

**Memorandum
Public Works Department**



To: City Manager
Subject: Water Treatment Plant Filtration Study - Notice to Proceed
Date: April 29, 2014
Number: 2014-098

Attached is a scope of work for professional engineering services for pilot testing of gravity and membrane filtration processes at the City of Rock Island's Water Treatment Plant. As part of the overall Water Treatment Plant Upgrade Project, this pilot study is necessary to test and verify the optimal filtration process in preparation of the new Water Treatment Filter Building Replacement project.

The anticipated start date will be during May 2014. Gravity filtration will be piloted from May through September and membrane filtration will be piloted in October 2014. Operational data will be compiled during both pilots and analyzed utilizing direct comparison. The final report and process recommendation will be presented in December 2014.

CDM Smith, Inc. proposes to provide their engineering services at an estimated total cost of \$75,000.00. Upon City Council approval, the City of Rock Island's engineering division will draft a notice to proceed (NTP) and submit to CDM Smith, Inc.

Recommendation

The Public Works Department recommends that the City Council approve the pilot study with CDM Smith, Inc. in the amount of \$75,000.00.

Vendor: CDM Smith, Inc.
Payment Amount: \$75,000.00
Account Chargeable:
Fund: 501 Water Operations and Maintenance
Division: 618 Utilities Services
Cost Center: 352 Water Treatment Plant
Object Code: 56501 Engineering Services
Project Code: 2760 WTP Filter Building Replacement

Requisition Number: R004614

Submitted by: Randall D. Tweet, Public Works Director
Larry P. Cook, Utilities Superintendent

Approved by: Thomas Thomas, City Manager

City of Rock Island, Illinois

Gravity and Membrane Filter Pilot Testing

Scope of Work (April 4, 2014)

This scope of work is for professional engineering services for pilot testing of gravity and membrane filtration processes at the City of Rock Island's Water Treatment Plant. This project is divided into the following tasks:

Task 1 – Develop Pilot Protocol

Task 2 – Support Services during Pilot Testing

Task 3 – Review and Analyze Pilot Data

Task 4 – Prepare Draft and Final Pilot Test Reports

Task 5 – Provision of Filter Pilot Equipment

Task 6 – Coordination with Illinois Environmental Protection Agency (IEPA)

Task 7 – Project Management and Meetings

Introduction and Background

The City of Rock Island, Illinois (City) operates a 12 million gallon per day (MGD) water treatment plant which treats Mississippi River water for distribution to the City's retail and wholesale water supply customers. Pretreatment of raw river water is conducted with alum coagulation and cationic polymer prior to clarification in two 6 MGD Infilco Degremont SuperPulsator® sludge blanket clarifiers. Clarified water is then disinfected, filtered and distributed to the City by high service pumps and gravity flow from the four Domed Reservoirs located in the adjacent Reservoir Park across 16th Avenue from the plant. CDM Smith and the City recently completed a Filtration Facility Plan which recommended abandoning the existing gravity filters due to age, hydraulic restrictions, and condition of the facility. A new gravity filtration or membrane filtration facility was recommended to replace the existing facility. Leading up to future design improvements, the City desires to pilot test gravity and membrane filtration process to investigate the process design parameters for the new process that will meet the City's water treatment objectives.

As part of the gravity filter pilot testing the City will investigate the following filter media columns:

- Existing Media Profile: 27" of 06 – 0.8 mm effective size (E.S.) anthracite, L/D Ratio: 980
- Alternative Media Profile No. 1 (Ten States Standards recommended media profile): 18" of 0.95 – 1.05 mm E.S. anthracite over 12" of 0.45 – 0.55 mm E.S. sand (30" total media depth, L/D Ratio: 1,067).
- Alternative Media Profile No. 2: 36" of 0.95 – 1.05 mm E.S. anthracite over 8" of 0.45 – 0.55 mm E.S. sand (44" total media depth, L/D of 1,300).

- Alternative Media Profile No. 3: 36" of 0.95 – 1.05 mm E.S. used GAC from a neighboring facility over 8" of 0.45 – 0.55 mm E.S. sand (44" total media depth, L/D of 1,300).
- Alternative Media Profile No. 4: 36" of 0.95 – 1.05 mm E.S. virgin granular activated carbon (GAC) over 8" of 0.45 – 0.55 mm E.S. sand (44" total media depth, L/D of 1,300).

A gravity filter pilot protocol will be developed as part of the study to include the following investigations:

- The pilot filter columns will be tested at a filtration rate of 4 gallon per minute per square foot (gpm/sf) for the entire pilot study to ascertain the performance of the media profiles at the maximum recommended loading rate under Ten States Standards.
- The existing media profile will be piloted for approximately 1 month to calibrate the pilot filter's performance compared to the full-scale plant; and to compare the existing media's performance against the alternative media profiles. After this brief pilot, this column will be replaced with Alternative Media Profile No. 4 (44" of media with virgin GAC) to be piloted for the remaining three months.

Alternative Media Profiles No. 3 and No. 4 will investigate the effects of biological versus adsorptive removal of taste and odor compounds. Alternative No. 4 will use virgin GAC while Alternative No. 3 will utilize spent GAC from American Water's Davenport, IA WTP (to be confirmed with American Water) to investigate the effects of an already seeded biological filter versus the adsorptive removal of target taste and odor compounds. The City of Rock Island has indicated that fishy smelling nitrogenous compounds are likely the cause of their most frequent taste and odor complaints and will confirm with CDM Smith the nature of this compound to be investigated in this study. The pilot filter columns will be operated upstream of the chlorination point simulating the future filter operations with chlorine fed downstream of the filters.

Most currently available microfiltration/ultrafiltration (MF/UF) membrane filters are proprietary systems. The membrane filter pilot testing will evaluate the performance of one MF/UF system on clarified water from the Rock Island WTP water treatment process, while operating without the use of cationic polymer. The membrane pilot test duration will include a minimum 30-day run to demonstrate a 30-day target chemical cleaning interval.

Task 1 – Develop Pilot Protocol

Under this task, CDM Smith will:

- Prepare draft gravity filter and membrane filter pilot protocols.
- As part of the filter protocols develop a daily data monitoring log for use by City of Rock Island staff during pilot testing.
- Hold a site visit workshop to review the pilot protocols with Rock Island staff and survey the site for location of the pilot apparatus. The site visit will tour the SuperPulsator® to ascertain the best locations for the unit. A potential location is between the SuperPulsator® units. Both electrical and drain service are available in this area and the unit can be located upstream of the chlorine feed point. The City of Rock Island staff will determine a means and install piping to convey water to the unit in this location from the SuperPulsators®. During the site visit, the draft protocol and filter media conditions will be discussed and finalized with Rock Island staff.

- Finalize the pilot protocols.
- Coordinate delivery of the pilot columns with CDM Smith's construction subsidiary, CDM Constructors Incorporated (CCI).
- Coordinate the delivery of the membrane pilot system with a MF/UF system supplier. The membrane piloting will likely occur after the conventional filtration pilot testing is completed.

Deliverables:

- Gravity Filter Pilot Protocol
- Membrane Filter Pilot Protocol

Meetings:

- Site visit workshop in Rock Island

Task 2 – Support Services during Pilot Testing

CDM Smith will perform the following on-site services during start-up, operation, and closeout of the gravity filter pilot column operations:

- Three eight (8) hour days for a CCI field technician to set up the pilot
- Instructions to Rock Island staff to disassemble the pilot and ship back to CCI. It's the City's responsibility to disassemble the gravity filter pilot units based on the instructions provided by CDM Smith. Shipment of the pilot units to and from the Rock Island WTP is the responsibility of CCI.
- Three eight (8) hour days for a process engineer during set up of the pilot
- One eight (8) hour day for a process engineer during shut-down and disassembly of the
- Three eight (8) hour days for a process engineer during operations of the pilot
- One eight (8) hour day for a senior process engineer during operations of the pilot
- Eight (8) hours of CCI technician time will be available during pilot operations for remote trouble-shooting, as needed.
- Respond to questions or concerns by Rock Island staff during pilot testing.

CDM Smith will perform the following on-site services during start-up, operation, and close-out of the membrane pilot operations:

- One eight (8) hour day for a membrane supplier field technician to set up the pilot
- One eight (8) hour days for a process engineer during set up of the pilot
- One eight (8) hour day for a membrane supplier field technician for chemical cleaning of the membranes
- Eight (8) hours of membrane supplier technician time will be available during pilot operations for remote trouble-shooting, as needed.

Deliverables:

- None

Meetings:

- None

Task 3 – Review and Analyze Gravity Filter Pilot Data

CDM Smith will review the following performance data over the four-months of gravity filter pilot:

- Turbidity and particle removal
- Loss of head in filter pilot columns
- Filter run time
- Backwash rate
- Air scour rate
- Filtration rate
- Taste and odor compound removal (as measured by Threshold Odor Number (TON), or other standard method measured by the City (or sent by the City to an outside laboratory), and specific compound measurements, where available)
- Additional periodic monitoring by City staff of heterotrophic plate counts, dissolved oxygen, and pH for biological filter performance.

CDM Smith will evaluate this data throughout the pilot to develop design recommendations for the new filtration facility in terms of filter performance for turbidity removal, head loss, backwash efficiency, and filter production efficiency. In terms of taste and odor compound removal, City of Rock Island staff will monitor the presence of taste and odor compounds using the TON, and sampling for individual compounds where necessary, in the raw Mississippi River water throughout the study. If a taste and odor event is suspected, samples for suspect compounds shall be taken on the downstream end of each filter pilot column to investigate removal by each column. The City will be responsible for all data sampling and analytical costs. CDM Smith will review data obtained by the City. The City will also sample and analyze for the data listed in the final bullet at an interval prescribed in the filter pilot protocol.

Day to day data collection will be the responsibility of Rock Island staff. As part of the pilot protocol development, CDM Smith will prepare a data collection log sheet for usage by City of Rock Island staff during the pilot. The City will track data manually throughout each day using this sheet. Digital data will be recorded by the software included with the rented laptop. The City will collect data weekly from the software and save to a USB. Data will be transferred to CDM Smith electronically via a project eRoom (the project eRoom will be setup by CDM Smith for data sharing).

During the first two weeks of the pilot test, CDM Smith will analyze the data daily to track the performance of the pilot units. Further, at the end of one month of operations, CDM Smith will prepare a summary memo on the first month of operations and the results of the calibration with the existing media profile column. CDM Smith will prepare weekly reports for the first month of

operations and bimonthly reports (once every two weeks), with a review conference call, for the remainder of the pilot.

Deliverables:

- Data collection log sheet for usage during the pilot
- Summary memo after one month of operations

Meetings:

- Weekly conference calls for the first month of the study, bimonthly calls for the duration of the study.

Task 4 – Review and Analyze Membrane Filter Pilot Data

CDM Smith will review and analyze the following performance data from the membrane filter pilot:

- Turbidity removal
- Increase in transmembrane headloss (TMP) as the membrane operates
- Effectiveness of backwash and maintenance wash processes
- Effectiveness of chemical cleaning processes

CDM Smith will evaluate this data throughout the pilot and make recommendations to modify operating parameters to improve membrane pilot operation, as needed.

Data will be collected by the membrane pilot data logger. The City will conduct daily visual inspections of the pilot unit and assist with minor troubleshooting, as required.

CDM Smith will analyze the data weekly to track the performance of the pilot units. CDM Smith will prepare weekly reports, with a review conference call during the membrane pilot duration.

Deliverables:

- Data collection log sheet for usage during the pilot
- Weekly reports including one (1) page of text summary and a graph, if applicable.

Meetings:

- Weekly conference calls for the duration of the study.

Task 5 – Draft and Final Report

CDM Smith will complete the following tasks:

- Prepare one (1) draft report summarizing the results of the gravity filter and membrane filter pilot testing
- Conduct a workshop in Rock Island to discuss the results of the draft report
- Finalize the report after the workshop

Deliverables:

- Five (5) paper copies of the draft/final filter pilot report; and one electronic copy.

Meetings:

- Half-day (four hour) report review workshop in Rock Island

Task 6 – Provision of Pilot Test Equipment

CDM Smith will provide the gravity filter column pilot equipment through our internal construction subsidiary, CCI. CDM Smith will provide the following equipment:

1. Two (2) filtration modules each with dimensions 32"x64"x140" tall, each containing the following:
 - Two (2) ten-foot high 4" clear PVC pilot filter columns; 4 pilot columns total
 - Variable speed pumped influent with flow rates ranging from 0.3 to 1.0 gpm (~3.5 gpm/sf minimum flow rate)
 - Hach 1720 C/D Turbidimeter
 - Flow indicator (0 – 1 gpm range)
 - Particle counter
 - Head loss pressure transmitter
 - 120 VAC, 60 Hz, 20 Amps electrical supply
2. One (1) backwash and air scour module with dimensions 22"x40"x50" tall, containing the following:
 - One (1) 50 gallon clearwell for provision of backwash water
 - 1-1/2" PVC overflow lines (2)
 - 1 variable speed backwash pump with flow indicator
 - 1 air compressor for provision of air scour with flow indicator
 - 3/8-inch diameter air hose, 25 feet in length, with quick-connect fitting
3. One (1) laptop computer interface with onboard software for data recording.

CDM Smith will provide, on a monthly rental basis, each filtration module, each backwash/air scour module, laptop with data recording software, and each particle counter. The scope of services covers operation of the gravity filter pilot for up to four months. The City will procure filter media using recommendations developed by CDM Smith in the pilot protocol.

CDM Smith will not provide the following: connection materials to settled water piping and skid influent piping, skid effluent piping and connection to drain, and connection materials for backwash module to finished water piping. The materials will be purchased or procured by the City. The City will also collect existing filter media sample for pilot testing and will also coordinate with Iowa American's Davenport WTP for a GAC sample.

CDM Smith will procure the rental of the MF/UF membrane filter from a proprietary membrane filtration system supplier. CDM Smith will procure the rental of the following equipment:

1. One (1) membrane filtration skid containing the following:

- One (1) membrane module
 - One (1) variable speed feed/backwash pump
 - One (1) Hach 1720 C/D Turbidimeter
 - Flow indicators
 - Pressure and temperature transmitters
 - Chemical cleaning metering pumps
 - One (1) control panel
2. One (1) membrane feed tank
 3. One (1) membrane filtrate tank
 4. One air compressor

The City will be responsible for providing the following: clarified water feed pump and connection piping, skid effluent piping and connection to drains, 3-phase 480v electrical feed connections, telephone or internet connection.

CDM Smith will provide each rental of the membrane pilot system for a duration of between 30 to 45 days.

Task 7 – Coordination with Illinois Environmental Protection Agency (IEPA)

Under this task CDM Smith will perform the following coordination items with IEPA:

- Conduct one (1) teleconference with the IEPA to review the pilot protocol for the pilot testing
- Conduct one (1) teleconference with the IEPA to discuss the results of the pilot testing

Task 8 – Project Management and Meetings

CDM Smith will complete the following tasks:

- Hold kick-off meeting/site visit with the City to review project tasks, goals, City expectations, project schedule, and draft protocol in addition to a walk-through to determine location for the pilot equipment.
- Monitor and maintain strict adherence to the established quality assurance standards.
- Prepare monthly status reports of Project progress, expenditures to date, cost-to-budget information, and submit in conjunction with monthly invoice.
- Immediately advise the City project team when established project expectations cannot be met.

Deliverables:

- Monthly Progress Report and Service Invoices, including Scope, Schedule, and Cost-to-Budget Updates
- Meeting Summaries

Meetings:

- Kickoff Meeting with City Staff.

Project Schedule

CDM Smith is prepared to start this project. Upon receiving a notice to proceed (NTP), CDM Smith will coordinate with our piloting group to prepare the gravity filter pilot units. We anticipate completing this study by December 30, 2014, as follows:

- Equipment procurement and site preparation – April to May 2014
- Gravity filtration piloting – May thru September 2014.
- Membrane piloting – October 2014
- Data analysis and report - November – December 2014.

Project Fee

CDM Smith agrees to complete the above scope of work for a lump sum fee of \$75,000 to be billed on a monthly basis based on the level of completion of the project.