APPENDIX 11

CONCEPTUAL DESIGN DRAWINGS AND REPORT

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Carlisle Water Storage Facility Environmental Assessment

Conceptual Design Report

Final

September 17, 2024

Prepared for:

Hamilton

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September 17, 2024

City of Hamilton
Public Works Department
71 Main Street West
Hamilton, Ontario
L8P 4Y5

Attention: Justin Wilson, M.Sc.
Project Manager

Dear Mr. Wilson:

Re: Carlisle Water Storage Facility Environmental Assessment
Draft Conceptual Design Report

Please find enclosed the draft Conceptual Design Report for the above referenced project for your review.

Please do not hesitate to contact the undersigned if you have any questions.

Yours very truly,

R.V. ANDERSON ASSOCIATES LIMITED

Andrew McGregor, MCIP, RPP
Project Manager

Encls.

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City of Hamilton

In Association With:

RVA 215933

September 17, 2024

CARLISLE WATER STORAGE FACILITY ENVIRONMENTAL ASSESSMENT

CONCEPTUAL DESIGN REPORT

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.0 Introduction and Background

R.V. Anderson Associates Limited (RVA) was retained by the City of Hamilton (City) to complete a Schedule B Municipal Class Environmental Assessment (Class EA) for a new water storage facility in the community of Carlisle.

The Class EA identified the preferred location and preferred water storage facility based on the City's planning policies, preliminary investigational data collected, and scoring based on specific evaluation criteria.

The purpose of the new water storage facility is to address Carlisle's water storage deficit and provide additional capacity to the Carlisle water distribution system required to support the community's needs now and in the future.

At the completion of the Class EA process in 2024, the preferred site for the water storage facility was selected, along with the preferred water storage facility. The conceptual design of the facility was then carried out to suit the unique requirements of the selected location.

1.1 Proposed Elevated Water Storage Facility

Multiple water storage facilities were considered during the Class EA process. The option to install a new water storage facility in addition to the existing elevated tank (ET) was also considered. However, through the EA process, it was determined that the preferred water storage facility would be a new ET, with the existing ET to be removed/demolished following the construction of the new water storage facility. The new ET would be sized for the 2051 buildout population and would be located on the same property as the existing ET. Additional information on the EA process undertaken is provided in the Project File Report.

1.2 Existing Water Storage Facility

The existing water storage facility is a 1,400 m^3 ET located at 40, 42, 46 Woodend Drive. The elevated tank is fed from four (4) groundwater wells, FDC01, FDC02, FDC03R, FDC05. Well FDC01 and FDC02 are located on the same property as the ET. FDC03R is located at 84 Acredale Drive and FDC05 is located at 6 Oldenburg Road. FDC03R and FDC05 utilize a well house on the same property as Well FDC05. The well house provides pre and post chlorination. A new well, FDC03RR, was added as a redundant well for FDC03R. Additional information on FDC03RR is provided in Section 3.15.

The well house for FDC01 and FDC02 is located adjacent to the base of the ET, within the same property. FDC01 and FDC02 are the primary pumps that supply water to the ET.

FDC03R and FDC05 have start and stop set levels for the ET but are primarily used when the tower is offline, and the distribution system is operating in Pressure Mode.

1.3 Objectives

The objective of this report is to present the conceptual design of the proposed ET in Carlisle and document key considerations to be carried forward into the detailed design process. The details provided in this report include the current design criteria and assumptions made, design parameters for the new ET, potential constraints and opportunities, anticipated implementation schedule, and a Class D cost estimate.

1.4 Acts, Regulations, Codes, and Standards

The following planning policies, regulations, and design standards need to be considered during detailed design due to their relevance to the project:

1. Planning Policies, Acts, and Regulations
    a. Provincial Policy Statement
    b. City of Hamilton Official Plan
    c. Carlisle Official Plan
    d. Conservation Halton
    e. Planning Act, R.S.O. 1990, c. P.13
2. Design Codes and Standards
    a. Ministry of the Environment, Conservation, and Parks (MECP) Design Guidelines for Drinking Water Systems
    b. Ontario Building Code
    c. American Water Works Association (AWWA) Standards
    d. City of Hamilton Outstation Design Manual
    e. City of Hamilton SCADA System Master Plan, Standards, Design & Implementation

2.0 DESIGN CRITERIA

2.1 Population Projections

There are two types of residential water service connections in the Community of Carlisle:

1. Public connection to the municipal water supply network; and
2. Private connection to a confined or unconfined aquifer through a well.

Based on the number of parcels from the City's GIS data, the estimated current population within the rural settlement area is 1,930 people. Forecasted population within the Carlisle Rural Settlement Area (RSA) to the year 2051, is comprised of three (3) components:

1. Potential Population to be Serviced by New Municipal Connections from Current Private Connections
    - City records indicate a total of 284 developed land parcels that are not connected to the municipal system.
    - An estimated population of approximately 969 people based on the land parcel data provided by the City's GIS data.
2. Future Development Population
    - According to City estimates, there are 14 undeveloped land parcels for single-family detached homes.
    - The resulting population for the future development would be approximately 48 people.
3. Secondary Dwelling Population
    - The city indicated that secondary dwelling units in Carlisle will not be approved until adequate municipal water servicing is in place.
    - The population for the secondary dwelling was assumed to be zero (0).

The total future population to be serviced within the rural settlement area is 2,947 people. The future population count was used to calculate the future maximum day water demands.

2.2 Water Demand and Pressures

The following design criteria were used for the water consumption calculations:

- Per Capita Consumption: 422 L/cap/d
- Maximum Day Factor: 3.4
- Projected Service Population: 2,947 people
- The MECP's acceptable pressure ranges between 275 to 700 kPa (40 to 100 psi) for the local service area.

The Per Capita Consumption and Maximum Day Factor were based on billing records from 2011 to 2013, previously completed Storage Memo by WSP (2015) from 2009 to 2013, City records from 2015 to 2019, and the City's Drinking Water Report from 2019 to 2022. Additional details are provided in the Carlisle RSA Well Capacity and Storage Requirements Technical Memorandum, dated July 20, 2023, included as Appendix 1 of the Project File Report.

3.0 PROJECT REQUIREMENTS

3.1 Elevated Tank Location

The selected site for the proposed elevated tank (ET) is located on City owned property, on the same property as the existing elevated tank, at 40, 42, 46 Woodend Drive, Hamilton. The property is between Acredale Drive and Woodend Drive, also referred to as Tower Park.

During the Class EA planning process, eight alternative locations were identified and comparatively evaluated using a set of criteria. The location was selected due to its technical, social, economical, and archaeological advantages. This included a technical review of the location within the City's water model. The details on the identification and evaluation of the sites are documented in the Project File Report.

The new ET is proposed to be located in the northeast section of the property, between the existing playground and the existing wells. The new ET is proposed to be located away from the existing ET as much as possible, while minimizing the impacts to the existing forested area. The new ET location needs to have sufficient access on all sides for construction, future maintenance, and to allow for the demolition of the existing ET. The proposed location is shown in Figure 3-1.

Figure 3-1 Proposed ET Location

3.2 Tank Sizing and Configuration

3.2.1 Sizing

According to MECP guidelines, it is recommended that the water supply provide sufficient storage for equalization of peak hours, firefighting, and emergency conditions. More specifically, the water storage volume for a community should be calculated using the following formula:

Total Treated Water Storage Requirement = A + B + C
Where: A = Fire Storage;
B = Equalization Storage (25% of maximum day demand); and
C = Emergency Storage (25% of A + B)

Fire Storage (A) is calculated based on theoretical fire flows over an estimated duration that the fire would require water. Equalization Storage (B) is calculated as 25% of the maximum day demand. This storage allows for fluctuation in water demand throughout the day. Emergency Storage (C) is calculated as 25% of the Fire Storage (A) and Equalization Storage (B). This storage accounts for unexpected issues that may arise in the water system, such as watermain break or equipment failure.

The required fire flow for the Carlilse RSA of 150 L/s for 2 hours was used to calculate the required fire storage volume. The future maximum day demand for the new ET service area was calculated to be 4.226 million litres per day (MLD). The following calculations show the overall daily storage volume required based on MECP guidelines.

A = 150 L/s x 2 hour = 1.080 ML
B = 25% x 4.226 ML = 1.057 ML
C = 25% (1.080 ML + 1.057 ML) = 0.534 ML
TOTAL = A + B + C = 2.671 ML

3.2.2 Panel Material

There are currently two types of panel material for elevated tanks (e.g. Composite Welded Steel and Composite Bolted Glass-Line Steel). Both are composite (concrete pedestal with steel storage tank) type, and both are design-build type structures. Both styles of panel materials are suitable for this project. Traditional welded steel elevated tanks have been constructed up to 9,000 m^3 in Ontario, and bolted steel elevated tanks can be constructed to volumes up to approximately 3,700 m^3. Therefore, the style of elevated tank can be selected during preliminary design based on the City's preference. The City's Water

Outstation Design Manual specifies all-welded steel reservoir that conforms to AWWA standard D107.

The major drawback of composite welded steel tank construction is that the steel tank portion needs to be painted internally and externally, and the paint needs to be maintained and re-applied typically every 15 to 20 years. The costs to refurbish an elevated tank have risen significantly, mainly due to the need for environmental controls, to prevent dispersion of dust and overspray. The recoating process would typically take the facility out of service for 6 months and the work must be performed within a certain temperature range.

Although glass-lined bolted steel tanks have higher capital costs upfront, the major advantage is that they do not need to be field-painted, and therefore the glass-lined panels do not require paint re-application throughout it's life-cycle, significantly saving on maintenance costs.

3.2.3 Key Elevations

The proposed conceptual design of the new ET has the following key elevations:

- Ground Level (Finished Grade): 273 m above sea level (ASL).
- Low Water Level (LWL): 313 m ASL. Existing ET LWL was 315.500 m per the existing Record Drawings.
- Bottom of Equalization Band: approximately at 319 m ASL
- High Water Level (HWL): 323 m ASL. Same HWL as the existing ET per the existing Record Drawings.

3.2.4 Configuration

It is proposed that the area at the base of the tank's concrete pedestal include the following features:

- A chemical room for housing sodium hypochlorite pumping and storage systems, for top-up chlorination
- A process room housing process piping and valves
- An electrical room housing electrical and control panels (if space allows)
- Ladder providing access to mezzanine level (storage area).

Other features on site include:

- Extension of existing asphalt access road from Acredale Crescent and an asphalt parking area around the pedestal. The asphalt area should be designed to meet heavy single unit truck turning radius requirements but minimized to prevent disruptions to the environment.
- Exterior lighting.

3.3 Property Requirements

The property on which the new ET is proposed to be located is City owned and will not require any acquisition costs nor easements, both temporary and permanent. The existing access road from Acredale Drive to the existing ET can be reused. An extension will be required from the existing ET to the proposed ET.

Following the preliminary sizing of the elevated tank, the tank diameter was determined to be approximately 19 m. A further 10 m buffer is recommended around the entire ET to allow access during construction, along with future maintenance (coatings) on the tank.

The ET overflow is proposed to be directly discharged to the environment via the existing ditch along Acredale Drive, therefore additional property for an overflow pond should not be required. The water needs to be dechlorinated prior to discharging to the environment. During detailed design, the capacity and condition of the ditch should be checked to determine that it is able to handle a tank overflow event.

3.4 Process Piping and Equipment Requirements

Process piping and equipment will be housed in the Process Room within the concrete pedestal at the base of the tank. The following piping, valves, equipment and instrumentation would be required for the tank:

3.4.1 Inlet and Outlet Pipes

Inside the new ET process room, the discharge from the well pump will supply water to the ET through a 300 mm inlet pipe. A 300 mm outlet pipe from the ET back down to the process room will be connected to the existing 400 mm ductile iron watermain from the new ET to the distribution system on Acredale Drive. The outlet pipe would have an approximate maximum velocity of 0.69 m/s. The inlet pipe velocity would vary depending on the well pump supplying water to the ET. The Process Narrative for the existing ET indicates pumps at FDC01 and FDC02 operate as duty-standby units for the ET. The maximum permitted flow for each pump is 9.83 L/s. The inlet pipe maximum velocity would be approximately

0.14 m/s. All flows are within the City's maximum flowrate of 2.5 m/s and 1.5 m/s for the inlet and outlet pipes, respectively,

Both inlet and outlet pipes are to be insulated and heat-traced inside the unheated areas of the concrete pedestal to minimize freezing of the water.

The inlet pipe will consist of the following:

- Actuated isolation valve
- Check valve
- Isolation valve prior to interconnect between inlet and outlet pipe
- Flowmeter with isolation valve and breakout point connection
- Recirculation pump discharge connection
- Chemical injection points and analyzers
- Temperature sensor
- Sampling line
- Riser to tank
- Multiple discharge nozzles to promote mixing.

The outlet pipe will consist of the following:

- Actuated isolation valve
- Check valve
- Flowmeter with isolation valve and breakout point connection
- Recirculation pump suction connection
- Chemical injection points and analyzers
- Temperature and pressure sensor
- Sampling line
- Riser from tank
- Connection to overflow pipe, complete with isolation valve.

A tank bypass connecting the inlet pipe to the outlet pipe with an isolation valve will allow the tank to be bypassed.

3.4.2 Overflow Pipe and Drainage

A 300 mm overflow pipe that provide means to overflow any excess water in the tank to be discharged into the existing 300 mm Storm Sewer via a dechlorination chamber outside of the pedestal. The maximum velocity through the overflow pipe would be approximately 0.7 m/s, below the maximum velocity of 1 m/s in the City's design standard. The City's standards note a minimum 400 mm diameter overflow pipe. However, a larger pipe will

decrease the pipe velocity to 0.4 m/s along with decreasing the available space in the pedestal (larger pipes and valves will be required).

The tank drain will be connected to the overflow pipe to allow proper drainage of the new ET. An isolation valve will separate the drain and overflow pipe.

3.4.3 Sampling Lines

One sampling line on the inlet and one sampling line on the outlet will feed the chlorine analyzers that monitor the free chlorine concentration in the water entering and leaving the tank. These chlorine analyzers, along with the flowmeter on the outlet pipe, will be used to adjust chlorine top-up dosing.

Two additional sampling lines from the inlet and outline lines will run along the pedestal wall and be directed to a sampling sink, which will be installed against the exterior wall. The chlorine analyzers will drain into the same sink.

3.5 Chlorination Top-Up Requirements

The water entering the new ET is already pre-chlorinated via the FDC01 and FDC02 well house. However, a top-up chlorine system is recommended as chlorine decay due to water age is possible when water stays in the storage tank for extended periods of time. The top-up chlorine requirement would be based on the City's target chlorine concentration both in water entering the tank and water leaving the tank and the turnover rate. The City will provide target chlorine concentrations for water entering and leaving the tank during detailed design and/or commissioning.

A top-up chlorination injection point would be provided on the inlet and outlet of the tank to achieve the following:

- Increase the chlorine dose at the inlet to meet the highest range of the chlorine concentration target for distribution if the chlorine analyzer on the tank supply pipe determines that the chlorine concentration is below the pre-set adjustable set point.
- Increase the chlorine dose at the outlet to meet the lowest chlorine concentration target for distribution if the chlorine analyzer on the tank discharge pipe determines that the chlorine concentration is below a pre-set adjustable set point.

It is recommended that, at a minimum, there should be two metering pumps (1 duty, 1 standby) and if the City wishes to be able to inject top-up chlorine into both the inlet and outlet streams simultaneously, consideration should be given to have two duty and one

standby metering pumps. Based on previous projects with the City, the City prefers peristaltic pumps for the chemical feed pumps.

Twin sets of 25 mm diameter half couplings will be available on both the inlet and outlet piping of the tank, for top-up chlorination injection points. This would allow the City to increase the chlorine dose to stay within the high and low chlorine concentration target range if the chlorine analyzers determine that the chlorine concentration is below a pre-set adjustable set point.

Analyzers would be installed on the inlet and outlet pipes to monitor the total and free chlorine readings. The inlet chlorine readings would be located downstream of the recirculation pump discharge pipe, while the outlet chlorine readings would be located downstream of the recirculation pump suction pipe connection.

The inlet chlorine injection point would be installed per the City's design manual, on the inlet pipe upstream of the recirculation pump and analyzers. It is recommended the injection point for the outlet pipe be located on the outlet pipe, compared to the suction pipe of the recirculation pump. Injecting chemical directly to the recirculation pump discharge pipe will not allow any chlorine top-up on the water going to the distribution system.

An emergency eye wash station is to be provided outside the Chemical Room, by the sampling sink in the Process Room.

3.6 Recirculation/Mixing Requirements

Mixing systems are used to improve water quality (by reducing stagnant water) and reduce ice buildup. Completely eliminating ice build-up during winter conditions is very expensive and rarely practiced.

Mixing can be achieved by a passive system, which consists of separate inlet and outlet pipe and nozzles to promote the movement of water during the fill cycle, or active mixing systems consisting of mechanical mixers or recirculation pumps to provide continuous mixing of water in the tank. Mixing will help reduce ice build up inside the tank during winter months and reduce water age and improve water quality by circulating the water and promoting mixing.

The City of Hamilton's Water Outstation Design Manual indicates a passive mixing system is required, along with a recirculation system. The recirculation system is to consist of a recirculation pump, with a shelf spare, a hot water tank, along with a flowmeter, check valve, pressure gauges, and isolation valves. The City's design manual notes the hot water tank is to be sized to heat the entire tank volume from 0°C to 5°C in 24 hours. This is

impractical and very costly for a tank this size. The purpose of the water heater is to add heat energy to the water storage tank during winter months to help reduce the amount of ice formation.

A recirculation pump, with a hot water tank, sized to allow for one complete tank volume turn over in approximately two (2) days, has been included in the conceptual design. The City's design standard requests the pump circulate the entire ET volume within 24 hours. This will require a larger pump and could require modifications to the electrical supply.

The recirculation pump will be connected to the outlet pipe and the inlet pipe within the Process Room. The suction pipe will draw water from the outlet pipe, through the hot water tank, and then discharge the heated water to the inlet pipe where it will be carried to the tank at the top of the ET. A bypass connection complete with isolation valves will be available to bypass the hot water tank.

The heating system should be reviewed during the detailed design to optimize its size against equipment and operating costs.

3.7 Overflow Outlet

The tank overflow would be discharged through the overflow pipe, into a dechlorination chamber and then out to the environment. A discharge pipe will be connected to the existing 300 mm Storm Sewer pipe, with an air gap, along the access driveway. The existing storm sewer discharges to the ditch along Acredale Drive.

A flow switch placed on the horizontal portion of the overflow pipe would send a signal to SCADA in an overflow event, instead of relying solely on the water level in the ET.

The dechlorination chamber will be installed outside the concrete pedestal. Operations would place dechlorination pucks into the chamber, as required to dechlorinate the water. A duck bill check valve on the end of the overflow pipe into the chamber and the discharge pipe from the dechlorination chamber prevents insects and wildlife from entering the overflow pipe and the dechlorination chamber.

Routine maintenance checks would have to be conducted for the dechlorination chamber to confirm that there are enough dechlorination pucks in place.

3.8 Tank Access Requirements

Galvanized steel ladders with landing platforms should be installed inside the pedestal from ground level to the upper landing platform below the bottom of the tank. The ladder should

be continued from the upper landing platform to the top of the tank via the minimum 900 mm diameter access tube. All ladders should be equipped with fall arrest devices.

The City's design guidelines request a drip pan under the access tube to collect condensation. The PVC drain is to discharge the collected condensation to the exterior of the pedestal. The installation of this drip pan will need to be investigated further during preliminary design.

Two 900 mm diameter rainproof access hatches are to be provided at the top of the tank, one for access to the tank and one for access to the access tube. In addition, a minimum 600 mm diameter watertight, submarine-style access hatch is to be provided at the bottom of the tank, that can be opened from the underside of the tank and accessible via a ladder from the upper landing platform.

A one-meter-high safety railing should be installed at the top of the tank, enclosing the roof hatches and all other equipment, including any future telecommunication antennas. The upper landing platform is to be complete with railings.

A davit socket with a 76.2 mm inner diameter is to be installed at the top of the tank that can be used for personnel safety purposes at the top of, or inside, the tank.

3.9 Structural and Architectural Requirements

The new ET base level will comprise of multiple rooms, including a vestibule area, a process room and a chemical room. The large process room will house all the process piping, and process equipment. A separate electrical room is recommended to house the electrical equipment and control panels, but if space is not available, the panels can be installed within the process room. Provisions should be considered to protect the equipment from water and moisture. A chemical room will house sodium hypochlorite storage and chemical feed pumps. Double doors are recommended for entry into the process room to provide easy access for large equipment.

Third party antenna installation are not anticipated at this time, however the structural design of the tank roof should account for the installation of an antenna structure in the future. The provisions for a dedicated antenna structure helps to prevent installation of antenna on portions of the tank that are not designed to accommodate the loading, such as guards or railings. The number of antennas is to be confirmed by the City during detailed design.

3.10 Building Mechanical Requirements

Building Mechanical Systems are comprised of HVAC (heating, ventilation, and air conditioning), plumbing (building sewers, domestic cold/hot water systems, fixtures), fire protection (fire extinguishers, sprinklers) and building controls (controllers, thermostats, dampers, etc.) The following summarizes features for proposed Building Mechanical Systems:

- All rooms to have individual electric unit heaters with dedicated ground level remote thermostats.
- The Electrical Room and Chemical Room feature emergency ventilation cooling systems.
- The Process Room features ventilation and partial dehumidification.
- Backflow preventer and water meter system designed to be in compliance with City's Standards and By-law, and the Ontario Building Code.
- Plumbing system including domestic cold water (DCW) and domestic hot water (DHW) piping supplying to various fixtures as required by the City.
- An electric hot water heater tank is used as a domestic hot water source.
- Emergency shower and eyewash systems are provided in accordance with the Ministry of Labour requirements.
- Drainage system including floor drains, cleanouts, and vent piping.
- Fire protection system including portable fire extinguishers (FE).

3.11 Electrical and Power Requirements

Hydro One overhead power lines run along the north side of Acredale Drive. There is an overhead power supply being fed from Acredale Drive to the existing ET. An extension of this power supply will be required for the proposed ET location. During detailed design, the City will need to coordinate with Hydro One to install a new hydro pole near the new ET. Pole mounted transformers may also be required to step down the voltage to the site's power requirements. It is estimated that the power requirement for the elevated tank is 100A, 600V, 3 Phase (depending on the City's requirements determined during detailed design).

The power requirements for the project will need to be confirmed during detailed design, when specific design requirements for the equipment are provided by the City. Equipment that would require power include:

- Programmable Logic Controllers (PLC)
- Lighting panel (LP) and distribution panel (DP)
- Chemical metering pumps
- Lights
- HVAC/heaters
- Control instruments
- Security System
- Recirculation Pump
- Heat tracing for piping
- Antenna.

Air terminals on the top of the tower along with associated down conductors are proposed to be provided for lightning protection. Obstruction lights at the top of the tower, along with beacon light will be provided with matching controller and site electrical.

3.12 Security and Communication Requirements

The following security measures are proposed and can be confirmed during detailed design:

- Provision of locks, fob access and security door contacts (to be monitored by SCADA) to be located on all exterior doors into the concrete pedestal to reduce unauthorized entry.
- Access ladders to the water tank portion are located within the concrete pedestal itself so that only individuals who have gained authorized entry to the pedestal would be able to access the ladders.
- LED motion sensor lights on the exterior of the building, facing the entry is recommended. A shield on the light may be required to keep the light from neighbouring properties.
- Additional security measures such as security cameras capturing the exterior of the building entrance and access driveway, fencing, etc. can be confirmed by the City.

3.13 Site Civil Requirements

Connection from the new ET to the existing watermain will be required. The connection will require a temporary shutdown of the watermain, including the existing ET. The existing ET and new ET will be connected to the same watermain. A new tee and isolation valves will be required. Connection details should be explored in detailed design.

The overflow chamber will be located outside the new ET footprint. Excavation and installation of the chamber will be required. The discharge pipe from the overflow chamber will need to discharge to the existing storm sewer along the entrance driveway. The depths and capacity of the pipe network will be reviewed during detailed design.

The existing access driveway can be used to enter the site, an extension of the asphalt driveway will be required from the existing ET to the new location. Parking spot(s) adjacent to the new ET should be considered, depending on space available. A turnaround point for chemical refills should also be considered.

A fence does not surround the existing ET. The City is to provide direction if the new ET should be within a locked fenced area.

3.14 Landscaping Considerations

Landscaping design will likely be dictated by environmental sensitivities and policies. The following should be considered during detailed design:

- Design for landscaping using native vegetation where possible to provide natural habitat for wildlife and aesthetics.
- Tree removal on the east side of the new ET site should be avoided. The limit of disturbance should be delineated with the appropriate tree protection measures (i.e. installation of tree protection fencing) within the project area to help protect trees to be retained.
- Where tree removal is proposed as part of the detailed design phase, a tree inventory should be completed with an assessment of wildlife habitat trees. If required, implement timing windows, relocation of plantings of interest, and the restoration of the area.
- The natural vegetation at the ET site should be protected as much as possible to maintain native plant diversity and the wildlife habitat it provides. Any vegetation that must be removed during construction should be replaced with plantings of native

species once development is complete. Revegetated areas should be monitored to ensure the successful establishment of native plantings.

- Stripping of the natural vegetation should be kept to a minimum. Ground cover should be re-established as soon as possible.
- Grading works should be kept to a minimum and slopes should be cut to ensure stability as soon as possible.
- Areas of disturbance and impervious surfaces should be limited/minimized at these locations.

3.15 Redundant Well

A new well, FDC03RR, was constructed to function as a redundant well to achieve firm water supply capacity in Carlisle. The new redundant well is located on the same property as well FDC03R, 84 Acredale Drive.

FDC03RR is to be connected to the existing 150 mm Ø Raw Water pipe that connects FDC03R to the Well House on Oldenburg Road. The existing Raw Water pipe from FDC03R extends along 84 Acredale Drive and the path between Acredale Drive and Appalosa Trail, before reaching the well house.

The connection of FDC03RR to the raw water pipe would occur on 84 Acredale Drive. A tee would need to be connected to the existing pipe, along with isolation valves upstream of the tee branches to each well. The valves would need to be direct buried and operated at grade. The new pipe from FDC03RR would need to cross a 100 mm Ø Raw Water pipe that was previously in service, prior to the current 150 mm Ø Raw Water pipe being installed. The drawings note the previous 100 mm Ø pipe was to be capped but does not indicate if it was abandoned. The pipe should not be disturbed unless it is confirmed that the pipe was emptied and abandoned. Depths of the watermain on the property are not known.

It is recommended that Well FDC03RR be put into operation once connected to the well house. A new pump and valve assembly will be required. The well should be part of the supply wells for Carlisle to avoid the water in the well becoming stagnant and requiring routine flushing and maintenance. If there are no operational issues at FDC03R, then a similar well setup could be installed. If FDC03RR was to be operational, it would be part of the well system and no changes would be required to meet Carlisle's Firm Capacity rating.

4.0 SUPPORTING STUDIES

4.1 Natural Environmental Assessment

A Natural Environment Assessment Report was completed by RVA to investigate Species at Risk (SAR) and highlight significant or sensitive natural heritage features that should be considered during the facility siting and design. No provincially rare vegetation communities were observed, along with any candidates or confirmed point-source areas of wildlife concentration/specialized habitats. The investigation noted the treed areas may provide significant wildlife habitat for bat maternity colonies, as well as habitat for at-risk bats. The wooded community adjacent to the property has potential project constraints and impacts, and further investigation should be completed.

The full Natural Environmental Studies Report is provided within the Project File Report documenting the study planning process undertaken through the EA.

4.2 Stage 1 & 2 Archaeological Assessment

A Stage 1 Archaeological Assessment was completed by Parslow Heritage Inc. (PHC). Following the Stage 1 assessment, it was recommended to undergo a Stage 2 test pit survey at 5 metre intervals to confirm the degree of disturbance and determine if any intact soils remain within the proposed study area.

The full Stage 1 Archaeological Assessment is provided within the Project File Report documenting the study planning process undertaken through the EA.

4.3 Cultural Heritage Assessment

A Cultural Heritage Assessment Report was completed by PHC. The assessment did not result in the identification of any potential impacts to known or potential heritage resources. No further cultural heritage assessment is required, and no mitigation options are presented.

Carlisle is identified by the City of Hamilton as an inventoried Cultural Heritage Landscape (CHL), and post construction landscaping and rehabilitation plans should be undertaken in a manner that is sympathetic to the overall setting of the community.

The full desktop Cultural Heritage Assessment Report is provided within the Project File Report documenting the study planning process undertaken through the EA.

4.4 Geotechnical and Hydrogeological Investigation

A desktop geotechnical and hydrogeological assessment was completed by Palmer Environmental Consulting Group Inc. (Palmer). The investigation was completed to assess the expected soil mechanic properties, assess potential groundwater issues, identify data gaps and to make recommendations for additional, site-specific work. The results showed the soil mechanical properties are considered generally suitable for the proposed elevated tank, and significant geotechnical and hydrogeological constraints are not anticipated. Construction dewatering efforts are anticipated to be low.

The proposed ET location is within the Halton Region Source Protection Area and is subject to the Source Protection Plan of Halton-Hamilton Source Protection Region. The Source Water Protection Plan identifies four main regulatory factors under the Clean Water Act (2006) relating to local hydrology to consider: Significant Groundwater Recharge Areas (SGRAs), Highly Vulnerable Aquifers (HVAs), Wellhead Protection Areas (WHPAs, and Intake Protection Zones (IPZs). The proposed ET site is located within a WHPA and a SGRA. The site is within 100 m of an existing supply well. Surficial contaminants have a higher risk to impact nearby wells, therefore appropriate mitigation measures must be implemented.

The full desktop Geotechnical and Hydrogeological Investigation Report is provided within the Project File Report documenting the study planning process undertaken through the EA.

4.5 Phase 1 Environmental Site Assessment

A Phase 1 Environmental Site Assessment (ESA) was completed by Palmer for due diligence purposes. The results of the Phase 1 ESA concluded no actual or potential sources of soil or groundwater contamination associated with the site have been identified. No further investigations are required.

The full Phase 1 Environmental Site Assessment Report is provided within the Project File Report documenting the study planning process undertaken through the EA.

4.6 Hydraulic Model Analysis

A watermain hydraulic model of Carlisle's Rural Settlement Area water distribution system was completed to determine the capability of the existing municipal water distribution system to meet the required water demands under existing and future conditions. All simulated pressures are within the acceptable range under existing and future demand conditions.

The full Hydraulic Modelling Technical memorandum is provided within the Project File Report documenting the study planning process undertaken through the EA.

4.7 Recommended Future Studies

The following studies are recommended to be completed during detailed design:

- Stage 2 Archaeological Assessment test pit survey at 5 metre intervals.
- Topographic Survey.
- Geotechnical and hydrogeological drilling should be conducted for the site selected. The drilling should extend to dense to very dense soils or bedrock expected at approximately 30 m depth. The drilling program should include at least three (3) boreholes outside but adjacent to the footprint of the storge tank. SPT testing, soil sampling and lab testing, and classification should be completed. Groundwater monitoring wells should be installed in all boreholes to measure stabilized groundwater levels.
- At least one borehole for each appurtenance structure should be drilled to a depth of 6 m and completed as a groundwater monitoring well. Standard Penetration Testing, soil sampling and lab testing, and classification should be completed.
- To facilitate soil management during excavation as required by O.Reg. 406/19, an Assessment of Past Uses (AP) is recommended during later design stages.
- Coordination of utilities with local suppliers.

5.0 PROJECT CONSTRAINTS AND OPPORTUNITIES

The following constraints and opportunities have been identified for this project:

5.1 Detailed Design

- Consultation with Conservation Halton, Ministry Environment, Conservation and Parks, Ministry of Natural Resources, etc. during the detailed design phase to mitigate visual and physical impacts.
- During detailed design, the volume of excavated soil should be reused on site. If it is not possible to reuse all excavated soil, an Excess Soil Management Plan will need to be developed and incorporated in the Contract Specifications. This will address issues such as identification, assessment, excavation conveyance, treatment, staging and disposal, as required.
- Long term, the appearance of the new ET will need be maintained. A coating system that considers longevity and frequency of recoating as well as routine maintenance to minimize aesthetic impacts.
- Maintain required clearances from the existing ET and wells.

5.2 Construction Staging

- Pre and post construction condition assessment or recording of the site should be taken prior to construction. Post-construction rehabilitation to return lands to pre-construction conditions, to be completed if required.
- Construction activities and staging should be suitably planned and undertaken to avoid negative impacts to built heritage resources and cultural heritage landscapes.

5.3 Environmental Protection During Construction

- Sediment and erosion control are to be incorporated into the construction contract documents and implemented to mitigate impacts on potential receiving water bodies. The controls are to be regularly monitored, and excess sediment will need to be removed as required during construction.
- Monitor noise and vibration from construction activities and machinery. Increased noise and vibration are to be mitigated by planning the working hours following the City of Hamilton's Noise Control By-Law (By-Law No. 11-285), and construction and

machinery equipment and heavy vehicles will comply source sound limits with NPC-115 and NPC-118.

- Dust will be generated from construction activities on/nearby the construction site. Construction activities are to abide by the local Dust Control By-law. Additional mitigation measures include, material wetting, the use of chemical (non-chloride) suppressants, wind barriers, limiting exposed areas that may be a source of dust, equipment washing, and street cleaning. It is recommended that best management practices be followed during the demolition of the old ET, and excavation and construction of new facilities to reduce any air quality impacts that may occur.
- Proper maintenance and operation of engines and exhaust systems of fuel burning equipment is required. In addition, construction should use newer machinery that meets more stringent air emissions standards or retrofit older diesel engines with abatement technologies.
- Loads on haul trucks are to be covered.
- Burning of waste is prohibited.
- Waste generated on-site will also be disposed of in accordance with MECP's requirements.

5.4 Traffic Control During Construction

- Traffic from construction vehicles travelling to/from the construction areas will be present. The materials and equipment will be brought to the new ET location by trucks/construction vehicles through local roads. Local roads are to be kept open to mitigate impacts on residents and businesses. To minimize impacts to the residents and businesses, lane closures, if required, should be limited to one (1) lane, and when a full closure is needed, pedestrian bicycle access are to be maintained, or alternative routes provided.
- The City is to investigate the possibility of restricting any lane or road closure hours during key travel times (e.g. rush hour), and implementing signage for local traffic to use specific roads only, to minimize the impact on traffic overall and reduce the chance of traffic using local roads as a bypass.
- The City will need to investigate the possibility of route restrictions for construction vehicles/equipment on local residential streets and incorporate these into the Contract Documents during the design process.

- Residential areas, businesses, etc. are located adjacent to the construction areas. The Contractor is to be made aware of this and are to exercise caution for all construction vehicle movements in the area. Contractor must notify the residents and put up signage in the immediate area when work begins.
- It is recommended that best management practices be followed during construction to mitigate diesel emissions from the truck traffic and other equipment operation.
- Mitigating traffic congestion and reducing or eliminating idling time of vehicles in accordance with the City of Hamilton's Idling Control By-Law (By-Law No. 20-017).

6.0 APPROVALS

The proposed works for this project will require approvals and permits from various agencies and regional/municipal departments, as shown in Table 6.1. Consultation meetings and design submissions are to be coordinated as required during the detailed design.

Table 6.1 Potential Permits and Approvals Required

Agency	Approval	Description
MECP	Drinking Water Works Permit (DWWP)	Amendment of existing DWWP to include the new ET and associated infrastructure.
MECP	Permit to Take Water (PTTW)	Permit required for dewatering activities during construction.
MECP	Species at Risk (SAR) Permit	In the event impacts cannot be mitigated from affecting SARs.
Conservation Halton	Work Permit	To review technical reports and plans, such as Site Plan Control, Stormwater Management Plan, Grading and Drainage, etc.
City of Hamilton	Building and Demolition Permits	To construct the new ET and demolish the existing ET associated infrastructure for both.
City of Hamilton	Site Plan Approval	To construct the new ET and associated infrastructure.
Transport Canada	Aeronautical Assessment for Obstruction Evaluation Form	Confirm the lighting requirements of the tank.
Nav Canada	--	Proposal to inform them of the location and height of the new ET.
Hamilton Community Enterprises (HCE) Telecom	--	Fiber optic internet connection to communicate with SCADA to be provided by HCE Telecom.
Electrical Safety Authority (ESA)	--	Approval of electrical installations during construction.
Utilities	--	Review existing utilities and coordination installation of new utility connections.

7.0 PROJECT IMPLEMENTATION SCHEDULE

The table below shows the anticipated project implementation schedule. The existing ET should be demolished once the new infrastructure is operational.

Table 7.1 Anticipated Project Implementation Schedule

Activity	Anticipated Schedule
Completion of Class EA	Late 2024
Enhanced Conceptual Design of New ET	Late 2024
Detailed Design of New ET	2025
Construction of New ET	2026 to 2027
Decommissioning Design of Existing ET	2028
Decommissioning Construction of Existing ET	2029

The construction of the ET is weather dependent. There is a minimum temperature required to install the coatings. Coatings typically cannot be applied between the months of November and March (weather dependant).

8.0 COST ESTIMATE

A Cost Estimate for the conceptual design was prepared and summarized in Table 8.1 with inclusion of a Class D estimating contingency (30%). This estimate was developed based on past industry experience and supplier costs, considering 2024 pricing. This estimate should be revisited and updated at least annually, and further refined during detailed design.

Table 8.1 Conceptual Cost Estimate for Construction

Item	Scope	Total Cost
1	Site Work for ET Pre and Post Tank site work including landscaping and paving	$1,100,000
2	Elevated Tank with Logo 2.4 m deep raft slab, concrete pedestal, steel tank, coatings, piping, ladders, platforms, antenna support structure	$6,000,000
3	Process Recirculation, chemical system	$225,000
4	Mechanical HVAC and plumbing	$200,000
5	Electrical and Controls	$875,000
6	Third Party Testing – Coatings	$30,000
	Construction Subtotal	**$8,430,000**
	Class D Cost Estimate Contingency (30%)	$2,529,000
	Total Construction excluding HST	**$10,959,000**

Table 8.2 summarizes the cost estimates for some of the operational and maintenance (O&M) activities. The list of O&M costs presented is not meant to be exhaustive as there could be other costs required, such as equipment breakdown and replacement.

Table 8.2 Conceptual Cost Estimate for O&M

Item	Scope	Total Cost	Frequency
C1	Estimated Annual Power Cost	$3,000	Every Year
C2	Estimated Annual Chemical Cost	$2,000	Every Year
C3	Fall-Arrest System Inspection	$2,000	Every Year
C4	Overcoating of Tank Interior and Exterior	$650,000	Every 10-15 Years
C5	Tank Interior and Exterior Re-Coating	$1,000,000	Every 20-30 Years
C6	Tank Inspection (Remotely Operated Vehicle)	$5,000	Every 5 Years
C7	Tank Pressure Washing – Interior Only	$25,000	Every 5 Years

Hamilton

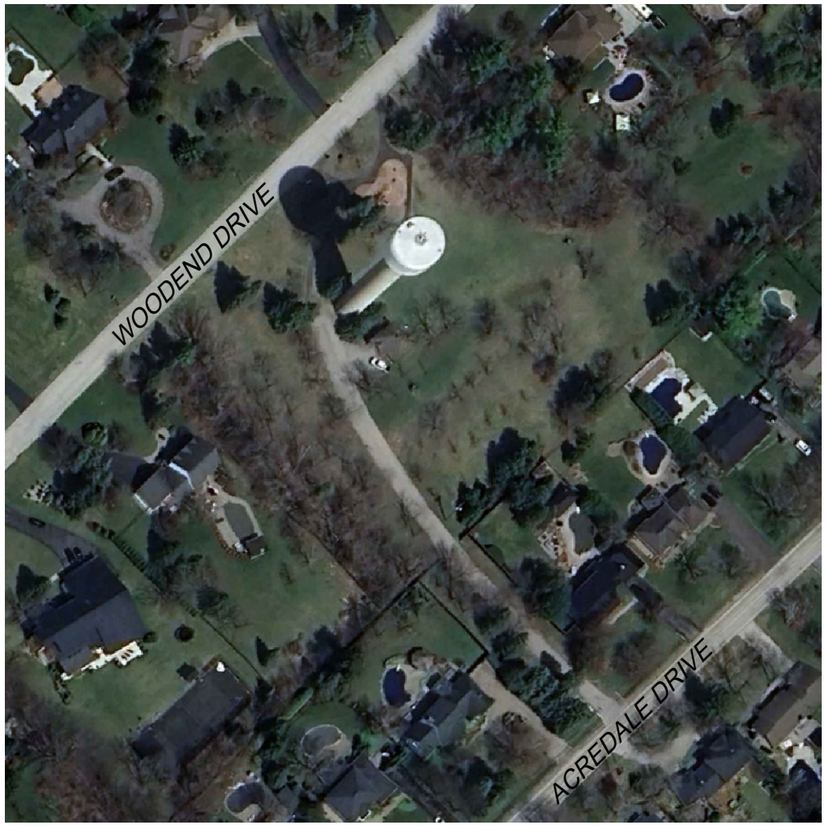
CITY OF HAMILTON

Public Works Department
Water Services Division

CARLISLE ELEVATED TANK

CARLISLE WATER STORAGE FACILITY EA

CONTRACT No. XX-XXXX-XX



DRAWING LIST	
DRAWING NUMBER	DRAWING TITLE
CS & DL	COVER SHEET & DRAWING LIST
Site	
G101	PROPOSED SITE PLAN
ELEVATED TANK	
P101	PLAN
P102	SECTION
P103	P&ID

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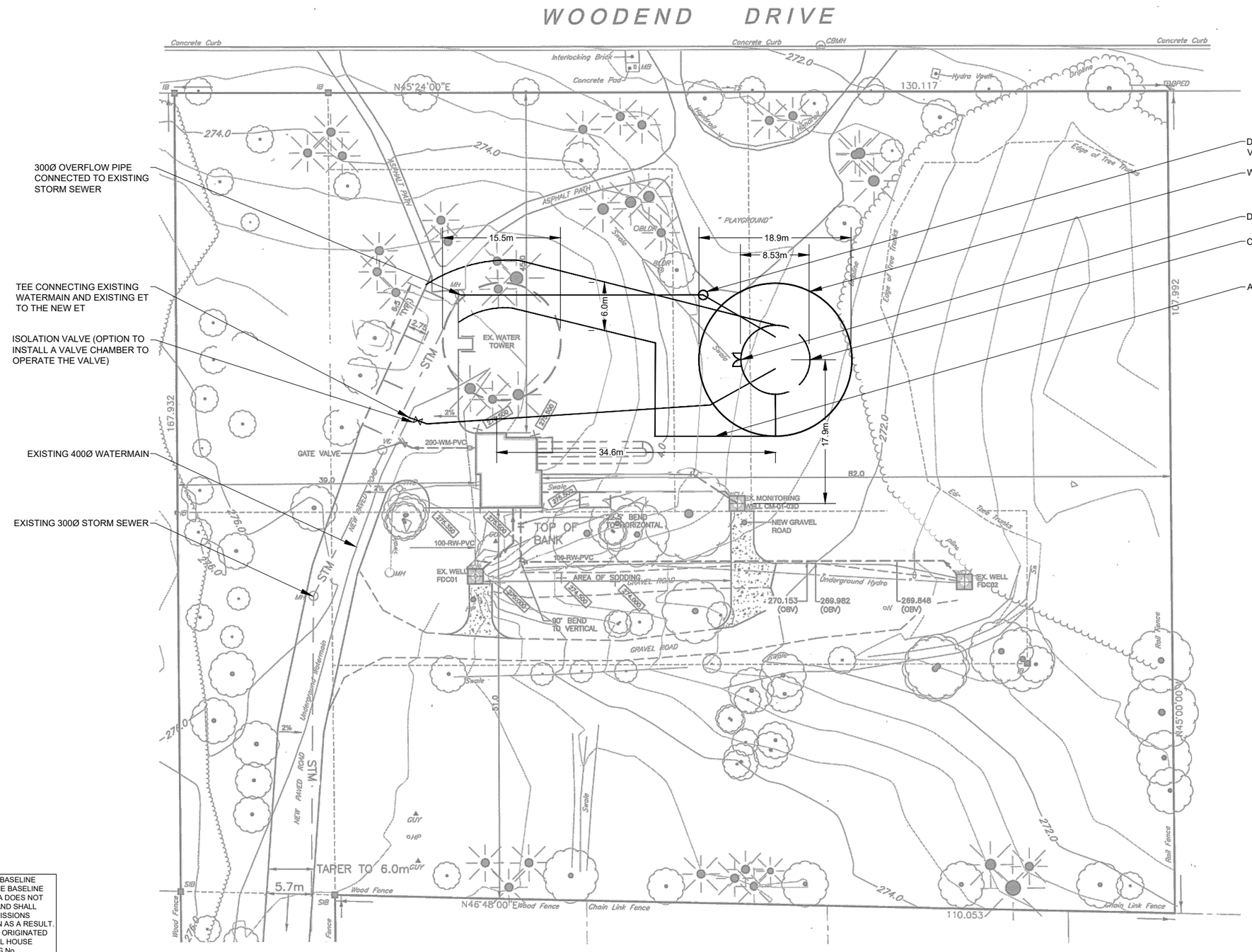
XX-XXXX-XX

CARLISLE ELEVATED TANK
CARLISLE WATER STORAGE FACILITY EA
CITY OF HAMILTON

NO.	REVISION	DATE	INIT.
A	CONCEPTUAL DESIGN	2024.07.31	AM



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No.	Description	By	YY.MM.DD
A	CONCEPTUAL DESIGN	AM	2024.07.31

CITY OF HAMILTON
Public Works Department
Hamilton Water Division

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CITY OF HAMILTON

CONTRACT NO. XX-XXXX-XX

CARLISLE ELEVATED TANK
CARLISLE WATER STORAGE FACILITY EA

Project No:	215933	Designed	TSY
Date:	Jul-2024	Checked	XXX
Scale:	AS SHOWN	Drawn	TSY

CIVIL
SITE
PROPOSED SITE PLAN

DWG NO. G101
REV. A

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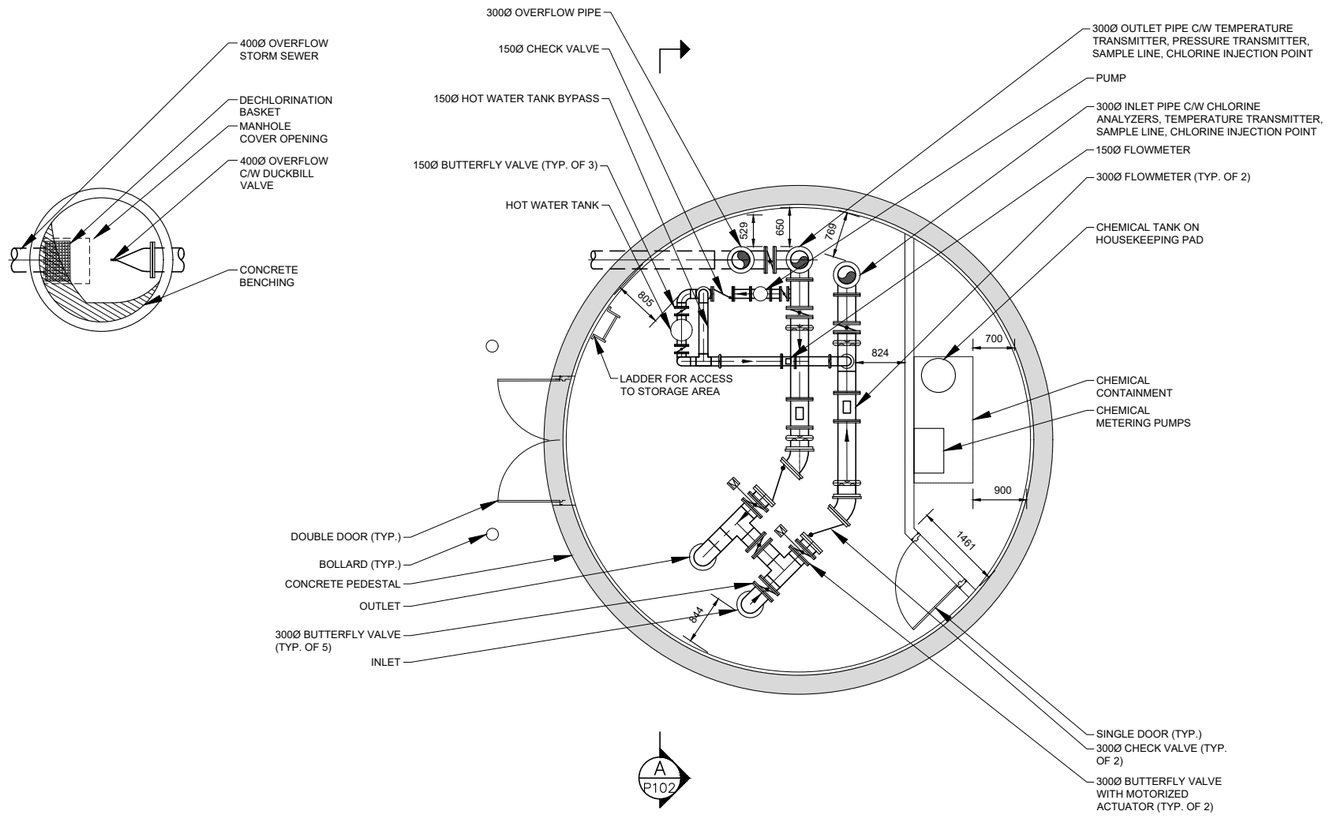

BASE FLOOR PLAN

0.5m 0 1m 2.0m
@M50

No.	Description	By	YY.MM.DD
A	CONCEPTUAL DESIGN	AM	2024.07.31

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CONTRACT NO. XX-XXXX-XX

CARLISLE ELEVATED TANK
CARLISLE WATER STORAGE FACILITY EA

Project No:	215933	Designed	TSY
Date:	Jul-2024	Checked	XXX
Scale:	AS SHOWN	Drawn	TSY

PROCESS
ELEVATED TANK
PLAN

DWG NO. P101
REV. A

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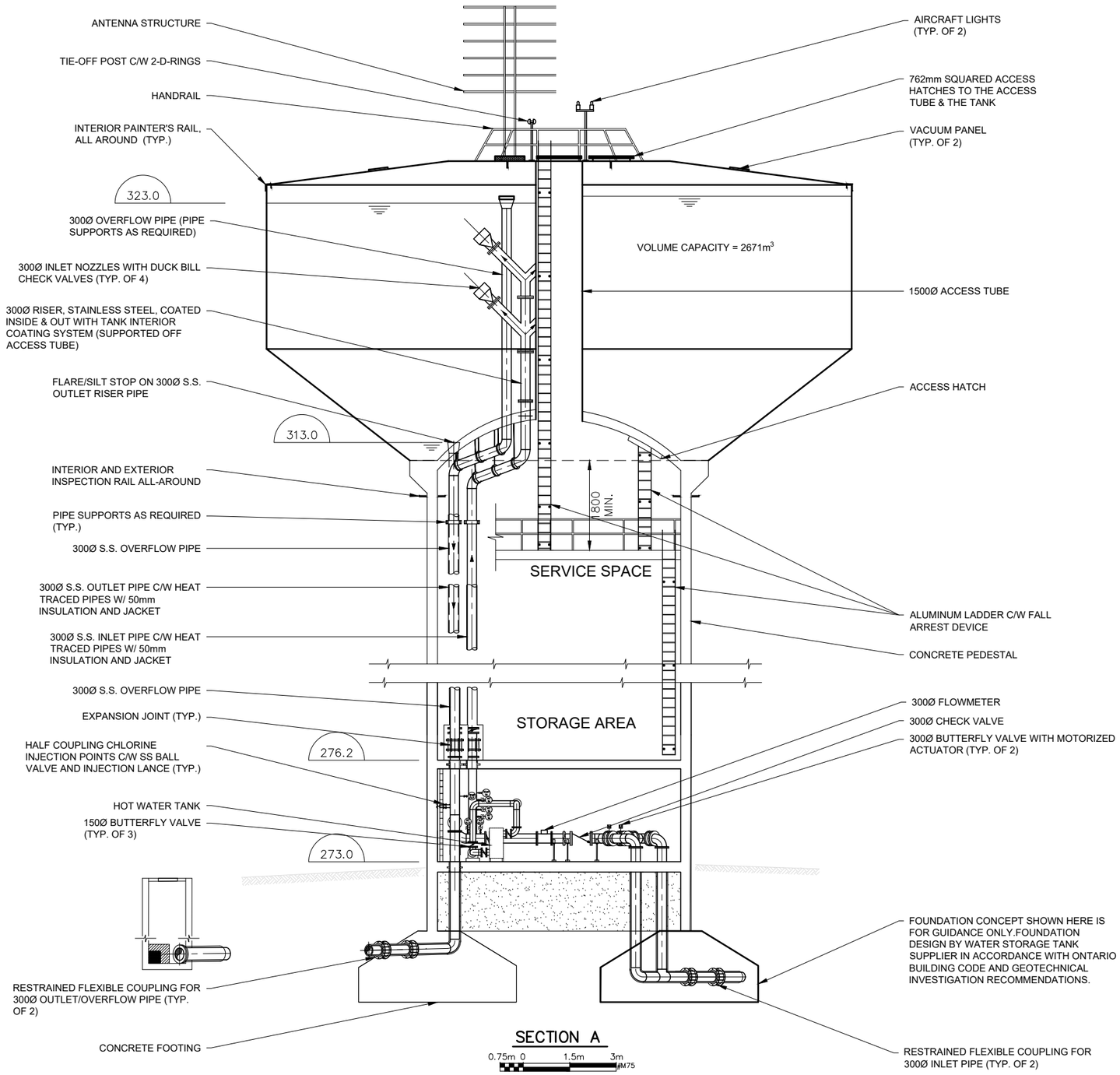

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CONTRACT NO. XX-XXXX-XX

CARLISLE ELEVATED TANK
CARLISLE WATER STORAGE FACILITY EA

Project No:	215933	Designed	TSY
Date:	Jul-2024	Checked	XXX
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PROCESS
ELEVATED TANK

SECTION

DWG NO. P102

REV. A

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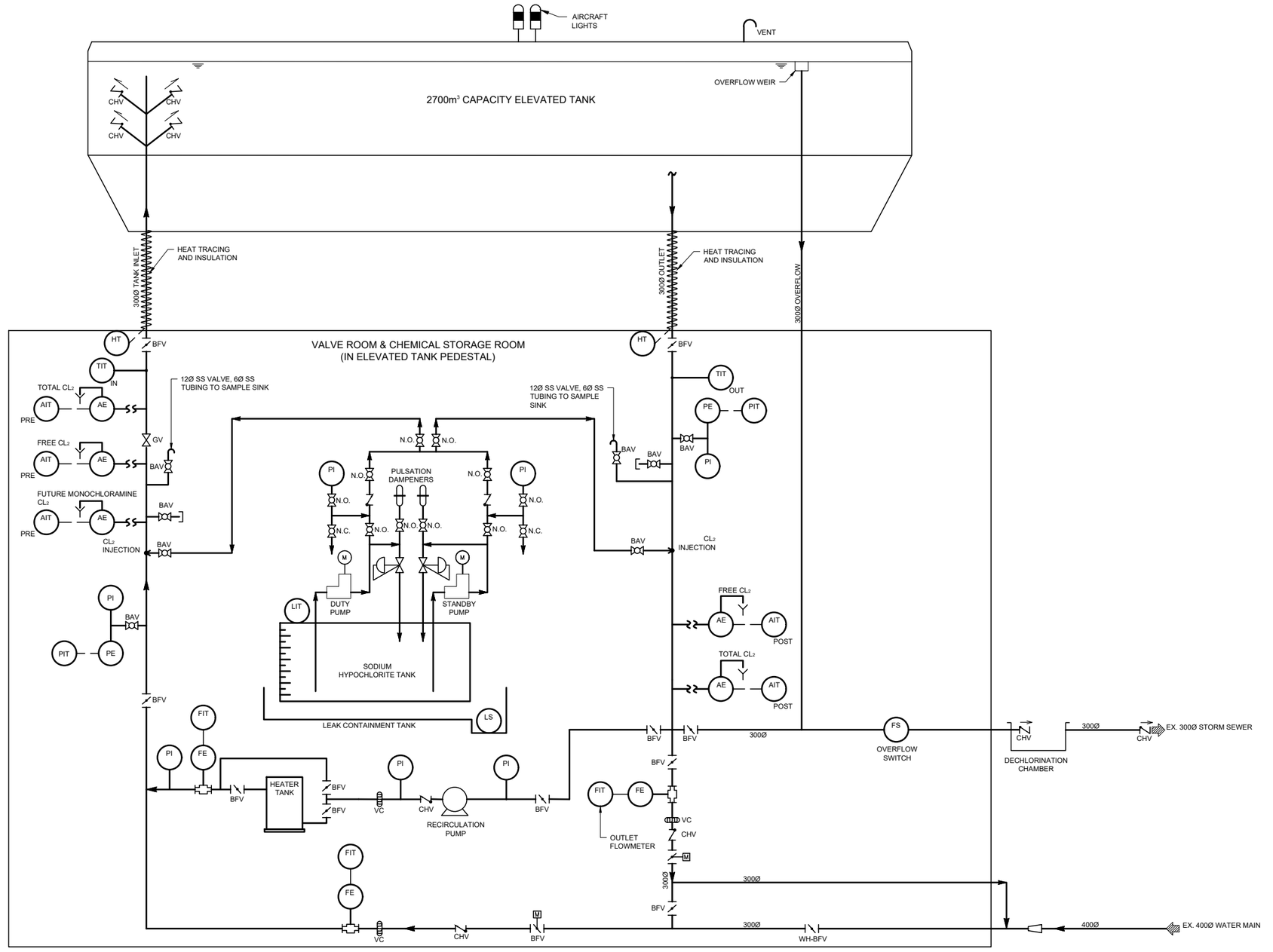

No.	Description	By	YY.MM.DD
A	CONCEPTUAL DESIGN	AM	2024.07.31

Hamilton

CITY OF HAMILTON
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Hamilton Water Division

CITY OF HAMILTON

CONTRACT NO. XX-XXXX-XX

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CARLISLE ELEVATED TANK
CARLISLE WATER STORAGE FACILITY EA

Project No:	215933	Designed	TSY
Date:	Jul-2024	Checked	XXX
Scale:	AS SHOWN	Drawn	TSY

INSTRUMENTATION
ELEVATED TANK
P&ID

DWG NO. P103
REV. A

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