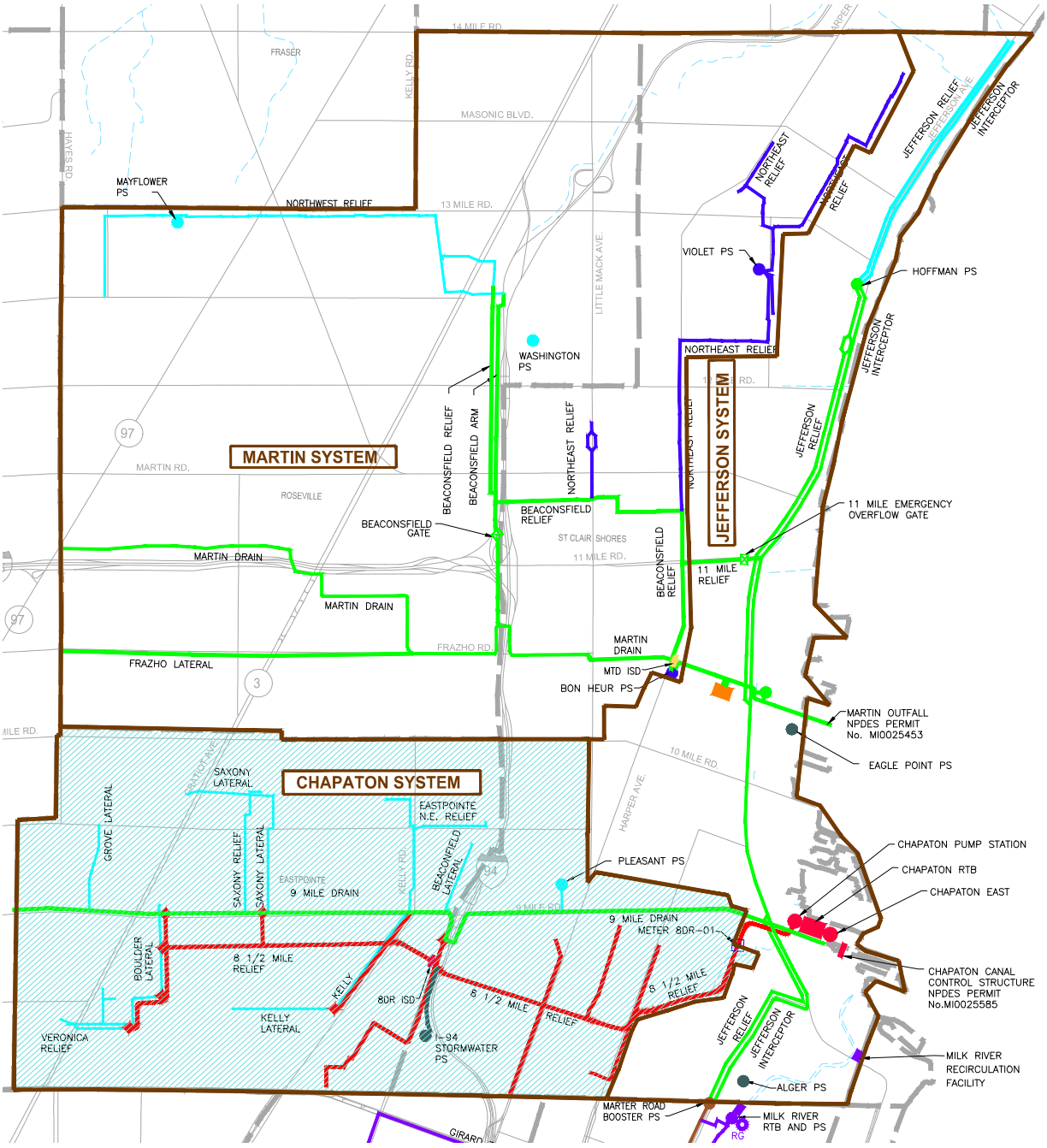
Miller
Santo
Lucido

EIGHT AND ONE-HALF MILE RELIEF DRAIN
INTRA-COUNTY DRAINAGE BOARD
SEPTEMBER 11, 2023
10:00 A.M.
AGENDA

**NOTE: THIS MEETING WILL BE HELD IN PERSON WITH TELECONFERENCE OPTION FOR PUBLIC**

**Call in Number: 1-224-990-0182**
**Access Code: 927 405 823**




## SYSTEM LEGEND
(AS OF DATE OF PUBLICATION)

- SYSTEM BOUNDARY

## DISTRICT LEGEND
(AS OF DATE OF PUBLICATION)

- 8 1/2 MILE RELIEF DRAIN DRAINAGE DISTRICT
- SOUTHEAST MACOMB COUNTY WASTEWATER DISPOSAL SYSTEM
- MARTIN SANITARY DIVERSION DISTRICT
- SOUTHEAST MACOMB SANITARY DISTRICT
- NORTHEAST SEWAGE DISPOSAL SYSTEM
- MILK RIVER INTERCOUNTY DRAIN DRAINAGE DISTRICT
- LOCAL MUNICIPALITY
- OTHER

## ASSET LEGEND

- PUMP STATION
- FLOW CONTROL STRUCTURE
- RTB
- GRAVITY INTERCEPTOR
- IN-SYSTEM STORAGE DEVICE
- OVERFLOW POINT
- LEVEL SENSOR
- RAIN GAUGE
- FLOW METER

fishbeck
Engineers | Architects | Scientists | Constructors

Hard copy is intended to be 8.5"x11" when plotted. Scale(s) indicated and graphic quality may not be accurate for any other size.

# CHAPATON SYSTEM MAP

Macomb County, MI

Southeast Macomb Sanitary District
Wastewater Master Plan

PROJECT NO.
181053

**3.6**





PLOT INFO: Z:\2018\181053\CAD\PRECD\SEMSD_OVERALL.DWG LAYOUT: FIG 3-6_CHAPATON SYS DATE: 7/20/2021 TIME: 1:33:59 PM USER: MESEDKI

An adjourned meeting of the Intra-County Drainage Board for the **EIGHT AND ONE-HALF MILE RELIEF DRAIN** was held in the Office of the Macomb County Public Works Commissioner, 21777 Dunham Clinton Township, Michigan on August 14, 2023, at 11:39 A.M.

PRESENT: Candice S. Miller, Chair

Vince Viviano, Member

EXCUSED: Sarah Lucido, Member

ALSO PRESENT: Daniel Acciavatti, Deputy Government Relations; Vince Astorino, Operations & Flow Manager; Brian Baker, Chief Deputy; Stephen Downing, Construction and Maintenance Manager; Norb Franz, Communications Manager; Jennifer Jozwiak, Drain Account Specialist; Bruce Manning, Finance Manager; Pamela Sonnenberg, Administrative Assistant; Tom Stockel, Construction Supervisor

PRESENT VIA TELECONFERENCE: Bonnie Rau, City of Sterling Heights DPW

The meeting was called to order by the Chair, Candice S. Miller. A motion was made by Mr. Viviano, supported by Ms. Miller to approve the agenda as presented.

Adopted: YEAS: 2
NAYS: 0

Minutes of the meeting of July 10, 2023, were presented. A motion was made by Mr. Viviano, supported by Ms. Miller to approve the minutes as presented.

Adopted: YEAS: 2
NAYS: 0

The meeting was opened to public participation, then closed, there being no comments from the public.

Mr. Astorino said that there were no wet weather events for the past month. He presented some photos of various sites where the In-System Storage project is taking place. Ms. Miller asked how the bladder is coming along. Mr. Astorino said that it is being made for the third time. He was told that if everything goes well, it should be ready in October or November. It is made by hand and they found a delamination failure in the first two that were made. They are changing up their process. Mr. Baker asked if there were any other manufacturers making this product and Mr. Astorino said no.

Mr. Astorino updated on the Chapaton Canal Rehabilitation project. Z Contractors is onsite and presented photos of the crane mats being delivered and installed. They have started clearing the grass, topsoil and the scrub trees for the entire site. We will replace the trees when the project is done.

Mr. Astorino said the 2023 Interceptor Inspection program is about 95% complete and ahead of schedule. There is a remaining segment from Malvern to the Chapaton Pump Station that still need to be done.

Mr. Astorino stated that we are waiting for submittals from Rotor Electric for the Chapaton Electrical Upgrades project. They are not planning on doing any work until July of 2025.

A motion was made by Mr. Viviano, supported by Ms. Miller to receive and file the project updates.

Adopted: YEAS: 2
NAYS: 0

Mr. Baker presented the County ARPA subrecipient agreement covering two district projects. The Electrical Upgrades for $9.5 million and $8.8 million for the In-System Storage project.

A motion was made by Mr. Viviano, supported by Ms. Miller to approve and authorize the Drain Board Chair to sign the $18.3 million in County ARPA Subrecipient Agreement.

Adopted: YEAS: 2
NAYS: 0

Mr. Baker presented the proposed 2023/2024 Eight and One-Half Mile Relief Drain budget and revenue requirement for the fiscal year beginning October 1, 2023. The community contribution increase of 4.9% is slightly lower than the projected 5% increase provided to the two communities and upon which their own budgets were established.

A motion was made by Mr. Viviano, supported by Ms. Miller to approve the 2023/24 Eight and One-Half Mile Relief Drain budget and revenue requirement for the fiscal year beginning October 1, 2023.

The Chair presented the invoices totaling $893,763.30 to the board for review and approval.

A motion was made by Mr. Viviano, supported by Ms. Miller to approve the invoices as presented.

Adopted: YEAS: 2
NAYS: 0

A motion to receive and file the financial report given by Mr. Manning was made by Mr. Viviano and supported by Ms. Miller.

Adopted: YEAS: 2
NAYS: 0

There being no further business, it was moved by Mr. Viviano, supported by Ms. Miller, that the meeting of the Eight and One-Half Mile Relief Drain Board be adjourned.

Adopted: YEAS: 2
NAYS: 0

The meeting was adjourned at 12:05 P.M.

Candice S. Miller

Candice S. Miller, Chair
Macomb County Public Works Commissioner

STATE OF MICHIGAN

COUNTY OF MACOMB

I certify that the foregoing is a true and correct copy of proceedings taken by the Intra-County Drainage Board for the Drainage District shown on the attached set of minutes, on August 14, 2023, the original of which is on file in the Public Works Commissioner's Office. Public notice of the meeting was given pursuant to Act No. 267, Public Acts of Michigan, 1975, including, in the case of a special or rescheduled meeting or a meeting secured for more than 36 hours, notice by posting at least 18 hours prior to the time set for the meeting.

Candice S. Miller, Chair
Macomb County Public Works Commissioner

DATED: 08/14/23

**Candice S. Miller**
Public Works Commissioner
Macomb County

To: 8 ½ Mile Relief Drain Drainage District Board Members

CC: File

From: Vincent Astorino, Operations Director

Date: September 11, 2023

Subject: Construction Projects Status Updates for the September 2023 Board Meeting

The following provides a status update for construction work completed within the 8 ½ Mile Relief Drain Drainage District (8MRDDD) for the previous month.

## Wet Weather Operations

**Wet Weather Event:** August 23, 2023

**Rainfall:** 3.54 inches

**Treated Discharge Volume:** 59.5 MG

**Water Quality Numbers:** 16 cts / 100 ml geometric mean (Permit maximum is 300 cts/ml)

**Description:** This event consisted of two separate significant rain events that per NPDES requirements, registered as one single event. During these events, the 9 Mile Emergency Bypass (Outfall 002) had to be used for each major storm that went through. The first use was due to issues with Storm Pump #1 not being able to start. Electricians were mobilized to the site and were able to fix the problem during the initial rain event. The second day of rain resulted in an intense rain that had all three storm pumps going at full speed and not being able to maintain the wet well level. Therefore, the emergency bypass was once again used. Everything that was discharged was treated per NPDES requirements and overall the water quality numbers far exceeded standards.

## Chapaton In-System Storage Project

**Contractor:** Weiss Construction

**Engineering Consultant:** Tetra Tech

**Project Description:**

The primary focus of the project is the construction of an access shaft and installation of the In-System Storage Device at Beaconsfield and Oak in Eastpointe. This project will achieve an additional 3.5 million gallons of storage within the 8.5 Mile Relief tunnel.

Significant project tasks that have occurred over the past month:

1. Submittals are being received and processed by the engineering team.
2. Construction Activities per Update Period:
    - Continued staging construction materials delivered & stored along Beaconsfield greenbelt.
    - Maintained secured work site with swing gates and privacy fence screening at construction sites.
    - Continued Beaconsfield site vibration and sensor monitoring and documentation during construction as required.
    - Continued dewatering and maintaining adequate working conditions within the interior of the Beaconsfield shaft as necessary.
    - Removed concrete forms from bypass base slab concrete placement as required at the Beaconsfield site.
    - Layout and set in place concrete forms and installed reinforcing steel, dowels, and water stop for 11ft tunnel emergency bypass walls within the Beaconsfield shaft as designed.
    - Poured in place high strength concrete emergency bypass walls adjacent to 11ft tunnel connecting East and West sections of 11ft tunnel within the Beaconsfield construction shaft as required.
    - Set concrete wall forms in place on East tunnel foundation and installed reinforcing steel, dowels, and water stop as designed to be encased in concrete wall within Beaconsfield shaft.
    - Poured in place 4 sides of high strength concrete walls along with intermediate bypass wall on East foundation of 11ft tunnel at inside the Beaconsfield construction shaft as required.
    - Layout and set in place concrete forms and installed reinforcing steel, dowels, and water stop for 11ft tunnel emergency bypass ceiling within the Beaconsfield shaft as designed.
    - Installed Door jambs encased with CMU block for the proposed inflatable dam Control Building at Beaconsfield as required.
    - Installed CMU block walls and started placing brick veneer for the Control Building at Beaconsfield as designed.
3. Construction Look Ahead:
    - Continue deliveries of construction materials along Beaconsfield greenbelt.
    - Continue Beaconsfield site vibration monitoring & documentation.
    - Set in place upper portion of concrete wall forms for 11ft tunnel west walls at the Beaconsfield construction shaft.
    - Install required reinforcing steel, dowels, and water stop within west and bypass walls at Beaconsfield work site.
    - Pour in place high strength concrete for the upper ceiling of the bypass as designed in the Beaconsfield shaft work site.
    - Pour in place high strength concrete for the upper west walls as designed in the Beaconsfield shaft work site.
    - Complete installation of required lamp-post vents and necessary components for carbon odor control unit at the Kelly Road worksite.

- Continue to excavate and place access drive subgrade at the Gaukler worksite.
- Finish installing odor pipe fittings, vents at the Gaulker Road work site as designed.
- Finished installing CMU block and brick veneer for the proposed inflatable dam Control Building at Beaconsfield as required.
- Begin placing Control Building trusses and roof at the Beaconsfield work site.

Construction Costs:

| | Date (if applicable) | Amount |
|---|---|---|
| Original Contract Amount | | $9,673,200.00 |
| Change Order #1 | 9/15/22 | $269,666.49 |
| Revised Contract Amount | | $9,942,866.49 |
| Total Spent to Date | Pay Apps. #1 - 17 | $5,701,433.64 |
| Remaining Budget | | $4,241,432.85 |

*Figure 1 – Placing Concrete for Tunnel Bypass Walls via Pump @ Beaconsfield Shaft*

*Figure 2 – Placing Concrete Walls for Tunnel Bypass @ Beaconsfield Shaft*

*Figure 3 – Setting Concrete Wall forms @ East side of Beaconsfield Shaft*

*Figure 4 – Installing Reinforcing Steel @ East Wall of Beaconsfield Shaft*

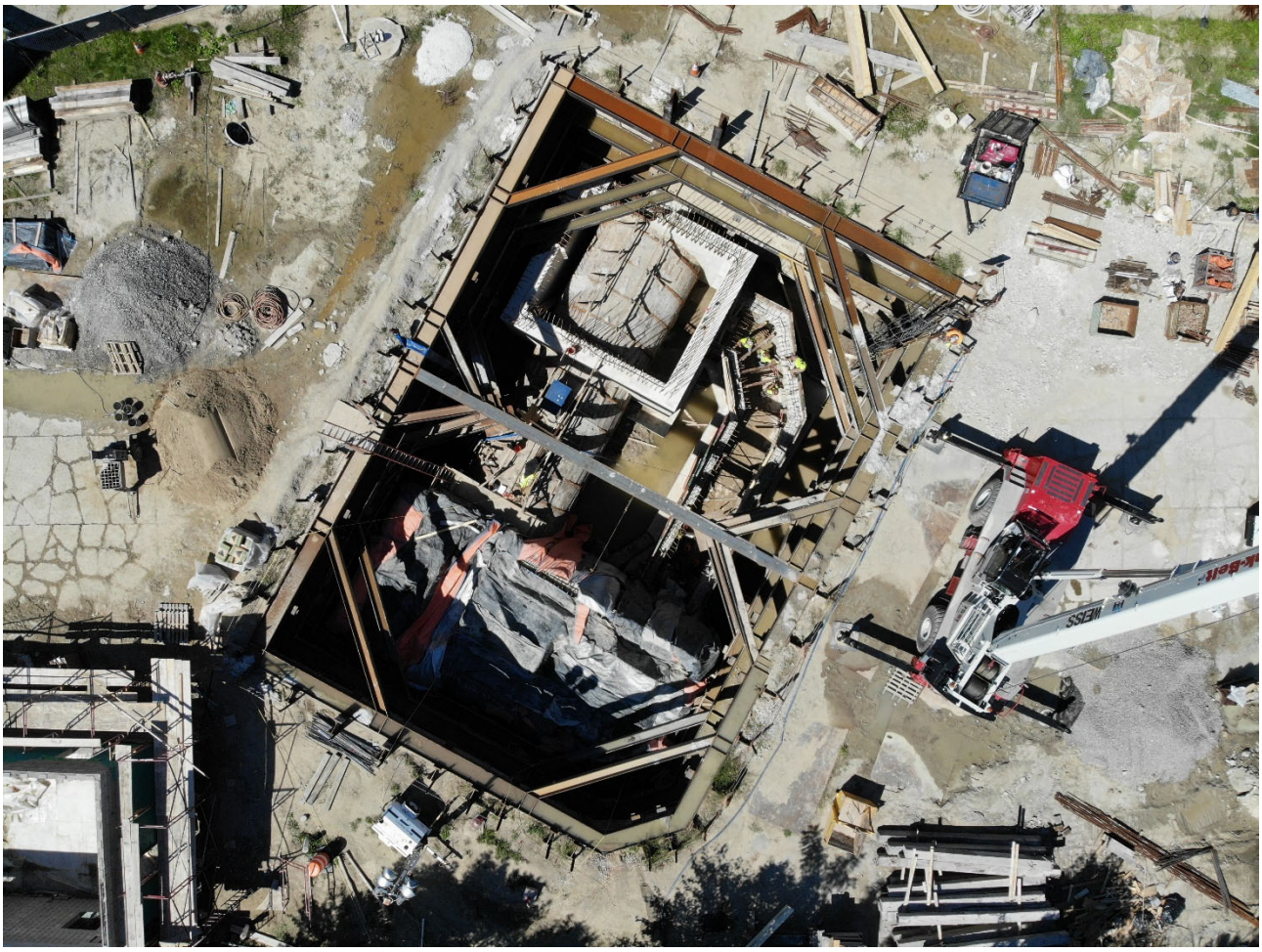
*Figure 5 – Installing Wall Forms @ East Wall of Beaconsfield Shaft*

*Figure 6 – Placing Concrete Walls via Pump @ East End of Beaconsfield Shaft*

*Figure 7 – Installing Door Jambs @ Beaconsfield Control Bldg.*

*Figure 8 – Installing Concrete Masonry Blocks @ Beaconsfield Control Bldg.*

*Figure 9 – Drone Aerial at 100 FT*



# Chapaton RTB Canal Rehabilitation Project

**Contractor:** Z Contractors

**Engineering Consultant:** Wade Trim

**Project Description:**

The primary focus of the project is to rehabilitate the Chapaton Treatment Canal which was last rehabilitated in the early 2000s, replace the Chapaton Canal Control Structure gates and associated building and electrical components, and raise the top of the Chapaton Treatment Canal above the 500-year flood elevation. This will provide flood resiliency for the surrounding area and will improve the water quality of Lake St. Clair by capturing more CSO and discharging fewer times per year. Additional project components include a direct process pipe to the lake to reduce treatment costs by using less water, proper abandonment of a portion of the 100-year-old 9-Mile Drain, and an 11-acre sewer separation along 9-Mile Road.

**Significant project tasks that have occurred over the past month:**

1. Construction Activities per Update Period:
    - Owen Tree Service removed trees atop 9-Mile Drain on south side of canal.
    - Completed installation of temporary dewatering system
    - Permanent north side sheeting driven near Aeration Building. Existing sheeting to be removed / reconfigured.
    - Installed stone access road within canal and stone construction yard in area of removed north side berm.
    - Installed access ports into the abandoned 9-Mile Drain to observe conditions.
    - Installed temporary utilities in trench along north property line. Tie-ins not made yet.
    - Job trailers powered up and operational.
2. Construction Look Ahead:
    - Install south side sheeting behind existing baffle. Baffle sheeting / earth to be removed.
    - Continue installing new permanent south side sheeting towards the east (in area where 9-Mile Drain is only form of bank stabilization).
    - Relieve earth load behind existing sheeting and begin excavating for Screening Structure.
    - Install easternmost portion of new 24” flushing line.

**Construction Costs:**

| | Date (if applicable) | Amount |
|---|---|---|
| Original Contract Amount | | $27,374,710.00 |
| Total Spent to Date | Pay App. #1 | $1,181,782.60 |
| Remaining Budget | | $26,192,927.40 |

*Figure 9 – South Side Tree Clearing*

*Figure 10 – Dewatering Well and Discharge Header*

*Figure 11 – Temporary Utility Trench*

*Figure 12 – North Side Sheeting: New, Existing, Template*

*Figure 13 – Drone Aerial at 100 FT Facing East (Baseline)*

*Figure 14 – Drone Aerial at 100 FT Facing East (8/31/23)*

## 2023 Interceptor Inspection Program

**Contractor:** Taplin

**Engineering Consultant:** NTH

**Project Description:**

The 2023 sewer inspection program was awarded to Taplin in March 2023. The inspection program includes inspection of approximately 24 miles of sanitary sewer ranging from 2-feet to 12-feet in diameter and 152 manholes across the MIDDD and 8.5 Mile Districts.

The inspection interval for the entire system is based on a 3-year cycle, where non-reinforced concrete pipe is inspected every 3 years and reinforced concrete pipe is inspected every 6 years. The 8.5 Mile, due to being a combined sewer and mostly stormwater, is on a 10-year schedule. This may be adjusted pending the results of the current inspection.

**Significant project tasks that have occurred over the past month:**

1. Inspection is 95% complete and ahead of schedule. The only remaining segment is from Malvern to the Chapaton Pump Station.
2. Sample videos have been sent to NTH and MCPWO for review. Official inspection data has not been sent yet.

**Construction Costs:**

| | Date (if applicable) | |
|---|---|---|
| Original Contract Amount | 4/10/23 | $403,919.38 |
| Total Spent to Date | | $0.00 |
| Remaining Budget | | $403,919.38 |

***This Table reflects the 8.5 Mile costs only.**

## Chapaton Electrical Upgrades

**Contractor:** Rotor Electric

**Engineering Consultant:** Tetra Tech

**Project Description:**

The project consists of installing three 2 MW generators and all associated synchronous gear, new motor starters for each of the three stormwater pumps, new 15 kV switchgear, and a complete motor rebuild for storm pump 2. This project will increase the electrical resiliency of the Chapaton Pump Station.

Significant project tasks that have occurred over the past month:

1. Submittals are being received and processed by the engineering team.

2. Construction Activities per Update Period:
    - No construction activities at this time. On-site work is currently not planned until 2025.

Construction Costs:

| | Date (if applicable) | Amount |
|---|---|---|
| Original Contract Amount | | $14,650,000.00 |
| Total Spent to Date | Pay Apps. # | $0.00 |
| Remaining Budget | | $14,650,000.00 |

**Candice S. Miller**

Public Works Commissioner
Macomb County

To: 8 ½ Mile Relief Drain Drainage District Board Members

From: Vincent Astorino, Operations Director

Date: September 11, 2023

Subject: 8.5 Mile Chapaton PS Ventilation Improvements – Design Recommendation

The Chapaton Pump Station (PS) has been experiencing significantly elevated temperatures within the main floor, which houses the large stormwater pumps, during wet weather events. This has caused the pump motors to reach critical temperatures sooner than expected during large wet weather events. These elevated temperatures within the storm pump motors are causing the stator and windings to degrade faster over time and therefore are reducing their useful life expectancy.

MCPWO Engineering staff has been investigating this issue. When the facility was constructed back in 1968, there used to be large louvers within the North wall near the pump motors which would allow some heat to be rejected to the outside environment during periods of storm pump use. In 2010, the previous administration, sealed these louvers and installed an energy recovery unit within that main floor and to serve the lower galleries. Since that project in 2010, the pump station has experience elevated temperatures during wet weather events due to not having the ability to exhaust the extreme temperatures rejected by the 2,750 HP storm pump motors. Portable fans have been used and windows are opened but are not capable of properly exchanging the air within that space which consists of a volume of approximately 204,525 cubic feet.

MCPWO utilized the 8.5 Mile as-needed engineering support with OHM to perform an evaluation of the facility. OHM has also come to the same conclusion as MCPWO Engineering staff. As part of their report, OHM also analyzed several options to remedy the excessive heat within the main floor of the Chapaton PS. Three options have been provided which all include exhaust fans and an air intake louver system. These range from 180,000 cubic feet per minute (CFM) to 90,000 CFM in exhaust fan capacity with the higher being for worst case scenario. After review of the options, MCPWO feels it best to start with the 90,000 CFM option and then evaluate this over time.

MCPWO has requested a design and construction administration proposal from OHM to move the project into the next phase. Attached to this recommendation you will find a proposal from OHM for those services in the total not-to-exceed amount of $55,280. MCPWO has reviewed this proposal and has no issues with what has been proposed. As part of the 23/24 budget, there has been $750,000 allocated to this total project.

MCPWO is confident that OHM can perform the scope of services as provided for the project.

MCPWO staff is recommending the following action:

That the 8 ½ Mile Relief Board award the contract to OHM in the total not-to-exceed amount of $55,280 to design and provide construction administration services for the Chapaton PS Main Floor Ventilation project.

Attachments: OHM Proposal Dated 9/1/23

ARCHITECTS. ENGINEERS. PLANNERS.

OHM Advancing Communities℠

September 1, 2023

Vince Astorino
Operations and Flow Control Manager
Macomb County Public Works Commissioner Candice S. Miller
23001 E. 9 Mile Rd.,
St. Clair Shores, MI 48080

RE: Proposal for Professional Services
Chapaton Pump Station Heat Removal Design & Construction Services

Dear Mr. Astorino:

Thank you for contacting us to provide professional services to Macomb County Public Works Office (MCPWO) for the Chapaton Pump Station heat removal ventilation design and construction services project. We have prepared this scope of work based on the information provided and discussions with Macomb County Public Works staff. This proposal represents our understanding of the project, work plan, schedule, and cost of services.

## Statement of Understanding

OHM understands that the interior temperature can become elevated within the pump room when one or more of the 2750 HP pumps are running. In a recent study completed by our firm in July 2023, it was determined that implementing a ventilation system comprising of two (20) 45,000 cfm exhaust fans and an associated intake louver would provide a 10-11 degree temperature differential from outdoor ambient temperatures. This reduction will lower the risk of failure to the motors and other electrical equipment due to overheating.

In addition to completing the existing ventilation analsyis at Chapaton Pump Station, our team brings a unique prospective to MCPWO with a full range of experts and construction technicians to see the project through construction. Of our nearly 700 employees, 10 are dedicated to Mechanical, Electrical and Plumbing disciplines, while nearly 150 employees are construction engineers and field technicians. Design efforts will be led by Senior Project Manager, Sean Tabacsko, a 20-year veteran in mechanical engineering projects for municipalities and public agencies. Sean will be supported by lead electrical engineer, Louis Meyette, PE, who brings 34 years of experience in electrical process controls and power distribution design. Overseeing construction progress will be completed by one of our local Macomb County Field Client Representatives, Paul Wilkerson, who brings over 29 years of industry experience in municipal projects of varying size and complexity. The following work plan includes the efforts the OHM team will provide during design engineering and construction contract administration services to successfully implement this project.

## Work Plan

We divided our work plan into the following two tasks, which are associated with the design and construction phases of the project. The current proposal includes the work necessary to successfully design, construct, and administer the heat removal ventilation project at Chapaton Pump Station.

- Task 1: Chapaton Pump Room Ventilation Design
- Task 2: Chapaton Pump Room Ventilation Construction Contract Administration

Our work plan includes the following effort required to complete design engineering and provide construction oversight for this project:

Task 1 – Chapaton Pump Room Ventilation Design

- Utilize previously provided record drawings as a basis for background electronic CAD file creation. Field verify critical areas including dimensions. A complete CAD model of the building will not be created, only areas needed for construction documents.
- MCPWO to provide updated electrical as-built documents from recent projects. Field verify feeder locations.
- Prepare the complete Bid Package in accordance with the approved recommendations and Owner direction as a result of the previously completed study. Bid Package shall identify and consider all active or in-design projects within the 8.5 Mile district that may impact construction operations.
- Design shall conform to two 45,000 cfm exhaust fans and include air intake louvers/fans. OHM will further evaluate the air intake system and location to minimize the footprint and obstructions within the existing space.
- Mechanical Design will include fan and louver schedules, construction details for installation of louvers and exhaust fans, and a sequence of operation.
- Electrical Design will include selection of variable frequency drive for each exhaust fan, power to exhaust fans, and damper actuators.
- Use the MCPWO NEXGEN naming convention provided by MCPWO to identify all assets.
- Produce drawings in AutoCAD in accordance with the MCPWO standards.
- Prepare a technical specification book to accompany the plans. The Division 00 specifications including the Agreement and the General Conditions will be provided by MCPWO.
- Prepare all specifications in MasterFormat 2014 in accordance with MCPWO standards.
- Submit construction documents at the 60%, 90% and 100% (IFB set) milestone phases for review.
- Prepare the necessary permit applications and assist MCPWO in securing permits, if needed. Any permit fees will be the responsibility of MCPWO.
- Assist MCPWO in advertising and soliciting competitive bids. Conduct and summarize a pre-bid meeting, answer bidder questions, and prepare addenda as necessary.
- Review bids, verify references, and provide bid award recommendation.
- Conduct and summarize any interviews and/or pre-award meetings with bidder(s), if needed.

Deliverables

- 60% and 90% design review plans
- Construction documents consisting of sealed plans and technical specifications
- Asset list for integration into NEXGEN Software
- Bid tabulation and award letter of recommendation

Task 2 – Chapaton Pump Room Ventilation Construction Contract Administration

- Prepare executable contract documents including insurances and bonds provided by the Contractor.
- Conduct and summarize the pre-construction meeting with awarded Contractor.
- The construction management software ProjectTeam will be utilized during the construction phase. MCPWO has purchased software licenses and will provide training and access privileges.
- Prepare a log form for all required contractor's submittals (shop drawings, catalogue cut sheets and materials certification letters).
- Review submittals and shop drawings, etc. and distribute to MCPWO.

- Respond to Requests for Information.
- Review Contractor's periodic Applications for Payment (assumed 2 progress payments). Prepare weekly e-mail progress updates to MCPWO staff summarizing project progress, construction issues and anticipated schedule. Hold bi-weekly progress meetings while work is active (assumed four progress meetings / two per month; one virtual, one in-person) and distribute minutes for those meetings. We have assumed 8 weeks of active construction with a progress meeting before start-up.
- Perform part-time construction observation and daily reporting during periods of contractor significant work activity (assumed an average of 24 hours of inspection per week for 8 weeks).
- Upon notice by the contractor, complete a preliminary walkthrough of the overall project with MCPWO staff at substantial completion, prepare substantial completion notice and develop a punch list for submission to the contractor.
- Once the contractor has completed punch list items, we will complete a final inspection and provide MCPWO with a recommendation for final payment to the contractor.
- Conduct contract close-out including preparation of record as-built drawings.

Deliverables
- Pre-construction & Progress meeting notes
- Submittal log and copy of final approved submittals
- Monthly estimates (assumes two progress payments)
- Preliminary/Final walkthrough punch lists and recommendation for Owner acceptance
- Provide a copy of Construction Daily Reports (CDR's) at completion
- As-built documentation

If additional as-needed items arise outside of the scope of this study, OHM will prepare a separate scope and a budget for each item for approval by Macomb County Public Works before proceeding.

## Schedule

The following table outlines the task durations for major project milestones.

| TASK | TASK DURATION (Weeks) |
|---|---|
| Task 1 – Chapaton Ventilation Design | 8-10 |
| Task 2 – Construction Contract Administration | 8 |

We are prepared to commence work on this project upon receipt of your written authorization to proceed.

## Compensation

OHM Advisors will provide the above-outlined professional services in accordance with the as-needed engineering services agreement between OHM Advisors and the Eight and One-Half Mile Relief Drain Drainage District. Our professional services will be performed on a not-to exceed, time and expense basis.

| Phase/Task Budget | Cost |
|---|---|
| Task 1 – Design | $35,000 |
| Task 2 – Construction Contract Administration | $20,280 |
| **Total Design & Construction Budget** | **$55,280** |

1. Budget was determined based on the noted assumptions. OHM Advisors proposes to confirm these assumptions with Macomb County Public Works prior to commencing with services.
2. "**Not-to-Exceed**" fees, as proposed, shall be invoiced for the actual hours of labor utilized on this task.

## Clarifications and Assumptions

This Scope of Services was prepared based on the following assumptions:

- If additional labor effort or change in schedule is required beyond what is described herein, OHM Advisors will negotiate an amendment with Macomb County Public Works. OHM Advisors will not proceed with additional services without written authorization to proceed from Macomb County Public Works.
- Meetings shall be conducted in accordance with the Scope of Services as described herein. Additional meetings, not described within our Work Plan, shall be considered additional services and will be billed on an hourly basis under Additional As-Needed Services Allowance upon agreement with Macomb County Public Works.
- Assume wet well is sealed and electrically classified (Class 1 Division 1) design is not required, and odors will not arise from a slight building negative pressure in the pump room.

## Client Responsibilities

- Macomb County Public Works will provide a single point of contact to OHM Advisors who is knowledgeable about the project needs and desired outcomes.
- Macomb County Public Works will provide the following, if available, to assist us with the project: previous as-built and existing plans, SCADA data, and other relevant information as needed.

## Additional Services

The following services are not included in our compensation but may be desired. Fees for these services can be negotiated later if deemed necessary. Additional services that may be needed are as follows:

- Terminal Air Balance
- Commissioning
- PLC programing design

## Authorization and Acceptance

If this scope of work is acceptable to you, please issue a Task Order that will serve as our authorization to proceed.

Thank you for giving us the opportunity to be of service. We look forward to working with you on this project. This proposal is valid for 30 days from the date of this letter. If you have any questions or comments, please contact me at steven.siklich@ohm-advisors.com or 248.751.3111.

Sincerely,
OHM Advisors

Steve Siklich, PE, Principal

Acceptance
Macomb County Public Works

Vince Astorino, Operations and Flow Control Manager

Cc: Sean Tabacsko, OHM
Nathan Zgnilec, OHM

**Candice S. Miller**

Public Works Commissioner
Macomb County

To: 8 ½ Mile Relief Drain Drainage District Board Members

From: Vincent Astorino, Operations Director

Date: September 11, 2023

Subject: 8.5 Mile Digital Twin Pilot Recommendation

The 8.5 Mile Relief Drain Drainage District (8MRDDD) and Macomb County Public Works Office (MCPWO) have been dedicated in improving system reliability and reducing combined sewer overflows (CSO). Significant projects are underway to reach significant milestones in CSO reduction and as part of the overall plan one of the next steps is to leverage digital technology to further improve these reductions.

MCPWO has been evaluating different technologies over the years and one of those is to develop a Digital Twin of the 8.5 Mile system. MCPWO already has a sophisticated Supervisory Control and Data Acquisition (SCADA) system where data from level sensors, flow meters, pump & gate operations, and so on are being fed to operators on 3-second intervals to be able to make quick decisions with system operations. This system along with the hydraulic model of the complete SE Macomb system can be leveraged together along with weather forecasting tools to allow operators to make even better-informed decisions.

The creation of a digital twin model of the 8.5 Mile system will accomplish the following key goals:

- The new digital twin software will establish a standalone software tool that will replicate the 8.5 Mile system operations. This software can be then used to input historical rain events or even create other training scenarios in which new operators can safely run through a wet weather event as-if it was a live event. There has been a turnover of staff over the past few years and a significant amount of historical knowledge lost especially with how to run the facility during extreme wet weather events. MCPWO engineering staff has supplemented this with support during those events but having the ability to properly train staff in dry periods will provide a significant benefit to the district for the future of operations.
- The new digital twin software will also be running parallel to the SCADA system during wet weather events. This software will be running as a machine learning tool while ingesting live and forecasted weather data, live SCADA data, and running it through the hydraulic model. This new software will then provide suggestions to operators for what to do during events. While this can be a fully automated system, that is not the intent as operators know the system needs and will be able to make their own decisions for operations. This is a tool to help operators safely maximize the system during wet weather events. While storage has been added across the system, our main goal still is to safely convey flows to not create issues for residents so therefore it is a delicate balance between storage and conveyance. This tool will help operators maximize storage will balancing that risk.

MCPWO has been in discussions with Jacobs who has been a leader in providing this service for over 20 years. Technology has significantly advanced over the years and Jacobs has been leading the charge to be a leader in the digital twin development for many communities across the United States and locally. They have developed a software known as Replica Operations which has been used for this digital twin creation. This software has been implemented at many utilities across the US and even locally where South Huron Valley Utility Authority is using it currently.

Ultimately a complete SE Macomb system model will provide the most benefit but as a starting point MCPWO would like to perform a pilot of the 8.5 Mile complete system. This will input up to the In-System Storage device, 9 Mile Drain, pump station, RTB, Canal, and all components such as gates at Chapaton. This pilot, when successful, can be expanded out to the rest of the system. MCPWO would seek grant funding with SEMSD to accomplish that.

For the current pilot, MCPWO has budgeted $275,000 to develop the model. Jacobs has provided a proposal to fully establish the pilot model for the 8.5 Mile district for $268,000. It is important to note that while this Replica Operations software, which is proprietary to Jacobs, will be installed directly on MCPWO SCADA servers and support for that is $30,000 for a two-year window. This support is included within the proposal fee from Jacobs.

MCPWO is confident that Jacobs can perform the scope of services as provided for the project.

MCPWO staff is recommending the following action:

That the 8 ½ Mile Relief Board award the contract to Jacobs in the total not-to-exceed amount of $268,000 to develop the Digital Twin model for the 8.5 Mile Relief District.

Attachments: Jacobs Proposal Dated 9/5/23

Jacobs

# 8.5 Mile Relief Drain Digital Twin Pilot Project

Macomb County Public Works Office
on behalf of the
8.5 Mile Relief Drain Drainage District

September 5, 2023

# 8.5 Mile Relief Drain Digital Twin Pilot Project

| | |
|---|---|
| **Client name:** | Macomb County Public Works Office<br>on behalf of the<br>8.5 Mile Relief Drain Drainage District |
| **Revision date:** | September 5, 2023 |
| **Project/Proposal no:** | BPO00YKK |
| **Project manager:** | Matt Deavenport |
| **Prepared by:** | Matt Deavenport<br>Jason Matteo |
| **File name:** | 8.5 Mile Relief Drain Digital Twin Pilot Project Proposal Draft |

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# Contents

# Project Understanding

Macomb County Public Works Office (MCPWO) personnel including engineers, technicians, and operators, working in collaboration with Southeast Macomb Sanitary District (SEMSD) personnel, operate the Chapaton facilities and the Martin Drain Retention Treatment Basin (RTB) CSO facilities in southeast Macomb County during dry weather flow conditions and wet weather events. Primary objectives during wet weather operations include:

- Maximize the use of upstream in-system storage in the following interceptors:
    - Jefferson Interceptor (JFI)
    - 9-Mile Drain (9MD)
    - 8.5-Mile Relief Drain (8.5MRD)
- Minimize the risk of upstream basement flooding in St. Clair Shores, Roseville, and Eastpointe
- Continue to meet NPDES permit requirements and minimize the frequency and volume of treated discharges to Lake St. Clair

These CSO facilities are highly responsive to storm events given the urbanized sewershed tributary to these facilities. Response hydrographs during some wet weather events can be flashy with extremely high peak flow rates.

While these CSO facilities continue to meet Michigan EGLE NPDES permit requirements (No. MI0025453 and No. MI0025585), the operational demands and need to continuously modify and refine operations in response to each unique storm event can be significant. In addition, recent operational modifications including managing surcharging of upstream pipes with in-system storage devices to maximize the use of available in-system storage sometimes requires operational changes outside the range of typical operator setpoints (i.e., increased surcharging levels). Further, while these CSO facilities continue to meet Michigan EGLE NPDES permit requirements, there remains the desire to reduce the frequency and volume of treated, permitted discharges to Lake St. Clair to improve water quality into the future.

Given the above, the MCPWO, on behalf of the 8.5 Mile Relief Drain Drainage District (8.5MRDDD), is interested in developing and deploying a Digital Twin of the 8.5MRD system that will predict influent flow rates the Chapaton RTB facilities from the 8.5MRD, simulate the Chapaton RTB facilities, and incorporate flow rates from the 9MD and JFI. MCPWO's ultimate goals of the overall project include the following.

Digital Twin Pilot (Phase 1), included in this proposed effort:

1. Provide the ability to conduct operator training of Chapaton facilities' operators, both experienced and relatively inexperienced operators, thereby increasing operational reliability during wet weather events through the utilization of the 8.5MRD Digital Twin.

2. Increase confidence in operating the Chapaton facilities outside of normal set point ranges, when necessary, thereby increasing operational reliability during wet weather events.

3. Ultimately reduce the burden on some MCPWO engineering staff to be physically present at the Chapaton facilities prior to and during wet weather events to make operational decisions, thereby reducing some ongoing operations and maintenance expenses.

4. Provide the ability for operators and engineering staff to forecast flows expected from 8.5MRD over the next 24 hours.

Digital Twin Pilot (Future Phases), to be potentially included in future efforts:

5. Reduce other annual operations and maintenance expenses such as sodium hypochlorite (NaClO) chemical costs as much as possible

6. Expand the extents of the digital twin to include additional facilities such as Martin CSO facilities, the SEMSD system, and others to provide a more inclusive and holistic operational optimization solution that further reduces the frequency and volume of treated, permitted discharges to Lake St. Clair, as much as possible, to improve water quality from other southeast Macomb CSO facilities.

We understand that the Digital Twin pilot project will be the first phase of an overall project to meet all the above ultimate objectives. To achieve these objectives, it will be necessary to expand on the Digital Twin by incorporating the Martin CSO facilities, the SEMSD system, and likely the SMCWDS system and the downstream collection systems that discharge from the Fox Creek Enclosure to GLWA's Detroit River Interceptor (DRI). However, it is desired to first deploy this Digital Twin pilot of the 8.5MRD to demonstrate the capabilities and benefits of the Digital Twin at the Chapaton facilities prior to developing and implementing a comprehensive Digital Twin of the larger southeast Macomb County wastewater collection system.

# Solution/Methodology

Digital technologies are already changing how we manage the world's water resources, but maximizing the use of these digital tools can be challenging. Jacobs offers an integrated ecosystem of data-enabled solutions, which we call **Digital OneWater**. Our vision for water's digital transformation is an extension of our OneWater approach. By taking a holistic view of our clients' challenges across the entire water cycle, we can deploy integrated data solutions that provide comprehensive benefits. We recognize the importance of a complete system-wide digital approach that moves beyond optimizing assets and networks in isolation.

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Digital OneWater | Jacobs

As water utilities respond to challenges on multiple fronts – climate change, tightening regulations, workforce shortages – adopting a Digital OneWater approach will be key. Here are the benefits:

- **Data-driven insights:** With tools like Digital Twins and machine learning, we can improve the understanding of our clients' water systems in their current condition – and predict how these facilities will perform in the future.
- **Enhance systems thinking:** We are not only focused on single assets. We can integrate data solutions across networks and catchments to better understand the entire water management system in real-time.
- **Reduce risk and improve performance:** Complete system-wide, lifecycle insight allows our clients to make better-informed decisions, optimize long-term operations and protect public health. Digital OneWater enables the shift from reactive to proactive planning and operations.
- **Support operations staff:** Data-enabled solutions help essential O&M staff perform their work more efficiently, from automated scheduling and operations to improved operator training and knowledge transfer.

- **Maximize digital benefits:** Digital OneWater avoids the silos created by separate products and isolated datasets. We help our clients look for common benefits and outcomes that maximize return on investment, incorporate system-wide cybersecurity practices and fully leverage existing information systems.

Jacobs serves as a trusted digital transformation partner for water sector clients. Our deep domain knowledge across the entire water cycle and asset lifecycle— from planning and design through to operations — means that we have a unique view on where digital solutions are best applied. We recognize that every client will adopt digital technologies at their own pace, and we support them at every step of their journey.

We have also placed data solutions at the heart of our business and Boldly Moving Forward strategy. We have formed a new business unit, Divergent Solutions, which serves as the core foundation for developing and delivering innovative, next-generation cloud, cyber, data and digital technologies. As a company, we are already responding to the rapid digitalization of our industry – and we bring that experience to our clients so that they, too, stay ahead of the curve.

Jacobs offers to the MCPWO for this project the following distinguishing qualifications that will benefit MCPWO on this project.

- A rare combination of local institutional knowledge of the southeast Macomb County wastewater facilities' operations and global digital solutions expertise .
- Local experience with successful implementation of Digital Twins and forecasting models in Michigan including at the South Huron Valley Utility Authority (SHVUA) Wastewater Treatment Plant (WWTP)
- A wide array of digital solutions offerings and demonstrated experience developing and implementing various combinations of these digital solutions offerings around the world.
- Direct wastewater operations experience as Jacobs is responsible for operating more than 400 wastewater facilities across the country, with many in Michigan. Our contract operations group offers our technical consultants insights from the operator's perspective. We proactively test and pilot many of our digital solutions at facilities we operate.
- A closely connected team of data scientists, data engineers, and software developers, coupled with our expertise in the water industry across the globe enables Jacobs to share innovative solutions across our regions and as a benefit, accelerates our ability to identify and deliver solutions that scale to MCPWO's needs.

## Solution

To provide an operational analysis and operator training Digital Twin, we propose utilizing Replica¼ Operations with Ignition by Inductive Automation as the Human Machine Interface (HMI) that provides replica screens currently used at Chapaton RTB. This will enable MCWPO to conduct hindsight evaluations of past operational events as well as simulate operator training on historical events. By coupling the Replica¼ model with a data-driven forecast model which will forecast influent flows arriving to Chapaton over the next 24 to 48 hours from the 8.5 MRD, operators and engineers will be able simulate, evaluate, and train for upcoming conditions.

Replica¼ Operations is a Jacobs proprietary dynamic simulation modeling solution that has been utilized for hydraulic and operations optimization, control strategy optimization and testing, operator training, and as part of a Digital Twin for over 20 years.

A Replica dynamic simulation model provides a more realistic representation of a process than traditional static analysis methods, as all the above aspects are integrated together into one model. A dynamic simulation can also react to conditions that change with time such as flow demands or water quality, where static analyses require assumptions for average and worst-case values.

The impacts of changes to hydraulics, process water quality, and control strategies can be observed in operating performance, energy consumption, and chemical consumption. Various alternatives can be explored leading to improved hydraulic design, operational performance, and optimization of capital and operating costs.

Replica¼ API enables models to be linked to PLC's for control programming testing and functional acceptance testing, third party hydraulic and process models such as EPA-SWMM5 and SUMO as well as to HMI's that enables the model to be used for operator training and operator support during real-time operations.

Replica¼ is Jacobs' solution when providing hydraulic, controls, and operational analysis support to our clients and has been utilized on hundreds of projects throughout the world and is a key solution we bring to our clients as part of our Digital OneWater focus.

All the Chapaton's Digital Twin interfaces will be developed in Ignition, by Inductive Automation. Ignition is a modern automation platform that can house HMI screens, manage data connections, perform analytics, and present powerful visualizations. Ignition licensing and software pricing is based on the number of active connections. It is recommended for the Chapaton Digital Twin that two instances are purchased to facilitate operator training (one instance for the trainer and for instance for the trainee) and data management activities.

**Figure 1** provides an overview of the Chapaton Digital Twin architecture.

It is assumed that the Chapaton Digital Twin will be deployed on an available virtual machine (VM) that is accessible via ethernet by engineers and operators via their own walk-on computer or laptop . It is also assumed that PCWPO will provide the appropriate communications that enables the VM to access necessary SCADA data which will be used by the Digital Twin for near real-time analysis and forecasting.

The Chapaton Digital Twin will incorporate a Replica¼ dynamic simulation model (mechanistic model) to simulate the Chapaton facilities with a data-driven forecast model that will represent flows from the 8.5MDR and historical data to represent flows that arrive to Chapaton from the Jefferson Interceptor and 9 Mile Drain.

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Replica | Jacobs

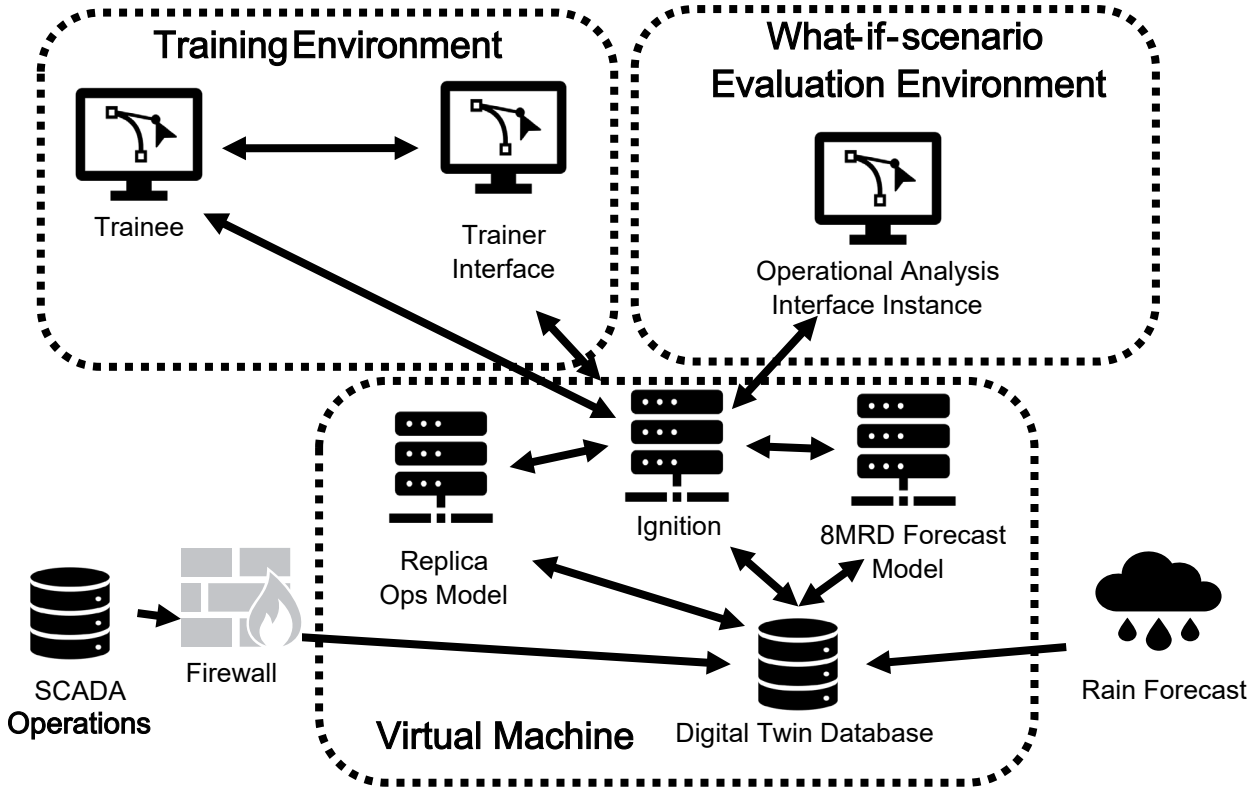



Figure 1 - Overview of proposed the Digital Twin architecture.

The extent of the Chapaton Digital Twin Project will consist of the Chapaton facilities and some piping that connects to Chapaton asillustrated in **Figure 2**. The Chapaton Digital Twin model will also include the storage volume as described inFigure 4.18 of the Southeast Macomb Sanitary District Operational Plan (SEMSDOP)document dated July 29, 2021. Upstream boundary conditions of the Chapaton Digital Twin will be set to two upstream flow meters:

- In-system storage device currently under construction at Beaconsfield & Oak on 8.5MRD. Anticipated start-up of the in-system storage device is February 2024
- Meter 9EB-01 & 02 on 9 Mile Drain just upstream of the 9 Mile station sluice gate

Downstream extent of the Chapaton Digital Twin will be set to the Jefferson Interceptor and Jefferson Relief Piping downstream of Chapaton and the boundary conditions of the Chapaton Digital Twin will be level sensor LS40 on the Jefferson Relief.

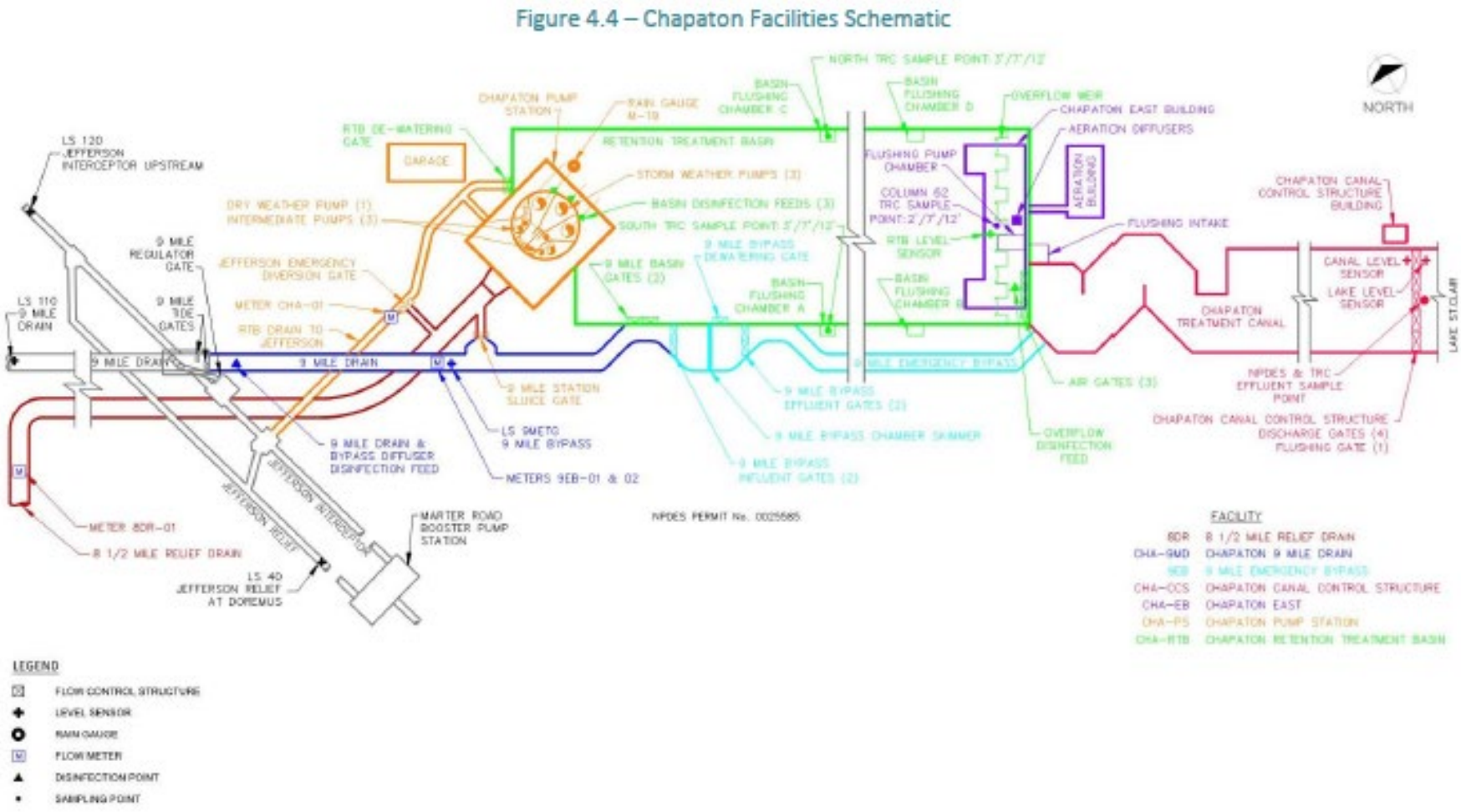



Figure 2 - Chapaton Retention Treatment Basin. Graphic taken from Figure 4.4 of the Southeast Macomb Sanitary District Operational Plan (SEMSDOP) dated July 29, 2021

The scope of facilities and assetsthe Chapaton Digital Twin include:

- Chapaton Pump Station
- Retention Treatment Basin
- Chapaton Treatment Canal
- Chapaton Canal Control Structure
- The 8.5 Mile Relief Drain in-system storage device
- 8.5 Mile relief drain primary trunk up to the proposed Beaconsfield/ Oak in-system storage device
- 8.5 Mile relief drain volume as illustrated in Figure 4.18 of SEMSDOP
- 9 Mile drain upstream of Chapaton to Level Sensor LS 9METG
- 9 Mile emergency pass
- Jefferson Interceptor and Jefferson Relief Piping downstream to level sensor LS40
- 9 Mile regulator gate (not operated by MCPWO)

The scope of the Chapaton Digital Twin under the Phase 1 efforts will not include:

- Aeriation system
- Flushing system hydraulics
- Disinfection System
- Hydraulic Accumulator
- Jefferson Interceptor Upstream

# Proposed Tasks

## Task 1 – Project Management and Coordination

Regular (bi-weekly) progress meetings will be held to exchange information, update task progress and confirm project milestones. At the end of each major deliverable task, aworkshop or conference call will be arranged to discuss and reviewthe deliverable. A kick-off meeting will be held to review scope of work and discussInvoicing and Project Management will be covered in this task as well.

## Task 2 – Data Acquisition and Review

The data required to construct and operate a Replicadynamic simulation model will be requested via a **Data Request Form**. All data received by Jacobswill be reviewed, screenedand evaluated before use in digital twin development. A **Model Input Data Summary** will be created providing the basis of all data used to construct and operate the models (Replica¼ as well asthe influent f orecast model).

The data requirements for the model can be broken into 3 categories:

1. Configuration Data
2. Property Data
3. Operational Data and HMI screens

## Configuration Data

Configuration data includes information defining the layout and connectivity of all the system components within the scope of the model. This phase of data acquisition defines what objects are going to be included in the model and how they interact with each other.

Configuration data requirements will typically include:

- Process Flow Diagrams (PFDs)
- Piping and Instrumentation Diagrams (P&IDs)
- Process Schematic Sketches
- Existing hydraulic models

Jacobs is already in possession of a hydraulic model of the SEMSD wastewater collection system in a Stormwater Management Model (SWMM) computer program file format. A screenshot of this hydraulic model is shown below in **Figure 3**.

Jacobs is familiar with this system and the hydraulic model set-up from some our team members' previous experience on other projects. Jacobs will confirm with MCPWO that the SWMM model in Jacobs' possession is the latest version. This SWMM hydraulic model will be used to extract appropriate configuration data to build the collection system hydraulic components in the Replica model.

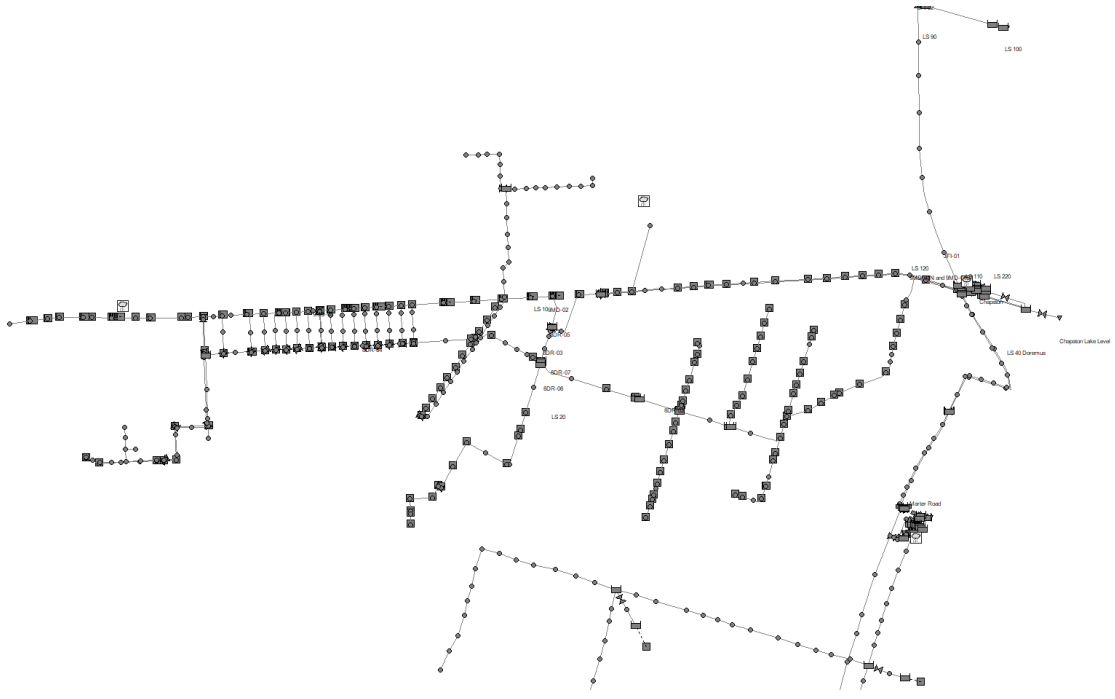


**Figure 3 - Screenshot of the existing EPA-SWMM5 hydraulic model of SE Macomb wastewater collection system in possession by Jacobs.**

## Property Data

Property data includes all information that defines the behavior and physical dimensions of the components that exist in the model. Examples of property data are:

- Pump hydraulic performance data: flow rate, head, pump efficiency, net positive suction head required (NPSHr), turbine pump propeller pitch
- Piping details: materials, sizes, junctions, valves, other fittings and associated head loss
- Valve details: type, size, service, flow characteristics (flow rate vs. head, if available)
- Storage tanks/ reservoirs: dimensions, elevations, and surface area
- Hydraulic boundary conditions, which may be time dependent: influent flow rate patterns, head/ pressure and elevation at discharge points
- Control strategies: descriptions of loops, control elements, and set points

These data can typically be found in the following documents:

- Mechanical design drawings
- Structural design drawings
- Control Narratives or Loop Descriptions
- Design Specification or Submittal Documents
- Equipment Data Sheets or Vendor Documents

As mentioned previously, Jacobs is already in possession of a hydraulic model of the SEMSD wastewater collection system in a SWMM computer program file format. Jacobs is familiar with this system and the hydraulic model set-up from some our team members' previous experience on other projects. Jacobs will confirm with MCPWO that the SWMM model in Jacobs' possession is the latest version. This SWMM hydraulic model will be used to extract appropriate configuration data to build the collection system hydraulic components in the Replica model and input property data.

### Operational Data and HMI Screens

Available SCADA historical data, operating SOPs, Rain gage data, Screenshots of HMI screens will be obtained and reviewed. This information will be used to develop control loops, automation, and operator choices in the Replica¼ model, calibrate the Replica¼ model, develop the influent forecasting model, and develop the Operator Training HMI screens. Jacobs will coordinate with MCPWO to identify the necessary tags, screens, and SOPs associated with the RTB.

Available SCADA historical data, standard operating procedures (SOPs) via Chapaton's Operational Plan document, rain gauge data via Macomb County's web portal, screenshots of HMI screens will be obtained and reviewed. This information will be used to create the Operator Training HMI screens, calibrate the Replica¼ model, and develop the preliminary Chapaton system influent forecast model.

## Task 3 – Chapaton System Influent Forecast Model Development

Developing a forecast of flow into the facility will provide operators with a better understanding of how to react to the anticipated flow. A forecast will be developed and integrated into the operator training tool to inform operational decisions.

Using machine learning, a forecast of flow rates entering the facility will be developed for 8.5MRD. This model will be produced using historical flow rate and level data from the system and rainfall data from a third party. This effort will be divided into four subtasks, data wrangling; feature engineering; model development; and model selection, which are outlined below.

The level of accuracy of the machine learning model will be dependent on the quality and quantity of data available to train the model. Due to this fact, there may be a future need to enhance the accuracy of the model developed in this phase by providing the model with more high-quality data for training.

## Data Wrangling

Thoroughly understanding the available data is the most crucial part to the success of data driven model. During this phase there will be extensive collaboration with collection system experts to fully understand any trends seen in the historical data.

Data wrangling is the process of taking raw data and transforming it into tidy data that can be used by a machine learning model. The data will be cleaned by removing irrelevant outliers and imputing missing data. The data will then be transformed into a format that can be ingested by a machine-learning model.

## Feature Engineering

Features are variables used as inputs to the model to predict flow. Feature engineering is the process of determining which set features will explain the largest amount of variance in the model. Feature engineering help determine which features will be important to include in the model and which ones can be excluded from the model. Some examples of potential features could be flows, levels, and rainfall quantities.

## Model Development

Machine-learning models provide insights by finding patterns in a set of data. The process of allowing the model to learn from data is known as training the model. The model will not be trained on the full dataset since this would result in an overfitting to the historical data that has been seen. It is common to divide the set of data into a training set used to train the model, test set used to select a model, and validation set used to validate the results of the selected model. For some algorithms, a k folds cross validation approach to validation may be taken as opposed to the traditional train, test, validate approach. Both validation approaches will be explored for the forecast model. Several different models will be trained on historical data. Some models that will be considered are random forests, XGBoost, and Prophet.

## Model Selection

The accuracy of the trained models will be measured based on the test subset of the data set. A model will be selected that results in the highest accuracy on the test data set. After the model with the highest accuracy is selected the model accuracy will be confirmed based on the validation subset of the data. In addition, a 95% confidence interval will be displayed on the forecasted period of data.

Jacobs' team of data scientists will coordinate with Jacobs' collection-system experts to develop and deploy the forecast within the HMI screens of the Chapaton Digital Twin. Collection-system experts will also QC the resulting forecast to ensure that it is consistent with their engineering judgement.

### Task 3 Data Sources

- SCADA Historian historical values from the system.
- Third party application programming interface (API) to access real time rainfall data from NOAA.

# Task 4 – Replica Dynamic Simulation Model Development

The Replica¼ Operations model is the foundation of the Chapaton Digital Twin. Data acquired in Task 2- Data Acquisition and Reviewdescribed above will be used to construct and calibrate the model.

## Model Construction

The model will contain:

- All elements necessary to represent the hydraulic behavior of the system such as: pipes, pumps, valves, tanks, reservoirs, flow, and pressure nodes.
- All elements necessary to represent the control strategy to be applied to the system such as: instruments, limit switches, control logic blocks (e.g., PID controller), and interlocks.
- All elements necessary to present output information from model operation such as: plotters, meters, animation objects, and a notebook summary of key parameters.

All these elements will have a dialog interface through which a user can change some parameters that influence the behavior of that object. Elements necessary for operator training and what-if scenario analysis will also be interfaced via the HMI's to be deployed.

## Model Calibration

The Replica¼ model will be calibrated against historical operating events that cover the unique operational modes utilized at Chapaton. These events will cover dry weather mode, wet weather mode with intermediate pumps in use, wet weather mode with storm pumps in use and dewatering mode. MCWPO will provide the necessary calibration data required to accurately calibrate the Replica¼ model which may include both historical SCADA data and a summary of operational decisions made during the event. Decisions both recorded by SCADA as well as any not available in the SCADA historian but impact the operation of the Chapaton facility will be provided.

### Determine Calibration Scenarios

Appendix 13 of the Southeast Macomb Sanitary District Operational Plan document (Fishbeck, July 29, 2021) provides 14 figures illustrating the operational configurations for 14 operational scenarios. It is assumed the that a recent event occurred, and that historical data is available for the following operational scenarios which will be used for calibration and operator training:

- Dry weather Scenario (dry weather pumps) – Figure No. B.1 of Appendix 13 (Fishbeck, July 29, 2021)
- Wet weather Scenario 1 transitioning to Scenario 2 (intermediate pumps) – Figures W.1 and W.2 of Appendix 13 (Fishbeck, July 29, 2021)
- Wet weather Scenario 3 or Scenario 4 (storm pumps) - Figures W.3 and W.4 of Appendix 13 (Fishbeck, July 29, 2021)
- Wet weather Scenario 9 (Jefferson Emergency Diversion Gate, 9 Mile emergency bypass, and storm weather pumps) – Figure W.9 of Appendix 13 (Fishbeck, July 29, 2021)
- Dewatering Scenario 2 – Figure D.2 of Appendix 13 (Fishbeck, July 29, 2021)

MCPWO and Jacobs will confirm the historical events that will be used to calibrate the Replica¼ model. This scope assumes that a total of five (5) calibration events will be identified and utilized to simulate and

evaluate the model's fidelity in terms of matching flow rates, levels, and pump speeds. During calibration, hydraulic responses to equipment settings modulating such as pump speed, weir gate height, or gate percent open predicted by the model will be compared to the historical SCADA data.

### Calibration Analysis Report

The results of the model calibration scenarios will be summarized in a technical memorandum with discussion of observations and recommendations where appropriate. Supporting information such as a summary of calibration data and assumptions will be included in appendices of the report.

### Deliverables

- Model Calibration Report

### Assumptions

Five scenarios will be used for calibration. Each scenario is assumed to be between 6- to 12-hours long:

- Dry weather scenario (Dry-weather pumps)
- Wet weather Scenario 1 transitioning to Scenario 2 (intermediate pumps)
- Wet weather Scenario 3 or Scenario 4 (storm-weather pumps)
- Wet-weather Scenario 9 (Jefferson Emergency Diversion Gate, 9 Mile emergency bypass, and storm-weather pumps)
- Dewatering Scenario 2

## Task 5 – HMI Development

Necessary HMI screens used by operators will be replicated in Ignition to interface with the simulation models, evaluate the operational events being simulated, and load scenarios. Jacobs will work with MCPWO to identify which SCADA HMIs are required for operator training utilizing the Chapaton Digital Twin. Jacobs will also provide HMI screens dedicated to the trainer setting up, starting, and observing the trainee. Alarms and alerts will be limited to what is necessary for standard dry-weather, storm-weather, and dewatering scenarios.

It's assumed up to eight 8 HMI screens will be developed for operator training and three for operations analysis. Graphics will not be developed based on any existing HMI standards but duplicated sufficiently to enable operator training.

### Define operator training scenarios:

To ensure all equipment is available for manipulation through the HMIs, Jacobs will meet with MCPWO engineers and operators to identify key equipment such as pumps, valves, gates, weirs, etc. that are managed for operating the Chapaton system. This set of equipment will determine what I/O is necessary to change settings in the Replica¼ model of the system via the HMI.

## Task 6 – Chapaton Digital Twin Pilot Delivery

The Chapaton Digital Twin will be delivery will include deployment of the Digital Twin, in person training workshops to guide engineers and operators on how to conduct operator trainings as well as analyze "what-if" scenarios, and license and maintenance fee documentation.

## Deployment of Digital Twin Pilot

Jacobs will work with MCPWO to setup the virtual machine, install necessary software and deploy the Chapaton Digital Twin. The necessary software includes Ignition server licenses and ExtendSIM (runtime version), which Jacobs will license on behalf of MCPWO and transfer the licenses to MCPWO. Jacobs will inform MCPWO of any other software licenses required for the environment.

It is assumed that MCPWO will be able to provide temporary remote access to the VM for configuration and deployment efforts Jacobs will work with MCPWO to setup the user groups and access to the Digital Twin. **Figure 4** provides an overview of the workstation configuration. A Virtual Machine will be loaded on an available server to run the Digital Twin components including:

1. SQL Server
2. Ignition Server
3. Replica¼
4. Forecast Model

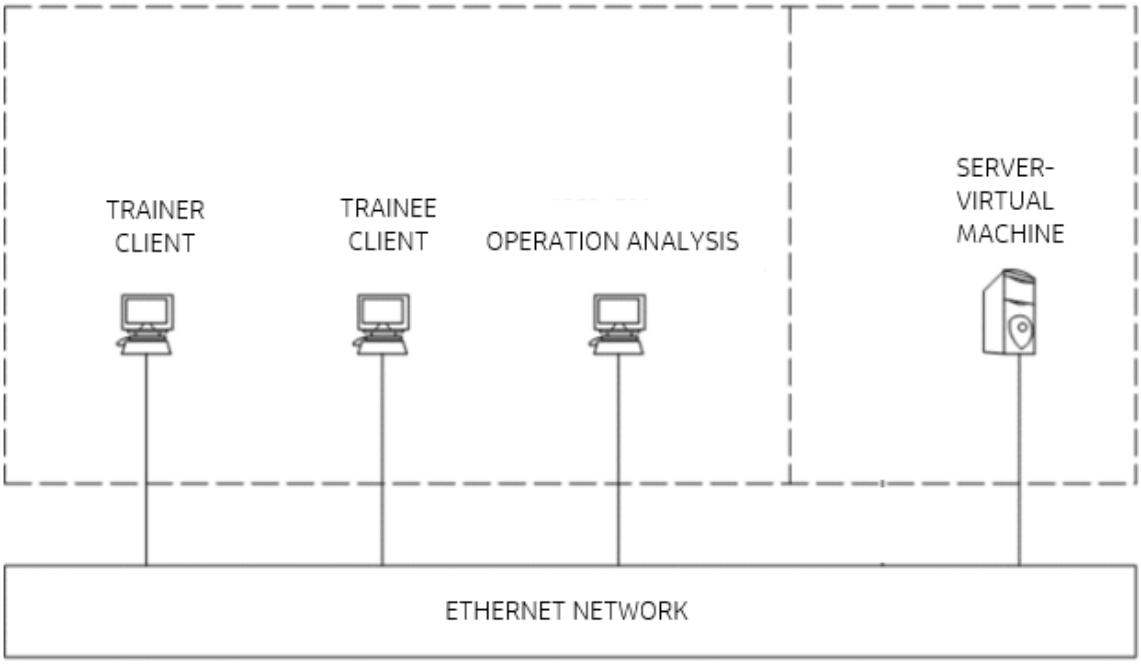



**Figure 4 - Chapaton Digital Twin workstation configuration**

**Table 1 – Chapaton Digital Twin workstation configuration details**

| COMPONENT | FUNCTIONS |
|---|---|
| Trainee Workstation[1] | Provides simulated environment for operators to experience operating variety of scenarios. |
| Trainer Workstation[1] | Enables trainer to setup, observe, and review operator training sessions. |
| Operations Analysis Workstation[2] | Enables operators to review predicted plant performance, evaluate historical events, test what if scenarios |
| Server Virtual Machine | Runs Ignition Server, Replica¼, and Forecast Model and SQL Server. Will store all operating, configuration, settings, and simulated data related to Chapaton Digital Twin system activities. |
| Notes | [1]Workstation can be any computer or laptop that has access to the network as the server and has Google Chrome or Microsoft Edge browser to access the HMI dashboard<br>[2]When not running an operator training exercise, the digital twin can be used to evaluate operations and evaluate an upcoming event |

**Minimum Requirements for Virtual Machine**

- CPU: 4-core, 2.5 GHz or equivalent
- Operating System Requirements: 64-bit version of Windows 10 or 11
- Dedicated Memory: 8 GB
- Disk Space: 500 GB

## Digital Twin Training and Manual

A manual will be developed and delivered to provide a quick "how-to" guide to setting up and running operator training events, developing custom events, running forecasted flows, and importing data into the Digital Twin. After deployment is complete, a 4-hour workshop will be conducted to provide training on these same functionalities.

## Support & Maintenance

Software subscription fees for use of Replica¼ software, including support services, for a minimum of a two-year term will be invoiced annually in advance at $20,000.00 (a 50% discount) for the first year of use, and $10,000.00 (a 50% discount) for the second year. The annual subscription will include maintenance and technical support for up to 80 hours per year beginning on the date of turnover. The 80 hours of technical support will be provided remotely. Technical support services will be available 8:00 a.m. to 5:00 p.m. Monday through Friday and may include:

- Assistance in making modifications to HMI screens or database
- Assistance in making modifications to the model
- Assistance with any errors that arise in Replica¼ during a simulation

# Deliverables and Assumptions

## Deliverables:

**Task 1 – Project Management and Coordination**

- **Bi-weekly coordination meetings**
- **Invoicing**

**Task 2 – Data Acquisition Deliverables**

- Data Request Form
- Model Input Summary

**Task 3 – Chapaton System Influent Forecast Model Development Deliverables**

- Data request form including details on pertinent data needed
- Model input Summary for forecast model
- Data driven model to forecast flow for the next 48 hours for the 8.5MRD Interceptor

**Task 4 – Chapaton System Replica Model Development Deliverables**

- Calibration summary technical memorandum of Replica¼ model
- 2-hour Replica¼ model review meeting

**Task 5 – HMI Development Deliverables**

- Setup of the environment on a local virtual machine, separate from MCPWO's SCADA
- Up to eight HMI screens to be reviewed with MCPWO
- Up to three HMI screens will be reviewed with MCPWO
- One dry weather scenario overview to be preloaded for operator training
- One wet weather scenario overview to be preloaded for operator training

**Task 6 – Digital Twin Pilot Delivery Deliverables**

- How-To-Guide for Operator Training HMI
- Turnover of Replica¼ model and associated object libraries (runtime version) and supporting software with 2-year license and maintenance agreement
- Ignition Automation license with Vision
- HMI Screens necessary for operator training and what-if-scenario analysis
- SQL DB used to store manage data exchange
- 4-hour training workshop operator Chapaton Digital Twin

## Assumptions

### Task 2 – Data Acquisition Assumptions

- A copy of the latest EPA-SWMM 5 model managed by MCPWO will be provided to Jacobs to extract appropriate configuration data and property data.
- Data will be provided within five business days of when requested to not impact schedule.

### Task 3 – Chapaton System Influent Forecast Model Development Assumptions

- Flow and rainfall are measured throughout the system and available for Jacobs to access
- Available data is adequate for use in a machine learning model.

### Task 4 – Chapaton System Replica¼ Model Development Assumptions

- SWMM model configuration is up-to-date and reliable for pipe diameters and pipe schedule.
- Five scenarios will be used for calibration. Each scenario is assumed to be between 6 to 12-hours long.
    - Dry-weather Scenario (Dry-weather pumps)
    - Wet-weather Scenario 1 transitioning to Scenario 2 (intermediate pumps)
    - Wet-weather Scenario 3 or Scenario 4 (storm-weather pumps)
    - Wet-weather Scenario 9 (Jefferson Emergency Diversion Gate, 9-mile emergency bypass, and storm weather pumps)
    - Dewatering Scenario 2.

### Task 5 – HMI Development Assumptions

- Up to eight HMI screens will be developed for operator training.
- Up to three HMI screens will be developed for operations analysis.
- One dry weather scenario will be pre-loaded.
- One wet weather event will be pre-loaded.
- Screens will be made to appear like HMI screens but will not adhere to existing HMI standards.

### Task 6 – Digital Twin Pilot Delivery Assumptions:

- MCPWO has a server available to create a Virtual Machine (VM) to deploy the Chapaton Digital Twin.
- Jacobs will not be responsible for licensing costs associated with software installed on the Virtual Machine.
- Jacobs will have temporary remote access to the Virtual Machine to setup, configure, test, and deploy the Digital Twin software.
- The VM will be hosted on MCPWO's resources.

- MCPWO will provide the necessary communications and security that enables the VM to request and access necessary SCADA data to be used by the Digital Twin for near real-time analysis and forecasting.
- Influent flow rates from the 8.5MRD will be forecasted periodically to determine when significant changes in flow are predicted to occur. The simulation will be run when it has been determined that a significant change in flow will occur in the 8.5MRD. Initially, it is anticipated that the forecast will be run at a minimum time interval of 5 minutes and the model will be run at a minimum time interval of every 30 minutes. The time increments that will be implemented will be determined based on coordination with MCPWO.

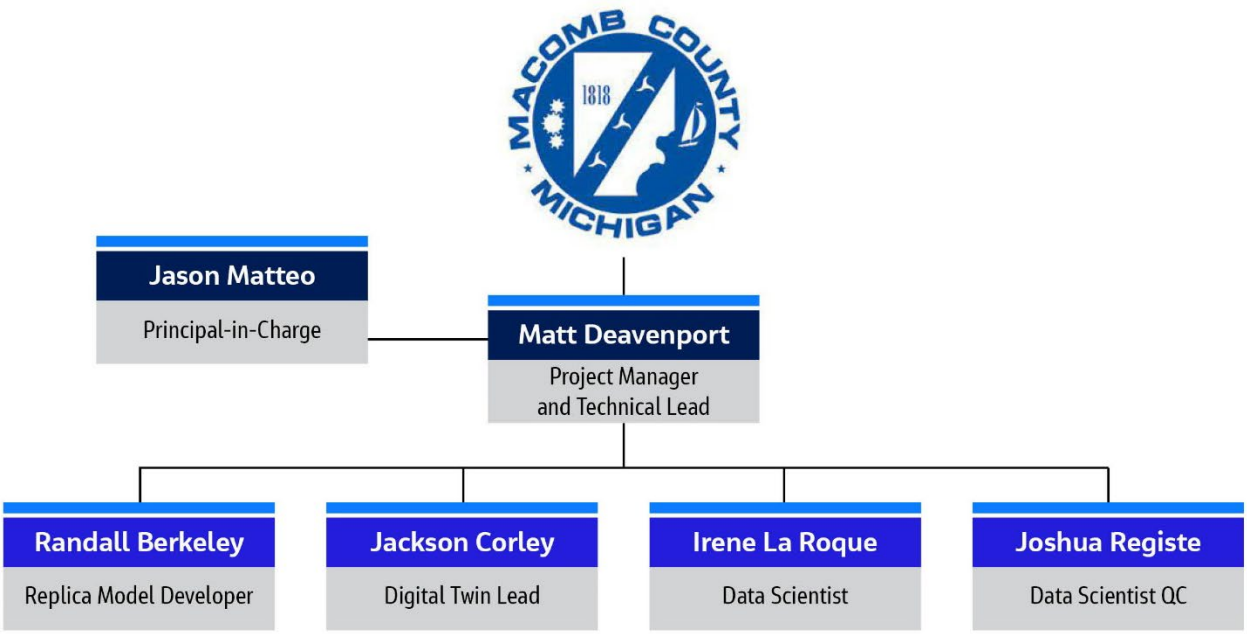
## Schedule, Milestones, and Fee

| TASK | START | END | MILESTONES |
|---|---|---|---|
| Task 1 Project Management & Coordination | 10/2/2023 | 2/18/2024 | Project Kickoff and progress meetings |
| Task 2 Data Acquisition | 10/2/2023 | 10/23/2023 | Data Request Form Submitte |
| Task 3 Chapaton System Influ Forecast Model Development | 10/23/2023 | 1/11/2024 | Forecast Model Developed |
| Task 4 Chapaton System Rep Model Development | 10/23/2023 | 1/26/2024 | Model Constructed<br>Model Calibrated<br>Model Review Workshop |
| Task 5 HMI Development | 1/7/2024 | 1/21/2024 | Training Scenarios Establish<br>HMI Screens Review Meetin |
| Task 6 Deployment of Digital Twin Pilot | 1/17/2024 | 2/18/2024 | Digital Twin Pilot Deployed<br>Training Workshop |

| TASK | LABOR | EXPENSES | TOTAL |
|---|---|---|---|
| Task 1 Project Management & Coordination | $27,500 | $2,500 | $30,000 |
| Task 2 - Data Acquisition | $14,500 | $0 | $14,500 |
| Task 3 - Chapaton System Influent Forecast Model Development | $43,100 | $0 | $43,100 |
| Task 4 - Chapaton System Replica Model Development | $58,900 | $5,000 | $63,900 |
| Task 5 - HMI Development | $43,200 | $5,000 | $48,200 |
| Task 6 - Deployment of Digital Twin | $38,300 | $30,000 | $68,300 |
| **Total Fee** | **$232,500** | **$42,500** | **$268,000** |

## Project Team

The project team is comprised of Digital Water Technologists who focus on operational optimization across the entire water infrastructure. From distribution networks to wastewater plants and all facilities and process in between, our teammembers utilize dynamic simulation, data analytics and artificial intelligence techniques at scale to optimize hydraulics, controls, and operations.



# Commercial Offer

## Maintenance and Licensing

Assumes 2 years of license and maintenance after project completion : renewal annually.

## Intellectual Property and Jacobs' Software Subscription Use Rights

All intellectual property contained in the elements used to construct Replica¼ models is the property of Jacobs. No access to the structure and code behind these elements will be provided. Use of the software is subject to Jacobs' Subscription Agreement with the Macomb County Public Works Office.

**Candice S. Miller**
Public Works Commissioner
Macomb County

To: 8 ½ Mile Relief Drain Drainage District Board Members

From: Vincent Astorino, Operations Director

Date: September 11, 2023

Subject: Replacement Backhoe Purchase Recommendation

The 8 ½ Mile Relief Drain Drainage District (8MRDDD) currently owns a backhoe/loader which is located at the Chapaton Pump Station. This backhoe is a 1976 JCB which was purchased by the district in 1996. This backhoe is frequently used for various activities around the facility and has been a very useful asset for staff.

It is currently becoming more difficult to find parts for this piece of equipment and has been experiencing more failures as of recent. Due to this, $80,000 has been allocated into the 23/24 budget to replace this vital piece of equipment.

Since the budget was approved, MCPWO have been searching the market for a used backhoe. A 2015, CAT415F2 backhoe/loader was located at Rosseel's Farm & Garden Supply in Chesterfield. This unit is in very good shape and has low hours along with meeting all other requirements for MCPWO staff. The initial cost of the backhoe from Rosseel's was $109,000. MCPWO staff were able to initially talk them down to $100,000. Once they were able to get them down in cost then our current backhoe was brought into the discussion as a possible trade in. After a back-and-forth negotiation, MCPWO staff were able to get them to offer $20,000 for a trade-in value of the current backhoe. This has brought the total price, delivered to Chapaton, to $80,000.

MCPWO is recommending to move forward with the purchase of CAT415F2 for $80,000 and trade-in the 1976 JCB to Rosseel's Farm & Garden Supply. The final cost is in line with the total budgeted amount and will provide the district with many years of value.

Attachments: Rosseel's Farm & Garden Supply Quote & Photos

**OFFICE LOCATION**: 21777 Dunham Road, Clinton Township, Michigan 48036 ● Phone: 586-469-5325 ● Fax: 586-469-5933
**MAILING ADDRESS:** P. O. Box 806, Mt. Clemens, Michigan 48046-0806
**ENGINEERING** ● Phone: 586-469-5910 ● Fax: 586-469-7693 ◇ **SOIL EROSION** ● Phone: 586-469-5327 ● Fax 586-307-8264

# 2015 CATERPILLAR 415F2


USD **$109,000**

**Machine Location:** 50025 N Gratiot Chesterfield, Michigan 48051

## Seller Information

**Rosseel's Farm & Garden**

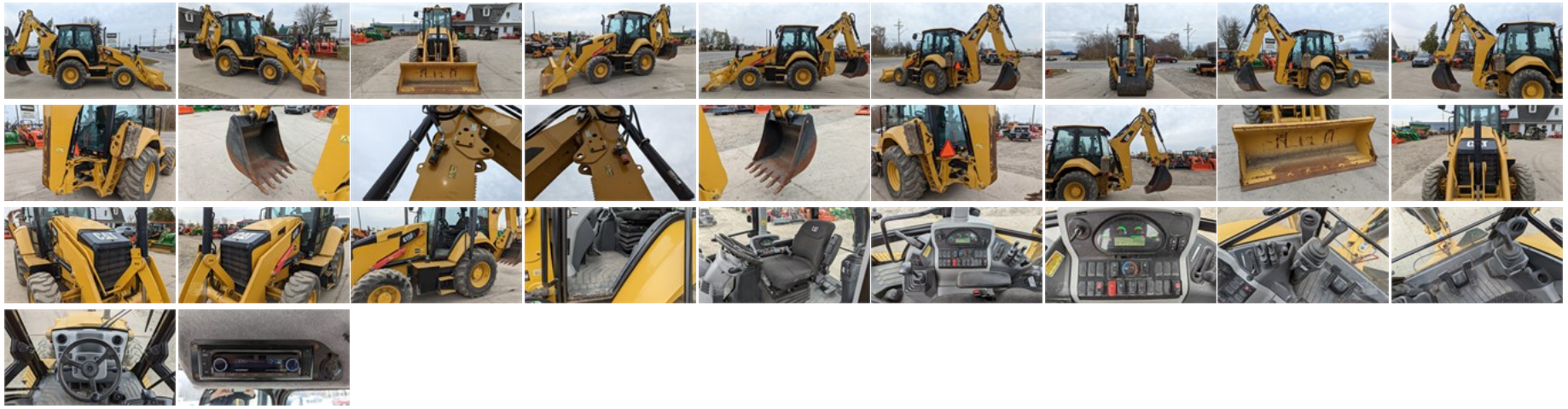
**Contact:** Sales Department

**Phone:** **(586) 745-8006**

Chesterfield, Michigan 48051

Visit Our Website

**(586) 745-8006**



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## Description

CAT 415F2 Backhoe w/ Cab Stock# 8876 2015 CAT 415F2 loader backhoe with a 68 HP diesel engine, 4 wheel drive, front tire size 12.5/80-18, rear tire size 19.5Lx24, and a power shuttle transmission with a left hand reverser. This machine has a 88" material bucket, a 36" digging bucket, extend-a-hoe, auxiliary hydraulics on the backhoe boom, pilot controls, R-4 tires, and a 17'11" digging depth. The cab has heat, AC, and a AM/FM/CD/USB/MP3 radio. It is clean and runs well. 1,000 metered hours.

## Specifications

| | | | |
|---|---|---|---|
| **Year** | 2015 | **Manufacturer** | CATERPILLAR |
| **Model** | 415F2 | **Hours** | 1,000 |
| **Condition** | Used | **Stock Number** | 8876 |
| **ROPS** | Enclosed | **Drive** | 4WD |
| **Horsepower** | 68 HP | | |

Show As Paragraph


415F2
CAT


CAT
415F2
CAT


DANGER STAY BACK
30,000 LB.

EIGHT AND ONE-HALF MILE RELIEF
08/08/2023 - 09/05/2023

| Funding Source | Apportionment | Manager | Vendor | Amount | Invoice Detail | Project Summary | Project Balance |
|---|---|---|---|---|---|---|---|
| **8 1/2 Mile Relief** | Chapter 20<br>State of MI – 16.04%<br>County of Macomb – 2.25%<br>Dept. of Roads – 2.25%<br>Eastpointe – 54.33%<br>St. Clair Shores – 25.13% | | | | | | |
| | | Astorino | Amazon | $ 795.97 | Invoice #1YJD-YCFW-1VL6 - 07.29.23 | Supplies - GoPro - Canal Rehab Project | |
| | | Astorino | Anderson, Eckstein & Westrick | $ 8,760.05 | Invoice #145755 - 08.23.23 | Chapaton Basin Gate Replacement - 07.01.23 - 07.30.23 | $ 27,156.15 |
| | | Astorino | DTE Energy | $ 582.91 | Invoice #23-475 - 07.31.23 | Monthly Electric - 07.01.23 - 07.31.23 | |
| | | Astorino | DTE Energy | $ 9,054.70 | Invoice #23-488 - 08.14.23 | Monthly Electric - 07.11.23 - 08.08.23 | |
| | | Astorino | JCI Jones Chemicals Inc. | $ 11,023.98 | Invoice #921953 - 08.29.23 | Hypochlorite Solution | |
| | | Baker | Kienbaum Hardy Viviano Pelton | $ 2,905.00 | Invoice #49977 - 08.01.23 | General Matters July 2023 | |
| | | Downing | Marino's Landscape | $ 1,156.00 | Invoice #23197 - 07.31.23 | Lawn Care July 2023 | |
| | | Astorino | OHM Advisors | $ 1,323.00 | Invoice #66003 - 08.15.23 | PS Ventilation Study | $ 82,430.00 |
| | | Astorino | PVS Nolwood Chemicals | $ 17,911.94 | Invoice #806416 - 08.25.23 | Sodium Hypochlorite | |
| | | Astorino | Tetra Tech, Inc. | $ 7,390.63 | Invoice #52114712 - 08.20.23 | Chapaton Electrical / Generator - Design / CCA | $ 709,853.37 |
| | | Astorino | Tetra Tech, Inc. | $ 33,297.47 | Invoice #52114710 - 08.20.23 | In-System Storage CCA 07.01.23 - 07.28.23 | $ 388,854.71 |
| | | Astorino | Titus Welding Company | $ 24,066.00 | Invoice #3067 - 08.02.23 | Safety Ladder Replacement | |
| | | Astorino | Verizon | $ 735.68 | Invoice #9940363222 - 07.23.23 | Monthly Cellular - 06.24.23 - 07.23.23 | |
| | | Astorino | Wade Trim | $ 20,142.76 | Invoice #2028409 - 08.30.23 | Chapaton RTB Flushing Improvements - Design | $ 227,110.59 |
| | | Astorino | Wade Trim | $ 50,172.60 | Invoice #2028408 - 08.30.23 | Chapaton RTB Canal Rehabilitation - CCA | $ 1,938,494.67 |
| | | Astorino | Warren Pipe and Supply Co. | $ 659.05 | Invoice #810219 - 08.15.23 | Supplies | $ 659.05 |
| | | Astorino | Weiss Construction | $ 376,175.00 | Invoice #WWS-2021-006 App 17 - 08.22.23 | In-System Storage App 17 through 08.18.23 | $ 4,511,099.34 |
| | | Astorino | Z Contractors | $ 1,181,782.60 | Invoice #APP 1 - 08.28.23 | Chapaton RTB Canal Rehabilitation | $ 26,192,297.40 |
| | | | **Total** | $ 1,747,935.34 | | | |

**Budget to Actual**
**8.5 Mile Relief**
**As of Aug 31, 2023 =92%**

| DESCRIPTION | 2023 FINAL BUDGET | ENCUMBERED | ACTUAL | REMAINING BUDGET | PCT UTILIZED |
|---|---|---|---|---|---|
| **REVENUE ACCOUNTS** | | | | | |
| Interest Earned | 20,000 | | 216,556 | (196,556) | 1082.8% |
| Other Revenue | 5,000 | | 158,836 | (153,836) | 3176.7% |
| State Grant-Electrical and Canal Rehab | - | | 699,889 | - | 100.0% |
| County ARPA Funds | - | | 5,765,546 | - | 100.0% |
| 8.5 O&M/Charge Required Revenue | 5,003,220 | | 5,003,220 | - | 100.0% |
| PY Revenue-Fund Balance | 4,412,010 | | | 4,412,010 | 0.0% |
| Use of Reserve from prior contributions | 3,738,110 | | | 3,738,110 | 0.0% |
| Use of Reserve(Flow Meters) | 350,000 | | | 350,000 | 0.0% |
| Use of SCADA Reserve | 64,750 | | | 64,750 | 0.0% |
| Use of Surplus from past collections | 1,051,830 | | - | 1,051,830 | 0.0% |
| *Total Revenue Accounts* | 14,644,920 | - | 11,844,047 | 9,266,308 | 80.9% |
| **EXPENSE ACCOUNTS** | | | | | |
| Application/Permit Fee | 6,000 | | 6,000 | - | 100.0% |
| Dues, Training, Conf, Subs. | 17,010 | | 1,638 | 15,372 | 9.6% |
| Engineering | | | | | |
| Sluice & Dewatering Gates Rehab/Replacement Project | 1,974,340 | | 23,561 | 1,950,779 | 1.2% |
| Canal Rehab Design | 320,000 | | 281,420 | 38,580 | 87.9% |
| 8.5 Mile Inspection Project | 500,000 | | 42,649 | 457,351 | 8.5% |
| 9 Mile Drain & Dewater Accusonic Flow Meters | 350,000 | | 247,208 | 102,792 | 70.6% |
| 9 Mile Emergency Bypass Structural Rehab | 3,000,000 | | 18,784 | 2,981,216 | 0.6% |
| Flushing | 1,895,660 | | 1,534 | 1,894,126 | 0.1% |
| Chapaton Electrical Upgrades (ARPA Funds) | - | | 125,187 | (125,187) | 100.0% |
| Canal Rehab (ARPA Funds) | - | | 158,288 | (158,288) | 100.0% |
| As needed Engineering | 39,110 | | 33,103 | 6,007 | 84.6% |
| Sluice and Dewatering Gates Rehab/Replace Project (Was 9 Mile PS) | 2,025,660 | | 75,622 | 1,950,038 | 3.7% |
| Cost Share Army Corp Grant-Green Infrastructure Project | 162,500 | | | 162,500 | 0.0% |
| 9 Mile Bypass Pipe Structural Repairs-Construction/CA | 308,010 | | 1,491 | 306,519 | 0.5% |
| Chapaton Improvements-Office Space Downstairs | 100,000 | | 1,231 | 98,769 | 1.2% |
| In-System Storage-Construction Admin and Construction (County ARPA) | 1,659,410 | | 2,889,506 | (1,230,096) | 174.1% |
| New Equipment | 3,000 | | | 3,000 | 0.0% |
| Office Supplies | 500 | | | 500 | 0.0% |
| Operating Supplies | 81,800 | | 73,124 | 8,676 | 89.4% |
| Other Professional Srvcs | 42,500 | | 35,869 | 6,631 | 84.4% |
| Personnel Services | 1,135,790 | | 614,093 | 521,697 | 54.1% |
| Repair & Maintenance | 246,000 | | 76,198 | 169,802 | 31.0% |
| Contribution to Reserve | 288,240 | | | 288,240 | 0.0% |
| Scada System | 199,390 | | 42,409 | 156,981 | 21.3% |
| Utilities | 290,000 | | 256,011 | 33,989 | 88.3% |
| *Total Expense Accounts* | 14,644,920 | - | 5,004,926 | 9,639,994 | 34.2% |

| | O&M Balance 9/30/2022 | O&M | Total 8/31/2023 |
|---|---|---|---|
| **Cash - Operating** | 9,802,509 | 6,839,121 | 16,641,630 |
| **Accounts Receivable** | | | 0 |
| **Assets** | | | 0 |
| **Liabilities** | | | 0 |
| **Revenues** | | 11,844,047 | 11,844,047 |
| **Expenditures** | | 5,004,926 | 5,004,926 |
| | | | 0 |
| **Equity*** | 9,802,509 | | 16,641,630 |

**Detail of 2022 Equity***

| | | | |
|---|---|---|---|
| 9 Mile Bypass Struct Rprs-Const/CA | 292,264 | Capital Reserve | 953,047 |
| As-Needed Engineering | 48,544 | Contribution from Macomb Cty | 2,000,000 |
| Chapaton Improvements-Lab/Office Space | 173,347 | In System Contrib from SEMSD | 1,351,239 |
| Chlorine storage tank #3 relining | 7,500 | LSCWWI 04B Transfer | 738,112 |
| Cost Share Army corp Grant-Green Infrastructure Project | 162,500 | SCADA Reserve | 155,140 |
| Fiber Optic Improvements | 16,130 | SRF Replacement Reserve | 2,592,140 |
| Firewall Hardware Design/Config | 12,900 | Painting | 25,000 |
| In-System Storage Design/Const Admin/Const | 116,276 | SolarWind -Network Mgmt Softwar | 9,670 |
| Obsolete Wireless backhaul replacement links | 16,120 | Storm PLC Replacments | 30,000 |
| Sluice & Dewatering Gates Rehab/Replace Proj(Was 9 Mile PS) | 1,102,581 | | |