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REPORT

Township of Woolwich

East Side Lands (Woolwich) Sanitary Servicing Class EA Pumping (Lift) Station Preliminary Design Report



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EXECUTIVE SUMMARY

For the East Side Lands Sanitary System Class EA, the initial plan included a large, deep lift station (PS) at the intersection of Fountain St. N and Middle Block Rd. However, after evaluating alternatives and optimizing the design, it was determined that the preferred solution, which involves passing over the Randall Drain Culvert, would require only three smaller and less complex lift stations.

This design report focuses on the proposed lift station LS 02, located near the junction of Jetliner Ct. and Fountain St. N. This lift station is necessary to elevate the incoming flow from Fountain St. N., directing it south towards Trunk 3B, which runs along Jetliner Ct. and turns left to merge with the incoming sewer branch. The sewer branch and trunk on Fountain St. N. must be lifted to pass over the Randall Drain Culvert as it approaches Kossuth Rd.

The lift station will be a dry/wet well configuration with a control building and underground storage tank. There are three proposed site locations for the lift station as seen in Appendix A. The design of lift station LS 02 addresses civil, structural, mechanical, electrical, instrumentation, and control requirements, detailed in Appendix B. Detailed system analysis indicates that the incoming sewer main to LS 02 will be approximately 10 meters deep, with an incoming wastewater flow rate of 162.7 L/s.

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1 PROCESS

This section describes the process design for the proposed new lift station and the emergency storage tank.

1.1 Applicable Design Codes and Standards

- Ontario Building Code;
- National Building Code;
- Occupational Health and Safety Act;
- Municipal by-laws and servicing standards;
- Ontario Electrical Safety Code and ESA Bulletins; and

Other reference material may be applied based on experience and professional judgement to reflect best practices, but in such a manner as to not conflict with the legislated requirements. These references may include the following:

- Ministry of the Environment Conservation, and Parks (MECP), Design Guidelines for Sewage Works 2008;
- WEF Manuals of Practice;
- City of Kitchener – Design Standards and Procedures Manual – Wastewater Pumping Facilities (Feb. 2013) and
- NFPA 820.

1.2 Design Concept Overview

The lift station, with a dry/wet well configuration and a control building, has a rated capacity of 162.7 L/s.

The lift station is comprised of one (1) split wet well and one (1) pump room. Two (2) grinders and associated isolation gates are installed on the influent channel within the wet well. The wet well is divided into two cells by a wall and interconnected by a normally-open isolation gate. Three (3) sewage pumps are to be installed in the pump room (2 duty and 1 standby). Each cell of the wet well is to be connected to one (1) sewage pump, and the third pump has two suction lines for both cells.

A control building above-grade of the SPS will include a flowmeter room, grinder room, mechanical room, electrical room, and odour control room. One (1) passive carbon odour control vessel is to be installed in the odour control room for exhaust treatment during the filling of the wet well.

The underground emergency storage tank (EST) has two (2) return pumps (duty/standby), two (2) flushing systems (tipping buckets), and access platforms. The design concept for the EST may be briefly summarized as follows:

- EST is sized at approximately 587 m³ which is defined as the volume of one (1) hour peak flow.

- Each return pump is rated at 21 L/s and configured as 1-duty 1-standby.
- Each tipping bucket is 4.5 m long, with DN40 solenoid valve for feeding.

Table 1 demonstrates the proposed area classification of areas at the lift station and the EST per the Electrical Code and NFPA 820.

Table 1: Area Classification

Area at the Lift station and the EST	Area Classification
Wet Well	Class 1 Zone 1
Pump Room	Class 1 Zone 2
Flowmeter Room	Class 1 Zone 2
Grinder Room	Class 1 Zone 1
Odour Control Room	Class 1 Zone 1
Mechanical Room	Unclassified
Electrical Room	Unclassified
Emergency Storage Tank	Class 1 Zone 1

1.3 Lift station Design

1.3.1 Wet Well

The proposed wet well will be a rectangular concrete structure which receives sewage from a manhole via a 1000 mm diameter gravity sewer. The underground wet well will be accessible from grade via the Odour Control Room. A staircase from grade to the grating over top of the divided wet well will be provided for ease of operator access. There will also be ladder access to the bottom of the wet wells via hatches in the grating.

The incoming sewage enters the influent channel where the flow can be split and passed through grinders before discharging into the wet wells. Two (2) channel grinders, each rated at 5 HP, will be running in parallel. The grinders will grind a wide variety of solids into small pieces to achieve equipment protection for the lifting pumps. Each grinder is rated for the peak flowrate so the grinding can be maintained operational when one of the grinders is taken out of service. Isolation channel gates will be installed ahead of the grinders so that the equipment can be isolated.

The wet well is split into two cells, Wet Well #1 and Wet Well #2, which are hydraulically interconnected by an isolation gate (normally open) located at the bottom of the dividing wall.

The operating stems for the slide gates on the influent channel and the isolation gate valve on the separating wall, which divides the wet well into two cells, can be manually operated.

Four (4) DN250 suction pipes penetrate the side wall of the wet well and connect to the pumps in the pump room (dry pit). No other valves are installed within the wet well to minimize maintenance in the confined space.

A 1000mm gravity overflow is proposed to divert sewage to the emergency storage tank.

The wet well is to be equipped with ultrasonic transmitter and backup level switches. Pending final design details, the operating levels in the proposed wet well are to be set as follows:

- Overflow to EST: 306.50 m
- Gravity sewer invert EL.: 306.00 m
- High High water level (LSHH): 305.50 m
- P2 Start EL.: 305.00 m
- P1 Start EL.: 304.00 m
- P2 Stop EL.: 304.50 m
- P1 Stop EL.: 303.50 m
- Wet well bottom EL.: 302.00 m

The drawings P-001 and P-102 in Appendix B show the plan and section of the lift station, pumps, piping, and valves.

1.3.2 Pump Selection

Three (3) sewage pumps (2 duty and 1 standby) with associated 304SS piping, valving and instrumentations are installed in the pump room adjacent to the wet well. Each pump is rated at 81.5 L/s, which is 50% of the lift station's rated capacity, and operates at a total dynamic head (TDH) of 12 meters.

1.3.3 Pump Room

The pump room will house three (3) sewage pumps and associated piping and valving. As each pump is sized at 50% of the total rated capacity, only two (2) pumps are allowed to run at the same time; both discharging via a common forcemain. The dry pit configuration provides good access for staff and significantly improves health & safety. Maintenance personnel can easily diagnose a pump or valve issues during operation in the pumproom. The proposed pump room will house all associated valves with the lift station to provide a safer work environment for normal operating. In summary, the pump room comes with the following features:

- Accessible from grade by stair access down to the basement level
- A pressure gauge on each pump discharge pipe
- A swing flex check valve and a knife gate valve on each pump discharge pipe (200 mm diameter)
- An air release valve on the common discharge header
- A sump pit
- A flooding float switch

The drawings P-001 and P-102 in Appendix B shows the plan and section of the lift station, pumps, piping, and valves.

1.3.4 Flowmeter Room

The Flowmeter Room, located above the pump room, will provide a location to access flow meter. This area will be provided with a monorail and access hatches in the floor to facilitate pump removal from the floor below. There will also be an access hatch provided in the floor above to provide a route to remove equipment from the station. The following equipment will be installed on the DN250 discharge line common header in the flowmeter room:

- A pressure transmitter
- An air release valve
- A magnetic flowmeter

1.3.5 Grinder Room

The Grinder Room, located one floor above the wet well, will provide access to the grinders through access hatches in the floor. Additionally, the DN250 discharge common header will transition to a DN300 discharge common header within the grinder room. This header will then exit the lift station and connect to the receiving manhole.

1.3.6 Odour Control Room

An odour control system is proposed to be installed to mitigate the potential odours that could be generated in the wet well. Potentially long travel times in the collection system followed by turbulence as sewage cascades into wet wells or extended retention times in wet wells (i.e., low flows over night) produce the right conditions for the release of odourous gas.

Two viable means for the wet well odour control may be considered:

- Using passive odour control to eliminate odour discharged from the wetwell to the air, and
- Using chemical feed system to prevent H₂S released from wastewater in the wetwell.

A chemical feed system will use one of many different chemicals to either inhibit H₂S generation or eliminate the H₂S formed to mitigate the release of the odourous gas. However, a chemical feed system is more costly to install and operate than a passive odour control system and may be difficult to size due to lack of H₂S concentration monitoring data.

Therefore, it is recommended to use a passive odour control system in this project. A chemical feed system may be added later based on the H₂S monitoring data for the proposed lift station.

Among the passive odour control systems, Granular activated carbon (GAC) is a proven technology that has been used for over a century. GAC removes odour from the air stream via adsorption in which the molecules of odorous compounds come into contact with, and become bound to, the surface of a solid media. Carbon adsorption systems only require approximately 1/10th of the contact time as biofilters, significantly reducing the physical size of treatment units. Activated carbon has the highest removal efficiency of any odour control technology, capable of removing 99.9% of all incoming H₂S.

Passive GAC treatment would require minimal moving parts and does not require supplemental chemicals. Carbon media replacement may be expensive in terms of both fresh carbon cost and labour required for the replacement should higher loading be experienced during abnormal operating conditions. However, as the air changes under passive venting condition are not significant, carbon replacement costs should be within an acceptable range.

The odour control system will be located in the Odour Control Room. The design wet well ventilation rate is set at 162.7 L/s which is the same as the 100% of peak storm flow in the wet well sewer and deemed conservative.

A 200 mm vent line will be routed from the head space of the wet well to the odour control room to direct the foul air inlet of the odour control unit. The treated air then will be discharged to atmosphere through the roof.

The Odour Control Room will have hatches in the floor and a monorail mounted on the ceiling to facilitate lifting the grinders from the wet well.

1.4 Loading Room

The Loading Room has access doors at grade, a monorail mounted to the ceiling and an access hatch in the floor to facilitate movement of equipment.

1.5 Emergency Storage Tank Design

The proposed design includes for 1-hour storage based at peak flow within an off-line underground tank located on site. This tank is sized approximately at 587 m³ and to be located at the South side of the lift station. A 1000 mm diameter overflow pipe will run from the wet well of the lift station to the nearest receiving manhole and then into the tank. Drawing P-101 in Appendix B shows the plan and section view of the EST.

1.5.1 Tipping Buckets

Drawings P-101 and P-002 in Appendix B shows the tank layout with tipping buckets on the east side and return pumps on the west. The tank is divided into two (2) flushing ways, each 4.5 m wide. A 2% floor slope towards the collection trough would maintain wave velocity as the tank is flushed. The volume of water required for flushing is approximately 320 L/m of tank length, or approximately 1.3 m³ per bucket, per flush. The tipping bucket system is simple and relatively low in capital cost. Service water from the City will be used to fill the buckets and they can be refilled for multiple flushes if necessary. Costs associated with using potable water for flushing is not significant as the sewage storage tank will only be used a couple of times per year.

Each tipping bucket has been provided with an access shaft to allow the units to be removed for major maintenance. The access will be large enough to accommodate a tipping bucket assembly. Inside the tank a service platform that will span the entire width of tank to facilitate regular

maintenance of each bucket. These features improve accessibility for on-going maintenance and safer access for operations staff.

1.5.2 Return Pumps

The return lift station within the tank will have two (2) submersible pumps, 1-duty-1-standby, and associated piping for pumping back to the wet well once the flows return to normal operating conditions. Guiderails, lifting chain and equipment hatch with safety grating will be installed to allow for easy pump removal. The return pump will be rated for 21 L/s at 11m TDH. The capacity of the pump is based on ensuring that the returning of the emergency overflow will last about 8 hours and not result in a second overflow. The piping inside the tank will be Schedule 10 316SS within the structure, but transition to PVC piping underground between the structures. All piping supports, and anchors will be 316SS. The piping systems will also be provided with flushing connections and suitably located drains.

1.5.3 Emergency Tank Control

A flushing procedure will be initiated automatically when the return pump stops. Each tipping bucket uses one (1) solenoid valve to turn on/off the feed line based on the tipping position (monitored by two position switches) of the tipping bucket, once the flushing procedure is started.

The return pumps will be controlled by one (1) level transmitter and three (3) backup level switches inside the tank. In addition, the duty return pump could also be prevented to start if the level inside the SPS is too high.

1.6 List of Major Process Equipment

- Two (2) channel gates, located in the influent channel
- One (1) slide gate, mounted on the wet well dividing wall.
- Three (3) sewage pumps (2 duty, 1 standby), each rated at 81.5 at a TDH of 12 with a 600 v, 3-Phase, and 27 Hp motor;
- Two (2) immersible grinders (2 duty), each is rated for 200 L/s flowrate and has a 5HP motor;
- One (1) flowmeter will be installed in the sewage pumps discharge header;
- Two (2) submersible pumps, each rated at 21 L/s at a TDH of 11 m (1 duty, 1 standby) with a 600 v, 3-Phase, and 12 Hp motor;
- Two (2) 4.5 m long tipping buckets with DN40 solenoid valves for feeding;
- One (1) passive carbon odour control unit for exhaust treatment of the wetwell.

2 CIVIL DESIGN

This section describes the civil design for the proposed new lift station and the emergency storage tank.

2.1 Applicable Design Codes and Standards

- Occupational Health and Safety Act;
- Municipal by-laws and servicing standards – Region of Waterloo and Area Municipalities “Design Guidelines and Supplemental Specifications” (DGSSMS)
- MECP “Design Guidelines for Sewage Works”

2.2 Conceptual Site Plan

The proposed site plan for the East Side Lands lift station and storage tank is shown on figure at the junction of Fountain Street North and Jetliner Court.

This property is currently owned by the Region of Waterloo as a part of the Waterloo International Airport. The proposed location currently features the Chartright Air Group aircraft hanger, parking lot, security fence and utility lines.

This site location was preferred as it is Regional owned and adjacent to the proposed incoming gravity sewer flowing from Fountain Street N. This pipeline must be lifted to join in with the trunk sewer converging into the system just south of the proposed site along Otter Ct.

2.3 Erosion and Sediment Control

Prior to construction, adequate erosion and sediment control methods shall be implemented as per the requirements of the GRCA and Regional and provincial standards. The ultimate method for erosion and sediment control shall also be subject to the recommendations of the geotechnical investigation.

2.4 Municipal Water Connection

The source of the municipal water for the LS will be via a connection to the existing watermain along either Fountain Street or Jetliner Court, subject to confirmation during detailed design. It is suggested that a separate 50 mm water service be added for the LS, separate from the existing water service to the hangar. This approach would require approval from the Township, as part of the site plan approval and / or building permit.

The design of the preferred water service alternative would not provide for Fire Protection. Municipal fire hydrants exist on both Fountain Street and Jetliner Court.

2.5 Utility Services

Electrical, telecom and gas servicing will come from existing servicing infrastructure along Jetliner Court, being the same location that supplies the aircraft hanger building and the rest of the airport.

2.6 Municipal Stormwater Connection

Storm drainage and SWM for the site would be incorporated into the existing drainage design for the hangar property, discharging to the existing ditch system that connects to Randall Drain.

3 STRUCTURAL DESIGN

3.1 Overview

The project consists of the following structural scopes:

- Construction of a one-storey lift station with a deep basement; and
- Construction of an underground Storage Tank

3.2 Applicable Design Codes and Standards

The structural design of the lift station and storage tank shall conform to the latest editions of the following applicable standards and codes:

- Ontario Building Code;
- National Building Code;
- ACI 350 Code Requirements for Environmental Engineering Concrete Structures;
- ACI 350.3 Seismic Design of Liquid-Containing Concrete Structures and Commentary;
- CAN/CSA A 23.3 Design of Concrete Structures;
- CAN/CSA S16 Limit States Design of Steel Structures;
- CAN/CSA S304.1 Design of Masonry Structures;
- Ontario Health & Safety Regulations; and
- Local By-Laws.

Based on code classification, all proposed new structures fall under the post disaster category for structural design. Temporary items which belong to specialized trades such as precast members, dewatering, excavation shoring system and similar other items will be designed by corresponding trades and not by Associated Engineering.

3.3 Geotechnical and Hydrogeological Investigation

The geotechnical investigation for the proposed project is not available at the current stage. However, per historical geotechnical information collected as part of the EA study, soils are anticipated to consist of a native till deposit that was encountered at an average depth of 1.9 m and generally extended to the borehole termination depths of between 3.0 m and 18.8 m. The proposed structures will be likely founded on this native till deposit and the exact soil bearing capacity will be referred to new geotechnical investigations.

Ground water was observed typically between 1.2 m to 4.0 m below existing grades in the area. Due to the size of the lift station and storage tank, deep excavation and high groundwater, a watertight shoring system will be required and should be capable of supporting all lateral loads from surrounding soil, groundwater pressure, adjacent road embankment and surcharge load during construction. Several watertight deep shoring systems such as secant pile walls, steel sheet

pile walls and diaphragm walls could be used for the project. The final recommendations for the shoring system should be included in the geotechnical report.

As the groundwater table at the site is high, construction of any structures below the water table could require significant dewatering efforts. The dewatering system will typically consist of a series of well points, wells and/or educator system and will be designed and implemented by a specialized dewatering subcontractor to be retained by the Contractor. Any specific requirements and constraints will be addressed in new geotechnical and hydrogeological investigation reports.

3.4 Climate and Seismic Data At the Current Site

The proposed site is located close to City of Kitchener. Based on the Ontario Building Code 2024, the following climate data for the City of Kitchener can be used for the design:

1. Hourly Wind Pressure: 0.29 kPa for 1 in 10 years and 0.37 kPa for 1 in 50 years.
2. Snow Load on Ground: $S_s = 2.0$ kPa and $S_r = 0.4$ kPa

As the geotechnical investigation for the proposed site is not available at the current stage, for the EA study purpose, the following seismic data from OBC 2012 will be referenced for the structural conceptual design. The final seismic data as per OBC 2024 shall be used once the geotechnical investigation is completed and the site classification is identified.

The 5% damped horizontal spectral acceleration values for 0.2, 0.5, 1.0, 2.0, 5.0 and 10.0 second periods are as follows respectively:

$$S_a(0.2) = 0.122$$

$$S_a(0.5) = 0.077$$

$$S_a(1.0) = 0.045$$

$$S_a(2.0) = 0.023$$

$$S_a(5.0) = 0.0056$$

$$S_a(10.0) = 0.0024$$

The horizontal peak ground acceleration with a 2% probability of being exceeded in 50 years:

$$PGA = 0.074$$

The horizontal peak ground velocity with a 2% probability of being exceeded in 50 years:

$$PGV = 0.060$$

3.5 Storage Tank

The proposed Storage Tank has an internal dimension of approximately 22m x 10m with a depth varying from 5m at the east side and 8m at the west side. The tank consists of 2 flush ways and will be divided into 2 cells with center separation columns. Two tipping buckets are installed at the

east side within a concrete tipping bucket chamber extending to finished grades. A concrete maintenance mezzanine is provided below the roof slab to facilitate maintenance of the tipping buckets in place. Stairs are provided on the north side of the tank for access from the maintenance mezzanine level. The storage tank will be designed to withstand any load combinations under normal service conditions, post disaster events and liquid sloshing effects as per ACI 350M-20, ACI 350.3-20 and OBC. In addition, the tank will be designed to resist the extreme uplift force from groundwater condition.

3.6 Lift Station

An approximately 10m by 8m lift station is proposed at the west side of the Storage Tank, consisting of a one storey superstructure above grade and a deep basement below grade. In the basement, there is a wet well and a pump room separated by a concrete wall. In the wet well, two levels of FRP mezzanines will be provided to assist with access and operation. In the pump room, one level of concrete mezzanine will be provided to house pipes and flowmeters.

The main floor of the building will house multiple service rooms including a Loading Room, Mechanical Room, Electrical Room and Odour Control Room.

A cavity exterior wall will be proposed to support a roof system that will consist of architectural sloped metal roof supported on 250mm thick hollow-core structural slabs.

One enclosed staircase will be provided in the pump room from the main floor to the basement. However, in the wet well an open staircase will be provided from the main floor to the grating on top of the divided wet well. In addition, another ladder will be in place to access the bottom of the wet well from the main floor.

Multiple equipment hatches will be provided at the main floor in both pump room and wet well to facilitate installation and maintenance of equipment. The hatches should be fireproofed and all gaps around the hatches should be sealed gastight to comply with fire classification requirements.

Electrical overhead monorails can be provided in any service rooms in order to lift equipment from the basement to the main floor.

3.7 Materials For Construction

In order to withstand the harsh environment and extend the service life in the Storage Tank and wetwell in the lift station, the following material will be proposed to be used for construction:

All stairs, ladders and platforms and handrails within the storage tank and wetwell in lift station will be made of H₂S resistant Fiberglass Reinforced Plastic (FRP);

All concrete will be low shrinkage concrete and have a minimum specified compressive strength of 35 MPa with a class C-1 of concrete exposure for wastewater application as per CSA A23.1;

All steel reinforcement will be deformed bars conforming to CSA G30.18 with a minimum yield strength of 400w MPa.

All structural steel will be grade 350W steel conforming to CSA G40.20/21 with a minimum yield strength of 350 MPa.

The monorail system due to the proposed location, will need to be provided with materials suitable for a corrosive environment and non-sparking due to the potential for explosive gases.

4 BUILDING MECHANICAL DESIGN

The following sections break down the applicable codes and design standards as well as the proposed HVAC and plumbing design concepts for different areas of the Woolwich Sanitary Lift station.

4.1 Applicable Design Codes and Standards

Building mechanical systems for the new lift station will be designed to conform to the latest revisions of the following standards, codes, and regulations:

- Ontario Building Code (OBC);
- ASHRAE 62.1 - Ventilation for Acceptable Indoor Air Quality;
- NFPA 820 – Standard for Fire Protection in Wastewater Treatment and Collection Facilities;
- Ontario Health & Safety Regulations (Green Book);
- Air Movement and Control Association (AMCA);
- Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) Standards; and
- Regional & Local By-Laws.

4.2 Heating & Ventilation

There are two ventilation approaches that could be implemented for process areas. The first option would be to design and size the ventilation system to declassify the areas that are designated as classified areas. The second option would be to provide ventilation on demand in classified areas. Since this building will not be a permanently attended facility, a ventilation on demand approach will be the design base for HVAC systems. Under this scenario, lower ventilation rates will be provided for process areas and consequently the operating costs for these systems will be reduced. The area classification for locations with ventilation on demand will stay the same. The on-demand ventilation systems usually only need to be operated when:

- Staff enter the classified areas or;
- Combustible gas has been detected.

Potentially, the new ventilation systems could be designed to be activated remotely by operators via SCADA system prior to any scheduled site inspection, maintenance or as needed. This will rather ensure that the station will be pre-ventilated for the staff during their site attendance while working in the process areas.

Requirements of NFPA 820 chapter 7 must be followed in the design of ventilation and alarm monitoring systems within the drywell area, loading room and odour control room. Combustible Gas Detectors (CGD) shall be installed as per NFPA 820 for classified areas. All the CGDs and signaling systems shall be provided with auxiliary power supply to ensure continuous operation

during any failure of the normal power supply. In addition, the CGD sensors shall be interlocked with ventilation systems to activate the fans upon combustible gas detection.

All HVAC components, including fans, dampers, and duct heaters, should be rated and certified for installation in classified areas. Fans and dampers shall also comply with AMCA Grade A standards. The odour control room is assumed as Class 1 Division 1 and will be provided with an exhaust fan and intake air damper. The intent of this ventilation assembly is not to declassify the room, therefore, this room stays as Class 1 Division 1. This area will not be provided with a supply fan system to ensure that possible odours will not transfer from this room to adjacent areas. The ventilation system can be activated by operators manually when they enter the room and also by CGD installed within the room in case combustible gas is detected. Heating for this room will be provided via a classified electric unit heater, sized based on room heating load and controlled by a wall mounted room thermostat.

The below grade pump room and the flowmeter room will be furnished with one supply and one exhaust fan for on demand ventilation, operating at minimum of 3 air changes per hour (ACH). Supply and exhaust ducts will be extended to serve both rooms at the same time. Based on NFPA 820 standard, Row 17, Line a, in order to declassify the drywell area, 6 ACH on a continuous basis will be required. Since the recommended flow rate for the new ventilation system will be lower than this amount, the pump room and flowmeter room will stay Class 1 Division 2.

The supply fan for the pump room and flowmeter room shall deliver outside air (O/A) upon operation in two different levels/ floors of the areas. In order to create a negative pressure area, the exhaust fan will be sized to exhaust approximately 10% more flow compared to the supply fan. These two fans must be always operating together. To provide an efficient distribution in each room, two separate ducts, supply and exhaust, will be installed and connected to the fans with dedicated grilles or diffusers mounted on the ducts for each level. Grilles for the exhaust system will be mounted close to the ceiling in each floor while supply registers will be mounted at 1.5 to 1.8 m above finished floors to supply the fresh air into the breathing zone. This will help to create a relatively efficient air distribution across each room.

An electric duct heater rated for Class 1 Division 2 area will be mounted on the supply duct in order to provide tempered air during winter season. To modulate the supply air temperature, the heater will be equipped with a SCR control module that control and modulate the heater output based on the supply air temperature's setpoint.

Two electric unit heaters rated for Class 1 Division 2 installation will be also installed at the flowmeter room and pump room of the drywell area. These unit heaters will be sized to compensate building heat losses and will be controlled by their dedicated wall mounted room thermostats.

The loading room is also assumed as Class 1 Division 2 and will be provided with an assembly of an exhaust fan and an intake air damper. Since the loading room is a small unoccupied area that will not house any critical equipment, no heating device will be provided in this area. This is mostly due to the size of such heating equipment as it won't be possible to properly specify a heating equipment in lower sizes that are rated for operation in such a classified area. The ventilation system can be either operated manually by operators via entrance to the room or automatically by the CGD system. The exhaust fan and intake air damper assembly upon activation can provide up to 6 ACH to the room. It's important to note that no plumbing services should be provided within this room to avoid freezing risk.

The ventilation system for the Electrical Room will be designed to provide a positive pressure inside the room by discharging filtered outside air into the room continuously. This approach will prevent the potential accumulation of corrosive gases inside the Electrical Room from adjacent rooms. In order to provide tempered air during wintertime to the room, an electric duct heater will be installed downstream of the supply fan. This heater will be equipped with SCR control module which control and modulate the heater based on the supply air temperature's setpoint. The first stage of heating inside the electrical room will be provided via heat dissipation from the electrical equipment within the room. However, to supplement the room during cold days, an electric unit heater and associated wall mounted room thermostat should be provided as well. Cooling for the electrical room will be provided via refrigerant based cooling system. This variable refrigerant flow (VRF) system will also be capable to provide some level of dehumidification inside the room during summer season should the humidity levels of the incoming air be above normal.

The mechanical room will be provided with a standard Intake/ Exhaust system that can be operated either manually (on demand) or automatically when there is call for cooling from the room thermostat during summer months. Similar to the other rooms, heating for this room will be provided by an electric unit heater sized based on room heating load and controlled by a wall mounted room thermostat.

Heating system for all the areas shall be designed to maintain at least 18°C indoor temperature for when these areas are occupied to conform to the requirements of the Green Book – Ontario Occupational Health and Safety Act & Regulations.

4.3 Plumbing

A DN80 (3") new potable water connection will be installed to provide potable water from the watermain to the new lift station. A building isolating valve and flow meter will be installed inside the mechanical room on the ground level. Two reduced pressure backflow preventers (BFP) will be provided on this line, both located in the mechanical room. One BFP and pressure reducing valve (PRV) will be upstream of a new DN25 (1") building service water line to protect the water source from backflow and back pressure. The other reduced pressure type BFP and a pressure reducer valve (PRV) will be upstream of the DN50 (2") line that will feed the process water network as

shown in the P&ID (DWG P-001) for flushing the Tipping Buckets as well as supply any potential hose bibb(s) inside the drywell.

The new DN25 (1") connection, protected by a BFP and connected to the new DN80 incoming water line will supply water to the building services including any potential hand washing sink, and water heater. One DN20 (3/4") hose bib will be provided inside the mechanical room and a frost proof self draining wall hydrant (DN15 x DN20) will be installed outside of the odour control room to service the parking area.

A DN100 (4") dedicated sanitary building drain system will be provided on the ground floor to service any potential sink and floor drains in the mechanical room, and odour control room. This sanitary building drain will be provided with a DN80 (3") vent as per OBC requirements. At least one (1) and maximum of two (2) DN80 (3") floor drains will be provided inside the mechanical room, to serve the water heater and the DN25 BFP. These floor drains will be connected to the sanitary building drain system. Another DN80 (3") floor drain will be provided inside the odour control room. All floor drains within classified areas will be equipped with PROSET Trap Guards.

A DN80 (3") floor drain equipped with Sure seal trap guard will be installed inside the flowmeter room to collect the water discharged from the BFP and any potential hose bibb. Another floor drain will be added to the pump room. A sump system will be provided inside the pump room to collect any water discharged to the flowmeter room and pump room's floor drains and pump it to the sanitary sewer main outside of the building. This sump will be furnished with a gas tight hatch and a DN80 (3") vent which will be terminated outside of the building as per Ontario Building Code (OBC) requirements. The discharge pipe for the sump pump will be directed to the outside of the lift station and will be connected to the sanitary building drain prior to connection to the sanitary main. In order to avoid back water in the building as a result of sump pump discharge into the sanitary building drain, a normally open backwater valve will be installed upstream of the sump pump connection to the sanitary building drain. This valve will protect the ground floor sanitary system from backflow.

4.4 Fire Extinguisher

Class ABC fire extinguishers will be provided inside the mechanical room, and pump room. A class C fire extinguisher will be provided inside the electric room. These fire extinguishers will be mounted at the room entrances and shall be provided with proper signage.

5 ELECTRICAL

The following section outlines the proposed scope required for the electrical system.

5.1 Applicable Design Codes and Standards

The design of the lift station will be completed in accordance with the most recent versions of the following standards:

- Canadian Electrical Code (CSA C22)
- Occupational Health and Safety Act
- Ontario Building Code
- National Energy Code
- The Region of Waterloo Standards

5.2 Electrical System

The sewage lift station electrical system is defined as a 600A, 600V, 3 phase, 4 wire, 60Hz system.

1. The electrical system consists of the followings:

- Utility Meter
- 600V, 600A, 3PH, 4W, 42kA NEMA 12, indoor, MCC c/w all breakers, ATS, motor starters and Soft Starters
- Customer power meter
- 75kVA, 600V/208-120V transformer and panelboard feeds the lighting, small power components and other auxiliaries.
- 200kW Standby Diesel Generator c/w attenuator enclosure
- Grounding system

A surge protection device (Transient Voltage Surge Suppressor type) will be provided for the incoming power and MCC.

All electrical equipment, process and mechanical equipment, and exposed structural steel shall be grounded and bonded in accordance with OESC & ESA standards and requirements.

5.3 Hydro Power Supply

Coordination with the power supply provider shall be made to define the exact voltage level that can be provided and identify potential locations for tapping points. Upon defining the available voltage level, the requirements for the incoming power transformer shall be made.

5.4 Design Criteria

It has been determined that using an MCC is much cheaper, easier, and efficient than a main 600V distribution panel. The number of loads and required drives make the size of a distribution panel quite large. Furthermore, the MCC will provide compartmented units that identifies each load and its subsequent components. With such loads, the MCC will be more reliable for providing short circuit capabilities and safe operation.

The MCC along with other equipment like the lighting transformer and other distribution panels shall be installed in the electrical room. The electrical room is well secured and isolated from other areas hence it is unclassified. Therefore, all equipment within the electrical room shall be NEMA 12 rated.

5.5 Electrical Loads

The electrical loads proposed are listed below in Table 2

Table 2- Electrical Loads

Process	Equipment	Voltage (V)	Size (HP)	Type of Starter
1	Sewage Pump #1	600	27	S.S
	Sewage Pump #2	600	27	S.S
	Sewage Pump #3 (Standby)	600	27	S.S
	Grinder #1		5	DOL
	Grinder #2		5	DOL
	Return Pump #1	600	12	DOL
	Return Pump #2 (Standby)	600	12	DOL
	Sump Pumps System (1 Duty / 1 Standby)	600	TBD	DOL
	Distribution Transformer (600/208-120V)	600	75(kVA)	DOL
	HVAC System (Fans, Heaters...etc.)	600	TBD	DOL
	Monorail	600	TBD	DOL

S.S.=soft start, TBD= to be determined, DOL = direct on line

An approximation of certain loads has been made to estimate the total power requirements. The building size, arrangement, equipment and similar projects have been used as a baseline to estimate the undefined loads. Further load calculation and precise power requirements shall be performed upon defining all required loads during upcoming design stages.

5.6 Sewage Pumps Power and Control

There will be three sewage pumps system will be based on two (2) duty and one (1) standby configuration. Each sewage pump is 27HP, 600V, 3PH, Soft Starter driven. Each Soft Starter shall be installed inside individual compartments within the MCC, inside the electrical room. A local control panel shall be provided next to each pump to provide local operation, testing and easy maintenance.

The sewage pumps control shall provide the operator the chance to remotely start, stop and switch over between pumps via the SCADA system.

The sewage pumps control system shall also be maintaining the equal operation hours of all pumps via time control function.

5.7 Other Equipment Power and Control

There are two continuously operational grinders, each is 5HP, 600V, 3PH and two return pumps, each is 12HP, 600V, 3PH. The return pumps are configured based on one (1) duty and one (1) standby basis. Grinders and return pumps are Direct On-Line loads and no drives are required for starting or speed control however, a local control panel shall be provided next to each one for local operation.

Similarly, the sump pumps are Direct On-Line loads, and a local control panel shall be provided.

Local isolation method such as a disconnect switch shall be provided for each equipment within its local control panel.

A 75kVA, 600/208-120V distribution transformer is proposed to provide power for lighting, small power components and other 120V loads. The transformer and other small power panels will be installed inside the electrical room.

The Master Single Line Diagram provides further information with regards to all proposed loads. Refer to Appendix B.

5.8 Lighting

Highly efficient, LED lighting fixtures shall be provided to provide sufficient illumination in each room. The wet well and storage tank shall not have lighting fixtures and portable lighting shall be provided during inspection and maintenance (if required).

Exterior lights shall be provided for safety and security measures.

As this lift station is proposed to be fully automated and unmanned, a lighting control such as motion sensors and photocells shall be provided to assist in energy reduction.

5.9 Fire Alarm System

An fire alarm system shall be provided in accordance with OBC. Detectors shall be tied to SCADA.

5.10 Emergency Standby Power

In order to avoid overflow and control loss during any unexpected power failure, a standby diesel powered generator will be installed as part of this project. The generator will be 200kW rated. The generator is sized to power two (2) sewage pumps, two (2) Grinders, one (1) return pump, HVAC loads, one (1) sump pump and the essential loads fed by the distribution transformer.

The generator has been sized according to estimated. Precise sizing to be performed when other load are clarified during next design stages.

The generator will be pad-mounted outdoors, with sound attenuating enclosure and integral diesel storage. A breaker will be provided for a load bank connection at the generator for testing purposes.

5.11 Equipment in Hazardous Areas

Electrical installations within classified areas will be minimized to mitigate risks and reduce costs. However, explosion proof rated materials shall be installed within classified areas as required.

1.6.12 Electrical Power Study

A preliminary Electrical System Power Study (using ETAP) shall be performed during the 90% - 100% design stage to ensure that the electrical power distribution system designed operates in a safe and reliable manner under both normal and fault conditions

Upon the completion of equipment production / installation, a full, complete, and detailed power study shall be performed and power study report to be issued. The relays settings shall be programmed accordingly, and Arc Flash labels provided for each equipment.

6 INSTRUMENTATION & CONTROL DESIGN

The following section outlines the proposed scope required for the instrumentation and controls components.

6.1 Applicable Design Codes and Standards

- The Region of Waterloo SCADA Standards
- Ontario Electrical Safety Code
- Occupational Health and Safety Act

6.2 Design Criteria

The East Lands SPS will be equipped with an Allen Bradley CompactLogix PLC. A 10" Emerson Quick Panel View OIT / HMI. The OIT is intended to provide a quick general overview of station conditions. The control panel will be within the PLC control panel, separate from the MCC. Conduits will be provided between the lighting panel, PLC control panel and instruments to provide power and I/O signals to the control panel.

The PLC control panel is to be NEMA 12 rated for indoor installation inside the electrical room. Provision for communication with other facilities via Cat6 cable will be provided.

The above-mentioned PLC control panel will have an Allen-Bradley CompactLogix series controller. The control panel will have enough I/O cards to allow for a minimum of 20% spare I/O points and spare parts. The PLC will be used to control & monitor the status of the station.

6.3 Level Transmitters

An Ultrasonic Level Transmitter will be provided for each cell of the wetwell to measure the fluid level inside the cells and control the sewage pumps operation accordingly (start, stop, one pump runs, or two pumps run). The sensor will be installed inside the wetwell while the transmitter will be inside the PLC control panel. Installation of a level transmitter inside the drywell might also be considered.

Similarly, An Ultrasonic Level Transmitter shall be provided in the storage tank to monitor the sewage level and control the return pumps operations accordingly.

6.4 Level Switches

A set of mechanical level switches shall be provided inside each cell of the wet well to back up the level transmitters. The level switches shall control the Low-Low level for pumps dry-run protection and High-High levels for alarming.

Similarly, A set of mechanical Level Switches shall be provided for the storage tank to back up its level transmitter, protect pumps from dry run scenario, and alarm the system for High-High events.

6.5 Flow Meter

The main discharge line shall be equipped with a flowmeter to measure the flow from the lift station. The flowmeter will be installed inside the flowmeter room. Additionally, a pressure transmitter shall be provided to the main discharge to monitor the line pressure accordingly.

6.6 Access Hatch Switch

To maintain the plant areas sealed and not to compromise the hazardous area classifications, a security sensor shall be provided to each access hatch which will alarm the operation when unwanted hatch open events take place.

6.7 Security System

A security system shall be provided to the lift station access doors to warn operations when an unwanted breach takes place. The security system control panel shall be installed in the electrical room next to the main entrance.

7 CONSTRUCTABILITY & TIMELINE

Construction of the lift station will need to address key constraints associated with the preferred site location. Specifically, confirmation of an updated lease agreement between the Region and its current tenant on the site to permit the construction of the lift station will be required. Should a suitable agreement update not be feasible, the Township can pursue utilizing the second choice (Alternative Site #3) for this Lift Station.

Timing for construction of the lift station is projected to occur within the 5-10 year timeframe and will be dependent on the demand associated with upstream development and related capacity constraints at the Victoria Street Pumping Station. Specifically, the Mad-West Subdivision and/or the proposed GO Station. These developments will require the sewers upstream / north of Jetliner Court along Fountain Street and Woolwich Street to be operational.

APPENDIX A - STUDY AREA

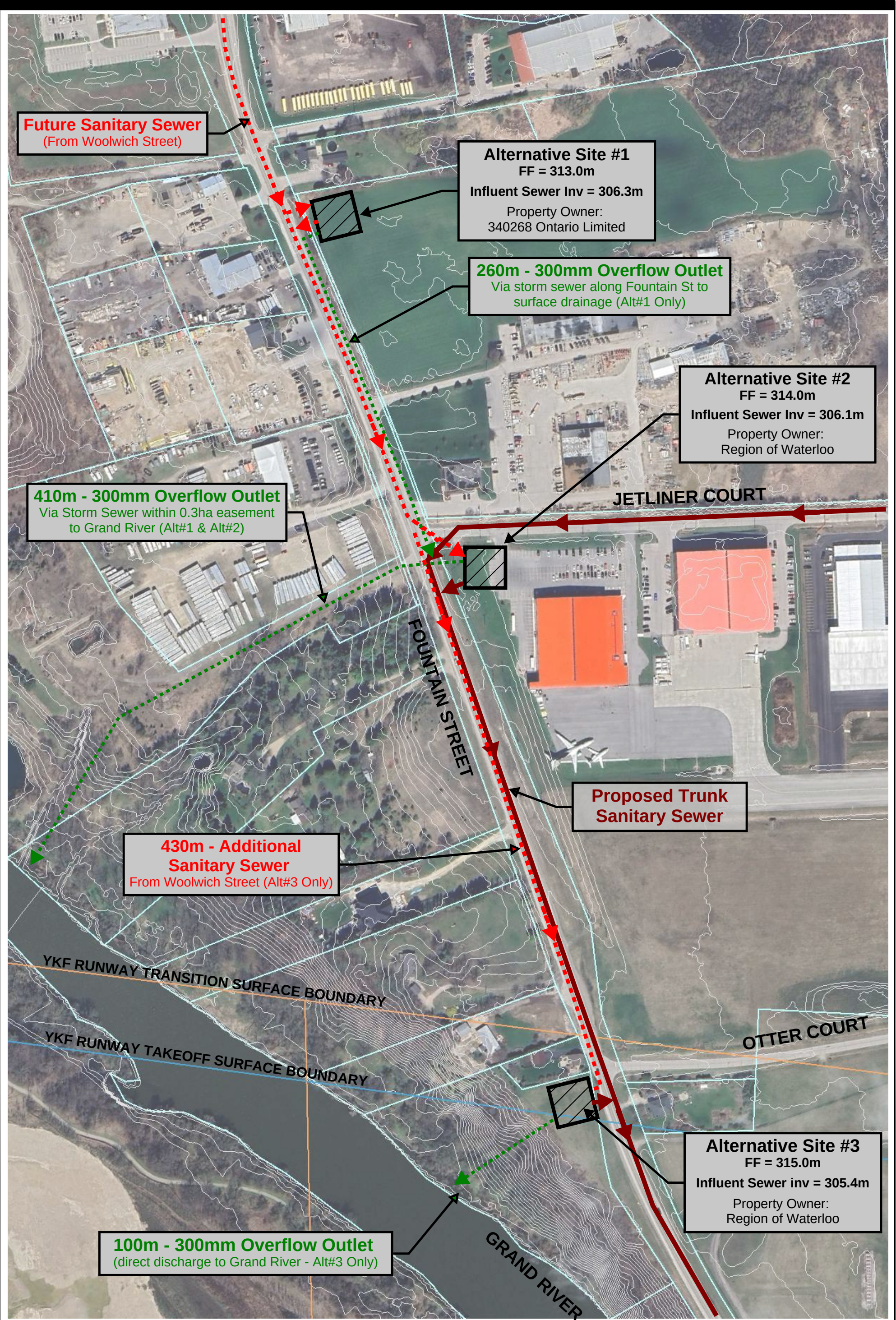
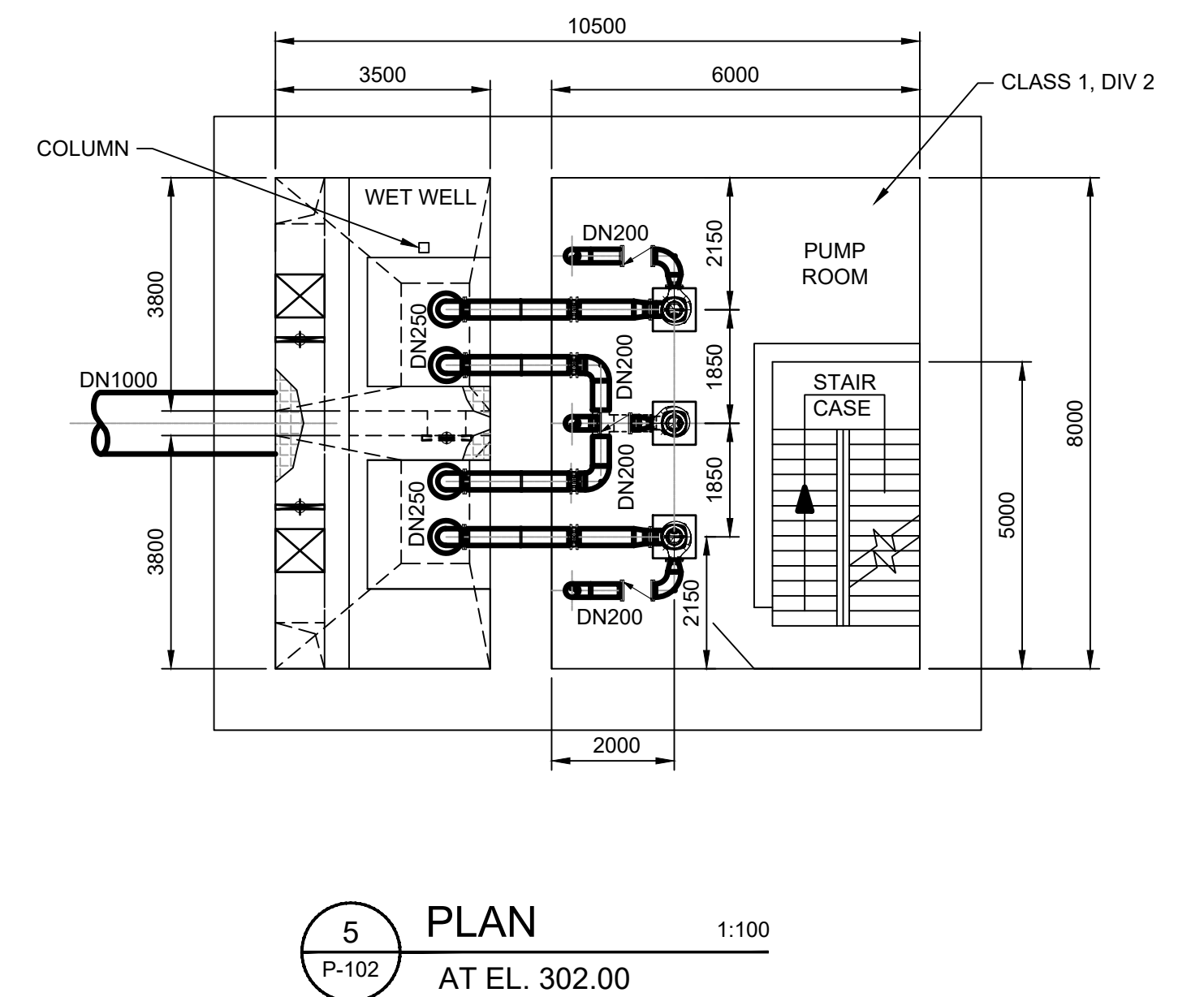
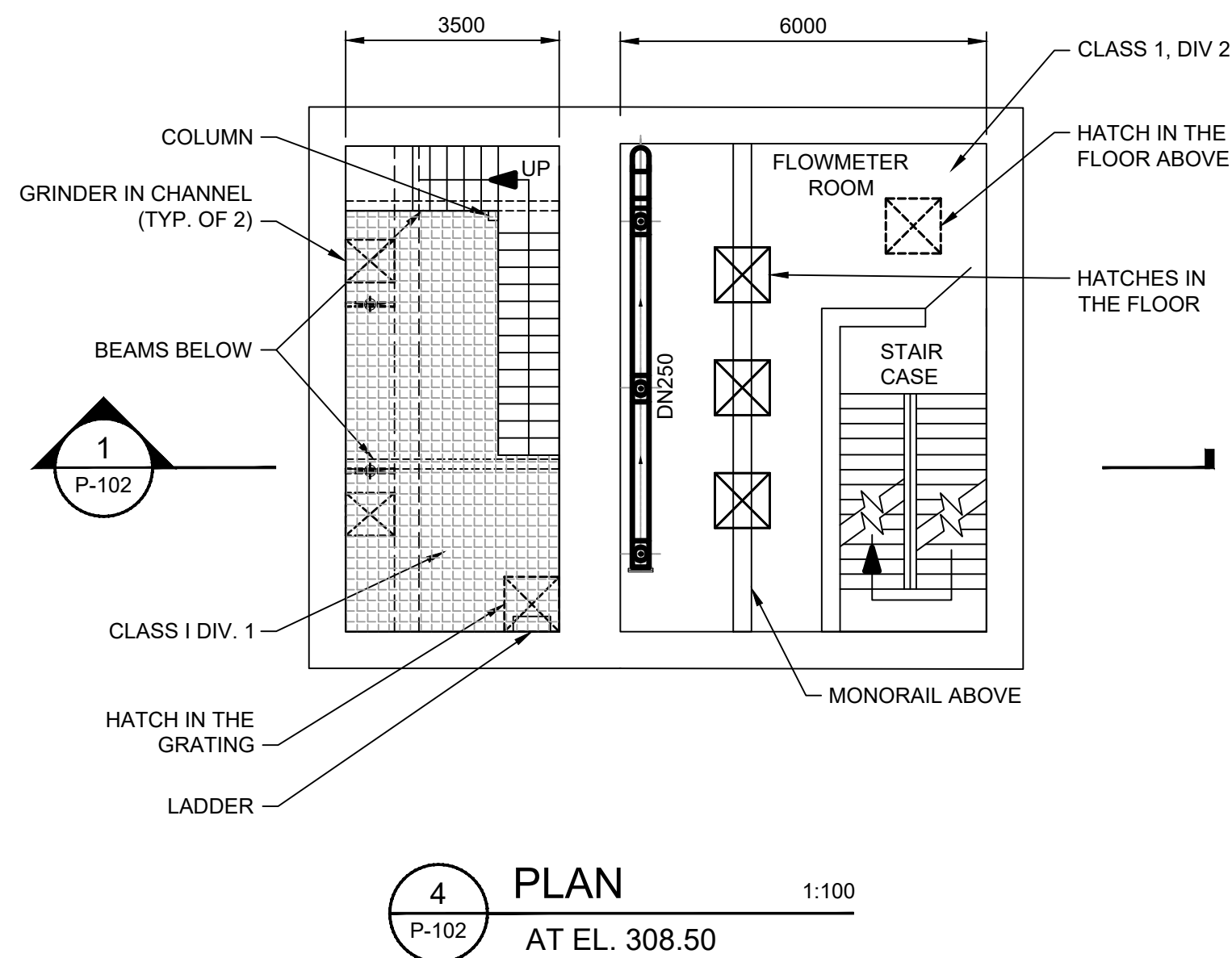
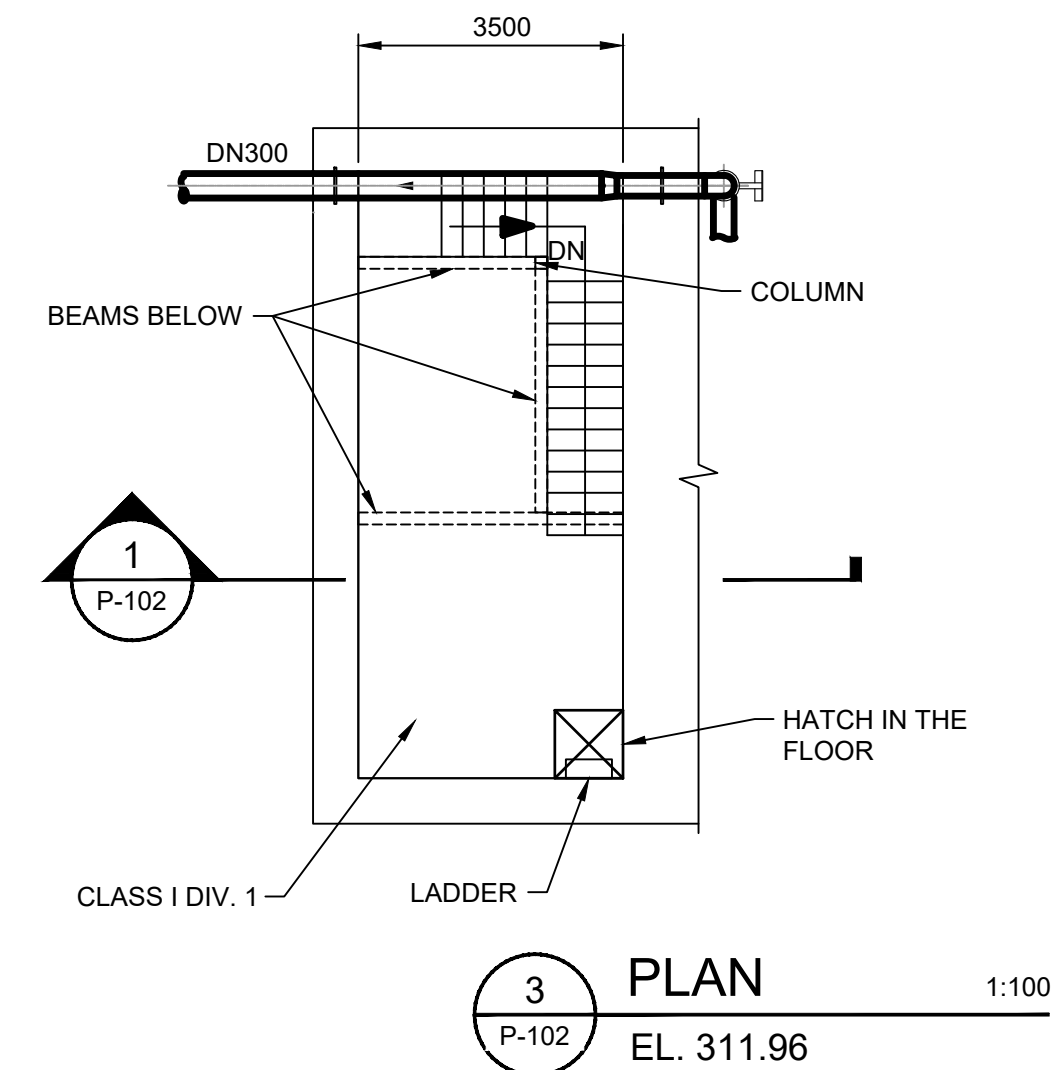
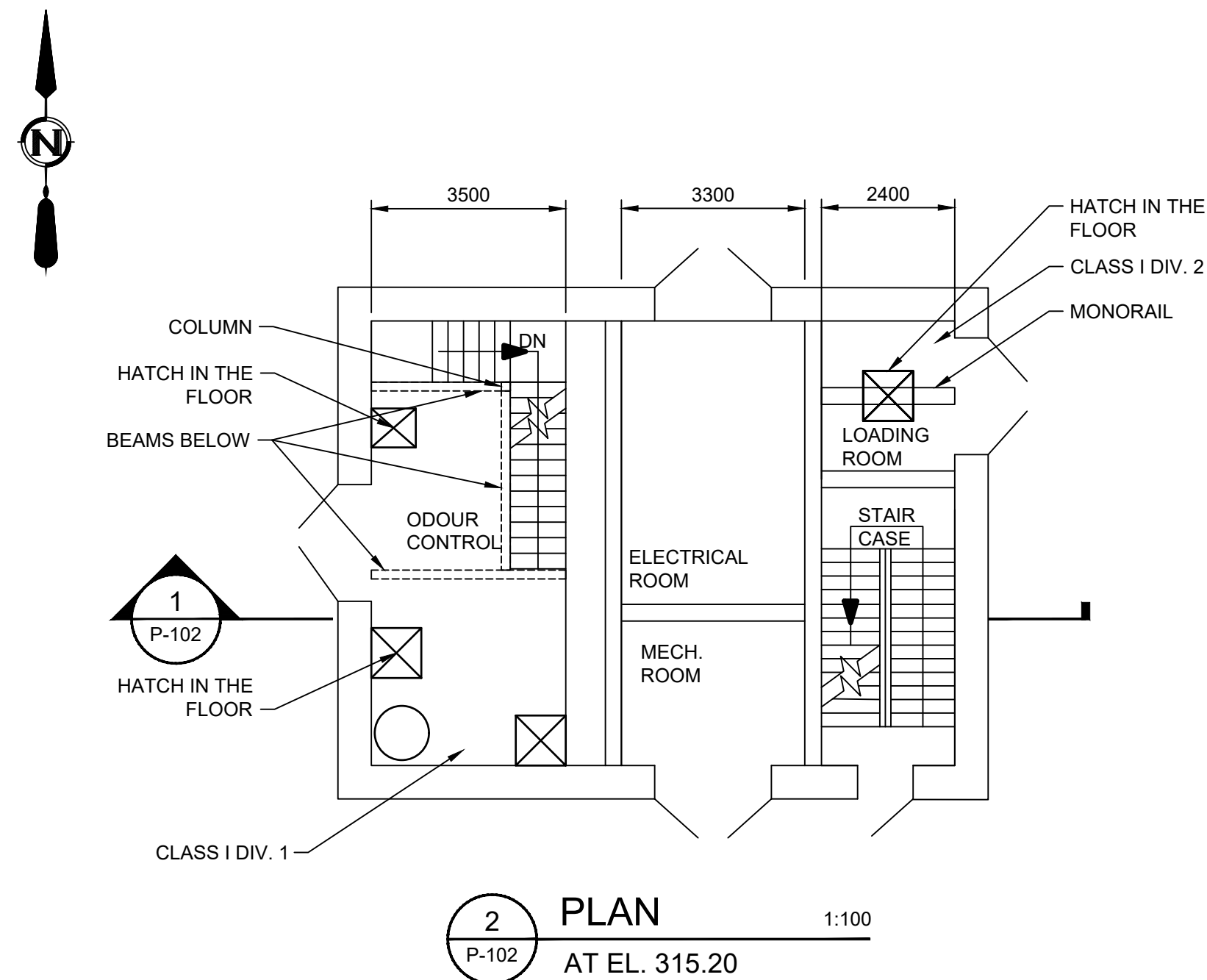
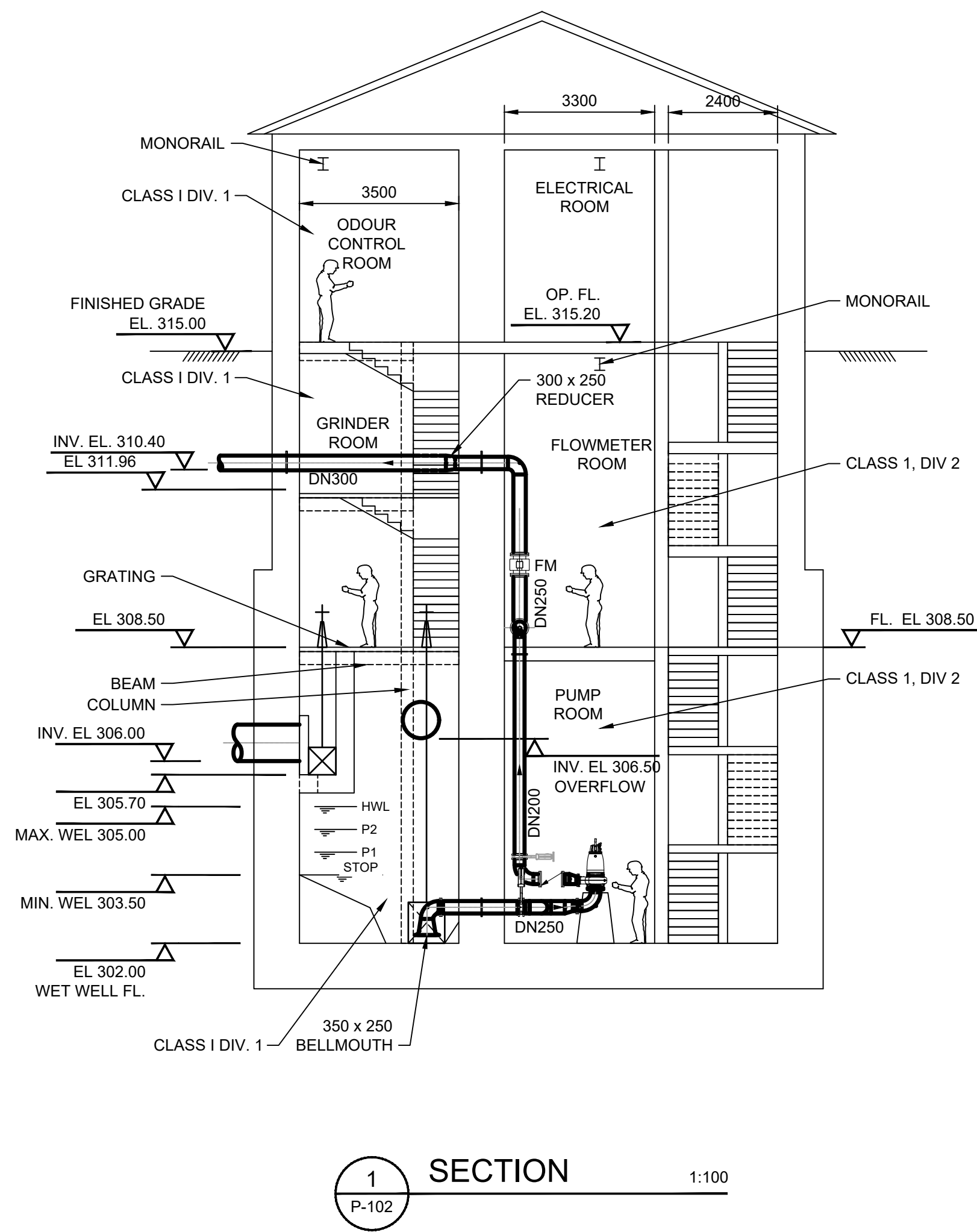
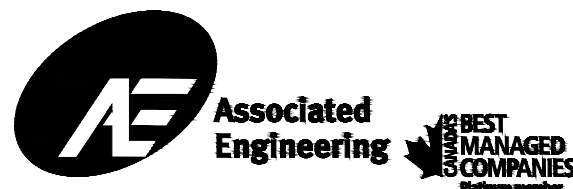


FIGURE X-X
East Side Lands Sanitary Servicing EA
Alternative Lift Station Sites

APPENDIX B – PUMPING (LIFT STATION) DRAWINGS



NOTES:
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No.	ISSUE/REVISION	BY	DATE		

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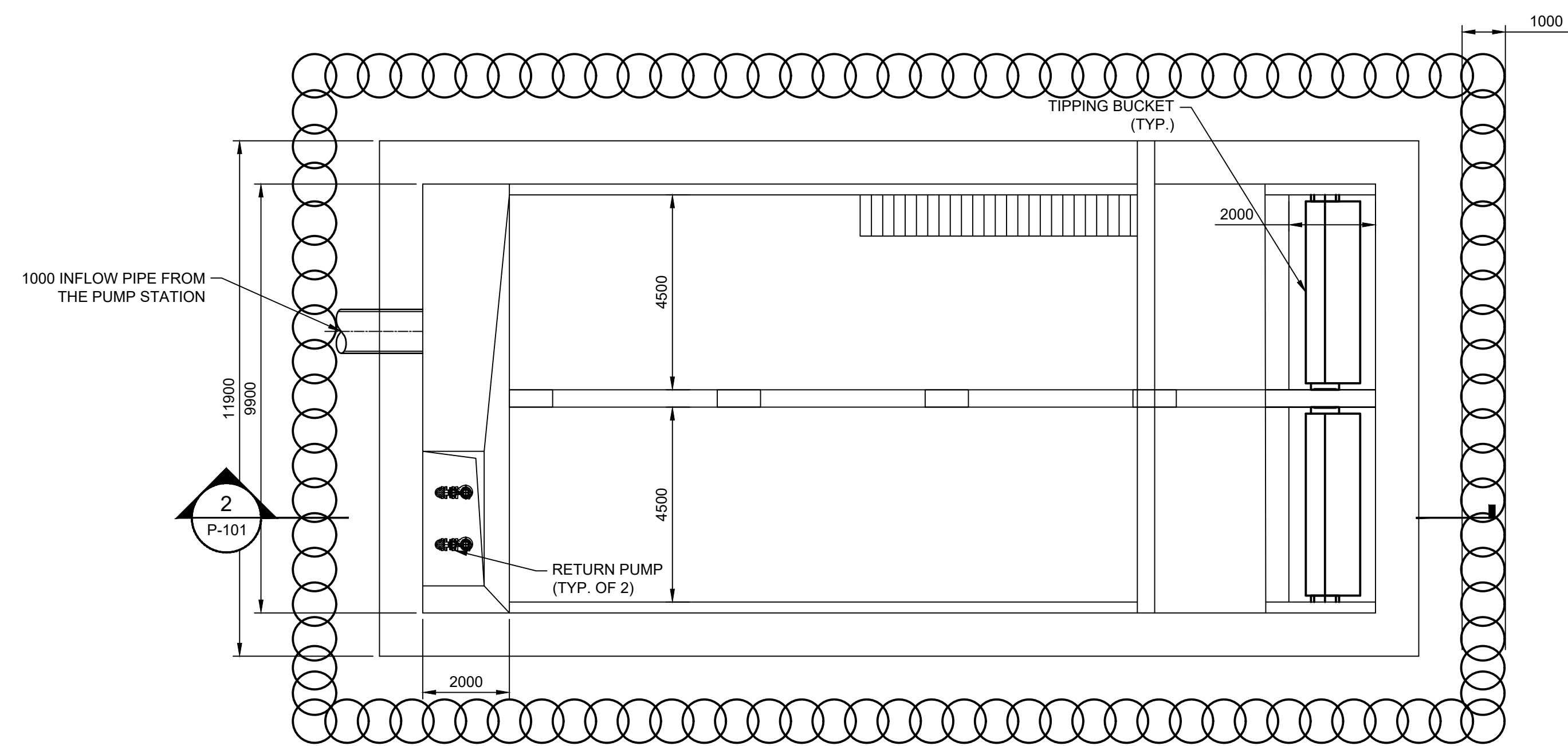


EAST SIDE LANDS - WOOLWICH SANITARY
SERVICING MUNICIPAL CLASS ENVIRONMENTAL
REGION OF WATERLOO

PROCESS
PUMPING STATION
PLANS AND SECTION

DRAWN BY: W.Z.	CHECKED BY: K.Y.	CONTRACT No. T2024-XXX	DRAWING No. P-102
SCALE 1:100	DATE: MM/YYYY	FILE No. 2023-5737	SHEET No. # OF ##

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TEMPORARY SHORING SYSTEM

FLOOR BOX

CL. EL. 307.90

INV. EL. 305.90

B/O SUMP EL. 299.50

TIPPING BUCKET

EL. 302.08

END OF SLOPE

SLOPE = 2%

EL. 302.61

GRADE EL. 315.00

TEMPORARY SHORING SYSTEM

SECTION 2

P-101

1:100



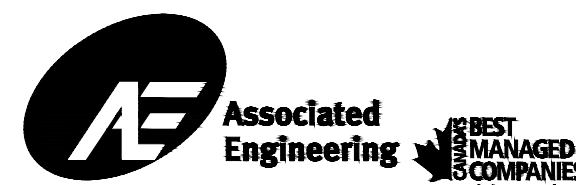
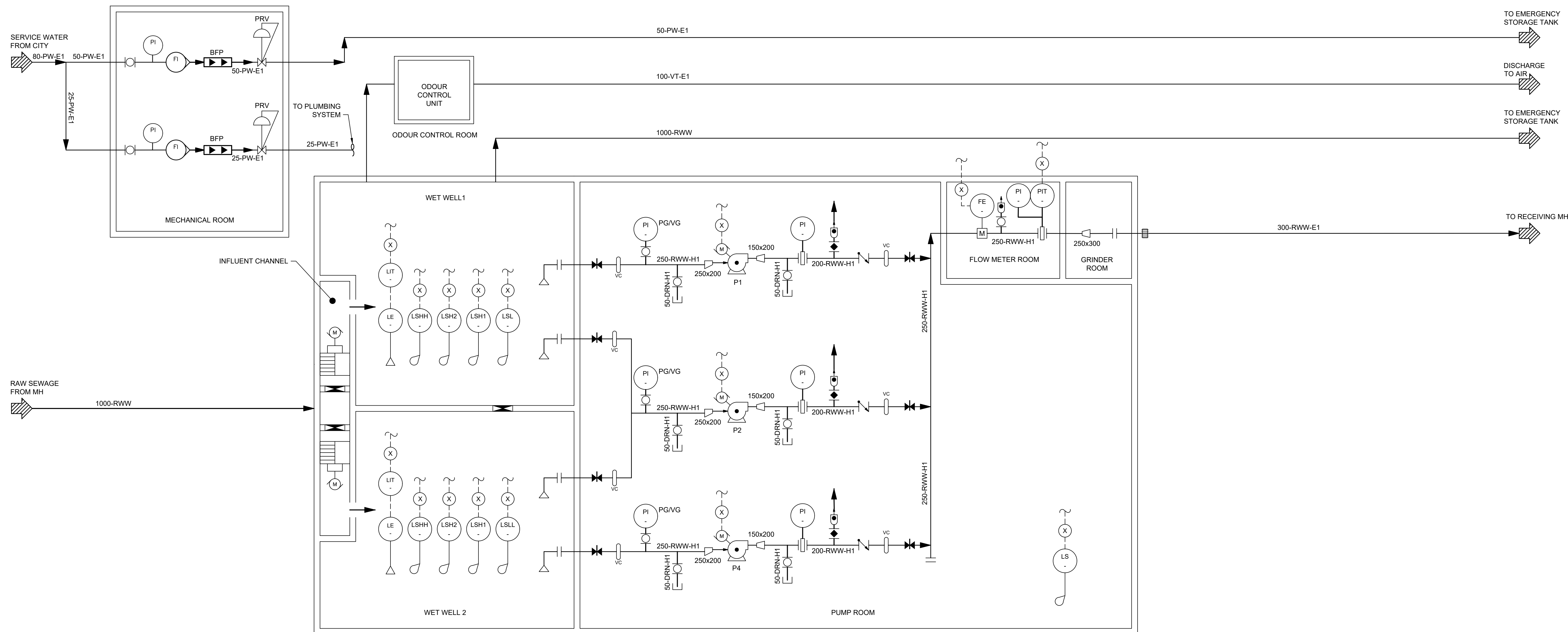
PROCESS
EMERGENCY STORAGE TANKS
PLAN AND SECTION

DRAWING No.

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SHEET No.	

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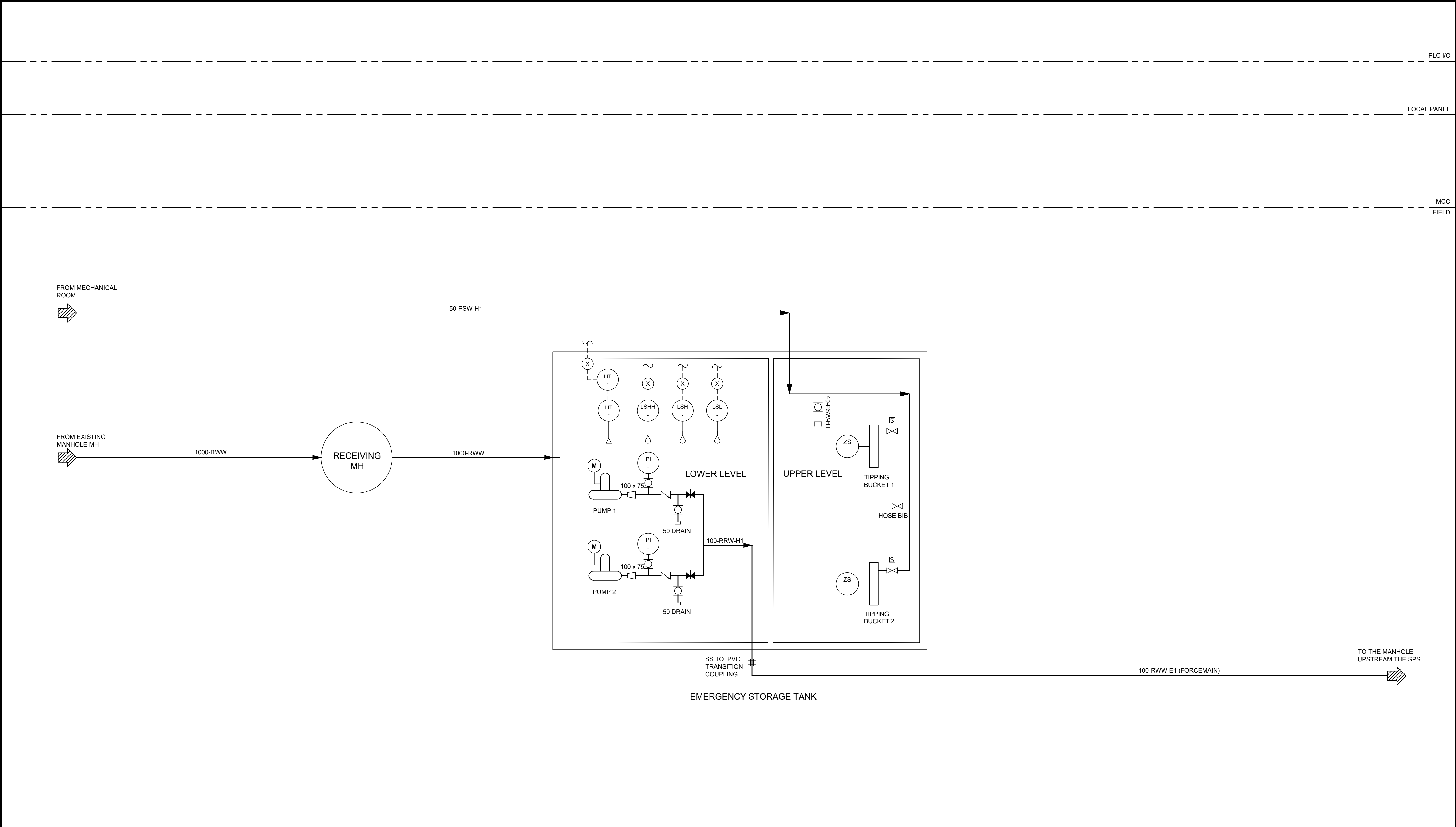
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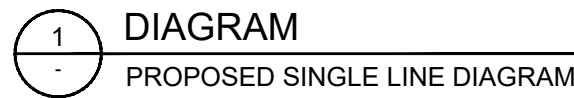
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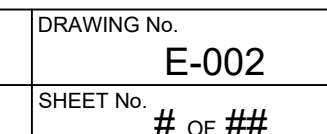


 Associated Engineering BEST MANAGED COMPANIES Proud member	NOTES: 1. xxxxxx.					CONTROLLING B.M.		 Region of Waterloo	EAST SIDE LANDS - WOOLWICH SANITARY SERVICING MUNICIPAL CLASS ENVIRONMENTAL REGION OF WATERLOO							
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1. REQUIREMENTS FOR POWER TRANSFORMER DEPENDS ON THE VOLTAGES AVAILABLE BY THE POWER SUPPLIER. FURTHER COORDINATION SHALL BE CONDUCTED

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APPENDIX C – PROCESS NARRATIVE

East Side Lands Sewage Pumping (Lift) Station

PROCESS NARRATIVE (PN)

REFERENCE drawings: P001, P002, P101, and P102

1.1 DESCRIPTION

East Side Lands Sewage Pumping (Lift) Station (SPS) is a proposed pumping station located at the junction of Jetliner Ct. and Fountain St. N. Flows are received from gravity sewer from Fountain St. N. There will be an underground emergency storage tank (EST) adjacent to the SPS to store the sewage during emergency overflow events. During an emergency event, when the level in the wet well exceeds the overflow elevation, the sewage will overflow into the EST via a DN 1000 line. Once the SPS returns to normal operation, the stored sewage in the EST will be returned to the wet well via return submersible pumps.

The SPS has three (3) sewage pumps (two duty and one standby) that discharge to a new DN 1000 diameter gravity sewer.

The planned SPS has a firm capacity of 162.7 L/s. The following are the main components of the SPS to be constructed:

- The SPS is comprised of one (1) wet well and one (1) pump room.
- The wet well is divided into two cells by a wall and interconnected by a normally-open slide gate.
- An above-grade control building of the SPS will include a, mechanical room, electrical room, loading room and odour control room, while below grade structure will contain wet well, flowmeter room and grinder room, .
- Two (2) grinders and associated influent channel gates are installed on the influent channel within the wet well.
- Three (3) sewage pumps equipped with soft starters will be installed in an underground rectangular pump room, with two pumps on duty and one on standby.
- The pump room will house all isolating valves and most of the associated instruments, including flow and pressure monitors.
- The underground emergency storage tank (EST) has two (2) return pumps (duty/standby), two (2) flushing systems (tipping buckets), and access platforms.

1.2 EQUIPMENT SUMMARY

The following equipment will be installed in the SPS (including control building) and the EST:

In the Wet Well

- Ultrasonic transmitter and backup float level switches
- A manual slide gate on the wet well separating wall.
- Two (2) 5HP channel grinders
- Two (2) manual channel gates are installed on the influent channel within the wet well.

In the Pump Room

- A pressure gauge on each pump discharge pipe
- A knife gate valve on each pump suction pipe (200 mm diameter)
- A swing flex check valve and a knife gate valve on each pump discharge pipe (200 mm diameter)
- An air release valve on each side of the discharge header
- A pressure transmitter on the common discharge header
- A flooding float switch

In the Flowmeter Room

- An air release valve
- A magnetic flowmeter

In the Odour Control Room

- One (1) passive carbon odour control unit for exhaust treatment of the wet well

In the EST

- Ultrasonic transmitter and backup float level switches
- Isolation valve for the discharge line
- Two (2) submersible pumps, 1-duty-1 standby, and associated piping and valving for pumping back to the wet well once the flows return to normal operating conditions.
- Two (2) tipping bucket, each is fed with service water by ON/OFF the associated solenoid valve

1.3 SPS OPERATION

This section briefly presents the control strategy for the pumping station.

The three (3) sewage pumps are running on a duty-standby configuration. Duty 1 and 2 could be assigned as pump P1 and P2 respectively from OIT/SCADA screen. When in auto alternation mode, the pump duty is automatically alternated on the completion of a pumping cycle to equalize pump run time. The standby pump will also be switched to duty in the event that the current duty pump fails to operate.

The Control System for the SPS includes:

1. SCADA system
2. Local control panels

During normal operation, the pumps will be controlled by the SCADA system in “AUTO” mode, based on the measured level in the wet wells. The pumps can also be controlled at the local panel in a Local Hand Mode for maintenance or during the start-up and commissioning period.

A level sensor and float switches are installed in the wet well. The level measurements will be used for pump control levels. The pump discharge flows will be monitored, recorded and summed up as total flow by the flowmeter on the common discharge header through the SCADA system. The discharge pressure will be monitored and recorded via a pressure transmitter on the discharge common header.

1.3.1 “Auto” Mode:

When the level rises to the preset level of Duty 1 Start (initially set at **EL. 304.00 m**, operator adjustable), the Duty 1 pump will start. When the wet well level drops to the preset low level of Duty 1 Stop (initially set at EL. 303.50 m, operator adjustable), the Duty 1 pump will stop. If the level rises to the preset level of Duty 2 Start (initially set at **EL. 305.00 m**, operator adjustable), the Duty 2 pump will start. And when the wet well level drops to the preset level of Duty 2 Stop (initially set at **EL. 304.50 m**, operator adjustable), the Duty 2 pump will stop

If the duty pump is running and the wet well level rises to the High High Level Alarm point at 305.50 (operator adjustable) an alarm will be triggered.

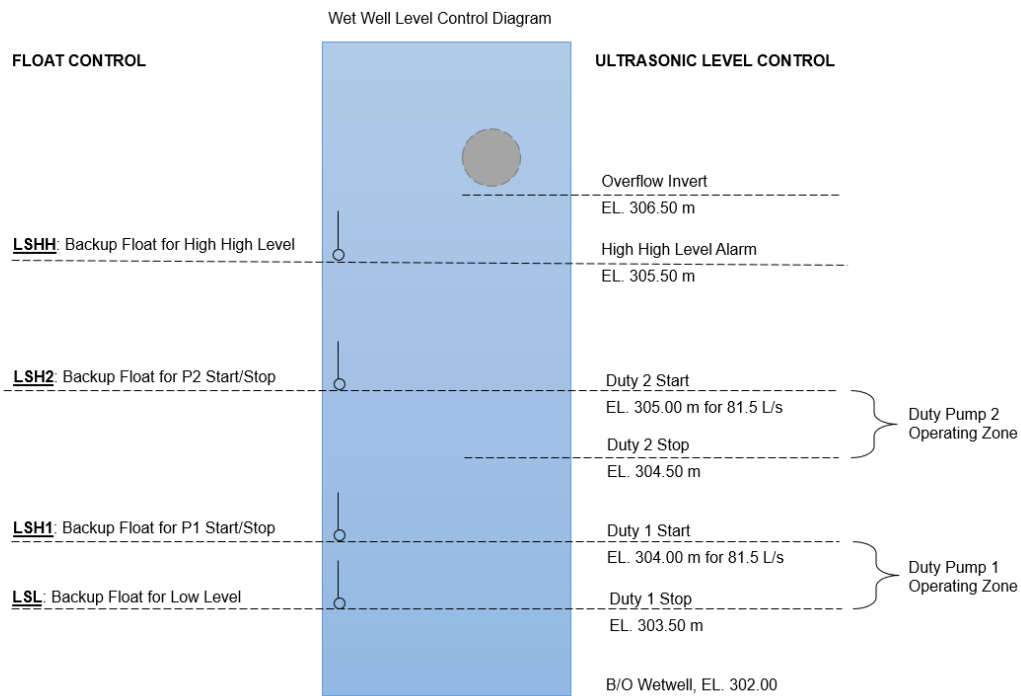
Four (4) backup float switches will also be installed in the wet well pump backup control.

- LSL: Backup Float for Low Level (all pumps stop)
- LSH1: Backup Float for P1 Start/Stop
- LSH2: Backup Float for P2 Start/Stop
- LSHH: Backup Float for High High Level

If the level rises high enough and activates the backup float LSH1 but no pump is running, then pump P1 starts. Once the float switch is off for a preset time (adjustable), then pump P1 stops. A similar backup float LSH2 is installed for Duty pump P2, but at a higher elevation than the float for P1. When any pump is started by a backup float, the station is under backup control. An alarm will be activated if the level rises high enough and activates the backup float LSHH.

Once a backup float has been triggered, operator intervention shall be required to return to normal-level sensor-based operation. The hard-wired interlock will prevent all three pumps from running if all floats are tripped.

The following diagram illustrates the control of the pumps based on the average wet well levels.



1.3.2 “Local” Mode:

When in Local (Hand) Mode (panel Local/Remote switch in Local), the operator can operate the pumps using the Start and Stop buttons on the panel.

1.4 EST OPERATION

This section briefly presents the control strategy for the EST.

The two (2) submersible pumps are running on a duty-standby configuration. Duty 1 could be assigned as pump P1 or P2 from OIT/SCADA screen. When in auto alternation mode, the pump duty is automatically alternated on the completion of a pumping cycle to equalize pump run time. The standby pump will also be switched to duty in the event that the current duty pump fails to operate.

The Control System for the EST includes:

1. SCADA system
2. Local control panels

During normal operation, the pumps will be controlled by the SCADA system in “AUTO” mode, based on the measured level in the tank. The pumps can also be controlled at the local panel in a Local Hand Mode for maintenance or during the start-up and commissioning period.

A level sensor and float switches are installed in the tank/sump. The level measurements will be used for pump control levels. The discharge from the EST will return to a manhole upstream of the SPS via a DN 100 line. The two pumps will have hardwired interlocks in place to only allow one pump to be in operation at a time.

The duty return pump also reads the level within the wet well of the pumping station and won't start if the level in the wet well is at high-high level (adjustable).

The flushing procedure using tipping buckets will be automatically started when the duty pump stops.

1.4.1 "Auto" Mode:

When the level rises to the preset level of Duty 1 Start (initially set at **EL. 301.50 m**, operator adjustable), the duty pump will start. And when the tank level drops to the preset level of Duty 1 Stop (initially set at **EL. 300.50 m**, operator adjustable), the duty pump will stop.

If the duty pump is running and the tank level rises to the High High Level Alarm point at **EL. 305.00 m** (operator adjustable) an alarm will be triggered.

The flushing procedure using tipping buckets will be automatically started when the duty pump stops for a preset time duration (adjustable). Once started, the solenoid valve will open to feed the tipping bucket with City Water and be closed to stop feeding once the position switch on the tipping bucket indicates the bucket is tipped. The flushing procedure will allow the operator to set how many flushes will be conducted for each tipping bucket during the flushing.

Three (3) backup float switches also will be installed in tank pump backup control.

- LSL: Backup Float for Low Level
- LSH: Backup Float for Duty Pump Start/Stop
- LSHH: Backup Float for High High Level

If the level rises high enough to activate the backup float LSH but no pump is running, the Duty Pump starts. Once the float switch is off for a preset time (adjustable), the Duty Pump stops. When any pump is started by a backup float, the station is under backup control. An alarm will be activated.

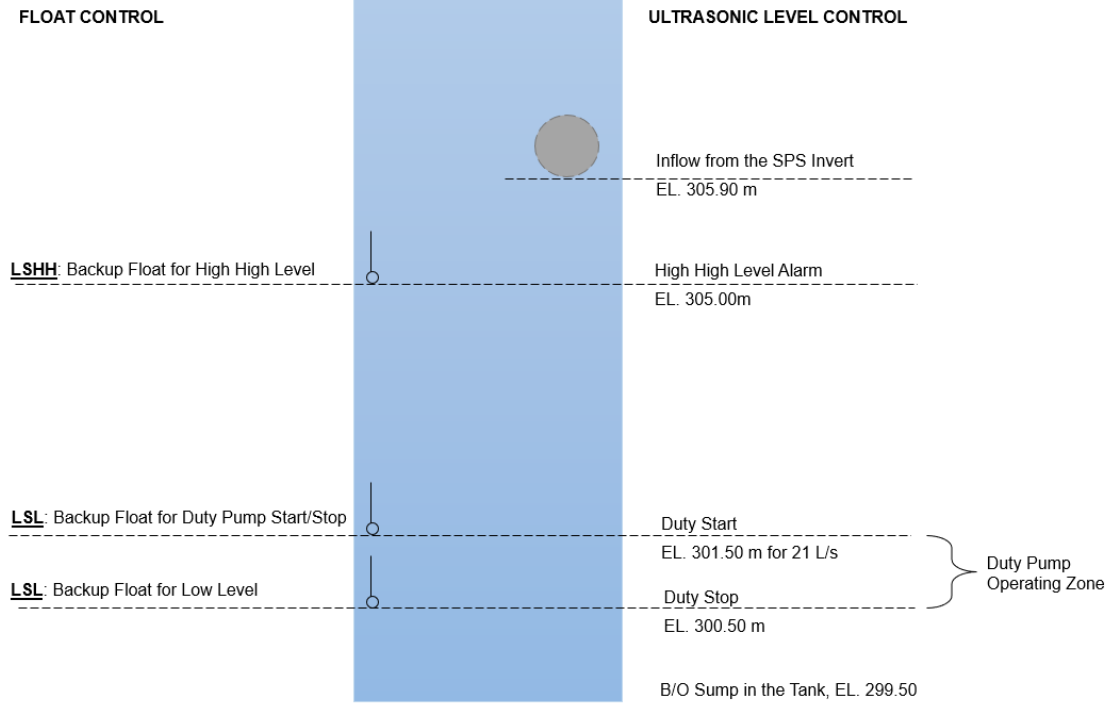
Once a backup float has been tripped, operator intervention shall be required to return to normal level sensor-based operation.

If the level rises to activate the float LSHH within the tank, a Water Level High High alarm will be triggered.

If the level in the wet well rises to high-high level, the duty return pump stops and will not run until the level in the wet well drops below high-high level.

The following diagram illustrates the control of the pumps based on the average EST levels.

Emergency Storage Tank Level Control Diagram



1.4.2 “Local” Mode:

When in Local (Hand) Mode (panel Local/Remote switch in Local), the operator can operate the pumps or tipping buckets using the Start and Stop buttons on the control panel.