Request for Qualifications

for

Professional Engineering Services

for the

FOX METRO WRD –
DISINFECTION FEASIBILITY STUDY

Fox Metro Water Reclamation District

Oswego, Illinois

August 2023

I. General Project Information

The Fox Metro Water Reclamation District (Fox Metro) seeks to procure Professional Engineering Services for the study of the feasibility of reconfiguring the district's existing chlorine disinfection system to an alternative disinfection process at its Water Reclamation Facility in Oswego, IL. Statement of Interests (SOIs) shall be submitted digitally to RFP@foxmetro.org by 3:00 PM on September 27, 2023. Submittals after this will not be accepted. All questions related to this SOI shall be e-mailed to jkerrigan@foxmetro.org by September 8, 2023. Questions and response will be shared with all firms by September 15, 2023. Fox Metro is anticipating to review the SOI's and make a recommendation of the selected firm by October 31, 2023.

Description of Project:

In June 2023, Fox Metro engaged the services of an external vendor to perform a short-term pilot study of the suitability of Peracetic Acid as an alternative to its current chlorine disinfection system. FMWRD would like to further investigate the suitability of this process as well as other disinfection systems that could be implemented to replace the existing system. Please refer to the attached Attachment X for the results of the pilot study, and the campus site plan for the location of the existing disinfection facility.

Questions and Tours:

Questions regarding submittal requirements can be directed to James Kerrigan, Senior Project Engineer, via email at jkerrigan@foxmetro.org. One non-mandatory pre-submittal meeting will be held at FMWRD Administration Building, 682 State Route 31, Oswego. IL. A tour of the proposed site will be held immediately afterwards. Pre-submittal meeting date is: September 12, 2023 at 9:30 am.

II. Scope of Services

Fox Metro requires professional services from a qualified engineering firm to assist with the following, including but not limited to:

- Review of suitability of proposed PAA system for wastewater disinfection, literature review and existing installation reviews and summary,
- Presentation to District of suitability of concept,
- Review of potential UV system,
- Assessment of combining UV and PAA,
- Alternatives analysis on up to three potential disinfection alternatives with associated permitting and opinion of probable construction costs for each alternative, including chemical usage costs,
- Advantages/disadvantages comparison of alternatives,
- Review of results from district performed full scale pilot,
- Preliminary conceptual design of the preferred alternative.

Desired Project Schedule

The district intends to begin a full-scale pilot study in November 2023 with a selected supplier. The consultant is expected to provide input to FMWRD on the proposed approach and provide technical assistance such as assisting in answering operational questions as needed during the pilot. Upon completion of the pilot, the data obtained will be available to the consultant in development of the feasibility study.

Subsequent project deliverables will be jointly determined as part of the preliminary design phase.

Fox Metro anticipates the study phase of the project will be completed in spring of 2024, with subsequent design services to follow.

SOI Submittal Contents

SOI's shall be limited to not more than eight (8 ½ X 11) pages, with a font of at least 12 pts; and include, at a minimum, the following information five sections:

- **Executive Summary**
  Name of firm with address and contact information; contact person for the firm; and statement indicating firm's interest in the project.

- **Project Experience**
  The firm shall identify a minimum of three projects in the past 5 years of similar size and scope. Each project shall list the client name, reference, brief summary of services provided, and key challenges addressed.

- **Key Personnel**
  Identify the management, design, and office staff proposed and their project responsibilities for this project. Include resumes of Project Manager and Design Engineers. Resumes are not included in the maximum page count. The firm shall also identify any subconsultants they may need.

- **Firm's Project Understanding and Approach**
  Describe how your firm has approached similar projects in the past, the firm's level of understanding of these projects, and how the firm would approach this project. The SOI submittal should focus on the consultant's proposed technical approach.

- **Firm's Project Schedule**
  Based upon the project approach, provide a project schedule that outlines key milestone deliverables for completion of the project.

Evaluation Criteria

Responding firms will be ranked in order of performance from this evaluation on firm's qualifications relative to the evaluation criteria with up to 100 points being awarded. The evaluation criteria are as follows:

1.	Completeness of SOI	15 points max
2.	Project Experience	25 points max
3.	Key Personnel's professional background	20 points max
4.	Firm's project understanding and approach	30 points max
5.	Project Schedule	10 points max

Agreement Type

The selected firm will be required to sign the Fox Metro standard agreement.

III. Selection

Selection: FMWRD may choose to make a preliminary selection based on the SOQs submitted or may choose to short list and interview 2-3 consultants. Once a preliminary selection is made, FMWRD will enter into negotiations on final scope and fee of services. If FMWRD cannot come to terms with the preliminary selection, FMWRD may make a second selection and restart negotiations.

Negotiations: Negotiations of scope and fee will include providing narrative scope of tasks, detailed breakdowns of task hours by individual team member, direct labor rates and salary multipliers or billing rates to be used by individual team members, and definition of additional expenses to be billed. FMWRD's standard contract format and conditions are expected to be used for the contract.

Confidentiality: FMWRD will examine the submittals to determine the validity of any written requests for nondisclosure of trade secrets and other proprietary data identified in submitted SOQs. After award of the contract, all responses, documents, and materials submitted by the consultants pertaining to this RFP will be considered public information and will be made available for inspection, unless otherwise determined by FMWRD. All data, documentation and innovations developed as a result of these contractual services shall become the property of FMWRD. Based upon the public nature of this RFQ, a consultant must inform FMWRD, in writing, of the exact materials in the SOQ which cannot be made a part of the public record in accordance with the Illinois Freedom of Information Act.

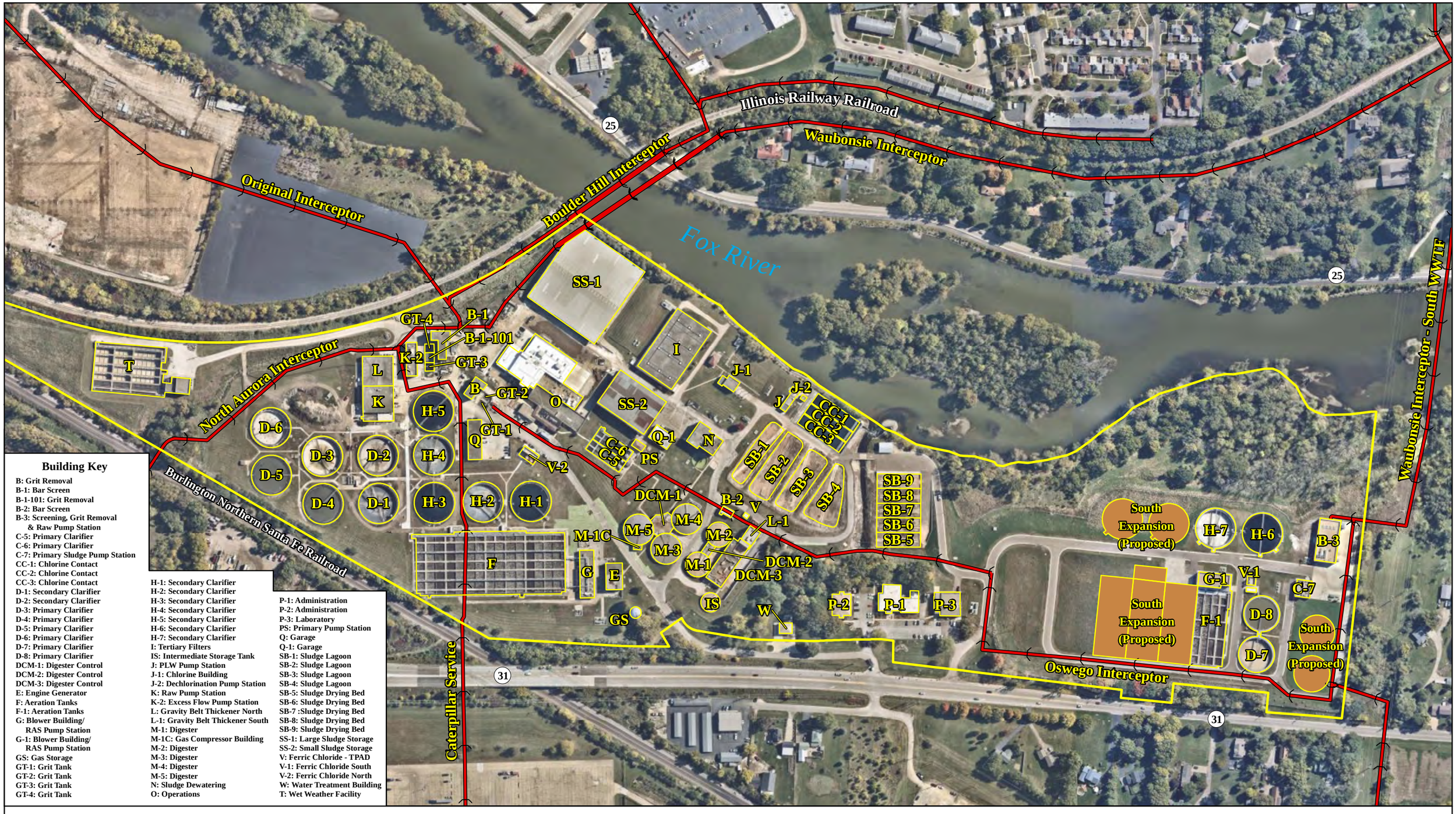
Reserved Rights: FMWRD reserves the right, at its sole discretion, to use without limitation any of the information, concepts, and data submitted in response to this RFQ, or derived by further investigation thereof. FMWRD further reserves the right at any time and for any reason to cancel this solicitation, to reject any or all submittals, to supplement, add to, delete from, or otherwise change this RFQ if conditions dictate. FMWRD may seek clarifications from a submitter at any time and failure to respond promptly may be cause for rejection. FMWRD also reserves the right to interview only those consultants it determines shall provide the most advantageous services to FMWRD, to make selection without interviews, and to negotiate with one or more submitters acceptable to FMWRD.

Incurred Costs: FMWRD will not be liable for any costs incurred by submitters in replying to this RFQ.

Addenda: If deemed necessary, FMWRD will issue addenda in writing prior to the date of receipt of submittals, which modify or interpret the RFQ by addition, deletion, clarification, or correction. Addenda may be issued via electronic transfer to all parties attending the pre-submittal meeting and will be posted to FMWRD website. FMWRD will not be responsible for potential submitters which do not receive the addenda because they are not listed with FMWRD as potential submitters for the project. Submittal of a SOQ shall be taken to mean that such consultants have received all addenda and that the consultants are familiar with the terms and requirements thereof.

IV. Background information:

- Overall Project Site Plan
- Proposed project location
- June 2023 PAA Pilot test results at FMWRD



Building Key

B: Grit Removal
B-1: Bar Screen
B-1-101: Grit Removal
B-2: Bar Screen
B-3: Screening, Grit Removal & Raw Pump Station
C-5: Primary Clarifier
C-6: Primary Clarifier
C-7: Primary Sludge Pump Station
CC-1: Chlorine Contact
CC-2: Chlorine Contact
CC-3: Chlorine Contact
D-1: Secondary Clarifier
D-2: Secondary Clarifier
D-3: Primary Clarifier
D-4: Primary Clarifier
D-5: Primary Clarifier
D-6: Primary Clarifier
D-7: Primary Clarifier
D-8: Primary Clarifier
DCM-1: Digester Control
DCM-2: Digester Control
DCM-3: Digester Control
E: Engine Generator
F: Aeration Tanks
F-1: Aeration Tanks
G: Blower Building/ RAS Pump Station
G-1: Blower Building/ RAS Pump Station
GS: Gas Storage
GT-1: Grit Tank
GT-2: Grit Tank
GT-3: Grit Tank
GT-4: Grit Tank

H-1: Secondary Clarifier
H-2: Secondary Clarifier
H-3: Secondary Clarifier
H-4: Secondary Clarifier
H-5: Secondary Clarifier
H-6: Secondary Clarifier
H-7: Secondary Clarifier
I: Tertiary Filters
IS: Intermediate Storage Tank
J: PLW Pump Station
J-1: Chlorine Building
J-2: Dechlorination Pump Station
K: Raw Pump Station
K-2: Excess Flow Pump Station
L: Gravity Belt Thickener North
L-1: Gravity Belt Thickener South
M-1: Digester
M-1C: Gas Compressor Building
M-2: Digester
M-3: Digester
M-4: Digester
M-5: Digester
N: Sludge Dewatering
O: Operations

P-1: Administration
P-2: Administration
P-3: Laboratory
PS: Primary Pump Station
Q: Garage
Q-1: Garage
SB-1: Sludge Lagoon
SB-2: Sludge Lagoon
SB-3: Sludge Lagoon
SB-4: Sludge Lagoon
SB-5: Sludge Drying Bed
SB-6: Sludge Drying Bed
SB-7 :Sludge Drying Bed
SB-8: Sludge Drying Bed
SB-9: Sludge Drying Bed
SS-1: Large Sludge Storage
SS-2: Small Sludge Storage
V: Ferric Chloride - TPAD
V-1: Ferric Chloride South
V-2: Ferric Chloride North
W: Water Treatment Building
T: Wet Weather Facility

Fox Metro Water Reclamation District

Fox Metro Water Reclamation District
Wastewater Treatment Plant

N W E S

Existing Disinfection Facilities

Boulder Interceptor

SS-1

B-1-101

GT-4

B-1

K-2

I

J-1

J-2

J

CC-1

CC-2

CC-3

GT-3

O&M

L

K

B

GT-2

SS-2

H-5

D-6

Q

GT-1

Q-1

N

C-6

C-5

SB-1

SB-2

SB-3

SB-4

SB-9

SB-8

SB-7

SB-6

SB-5

D-3

D-2

H-4

D-5

V-2

PS

DCM-1

B-2

V

L-1

M-1C

M-4

M-5

M-2

D-4

D-1

H-3

H-2

H-1

M-3

M-1

DCM-2

DCM-3

Burlington Northern Santa Fe Railroad

F

G

E

DCM-4

P-2

P-1

P-3

W

GS

IS

Fox Metro
Water Reclamation District

Chlorine Building Location

N E S W

Final Report

VigorOx® WWT II
Disinfection Pilot Trial for

Fox Metro Water Reclamation District
682 State Route 31
Oswego, IL 60543

June 5-23, 2023

Executive Summary

VigorOx® WWT II peracetic acid (PAA) was shown to provide effective bacterial reduction during field pilot reactor trialing at the Fox Metro Water Reclamation District, located in Oswego, IL. Reduction of Fecal coliform to below the TPDES permit requirements was achievable at several of the PAA doses and contact times tested during the reactor trial.

Key findings:

- A PAA dose concentration of 0.75 mg/L at a contact time of 35 min, 70 min and 122 minutes was sufficient to insure the effluent Fecal coliform daily average concentration remained below 200 CFU/100 mL. The PAA residual limit at the outflow, expected to be set by IL DEP at 0.16 mg/L, was met at all three contact times.

- A PAA dose concentration of 1.0 mg/L at contact times of 35 min, 70 min and 122 minutes was sufficient to achieve a Fecal coliform daily average concentration below 200 CFU/100 mL. The PAA residual was not below the anticipated limit at this starting PAA concentration.

- A PAA dose concentration of 0.5 mg/L at a contact time of 122 minutes was sufficient to ensure the effluent Fecal coliform daily average concentration remained below 200 CFU/100 mL and meet the expected residual limit.

- At 0.5 mg PAA / L, Fecal coliform daily average effluent concentrations were in excess of 200 CFU/100 mL at contact times of both 35 and 70 minutes.

- Addition of PAA to the wastewater was shown to minimally impact pH, TSS, BOD_5 and $cBOD_5$.

- Whole Effluent Toxicity (WET) testing was not completed during this trial.

Proposed Next Steps:

Given the success of VigorOx® WWT II PAA in achieving microbial reduction, it is recommended that a full-scale field trial (starting at 0.75 mg/L) be conducted within the plants' disinfection contact chambers to assess long term performance under water quality and hydraulic flow conditions experienced at the site.

This report and the conclusions herein are accurate based on the data generated from the bench test.

Jonathan W. Bever
Field Services

I. Introduction

1.1 Objectives

A pilot disinfection trial was conducted at the Fox Metro Water Reclamation District (the Plant), located in Oswego, IL. The objectives of this trial were:

- To confirm the effectiveness of VigorOx® WWT II peracetic acid (PAA) to achieve compliance with the TPDES wastewater discharge permit disinfection criteria for Fecal coliform.
- To determine the operating conditions (dose and contact time) required to achieve the targeted microbial reduction goals.
- To assess the impact of PAA on the water quality of the wastewater effluent.

NPDES Permit IL0020818 for the Fox Metro Water Reclamation District with discharge to the Fox River sets the maximum Fecal coliform concentration in the effluent at a daily average of 200 CFU/100 mL and no more than 10% of the samples collected shall exceed 400 CFU/100 mL twice a month. The anticipated allowable PAA maximum dose concentration at the outfall is 0.16 mg / L.

1.2 VigorOx® WWT II Peracetic Acid

VigorOx® WWT II is a strong disinfectant that results from the equilibrium reaction between acetic acid (vinegar) and hydrogen peroxide (H_2O_2). The resulting solution contains 15% peracetic acid (PAA) and 23% hydrogen peroxide (see Figure 1 for the chemical structure). The PAA molecule attacks and kills microbial organisms of concern in wastewater treatment, such as fecal coliforms and *E. coli*, by disruption of cell membranes.

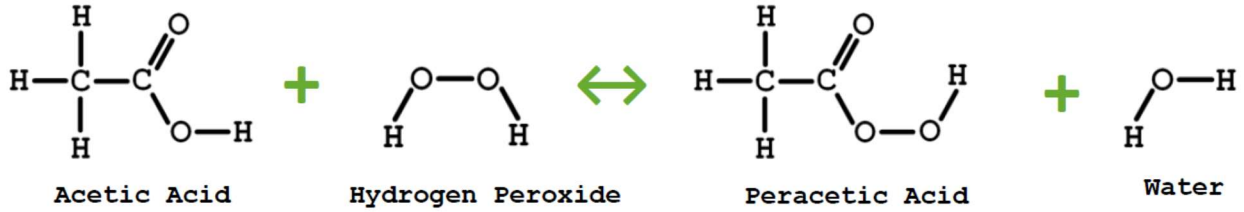


Figure 1 PAA Equilibrium

The oxidation potential of PAA is greater than that of hyporchlorous acid, hypochlorite ion and monochloramine (shown in Table 1), resulting in typically lower dosages and contact times as compared to using chlorine or chloramines. In addition, PAA has a much lower aquatic toxicity profile than chlorine and decays rapidly in the environment. As a result, PAA generally does not need a quenching step, such as dechlorination, reducing process complexity and cost. PAA is not a chlorine-based chemistry and does not result in the formation of chlorinated disinfection by-products such as cyanide, n-Nitrosodimethylamine (NDMA), trihalomethanes (THMs) and haloacetic acids (HAAs).

Table 1 Standard Oxidation Potential

Oxidation Potential Oxidant	Standard Potential (V)
PAA (CH_3COOOH)	1.81
Hyporchlorous Acid (HOCl)	1.48
Monochloramine (NH_2Cl)	1.40
Hypochlorite Ion (OCl^-)	0.81

2. Test Plan

2.1 Disinfection Pilot Reactor (DPR)

Figure 2 The Disinfection Pilot Reactor

The Evonik disinfection pilot reactor (DPR) was utilized in this pilot study and is shown in Figure 2. Wastewater is fed into the DPR via a pump, typically situated within the effluent weir of the secondary clarifier (non-disinfected wastewater is required for testing purposes). The flow rate through the DPR can be adjusted to a maximum of 30 gallons per minute (gpm), and the effluent is discharged back to the plant process stream prior to the final disinfection stage. A series of sampling ports are located along the reaction section of the DPR. The combination of flow rate through the DPR and selection of the sampling port allows for a wide range of contact times to be simulated. PAA dosage at the head of the DPR is controlled via a metering pump to achieve the desired target PAA dose concentration. As a result, microbial reduction, PAA usage and water quality impacts can be assessed in the actual plant wastewater under a variety of initial PAA dose concentrations and contact times.

For this trial, the wastewater flowrate through the DPR was set to 4.1 gpm, and samples were taken from port #3, #4 and #6. This allowed for contact times of 35 (port #3), 70 (port#4) and 122 (port #6) minutes to be achieved.

2.2 Trial Schedule

The PAA DPR sample collection was started on June 5, 2023 and ended on Jun 23, 2023. The reactor data was unusable for Jun 6, 2023 due to a plant shutdown that took Tertiary Filter off line. During the testing period, the DPR was operated by Evonik staff, who also performed sample collection. All microbial sample analyses were performed by the Plant staff. Results were provided to Evonik on a routine basis. Close communication between Plant staff and Evonik staff was maintained during the trial period. Results that were Greater Than (>) used the greater than values as an estimate for the data in charts.

2.3 VigorOx® WWT II Dose

The PAA dose concentrations used during the sample collection period were 1.0 mg/L for week Jun 5-9, 0.5 mg/L week of Jun 12-16 and 0.75 mg/L week of Jun 19-23 as shown in Figure 3. The dose rate was adjusted as needed, mainly based on monitored results of the Fecal coliform concentration in the final effluent. During the trial period, the Plant staff and Evonik staff reviewed testing data weekly and made necessary adjustment for the PAA dosing rate.

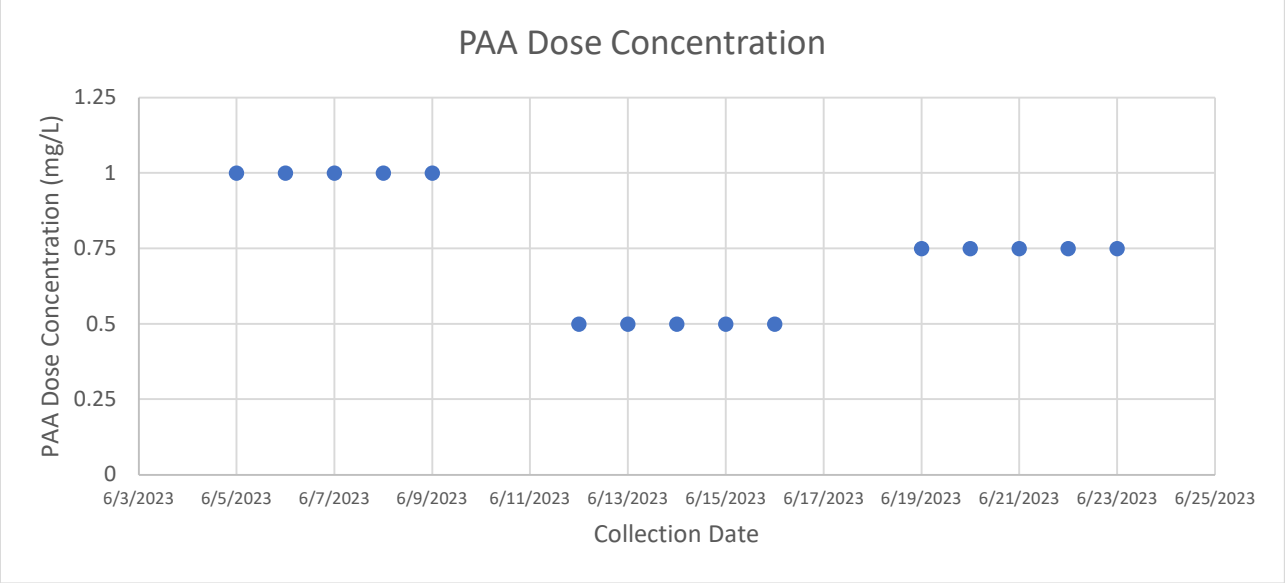


Figure 3 PAA Dose Concentration during the Testing Period

2.4 Water Quality Monitoring

The water quality monitoring plan is shown in Table 2 below.

Table 2 Water Quality Monitoring Plan

Water Quality Parameters	Sampling Locations				Sampling Frequency	Sampling Type
	Influent	Sampling Port #3[(1)]	Sampling Port #4[(1)]	Sampling Port #6[(1)]		
Fecal coliform (CFU/100 mL)	✓	✓	✓	✓	Three times a day	Grab
PAA Residual [(2)]	**NA**	✓	✓	✓	Three times a day	Grab
TSS (mg/L)	✓	**NA**	✓	**NA**	Weekly	Grab
cBOD5 (mg/L)	✓	**NA**	✓	**NA**	Weekly	Grab
pH	✓	✓	✓	✓	Three times a day	Grab
Water Temperature (C)	✓	✓	✓	✓	Three times a day	Grab

Notes:

(1) At the DPR wastewater flow rate of 4.1 gpm, the corresponding contact time at Port #3 was 35 Minutes, Port #4 was 70 minutes and at Port #6, 122 minutes.

(2) PAA residual was measured using CHEMetrics V-2000 method.

(3) Sampling bottles for *Fecal coliform* contained quenching agent to neutralize any oxidant residual in the samples.

(4) Dilution of Fecal coliform samples was done as needed to obtain the exact microbial count number.

3. Results and Discussions

3.1 Influent *Fecal coliform* Concentrations

The Fecal coliform concentrations in the influent to the DPR during the trial period are shown in Figure 4. The horizontal thin dashed line in Figure 4 represents the target Fecal coliform limit value of 200 CFU/100 mL. The horizontal thick dashed line in Figure 4 represents the 400 CFU/100 mL limit value that only 10% of the monthly values are allowed to exceed.

The influent Fecal coliform concentrations varied from 3000 CFU/100 mL to >40,000 CFU/100 mL, with a geometric mean of >12357 CFU/100 mL. Correspondingly, PAA disinfection would need to result in an average 1.79 log reduction of microbial concentration to meet the target 200 CFU/100 mL.

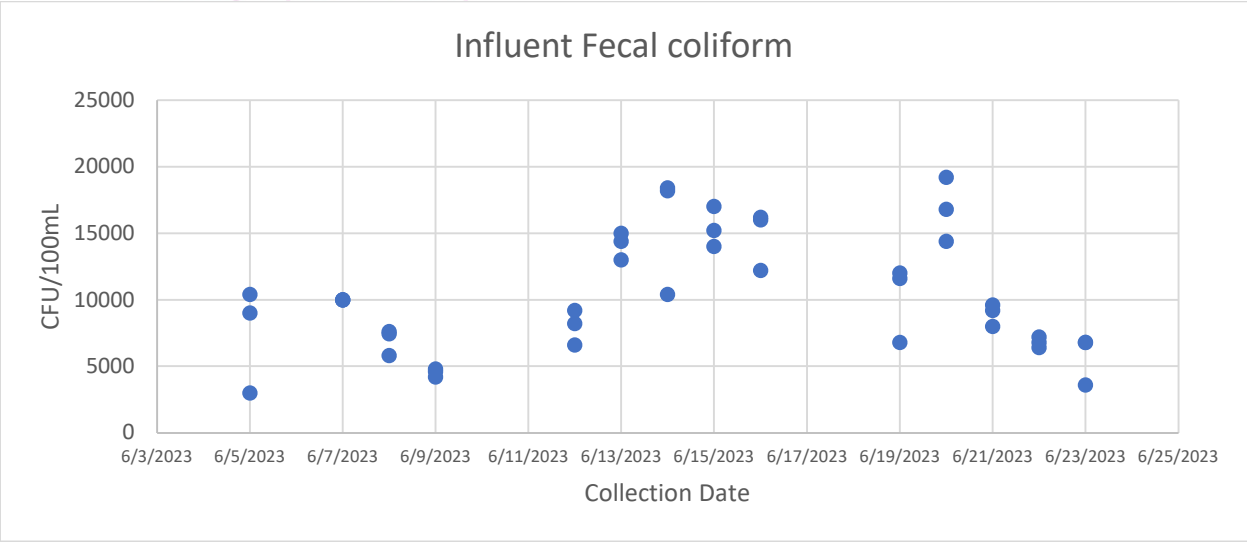


Figure 4 Fecal coliform Concentrations Influent to the DPR

3.2 Disinfection Performance against Fecal coliform

The disinfection performance of PAA on Fecal coliform during the pilot trial is described in this section. The Fecal coliform concentrations measured at the influent and effluent of the DPR at contact times of 35, 70 and 122 minutes are shown in Figure 5. A statistical summary of the effluent Fecal coliform concentrations at different contact times under various PAA doses is illustrated in Table 3.

PAA Dose	Fecal coliform daily average[1] per 100 ml					Fecal coliform daily maximum per 100 ml				
ppm	DPR Influent	Port 3	Port 4	Port 6	NPDES Permit Level	DPR Influent	Port 3	Port 4	Port 6	NPDES Permit Level
1.00	7238	62	35	23	200	10400	179	56	45	200
0.50	13600	979	229	65		18400	3900	865	172	
0.75	9680	245	71	71		19200	1830	166	174	

Table 3 Statistical Summary of *E. coli* Concentrations

[1]Daily average vales were calculated based on the available data, rather than a 30-day average.

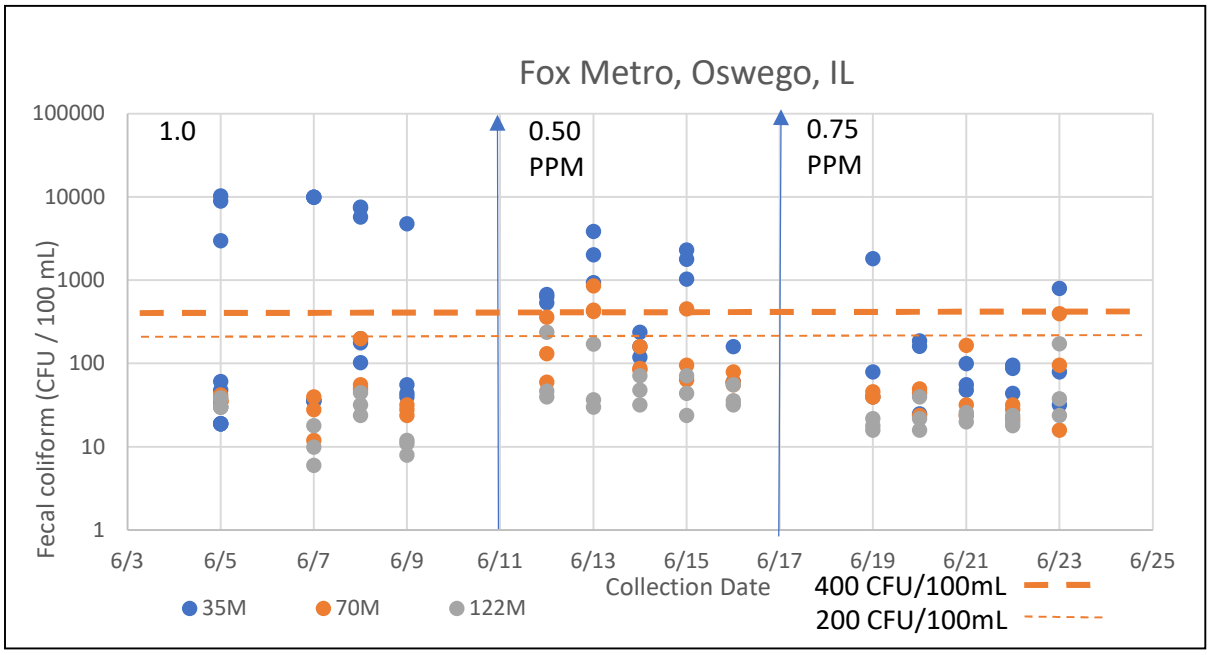


Figure 5 Fecal coliform Concentration in the DPR Effluent and after 35, 70 and 122 Minutes of Contact Time

The results demonstrated that:

- A PAA dose concentration of 0.50 mg/L was not able to reduce the Fecal coliform concentration consistently to below the target daily average of 200 CFU/100 mL or the daily maximum of 400 CFU/100 mL for either contact times of 35- or 70-minutes.

- At a dose rate of 1.00 mg PAA / L, the target Fecal coliform target daily average and maximum was achievable with 35-, 70- and 122-minutes of contact time. The PAA residual was not below expected residual limit of 0.16 mg/L at the 35- and 70-minute contact times.

- PAA dose of 0.75 mg/L was able to meet the target 200 MPN / 100 mL daily average for contact times of 35-, 70- and 122-minutes. Two samples at 0.75 ppm PAA set exceeded the value of 400 CFU/100 mL at a 35-minute contact time and one sample exceeded the value 400 CFU/100 mL at 70 minutes.

3.3 Peracetic Acid Residuals

PAA residuals in the DPR Influent at contact times of 35-, 70- and 122-minutes and the initial doses of 1.00 mg /L, 0.75 mg/L and 0.50 mg/L are shown in Figure 6.

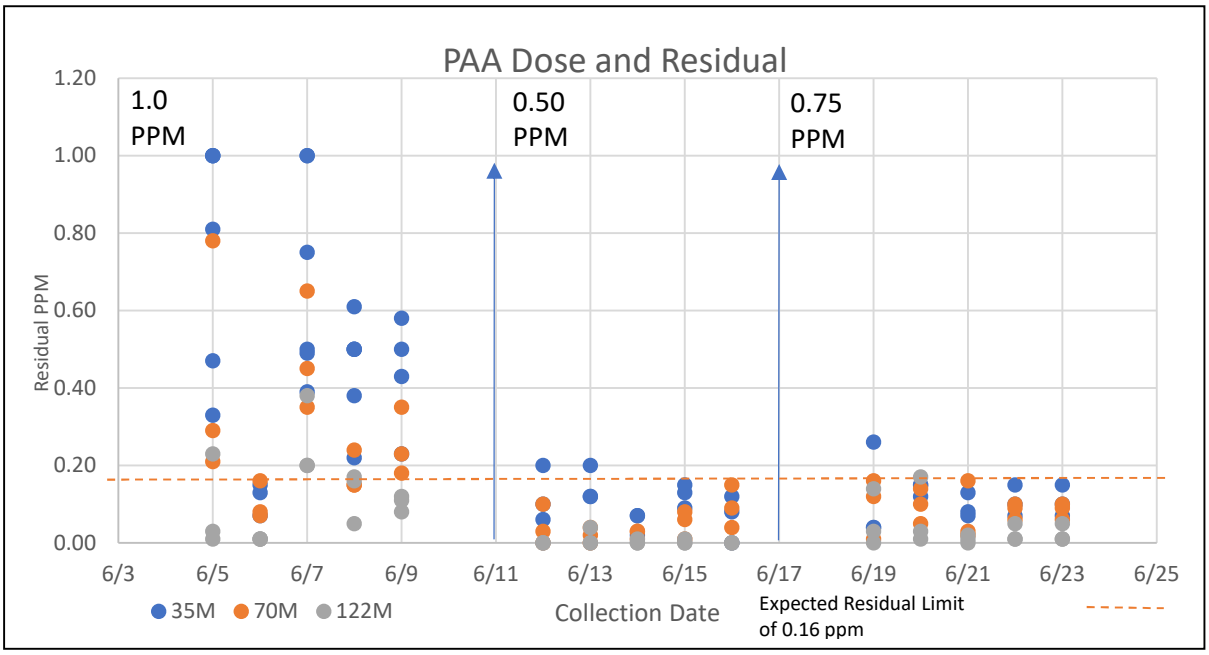


Figure 6 PAA Concentrations in the Effluent at 35 (port #3), 70 (port #4) and 122 (port #6) Minutes of Contact Time

Due to its low toxicity impacts to aquatic organisms, the USEPA approved labeling for VigorOx® WWT II has allowable, dilution factor based, discharge limits for PAA as:

1.0 ppm (mg/L), if dilution factor (DF) is < 12 or unknown

0.09 ppm x DF, if DF is equal to or greater than 12 (for example, if DF is 20, then the limit is 1.8 ppm)

Where $DF = \frac{plant\ effluent\ dishcarge + receiving\ stream\ 7Q10}{plant\ effluent\ discharge}$

(7Q10 is the lowest seven-day average stream flow of the receiving stream over a ten-year period).

At the PAA initial dose concentrations of 1.0 mg / L, the PAA residuals in the effluent after 35- and 70-minutes of contact time were between 0.07 and 0.78 mg / L. At the initial PAA dose concentration of 0.50 mg / L, the effluent PAA concentration at 70-minute contact times were between the range of 0.00 and 0.09 mg / L. Finally, for a PAA dose of 0.75 mg / L, the PAA residual in the effluent ranged from 0.02 to 0.16 mg / L. While the final site-specific discharge limit for PAA needs to be confirmed with the Illinois EPA, Division of Water Pollution Control, it is possible that quenching of PAA before final discharge will only be needed occasionally during the events that significantly reduce detention time below the 70-minutes to the 35-minutes if VigorOx® WWT II PAA disinfection technology is implemented at this plant. This quenching if preformed with Sodium Bisulfite ($NaHSO_3$) would average 0.05µL/L to reduce PAA residuals by 0.5 mg/L.

3.4 Impact of PAA on Water Quality

3.4.1 pH

Table 4 displays the pH of the wastewater measured at the influent to the DPR and at the effluent (port # 4), which represents 70-minutes of contact time. The effluent pH average is across all of the initial PAA dose concentrations (1.00, 0.75 and 0.50 mg PAA / L).

Table 4 pH of the wastewater at the DPR influent and effluent pH

	pH	
	influent	effluent
average	7.35	7.32
Std dev	0.19	0.21

There is no significant change in wastewater pH upon the addition of PAA, even at the dose concentration of 1.0 mg / L

3.4.2 $cBOD_5$ and TSS

One grab sample per each PAA dose concentration of 1.00, 0.75 and 0.50 mg / L was taken for the DPR influent and the DPR effluent (70-minute contact time) and measured for $cBOD_5$ and TSS. The results are shown in Table 5.

Table 5: PAA Impact on Wastewater Quality

	$cBOD_5$ (mg/L)		TSS (mg/L)	
PAA Dose (mg/L)	Influent	Effluent	Influent	Effluent
0.50	2	2	9	1
0.75	3	3	<2	1
1.00	<2	3	2	<1

The data indicates that the addition of PAA at the higher concentrations generated a small increase in chemical biological demand ($cBOD_5$) and a small decrease in total suspended solids (TSS).

4. Conclusions

VigorOx® WWT II peracetic acid (PAA) was shown to provide effective bacterial reduction during field pilot reactor trialing at the Fox Metro Water Reclamation District, located in Oswego, IL. Reduction of Fecal coliform to below the NPDES permit requirements was achievable at PAA doses of 1.0 and 0.75

mg/L and a contact time of 35-, 70- and 122-minutes and at a PAA dose of 0.5 mg/L and a contact time of 122-minutes.

Key findings from the trial include:

- A PAA dose concentration of 0.75 mg/L at a contact time of 35 min, 70 min and 122 minutes was sufficient to insure the effluent Fecal coliform daily average concentration remained below 200 CFU/100 mL and less expected residual limit expected to be set by IL EPA (0.16 mg/L) at all three contact times.

- A PAA dose concentration of 1.0 mg/L at contact times of 35-minutes, 70-minutes and 122-minutes was sufficient to achieve a Fecal coliform daily average concentration below 200 CFU/100 mL, yet residual was not below the expected limit.

- A PAA dose concentration of 0.5 mg/L at a contact time of 122- minutes was sufficient to ensure the effluent Fecal coliform daily average concentration remained below 200 CFU/100 mL and meet expected residual limit.

- At 0.5 mg PAA / L, Fecal coliform daily average effluent concentrations were in excess of 200 CFU/100 mL at contact times of both 35- and 70-minutes.

- Addition of PAA to the wastewater was shown to minimally impact pH, TSS, BOD_5 and $cBOD_5$.

- Whole Effluent Toxicity (WET) testing was not completed during this trial.

Proposed Next Steps:

Given the success of VigorOx® WWT II PAA in achieving microbial reduction, it is recommended that a full-scale field trial (starting at 0.75 mg/L) be conducted within the plants' disinfection contact chambers to assess long term performance under water quality and hydraulic flow conditions experienced at the site.