
6) Winkler test apparatus.

c. Instrumentation requirements for Headloss tests.

1) Tap minimum 2 distribution headers at top to measure pressure.
2) Provide a bubbler dip tube to measure submergence depth on the diffusers.

3) Install water manometers or differential pressure transmitters (Yokogawa or equal, 0.2% accuracy) and pressure gages to read headloss across the diffusers and header pressures.

d. Clean Water Oxygen Transfer Test Procedures:

The test tank shall be thoroughly cleaned and filled to the indicated depth with potable water. Care shall be taken to avoid any contamination of the test water with the chemicals used for tank cleaning. The temperature of the test water shall be between 68 and 77°F (20 and 25°C).

1) Initial Check-Up:
   i. Test set-up
   ii. Calibration of all instruments.
   iii. Test water temperature.
   iv. Initial total dissolved solids of test water.
   v. An understanding of computer program being used for data collection and analysis.
2) Calibrate all DO probes and meters to the saturation value by Winkler Method. Recheck all DO probes at start of each new run.
3) Add cobalt chloride ($CoCl \cdot 6H_2O$) solution as a catalyst for soluble cobalt concentration of 0.1 to 0.5 mg/l.
4) Add technical grade anhydrous sodium sulfite solution to the test basin 1 hour after the addition of cobalt. Discharge sulfite solution into the test basin at 2 or more locations within 5 minutes. Add sufficient sodium sulfite to depress the dissolved oxygen concentration to below 0.5 mg/l at all points in the test water.

e. DATA COLLECTION:
1) Take minimum 40 DO readings versus time for each DO probe, until the test basin reaches 98% saturation. Select data to allow approximate proportions of 2/3 of DO values from 20 to 86% of saturation and 1/3 of data from 86 to 98% of saturation.
2) Airflow readings from two meters including inlet pressure and temperature. Take airflow measurements in the beginning, middle and end of each run.
3) Water temperature.
4) Ambient pressure, temperature and humidity.

f. DATA ANALYSIS:
1) Use non-linear regression method to determine $K_L a_t$ for each DO probe.

2) Adjust K_La_t to K_La_{20}, standard condition. Individual K_La_{20} value for each DO probe shall be within ±10% of the average.
3) Adjust measured DO saturation value to standard condition.
4) Calculate Standard Oxygen Transfer Rate (SOTR) as follows:

$$SOTR(lbs/hr) = \frac{W \times \sum (K_L a_{20} \times C^*_{sat20})}{P_n}$$

Where:

K_La_T = Overall mass transfer coefficient at temperature T (degrees C)
C^*_{sat20} = Steady-state DO saturation corrected to 20°C and standard barometric pressure
W = Weight of water tested, millions of pounds
P_n = Number of probes in test basin.

5) Calculate Standard Oxygen Transfer Efficiency (SOTE) as follows:

$$SOTE(\%) = \frac{SOTR \times 100}{Q_s \times 60 \times 0.075 \times 0.232}$$

Where:

Q_s = Average standard air flow rate supplied to the test basin, scfm
0.075 = Standard weight of air, lbs/ft^3
0.232 = Weight fraction of oxygen in air

6) Discard results of the first run, considered as a conditioning run.

7) Perform 3 test runs for each of the air flow rates listed in 1.01 E.2:

8) Headloss Test: Measure headloss in system at each flow rate tested. Measure total headloss across the diffusers. Tap at least 2 distribution headers for measurement of pressure. Take readings at each air flow and draw overall headloss curves.
9) Collect water sample from test tank and test for dissolved solids. Total dissolved solids shall not exceed 1,500 mg/L.

g. Oxygen Transfer Test Results

1) The measured oxygen transfer efficiencies shall show a rising trend towards lower airflows for the same diffuser density. That is, at lower airflow per diffuser the oxygen transfer efficiency shall be greater than the oxygen transfer efficiency measured at the higher airflow rate per diffuser.
2) The minimum standard oxygen transfer efficiencies shall be as shown in the table in paragraph 1.01 E.2
3) Should the diffuser system fail to produce the indicated oxygenation capacity and oxygen transfer efficiency, the test procedure shall be repeated. If the indicated performance is not demonstrated after 2 test repetitions, the CONTRACTOR shall modify the diffuser system by replacing the defective items, increasing the number of diffusers if acceptable to the OWNER's Representative, or by a combination of the 2, and repeat the test procedure described herein until the test results are satisfactory. This shall be done at no additional cost to the OWNER.

h. Witness Tests
   1) The following tests shall be witnessed by representatives of the OWNER:
      i. Clean Water Oxygen Transfer Tests
i. Provide written test notification at least six (6) weeks in advance of the scheduled test dates.

C. EXPERIENCE OF MANUFACTURER:

The diffuser manufacturer shall have prior experience of at least three successful projects similar in nature and size as this project. The prior projects shall have used a similar type of membrane tube diffuser as proposed for this project and have at least a total of 25,000 diffusers installed. Products must have proven reliable in operation of prior project facilities for at least three years. The OWNER may require evidence, in the form of operating records, from existing installations, to substantiate any claims concerning the ability of the equipment to perform as required.

One entity shall be responsible for the manufacture of the principal elements and components, including the manifolds, laterals, the diffuser assemblies and support systems.

A description of the manufacturer's prior projects shall be included with the bid and shall document the following: Project name and location; client representative and telephone number; final acceptance date; and number and type of diffuser.

1.03 SUBMITTALS

All submittal information shall include units expressed in United States Customary System Units for all calculations, and measurements. The System International d'Unites (SI) equivalent unit may appear in parentheses after the customary unit.

A. BID SUBMITTAL

1. The diffuser manufacturers shall submit a preliminary submittal to assist in the Owner's selection of the diffuser systems. The preliminary submittal shall include adequate information for a through evaluation of the proposed diffuser system. The system and final selection will be based on the successful demonstration of the following criteria and/or considerations:

    a. Manufacturer's Qualifications:

        1) Business Structure: Submittal shall identify the proposed manufacturer's current approach on the development and implementation of diffuser technology in the North American market.

        2) Installation List: Include a comprehensive list of all installed systems, with North American installations clearly identified. List must include diffuser model and service application.

        3) Submittal shall identify the individual that will serve as the point-of-contact for the procurement, service, and warranty of the diffuser system.

        4) Manufacturer shall describe their current service network, by listing the nearest factory authorized service center and/or qualified service representative to the Owner's facility. Identify service technicians and include pertinent certifications to substantiate their knowledge and expertise.

        5) Manufacturers shall describe and demonstrate their approach to field start-up and training.

        6) Start-Up: Include a description and sample test procedure for field start-up.

        7) Factory Training: Include a description of the factory training facility and sample outline for typical factory training that will be available to the Owner. Identify the trainer and associated qualifications, including resume and/or training certifications.

        8) Field Training: Include a description of the typical field training and sample outline that will be available to the Owner, as specified in this Section. Identify the trainer and associated qualifications, including resume and/or training certifications.

    b. Quality of Construction:

1) Statement of conformance letter stating conformance to the specifications with all exceptions noted. Statement of conformance must be signed original copy by an individual authorized to make such statements.

2) Bill of Materials: Complete bill of materials of all components and equipment supplied. Bill of materials shall include make and model number and replacement cost of the primary components.

3) Spare Parts: Include a list of spare parts and point of purchase. Include a statement of availability of all parts.

A. CONSTRUCTION SUBMITTAL

The following information shall be submitted in accordance with Section 01 33 00:

1. Documentation of manufacturers experience requirements and reference project data. Provide the name of the manufacturer's qualified technical representative, who will be responsible for witnessing, testing and commissioning the diffuser system. Provide a list of the technical representative's project experience and responsibilities on those projects.

2. A testing plan designed to ensure the quality and uniformity of the diffuser assemblies, including a sampling plan. The plan shall specify the number of diffuser elements to be tested from each batch, quality control test procedures, and the credentials of the agency conducting the tests.

3. The proposed testing plan for the Clean Water Oxygen Transfer Test.

4. A complete system description in sufficient detail to permit item by item comparison with the specifications.

5. Manufacturer's catalog information including diffuser name, model number, type designation and operating characteristics.

6. Shop Drawings: List of materials and scaled drawings with dimensions showing aeration piping system layout. Dimensioning shall include required clearances and tolerances. The plan shall include plan and section drawings showing:
   a. Number of complete diffuser assemblies.
   b. The location of all components including diffusers, fittings, pipe supports, expansion joints, water purge system.
   c. Anchor bolt locations and installation procedures
   d. Details of drop pipe assemblies, manifolds, and laterals.
   e. Dimensional details of diffusers.

B. A complete shop welding procedure for stainless steel.

C. The design minimum, design average and design maximum air flows per diffuser.

D. A curve showing headloss versus air flow rate for the diffuser assembly.

E. A curve showing headloss versus air flow rate for components of the diffuser system (which includes the tee, reducer, manifolds, laterals and diffuser assembly) over the full range of operation.

F. The equipment manufacturer's recommended installation procedures including level test, uniformity and leakage test, and oxygen transfer test.

G. Descriptive literature and dimensional drawings showing the proposed method of compensation for thermal expansion and contraction in the diffuser distribution system which includes the manifolds, laterals and diffusers and supports.

H. Relationship between standard oxygen transfer efficiency (SOTE) and diffuser air flow rate for each grid.

I. For each condition specified in paragraph 11236-1.01 E.3, the following information shall be provided:
   1. Standard oxygen transfer efficiency, percent
   2. Total air flow required by the aeration system, scfm
   3. Air flow rate per diffuser, scfm/diffuser

J. Clean water data, along with standard test conditions, used as basis for standard oxygen transfer rate (SOTR).

K. Documentation from the independent test engineer stating competence and capacity to perform the required tests under paragraph 46 51 00-1.02 B.

L. Installation, testing and adjusting instructions.

M. Maintenance and Operating Instructions: Distributor – Level documentation applies to this Section.

N. Repair Parts and Maintenance Material: Submit a list of repair parts and maintenance materials furnished.

O. Instruction of Operating Personnel: Submit Lesson Plan and Instructor’s credentials.

P. Manufacturer’s Representative’s Field Installation Reports.

Q. Certifications: The following certifications shall be provided:
   1. Manufacturer’s certifications for the properties listed in 2.03 F

2. Material certification for the Type 304L stainless steel used for the manufacturing of all stainless steel tubing. Certifications shall include the chemical composition of the material.
3. Certified Diffuser Test Data: Provide air flow versus headloss data and Standard Oxygen Transfer Tests conducted in clean water in accordance with the latest standard published by the ASCE Subcommittee on Oxygen Transfer Standards.

R. Calculations

a. Provide SOTE calculations to verify the clean water oxygen transfer efficiency of the diffuser at maximum month, maximum day, average annual and minimum day airflow for each bay.
b. Calculations verifying that air flow per diffuser shall not vary greater than 5 percent with a grid during maximum and minimum air flow conditions.
c. Calculations showing normal buoyancy uplift forces and structural calculations to meet the requirements of paragraph 46 51 00-2.03 E.

S. Quality Control Submittals

1. Submit manufacturer's certificates of compliance with ANSI and AWWA standards listed for products specified in Part 2.
2. Manufacturer's Installation Report: Submit report as specified in subparagraph 3.02.A.

T. Project Record Documents

PART 2--PRODUCTS

2.01 ACCEPTABLE PRODUCTS

Fine bubble tube type membrane diffusion equipment shall be Magnum 2000 Fine Bubble Diffusers with FlexSil® membranes by OTT GmbH of Langhagen, Germany, or FlexAir™ MiniPanel Diffusers by Environmental Dynamics, Inc.

2.02 MATERIALS FOR DIFFUSER SYSTEMS

Component	Material
Drop piping	Stainless steel, AISI 304L.
Submerged air manifolds	Stainless steel, AISI 304L.
Distribution headers	Stainless steel, AISI 304L for welded components; AISI 304 for non-welded
Laterals	3 inch by 3 inch, 12-gage minimum wall thickness, Type 304L stainless steel tubing.
Fabricated Piping support	Stainless steel, AISI 304L for welded components;

components	AISI 304 for non-welded
Piping gaskets	Neoprene, 45 to 55 durometer, polyisoprene, ASTM D1869-78
Pipe clamps, threaded rod, fasteners, nuts, washers, and anchors	Stainless steel, AISI 316
Tube diffuser assembly	
Diffuser membrane	Elastomeric, Polyorgano siloxane, ultraviolet light, chemical attack, weathering, and aging protection. .
Metallic components	Stainless steel, AISI 304L for welded components; AISI 304 for non-welded
Pressure monitoring system	
Tubing	Black polyethylene
Carrier pipe	Polyvinylchloride (PVC) with minimum 2 percent TiO_2 ultraviolet light inhibitor
Junction box	ASTM 308-86 aluminum-alloy 6061-T6 or fiberglass
Portable pressure monitoring panel	ASTM 308-86 aluminum-alloy 6061-T6 or fiberglass
Brackets and hinges	Stainless steel, AISI 316

2.03 EQUIPMENT FEATURES

A. GENERAL:

The air distribution piping system shall be designed for easy field installation and include provisions for level adjustment, for rotational adjustment of the distribution headers, and for thermal expansion of all piping elements. All welding shall be done in the manufacturer's shop. Field welding will not be permitted.

All welding shall be completed in the factory. Field welding will not be permitted. All welding shall be by the shielded arc, inert gas, MIG or TIG method. Filler wire shall be added to all welds to provide for a cross section of weld metal equal to, or greater than, the parent metal. Butt welds shall have full penetration to the interior surface and gas shielding shall be provided to the interior and exterior of the joint. Interior weld beads shall be smooth, evenly distributed with an interior projection not exceeding 0.0625-inch beyond the inside diameter of the air header or fitting.

The outside weld area shall be wire brushed. Brushes shall be of stainless steel and used only on stainless steel. All discoloration and deposits left by welding shall be removed by pickling.

After welding, fabrication, and wire brushing, all stainless steel assemblies and parts shall be passivated by complete immersion in a pickling solution as specified in ASTM A380-88, Section

6.2.11. The acid shall be a nitric-hydrofluoric solution as defined in Table A2.1, Annex A2 of ASTM A380. Provide a final rinse using ordinary industrial or potable water and dry in conformance with Section 8.3 of ASTM A380. Parts shall be free of iron particles or other foreign material

B. PIPING:

Each aeration basin shall have the number of headers and drop pipes, of the size and at the location shown on the drawings. Each drop pipe shall be suitably supported at its upper connection and along the basin wall. Drop piping shall conform to the requirements of Section 40 27 05.

C. SUBMERGED AIR MANIFOLD AND LATERAL:

The supports shall be capable of supporting manifold and lateral and also resisting buoyant forces. Supports shall be designed to withstand forces from movement of MLSS, including any localized high forces due to higher velocities at baffle walls, wall openings, and RAS distribution areas.

Manifold connections to the distribution headers shall be designed for level adjustment, rotational adjustment, and thermal expansion. Design manifold to ensure crown of diffusers to be at a constant elevation throughout the tank.

The support assembly shall be designed to allow for a minimum 2-inch vertical adjustment above and below the elevation shown on the drawings.

The manifold clamp's bearing surface shall contour to fit the full outside diameter of the pipe. Worm gear clamps are not permitted for attaching pipe to supports.

Where changes in pipe size are required, provide eccentric reducer to maintain inverts of the manifolds and laterals equal.

Each submerged air manifold and expansion joint shall conform to the requirements of Section 40 27 05. The submerged air manifold shall be fabricated in sections up to 30 feet long. The invert elevation of the manifold shall be the same throughout the basin.

Connections between sections of the submerged air manifold shall be flexible pipe couplings or follower flange joints designed so that individual manifold sections can be rotated independently of adjacent sections for proper alignment. Expansion joints shall be provided and shall be located adjacent to the supports. Expansion and connection functions can be combined in common elements. Flexible coupled connections shall be provided at the manifold bottom or side centerline for connection to the distribution headers.

Supports shall not extend above the tops of the diffusers. Supports shall be neatly trimmed with all sharp edges removed. Supports shall be secured to into the floor with stainless steel adhesive type anchors designed with a minimum safety factor of 10 for pull out resistance.

Each manifold shall be supported by floor mounted stainless steel anchors and supports spaced no more than 8 feet apart. Manifold and lateral support spacing shall not exceed 7 feet-0 inches.

Supports shall utilize double nuts and nylon insert lock washers to ensure connection does not loosen. Nuts shall be Type 316 Stainless Steel.

Lateral supports shall consist of rectangular sections of supports located under the laterals, with a rectangular pipe clamp, secured with threaded rods, nuts, washers and adhesive anchors.

D. DISTRIBUTION HEADERS:

Each distribution header and its associated connections shall conform to the requirements of Section 40 27 05. Each distribution header shall connect to the bottom centerline or side of the manifold. Headers for flexible membrane diffuser systems shall be fabricated in sections not to exceed 30 feet, and shall be jointed by flanges or threaded union type joints.

Bell and spigot joints are not acceptable. Maximum spacing of supports shall be 8 feet.

E. PIPING SUPPORT AND ANCHORS:

The support system shall securely anchor the manifold and distribution headers to the tank floor. The supports shall be secured to the floor with anchor bolts. Epoxies cannot be used to secure the diffusion equipment. The minimum diameter of any fixing rod type support shall be 1/2 inch and the minimum thickness of steel plate support shall be 3/16 inch. The minimum diameter of any guide type rod supports shall be 5/16-inch-diameter. Each support shall have a minimum 1 1/2" wide full circumferential bearing surface contoured to fit the pipe being supported. Worm gear clamps shall not be permitted. All supports shall include a method to provide for vertical, lateral and angular alignment adjustment to allow level installation. Supports shall be designed, manufactured and installed in such a manner that the horizontal surfaces of all diffuser elements are within plus or minus 1/8 inch of a common horizontal plane. After the pipe has been installed and leveled, all adjusting mechanisms shall lock in place.

Anchor bolts for grid piping shall be designed for at least 10 times the normal buoyancy uplift forces.

F. SUPPORT TUBE AND PERFORATED ELASTOMERIC MEMBRANE ASSEMBLIES:

The diffuser assembly shall consist of a 2 1/2-inch (64-mm) diameter molded polypropylene tube supporting two finely perforated elastomeric membranes. Elastomer shall be polyorgano siloxane. The 2 membranes shall be held in place by stainless steel pinch clamps. The membrane length shall extend past the clamps far enough to allow the membrane to be folded back over the clamps. A ridge integral with the support tube shall be cast, extruded or molded to eliminate the possibility of the membrane folding when the air is turned off. Support tubes shall be free of

adhesives. Air shall be evenly distributed around the entire periphery of the support tube and down the entire length under all recommended flux rates.

The tube construction shall be of the non-buoyant design. Diffusers shall be free of any material soluble in wastewater.

The diffuser shall be resistant to wastewater containing grease, oil, and hydrocarbons with high heat resistance and shall conform to the following:

1	Color	Light gray
2	Minimum Specific Weight:	73.67 lb/ft^3 (1.18 g/cm^3)
3	Shore Grade of Hardness (DIN 53.505)	A 60 ±5
4	Continuous Temperature Resistance	285° F (140° C)
5	Unperforated Tensile Strength (DIN 53.504 SII)	> 1595 psi (>11 N/mm^2)
6	Tensile Dilation (DIN 53.504 SII)	>630 %
7	Elasticity (DIN 53.512)	> 40%
8	Residual Tensile Strength (ASTM D624 B)	> 206 lb/in (>36 N/mm)
9	Minimum Inside Diameter	2.64 inch (67mm)
10	Minimum Wall Thickness	0.07 inch ± 0.002 inch (1.4 mm ± 0.05 mm)

Diffuser membranes shall have a uniform distribution of 0.04-inch (1.0 mm) perforations across the entire surface of the membrane except for non-perforated areas on the top and bottom of the membrane. The non-perforated area on the top and bottom shall provide a backflow prevention mechanism to prevent the wastewater from entering the air distribution system when air supplied to the system has been shut off or interrupted.

The membrane shall extend beyond the stainless steel bands and fold over the bands in order to provide protection from the edges of the bands. This area shall not be perforated.

Diffusers shall be UV resistant without additives.

Manifold shall have welded end caps.

Diffuser assemblies shall be shipped completely assembled to the job site. Diffuser assemblies which require on-site assembly are not acceptable. Diffuser assemblies shall be installed along the top centerline of the distribution header. Each assembly shall include a diffuser element, a matching element holder, provision for securing the element to the assembly, and sealing gaskets.

2.04 SPARE PARTS

Furnish 10 diffuser assemblies without membranes (including all required hardware to attach diffuser assemblies to lateral) and 20 membrane kits (including the membrane and two stainless steel pinch clamps).

Spare parts supplied as part of the diffuser package shall consist of 6 sets of all related special tools and equipment required for maintenance and installation.

In addition to the spare parts listed previously, the Contractor shall furnish and identify separately in the bill of materials a nominal quantity of spare parts for the Contractor's use to cover loss, breakage, and replacement.

2.05 PRODUCT DATA

The following information shall be provided in accordance with Section 01 3300.

2. Operation and maintenance information in accordance with Section 01 78 23.

3. Manufacturer's installation certification form in accordance with Section 01 75 03.

2.06 WARRANTY

Manufacturer’s Extended Express Warranty: Provide a two-year warranty on all equipment, materials, and workmanship. The warranty shall repair or replace any component that fails due to such defects within the warranty period.

Reference Section 01 78 36

PART 3--EXECUTION

3.01 INSTALLATION

The CONTRACTOR shall remove all grit, sand, sludge, scum, and other foreign materials deposited in the Little Miami WWTP Aeration Tanks. It is anticipated that 1,200 tons of material shall need to be removed from the Aeration Tanks. Such removed material shall be dewatered and disposed of off site by the CONTRACTOR at the CONTRACTOR's expense. The OWNER's equipment will not be available to the CONTRACTOR for dewatering material removed from the Aeration Tanks.

After evacuation of the Aeration Tanks, all interior surfaces shall be pressure washed clean and the tanks shall be pumped dry. All hydraulic pressure washing equipment shall be suitable for the purpose of thoroughly cleaning secondary treatment tank interior concrete.

The entire system shall be designed, manufactured, and installed in such a manner that all the diffuser elements are within ±0.125-inch of a common horizontal plane. Air distribution shall be uniform throughout the entire system and shall be uniform over the entire horizontal projected surface of each diffuser element.

The Contractor shall install the number of diffuser elements required for the initial layout. All unused diffuser holders and taps shall be plugged. All spare parts shall be stored and protected in accordance with paragraph 01 78 43.

Prior to connecting the diffuser to the headers, carefully clean all piping, headers and accessories through which air is delivered so that all dust, dirt, oil, grease, or other foreign material is effectively removed from contact with air blown through the diffusers. Clean with air at a velocity of 2,000 to 3,000 fpm. Perform air cleaning in a three step process; blow out new air supply piping, blow out drop pipes and manifolds, and blow out laterals after connection to manifolds.

Install drop pipes, manifolds, headers and diffusers in strict accordance with manufacturer's installation instructions.

The perforated flexible membrane tube diffusers shall be installed such that the top at each diffuser is at the elevation specified on the design plans. As required, the support system shall be adjusted to account for a sloping floor to keep the top of the diffusers to match the slope of the tank floor.

Equipment provided under this section shall be installed in conformance with the manufacturer's instructions. In addition, pipes shall be installed a set distance from the end to ensure that when inserted into the compression couplings, the pipe ends are centered within the coupling. After the requirements of this specification section have been fulfilled, unless otherwise directed by the OWNER, the aeration basins shall remain filled with plant water to protect the installed diffuser system. Air shall be applied to all submerged diffusers at least 30 minutes per week until placed into operation.

3.02 FIELD QUALITY CONTROL

A. GENERAL:

Manufacturer's Representative shall perform field inspection of all components prior to placing in operation and submit Manufacturer's Installation Report addressing the following:

1. List of deficiencies in installation and recommended corrective action.
2. Certification that all corrective actions have been completed and that all items are properly installed, aligned, adjusted and the diffuser system is fully operational.

The fine bubble diffusion equipment shall be subject to the following tests for leveling, leakage, distribution of flow, and operating pressure. All costs for field testing shall be borne by the Contractor. At least 14 days prior to the performance of field tests, the CONTRACTOR shall notify the Construction Manager in writing when these tests are to be performed. The CONTRACTOR and Construction Manager shall agree upon the actual time the tests are to be performed. The CONTRACTOR shall furnish all labor, equipment, and materials required to perform the tests. All defects shall be corrected by the CONTRACTOR and all required retesting shall be performed by the CONTRACTOR at no additional cost to the OWNER.

B. LEAKAGE AND AIR FLOW DISTRIBUTION TESTS:

After diffuser installation, the water level shall be raised to 2 inches above the diffusers. Air shall then be introduced into the system. The water surface shall be visually inspected to ensure that the air flow is uniformly distributed across the tank. Any leaks in the element holders, elements, pipes, or the like shall be repaired by the Contractor. The test shall be repeated until a representative of the Resident Engineer and the manufacturer witness that the installation is void of air leaks.

3.03 TRAINING

The Contractor shall make available experienced factory trained representatives to provide the required operation and maintenance instructions as specified in Section 01 79 00. The requirements below should be considered a minimum:

A. Maintenance

Number of Sessions	2
Hours per session	2

B. Operations

Number of Sessions	2
Hours per session	2

3.04 DELIVERY, STORAGE AND HANDLING

A. Handle piping, diffusers and membranes with care and in accordance with manufacturer recommendations.
B. Piping or diffusers which are cracked, dented, or otherwise damaged or dropped will be rejected.
C. Store membranes in their original packaging in a dry and well ventilated place off the ground in enclosed shelter and protect from getting dirty and/or plugged and damaged from elements.

3.05 SCHEDULING

A. Time is of the essence for this Contract and approval of the submittals for the work under this section is critical.

B. The following submittals required in paragraph 1.03 shall be submitted within 30 days of the Notice to Proceed and coordinated with the Construction Manager per the requirements of the Contract documents:
   1. All items listed in Paragraph 1.03.A
   2. Items listed in Paragraph 1.03 B “Samples and Mockups.”
   3. Items listed in Paragraph 1.03.S.1,

C. The Clean Water Oxygen Transfer Test shall be completed within 60 days of the Notice to Proceed.

END OF SECTION