

### Scope of Project

The goal of the project is to provide public potable water distribution and wastewater collection to 62 homes in Herring Cove, Nova Scotia. The houses are currently serviced by wells and septic systems. The objectives include:

- Perform Hardy Cross analysis and natural flow analysis for potable water distribution system
- Provide design options for the wastewater collection system including a conventional system and a low-pressure sewer option on Shore Road
- To be designed with future population growth in mind

### Design Process

#### Potable water design:

1. Water demand and fire flow calculations
2. Thrust restraint calculations and determining thrust block size
3. Hardy Cross analysis of the network
4. Horizontal and vertical alignments of the pipes
5. Determining location of pipe elbows and other fittings
6. Locating hydrant tees along the pipes - made stations at every 150 meters along the horizontal alignment
7. Location of Fire Hydrants - based on standard detail drawings

#### Wastewater Gravity Design:

1. Average and peak flows calculations using Harmon peaking factor.
2. Initial manhole layout based on topography
3. Pipe sizing based on hydraulic capacity
4. Check minimum depth of bury for each area based on minimum service connection grade 2%
5. Adjust each line for self-scour slopes using Halifax Water minimum velocity guideline (0.6 m/s) and ASCE's tractive force method
6. Adjust for manhole energy losses

#### Low Pressure Sewer Design:

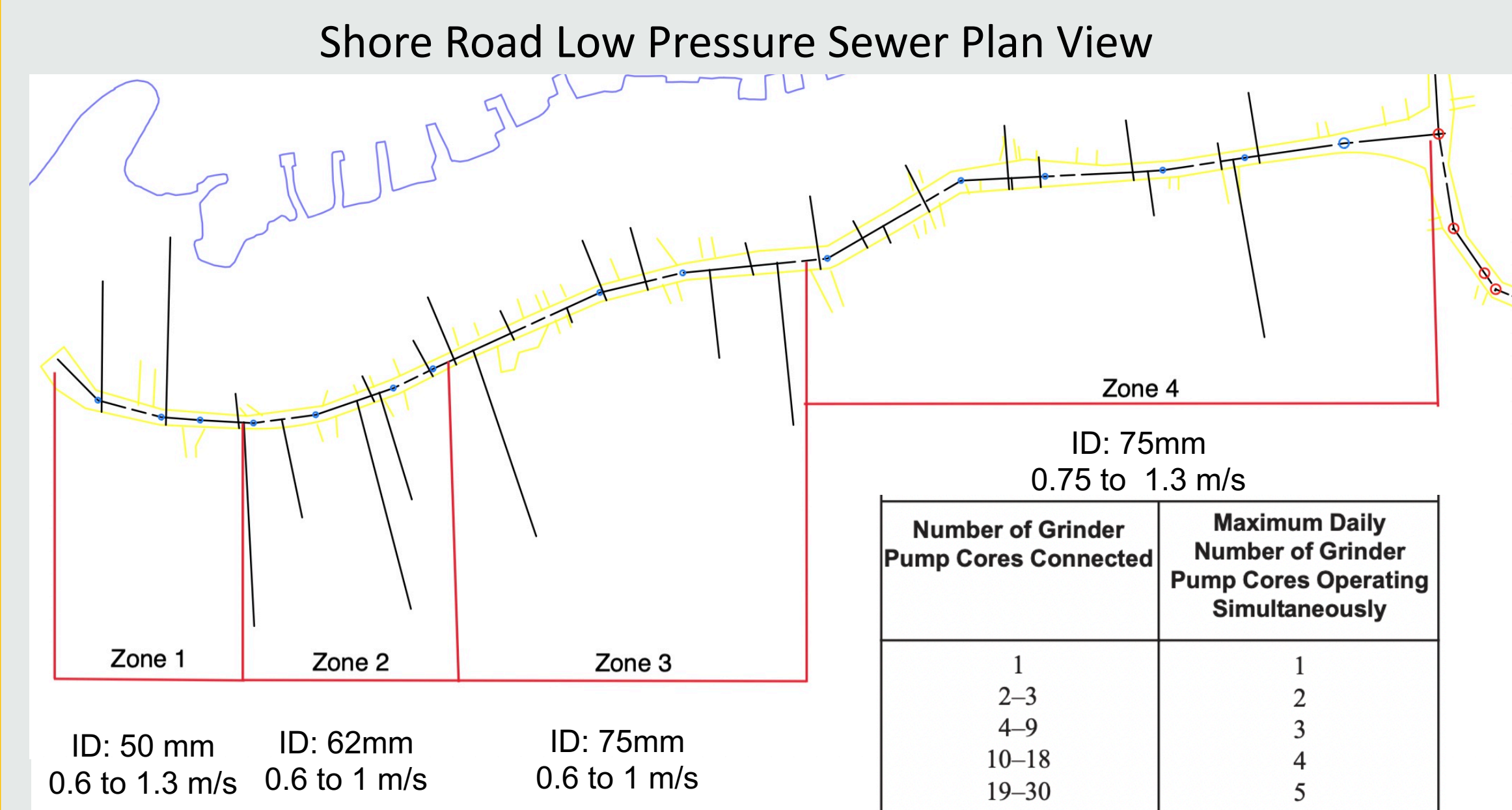
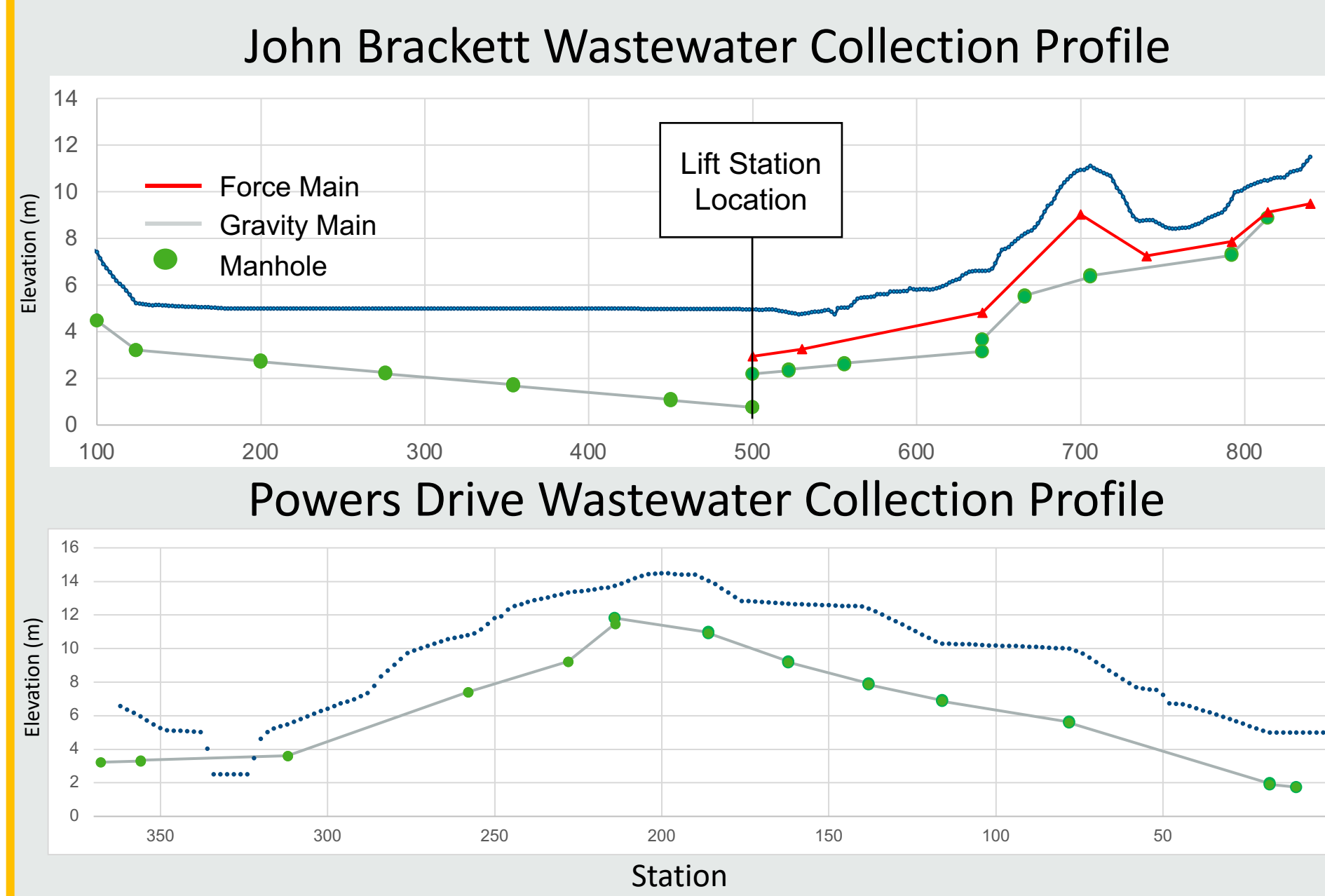
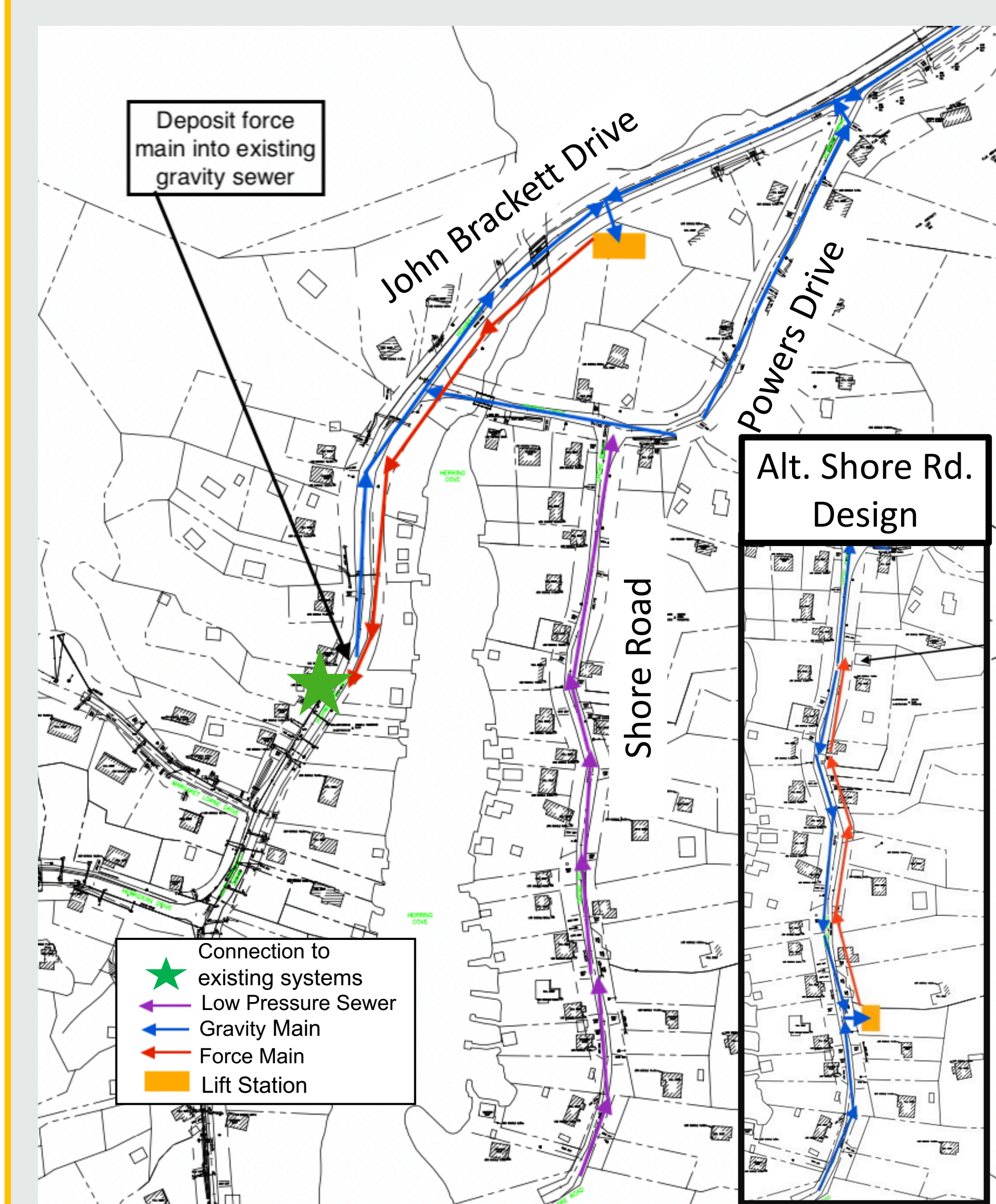
1. Initial alignment including elbows, service connections and valves
2. Semi-Positive Displacement pump chosen for its reliable flow output. Main design was based on method of probability (WEF) and research by Environment One ©
3. Sizing of main and individual home wastewater tanks
4. Hydraulic analysis: total dynamic head checks (pump at highest and lowest static head conditions, and post-power outage)
5. Pressure relief system for emergency scenarios

#### Lift Station Design

1. Design layout of force main following specifications outlined by Halifax Water
2. Determine location and size of pipe elbows and thrust blocks in system
3. Determine total dynamic head by calculating static head and friction losses across force main system
4. Select pump suitable for operating conditions by creating system curve
5. Calculate effective volume of wet well in lift station and determine elevations of pump on and off sensors

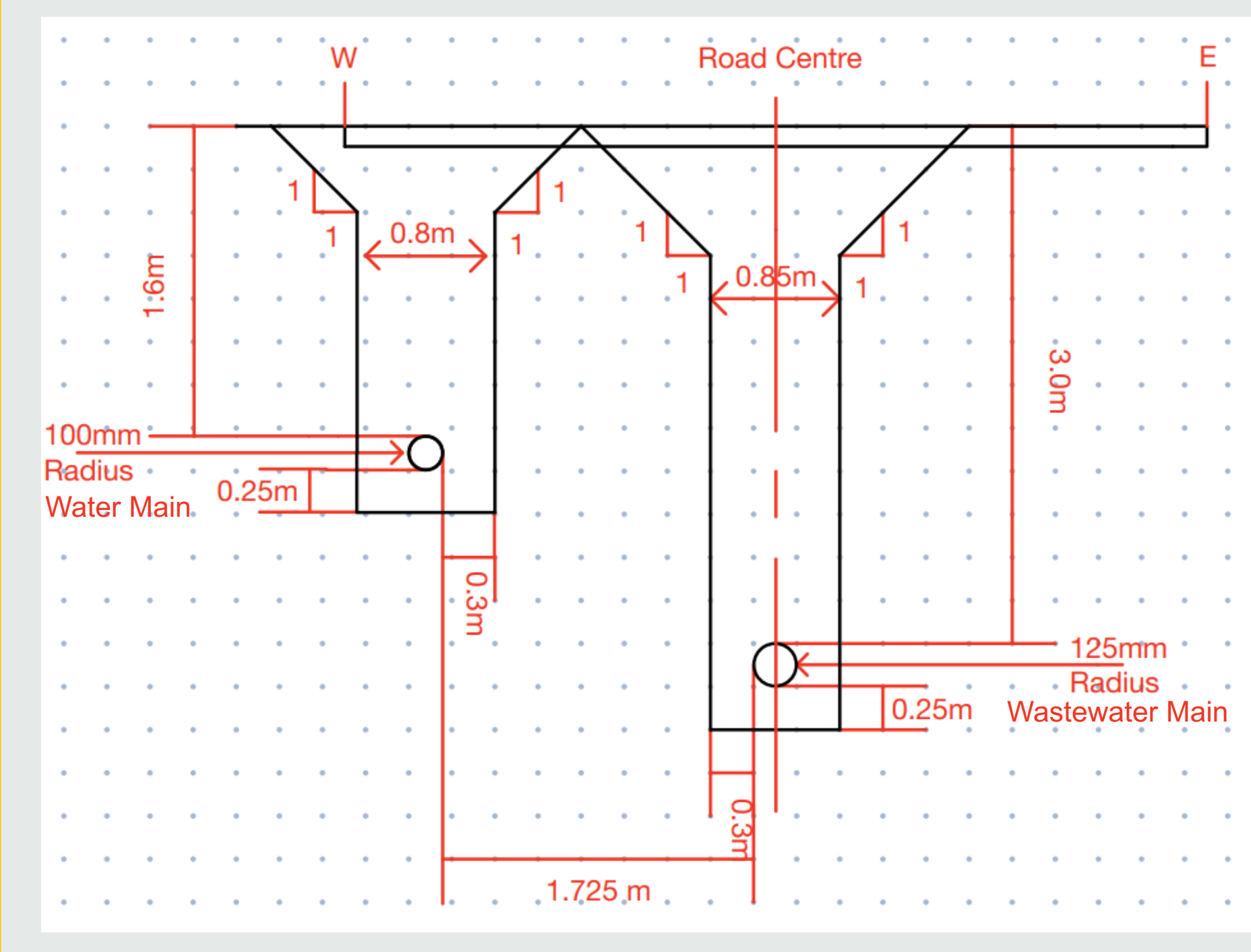
### Design Overview

The wastewater collection design overview is shown in plan with two of the design profiles. The potable water distribution is not shown but will be laid on the west side of the road, as shown in the trench details. Bury depths of 1 and 1.6m were analyzed for the potable water alignment.

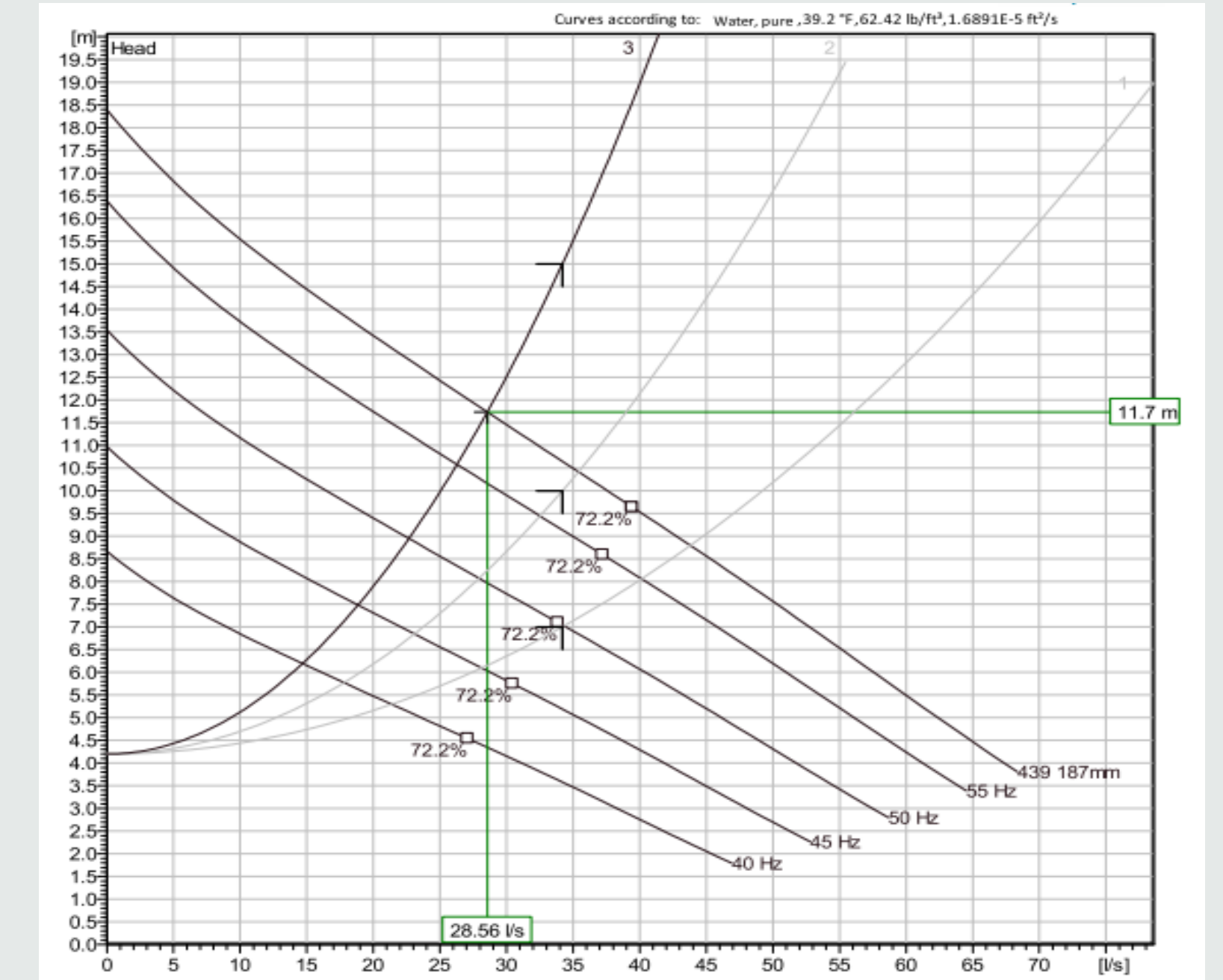


**Pump:** Environment One Semi-Positive Displacement Pump  
**Operating head ability:** -9m to 70m,  
**Flow:** 0.49 to 0.95 L/s  
**Limiting Scenarios:**  
Typical max operating total dynamic head in system: 19 - 24m  
Lowest operating total dynamic head in system: -4 m  
Emergency scenario total dynamic head after power outage: 67 to 110 m: over pressurized, pressure relief needed (see recommendation)

#### Trench Detailing: Typical Cross Section of Powers Rd.



#### Characteristic Curve for Pump Selection



- A system curve determines a pump's ability to produce flow under the conditions that affect pump performance and ultimately choose the most efficient pump.
- By Calculating the total dynamic head of the system and using the flow coming into the lift station on John Brackett Drive of 35.4 L/s a pump was selected that discharges a flow of 28.56 L/s pumping at an efficiency of 72%.

- Wastewater main is located in the centre of the road. This put its at the crest of the road minimizing the inflow of surface water into the system through pick holes.
- To minimize the number of manholes, the wastewater main must remain straight, as a result the wastewater section does not remain perfectly in roads centre.
- Minimum spacing of wastewater and potable systems is to be 3m, this would put potable far off the road if wastewater system, was to remain in road center. However in a dual trench system these two systems can be closer allowing the wastewater to stay in the roads centre and keep the potable in the roads area. This design will aid in reducing traffic disruption during construction on the narrow roads.
- Any potable system within 1.2m of a manhole must have insulation. With a manhole radius of 0.525m the spacing between the wastewater and potable must be at minimum 1.725m to avoid the need for insulation.

### Conclusion and Recommendations

The potable water design recommended includes depth of bury of 1.6m, because it has a lower life cycle cost and requires less maintenance compared to the 1m depth of bury option. The 1m depth design is above frost depth which requires insulation that must be maintained consistently, resulting in a higher life cycle cost.

The final wastewater design recommended utilizes the low-pressure sewer option on Shore Road. The low-pressure sewer was determined to be feasible for the current and future population. A pressure relief valve is needed for each tank as a safety mechanism against possible over-pressurization events that may occur after power outage.

The self-scouring velocity was not met at all locations in the gravity system in the initial stages of development. The client will be provided with a map detailing the areas of concern. Manual flushing is recommended.

### References

- Alternative Sewer Systems. (2008) Water Environment Federation (WEF) manual of practice FD-12
- Gravity Sanitary and Sewer Design and Construction. (2007) American Society of Civil Engineering (ASCE) manual of practice No. 60
- Design Specifications & Supplementary Standard Specifications for Water, Wastewater & Stormwater Systems. 2020 Edition.