



Engineering Services for Charlie Lake Sewer

East Side Capital Improvement Plan

August 29, 2025

Prepared for Peace River Regional District

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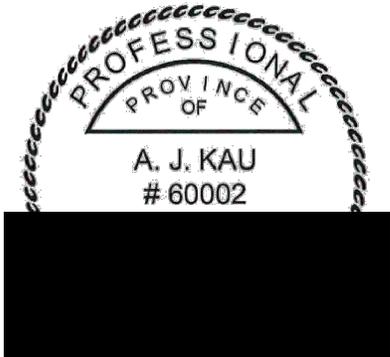
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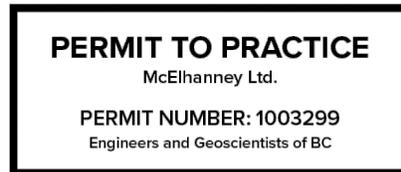


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Glossary of Terms

Conduit – Term used in PCSWMM that is synonymous with pipe.

Equivalent Dwelling Unit (EDU) – A typical single-family residence. In this report, EDUs are used to analyze industrial flow rates in terms of residential flows. Some industrial connections produce more waste than a typical single-family residence, while some produce less.

Forcemain – A pipe or conduit with pressures over 271 kPa (39 psi). Typically, this pipe has a dedicated pump to push flows to a higher elevation.

Horizontal Directional Drilling (HDD) - A trenchless construction method used to install underground pipelines, conduits, or cables along a precise path without digging large trenches. It's especially useful for crossing obstacles like roads, rivers, or urban areas where traditional excavation would be disruptive.

Hydraulic Grade Line (HGL) – The water level throughout the sewer collection system. For a low-pressure system, the HGL is expected to be above the pipes to represent the pressure in the system. For a gravity system, or for pressurized lines with minimal to no pressure, the HGL is expected to be within the pipes.

I/I – Infiltration and Inflow entering the system that is not intended to be entering. Rainwater and groundwater are common sources of I/I.

Junction – Term used in PCSWMM to represent pipe connections, the end of pipe segments, and/or sewer curb stops. In PCSWMM, every conduit must have a junction at both ends, and all junctions must have rim and invert elevations. Junctions are also where system loading, and flows can be entered into the system. Junctions may also be referred to as nodes.

Septic Tank Effluent Pump (STEP) System – A sewer collection system that has septic tanks at the individual connections and effluent pumps that direct effluent from the septic tanks to the sewer collection system.

Sewer Collection System – The pipe network in Charlie Lake that individual effluent pumps connect to. These pipes collect waste throughout Charlie Lake and direct flows to the Lift Station. This type of sewer collection system is often referred to as a STEP system.

Service Area Boundary – The local service area is contained within the service area boundary. Not all lots in this region are currently connected to the sewer collection system, but they do have the ability to connect by submitting an application for a sewer service connection.

Sewer Main – The low-pressure pipes in the existing sewer collection system, as well as proposed pipes that would have low pressures. These pipes experience pressure ranging from 0 up to 271 kPa (39 psi).



Executive Summary

A Capital Improvement Plan (CIP) was prepared for the Peace River Regional District (PRRD) for the Charlie Lake sewer collection, distribution, and treatment facilities in 2023 which covered the entire Charlie Lake Community.

This report is a supplement to the 2023 CIP, and focuses on the northeast side of the Charlie Lake sewer collection system where the system is pressurized. This detailed investigation of the existing Charlie Lake East Side (CLES) system was performed using record drawings, previous reports, discussions with operators and PRRD staff, and available Geographic Information System (GIS) data. This information was used to further evaluate the condition of the existing CLES system, investigate opportunities for system improvements, and consider system expansion over the next 10 years.

A detailed account of findings is provided in this report, along with an options analysis of possible solutions to address existing deficiencies. Recommendations for system improvements, associated construction schedules, and estimated costs are provided for the two most feasible solutions.

CHARLIE LAKE SEWER SYSTEM OVERVIEW

Charlie Lake is in Northeastern British Columbia, within Electoral Area C, and is an unincorporated community within the Peace River Regional District. Charlie Lake has approximately 573 existing lots, and approximately 434 of those lots are connected to the sewer collection system. The lots have septic tanks and effluent pumps for preliminary treatment, prior to flows being discharged into the low-pressure sewer mains; this type of sewer collection system is often referred to as a STEP system.

The CLES is located on the northeast side of the lake along the shoreline and comprises 49 existing residential lots. The CLES, which contains Branch 24 of the Sewer Collection System, is a pressurized area with a hill delimiting the south boundary, beyond which the system performs like a gravity system. Referring to Figure E.1., the orange dots on the east side of Charlie Lake represent the sewer connections subject to a higher pressure, and this area is the focus of this CIP. The transition to green dots on the south end is where the system transitions to gravity feed and the pressure is reduced or removed from the system.

The sewer mains direct flows to the lift station located on 273 Road just south of Highway 97. Effluent is then stored in connected wet wells until the water level is high enough that the pump turns on. Flows are then pumped to the Sewer Treatment Plant (STP) located further south on 273 Road. Flows are discharged into the Complete Mix Tanks (CMTs), then flow to the aerated lagoons, and are eventually discharged to the Peace River after treatment is complete.



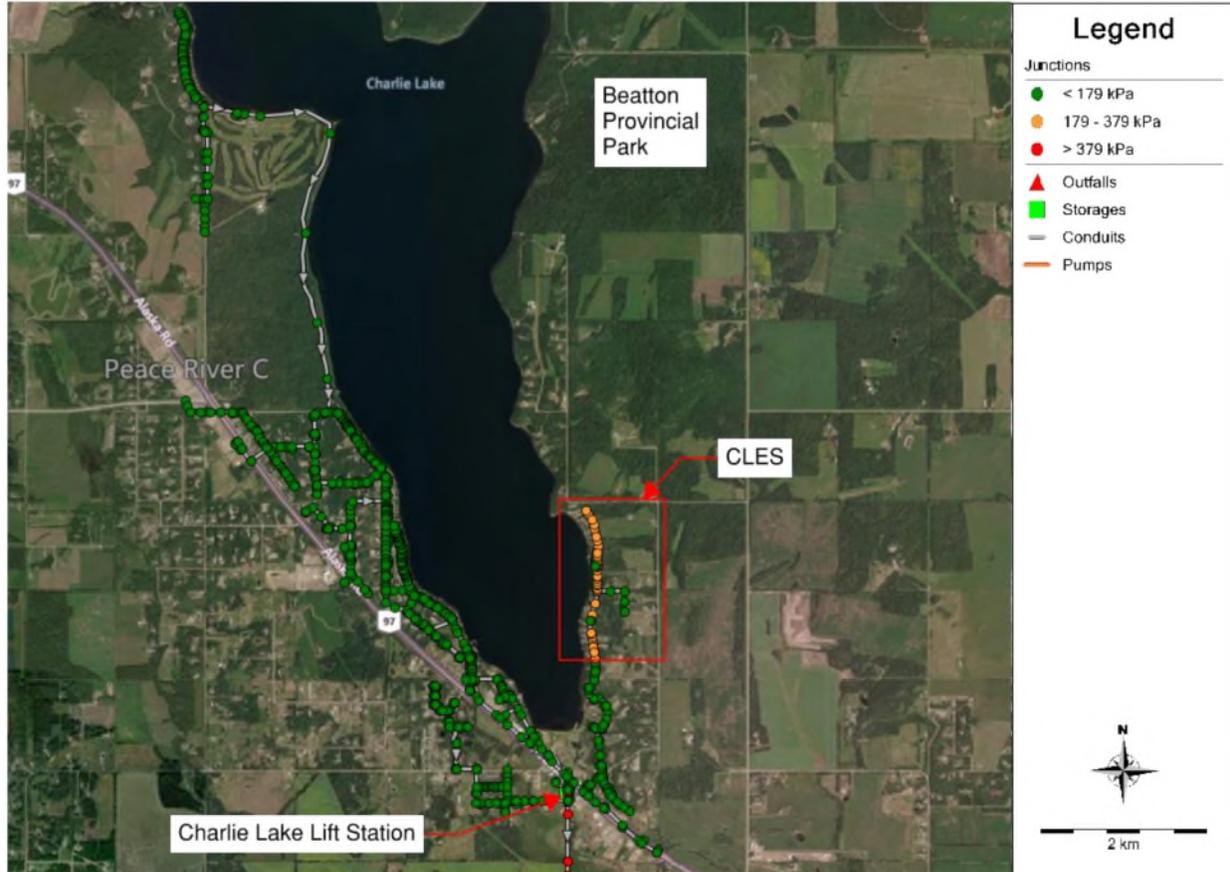


Figure E.1. Charlie Lake East Side Collection System Connections as Modeled in PCSWMM

CHARLIE LAKE EAST SIDE SEWER COLLECTION SYSTEM

Based on Record Drawings and available GIS data, the existing sewer collection system was initially built in the 1990s. Since then, the system has been expanded to connect new developments. Each year, the PRRD receives sewer connection applications from residents wanting to connect to the system, as not all residents are connected at this time.

The CLES has no plans for system expansion outside of the existing sewer service area. The only plans for growth are connecting lots in the existing service area to the sewer collection system.

Some of the primary deficiencies noted during the system investigations in 2023 include:

- Seized gate valves throughout the collection system. (C.5 in the 2023 CIP)
- Low flows or stagnant water in many pipes. (C.6 in the 2023 CIP)
- Closed and inoperable air release valves throughout the collection system. (C.5 in the 2023 CIP)

Seized gate valves make emergency response activities and construction projects challenging as the pressure main stays active if the valves can not be closed. Also, if a valve seizes or breaks when being operated, this leads to an emergency if flows cannot by-pass the closed valve and reach the lift station. If the emergency is not quickly rectified, residents may experience overflowing of their septic tanks, and with many properties being adjacent to Charlie Lake, this would be an environmental concern.

With the air release valves being closed, gases are trapped in the system and may be causing valves to corrode or break faster than expected. The built-up gasses may also be leading to increased corrosion and odour issues at the lift station.

CHARLIE LAKE EAST SIDE RECOMMENDATIONS

The goal for CLES is to accommodate future growth within the existing service area, provide additional redundancy to reduce the risk associated with a system break, and to reduce pressure in the northeast branch of the sewer collection system.

This investigation evaluated several options to improve system capacity, provide system redundancy, and reduce system pressure. Of the investigated options, two were identified as the most effective at addressing these three system requirements:

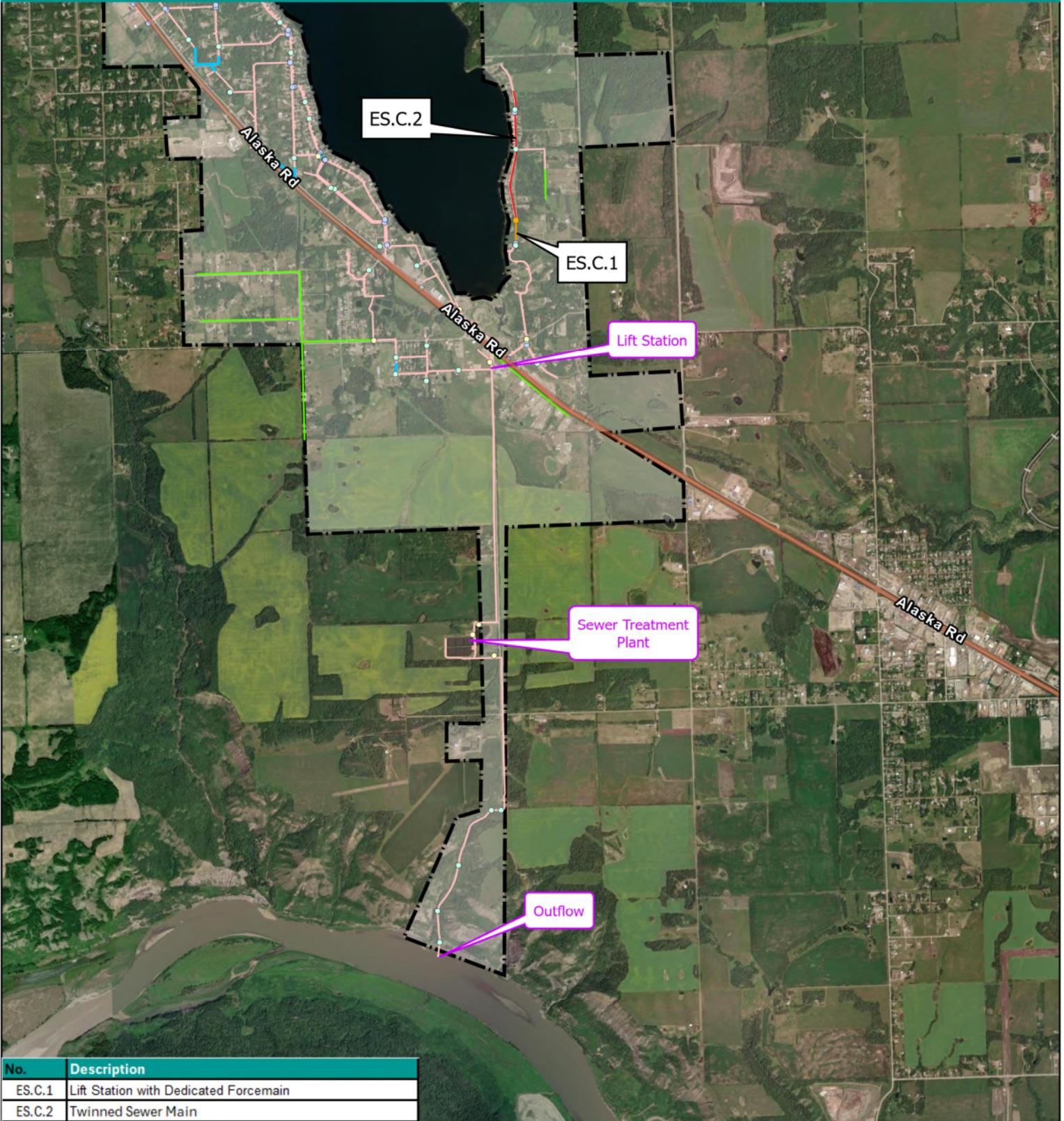
- A regional lift station
- Twinning of the existing sewer main.

A summary of the estimated costs and project benefits is provided in Table E.1. below. Inflation has been applied to the cost estimates found in Appendix A, which are in 2025 dollars, at a rate of 5% per year after 2025. Figure E.2 shows the recommended projects and their location in the CLES. Since the cost difference between the two options is not significant for a Class D cost estimate (+/- 40%), the constructability of the two options is discussed in more detail, as this may be a deciding factor for the PRRD.

Table E.1. Summary of Charlie Lake East Side Sewer System Recommendations

No.	Description	Benefit	Estimated Cost
ES.C.1	System Redundancy – Regional Lift Station with Dedicated Forcemain	System rerouting, emergency response, reduced system pressures, overall system robustness	\$1,377,000
ES.C.2	System Redundancy – Twinning of the Existing Sewer Main	System rerouting, emergency response, future capacity	\$1,029,000



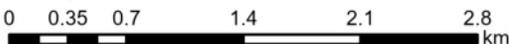


No.	Description
ES.C.1	Lift Station with Dedicated Forcemain
ES.C.2	Twinned Sewer Main

CLÉS - Collection System Recommendations Map

Figure E.2. Charlie Lake East Side Recommendations Map

1:45,000



Coordinate System: NAD 1983 UTM Zone 10N
Projection: Transverse Mercator



LEGEND

- Regional Pump Station
- System Expansion
- Flow Meter
- ES.C.1
- Main Valve
- ES.C.2
- Blow Off/Air Valve
- Charlie Lake City Extent
- Existing Sewer System Pipes
- System Redundancy

RECOMMENDED OPTIONS - CONSTRUCTIBILITY

The lift station offers a more robust solution that will reduce the required pressure for individual effluent pumps pumping into the system. This option adds storage capacity to buffer peak flows, and installs a dedicated forcemain to convey flows up the hill and into the gravity feed portion of the system. However, the twinned forcemain also addresses some concerns and could be a lower-cost viable alternative.

REGIONAL LIFT STATION WITH DEDICATED FORCEMAIN

A package lift station is proposed for this option. This package would include a prefabricated wet well, pumps, valves, piping, kiosk, electronics, and controls. Installation, concrete work, piping connections, and commissioning will be handled by a contractor, with electrical upgrades coordinated through BC Hydro. A dedicated 100 mm forcemain would be installed using Horizontal Directional Drilling to avoid tree clearing and ground disturbance.

The recommended location for the lift station is at the south end of Paradise St. within the turnaround right-of-way at approximately 708 m elevation. An existing sewer right-of-way (PGP37582) runs through this area and can be used for the new forcemain, providing access for drill entry/exit and valve tie-ins. Design and approval considerations include permits, electrical servicing, lead times, and notifications to adjacent properties, with timelines ranging from three to nine months.

The lift station discharge line will be directionally drilled to Krackling Cove Dr. and terminate at the existing high point with an air release valve. Isolation valves will be installed for flow control and future flexibility. Construction will be low impact, with the existing system remaining online until final tie-ins are completed. Once components and approvals are in place, construction is expected to take two to three months.

TWINNING OF EXISTING SEWER MAIN

The soil conditions at the CLES site, mainly silty clay and loam with low coarse fragments, is well-suited for horizontal directional drilling (HDD). These characteristics support borehole stability and reduce equipment risk. However, a detailed geotechnical investigation is recommended to confirm site-specific feasibility.

The proposed placement of the new sewer main along the east side of Paradise Street, parallel to the existing line, offers construction advantages. This alignment would avoid private property, minimize environmental disruption, and simplify logistics, making it a practical and cost-effective solution.

Given the presence of buried sewer, electrical, and telecom lines in the area, an alignment that can avoid utilities is critical. Strategic placement and careful excavation of entry/exit pits, and maintaining safe distances from utilities are crucial for a successful HDD installation without affecting nearby infrastructure. Pre-construction locating, potholing, and drill head tracking would be recommended to prevent strikes, service outages, and safety hazards during installation.



1. Introduction

Charlie Lake is in Northeastern British Columbia, approximately 7 km northwest of Fort St. John and along the Alaska Highway. It is a recreational destination, with water skiing, boating, and fishing being popular activities on the lake. Charlie Lake is an unincorporated community within the Peace River Regional District (PRRD) and is located in Electoral Area C.

A Capital Improvement Plan (CIP) was prepared in 2023 encompassing the entire collection system, the lift station and the STP. This report is a supplement to the 2023 CIP and focuses on the CLES, particularly Branch 24 where the system is pressurized, and identifies the unique issues and potential solutions for this area. Refer to Figure 2 for sewer infrastructure in the CLES area.

1.1. TOPOGRAPHY

The CLES shores are the lowest elevation in the area at about 700 m geodetic. The average elevation is 710 m, with the highest elevation reaching 730 m on the south side of the sewer service area. The CLES terrain generally slopes from east to west toward Charlie Lake, and is hilly. The two elevation peaks in this service area are 710 m and 730 m. Refer to Figure 3 which shows the topography of CLES.

Figure 1 depicts the existing ground elevation, sewer main profile, and corresponding pressure (HGL), displayed in metres of water.

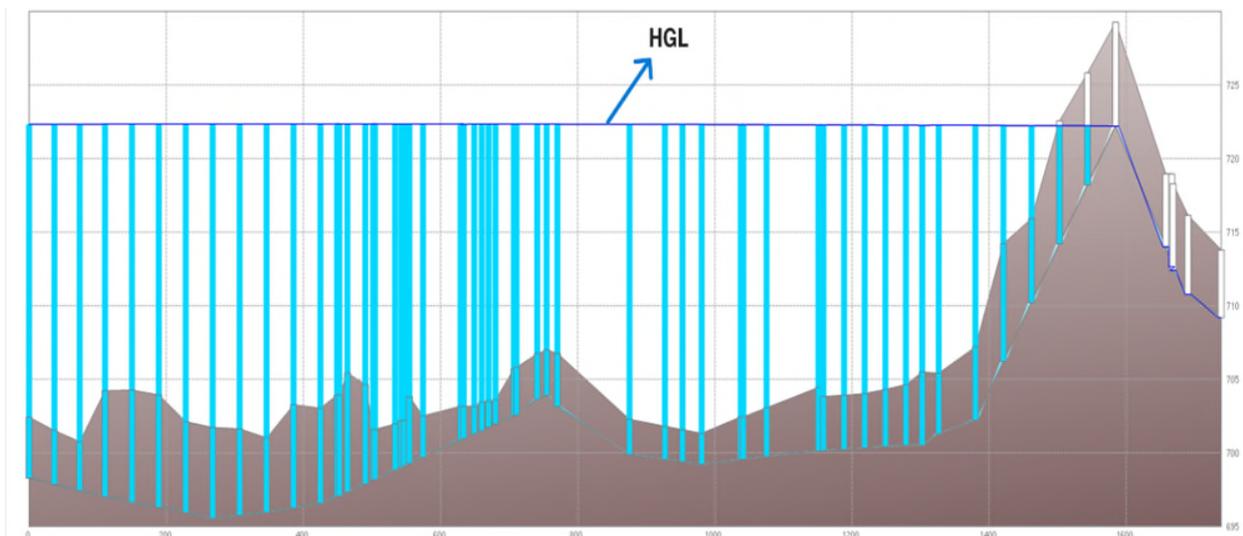
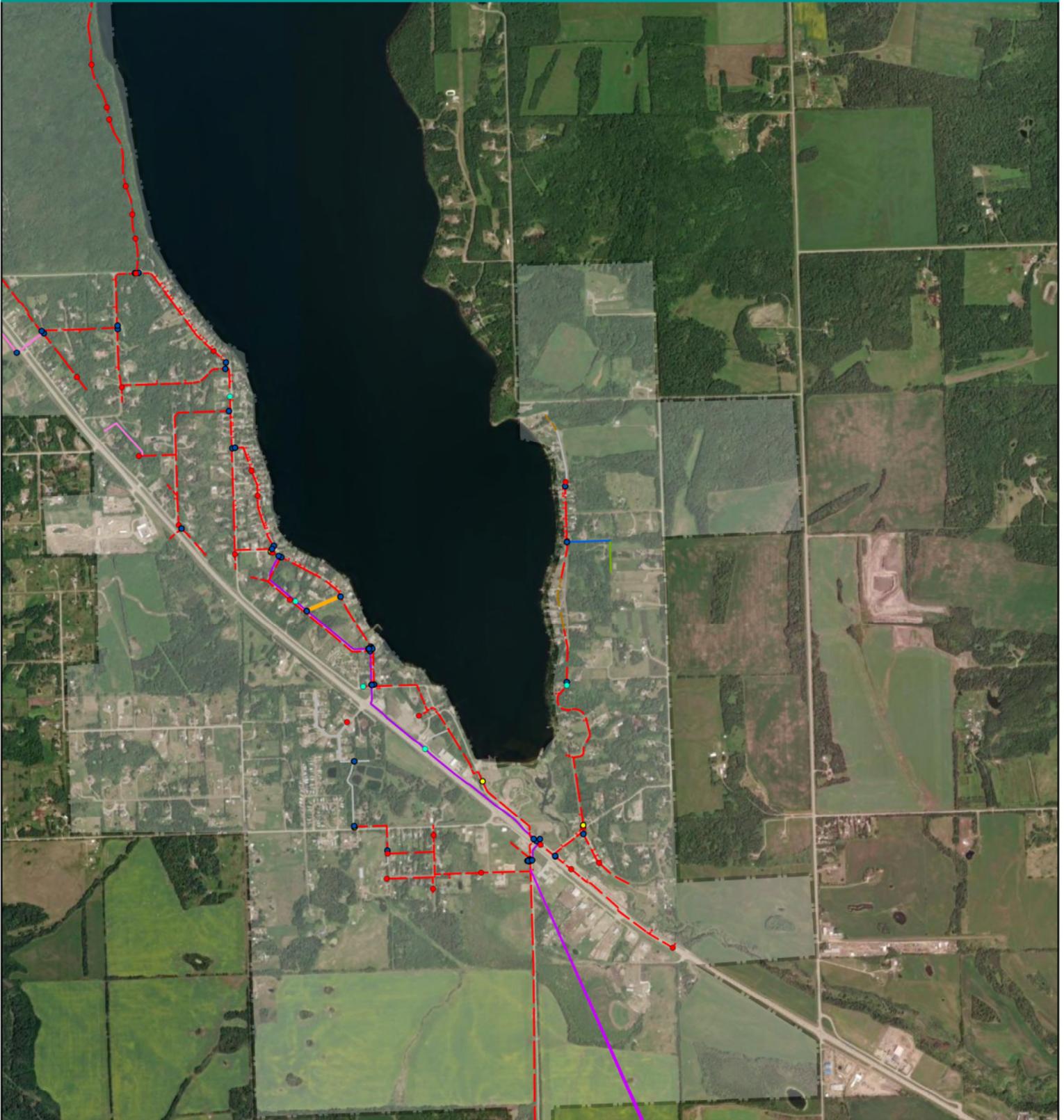


Figure 1. Charlie Lake East Side Elevation and Hydraulic Grade Line as Modelled in PCSWMM

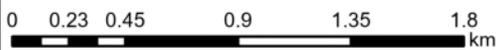


Existing Sewer System Map
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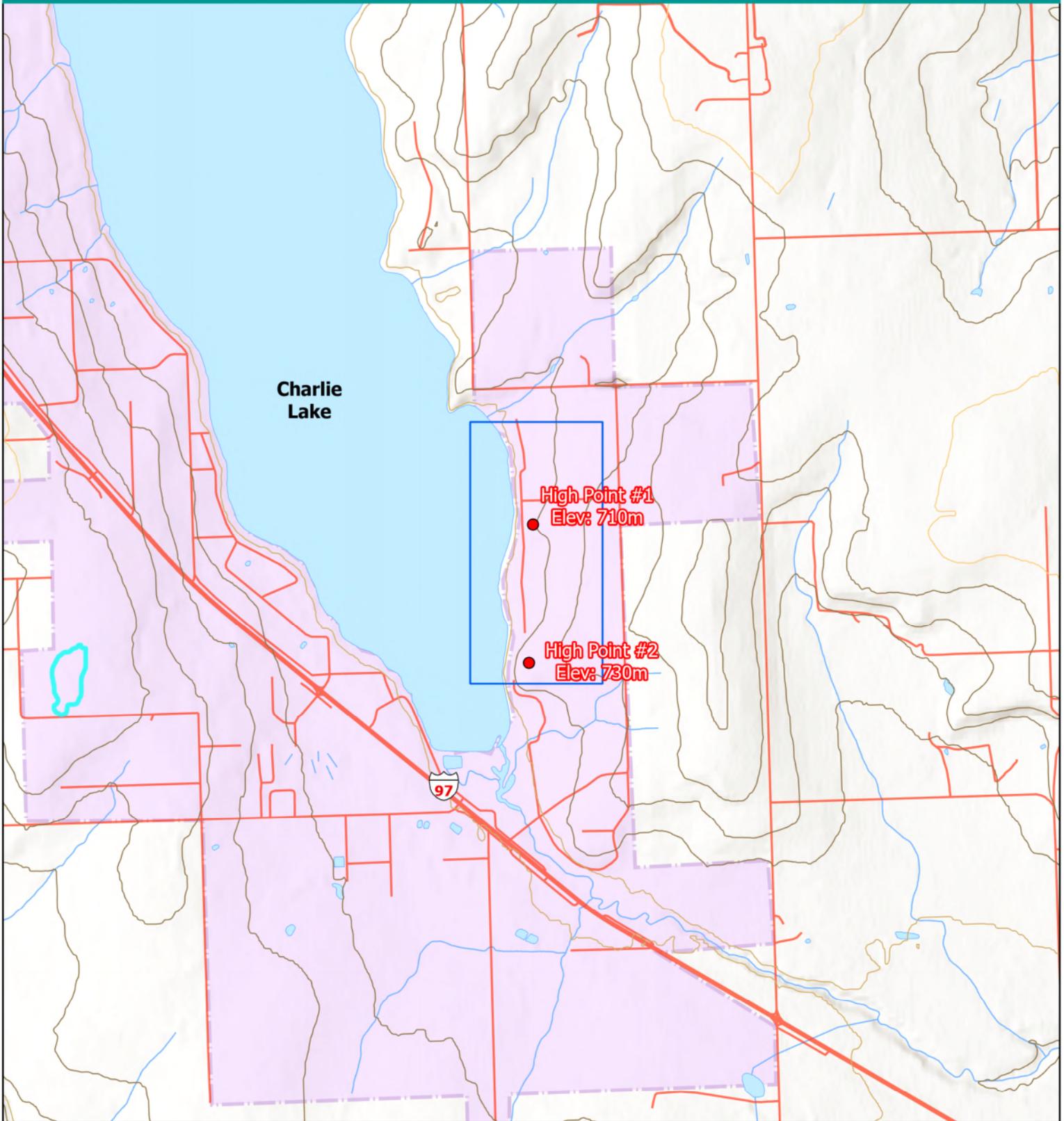
LEGEND

Figure 2. Charlie Lake East Side Existing Sewer System



Coordinate System:

- Flow Meter
- Gate Valve
- Blow off Valve
- Air Valve
- Charlie Lake City Extent
- N/A
- 1990 - 1995
- 1995 - 2000
- 2000 - 2005
- 2005 - 2010
- 2010 - 2015
- 2015 - 2020
- 2020 - 2023



Charlie Lake Topographic Map
3111-27494-00

Figure 3. Charlie Lake East Side Topographic Map

1:30,000



Coordinate System: NAD 1983 UTM Zone 10N
Projection: Transverse Mercator



LEGEND

- | | |
|---------------------|----------------------------|
| Highway | Contour Line, Intermediate |
| Secondary Road | Contour Line, Minor |
| Local Street | River/Creek |
| Railway | Lake/River |
| Contour Line, Major | Charlie Lake City Extent |
| | CLES |

1.2. PLANNING PERIOD

This CIP is for a period of 10-years. The East side of Charlie Lake is not expected to see significant growth, however there are existing lots that will be connected in the future. There is a total of 49 residential lots in the CLES, of which 40 are already connected to the Charlie Lake sewer system, leaving 9 residential lots to be connected. There is potential for future subdivisions leading to more connections, however this addition is not expected to be significant and the PRRD will have control over new servicing requirements.

The purpose of this document is to develop a plan for the connection of additional lots in the existing CLES sewer service area, and to ensure the system can accommodate those additional flows.

1.3. PLANNING AREA

The Charlie Lake sewer service area is shown above in Figure 2. The homes within this service area are either already or will be connected to the sewer system. Locations outside of the Service Area Boundary are not currently connected and may or may not be connected in the future depending on growth and demand for services or capacity restrictions of the system, respectively.

The CLES area mostly consists of Rural Residential (RR) while being surrounded by Agricultural (Ag) land. Currently, developers can submit zoning change requests that are addressed on a case-by-case basis. This approach avoids pre-zoning, and the need for the PRRD to anticipate development in Charlie Lake. This approach also allows the PRRD and the community more control over development type and location.



2. Existing STEP System

The PRRD provides sewer services to approximately 81% of the existing 49 lots in the CLES region. Lots that are currently connected to the Septic Tank Effluent Pump (STEP) collection system consist of only residential services as detailed in Table 1 and depicted in Figure 4.

Table 1. Breakdown of existing septic connections in CLES.

Type of Connection	CLES No. of Connections
Total Lots (Residential)	49
Existing Connections	40
Not yet Connected	9

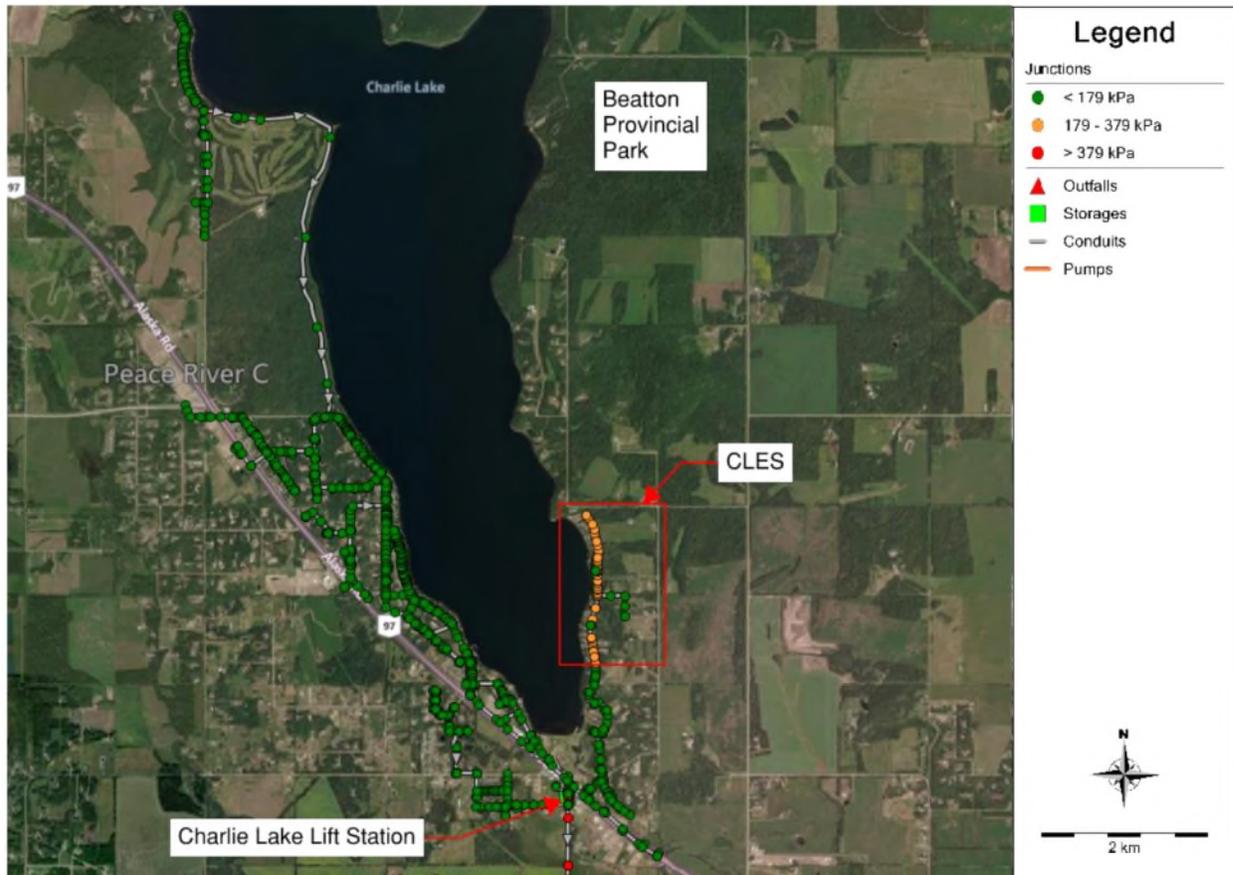


Figure 4. Charlie Lake East Side Collection System Connections as Modeled in PCSWMM

In the CLES, each residential connection has a septic tank and an effluent pump. The individual effluent pumps convey flow from the septic tank into the sewer collection system. The exact configuration of each individual septic tank and make/model for individual effluent pumps is unknown as this infrastructure is the property of the individual homeowners and the systems are not maintained or operated by the PRRD. The PRRD has sent out surveys in the past in an attempt to obtain information related to this infrastructure and

has been unsuccessful in obtaining valuable information to assist with the assessment of the sewer collection system in this area.

This area of the collection system is pressurized, with pressures ranging from 0-271 kPa (0-39 psi), due to elevation changes in this area. The individual effluent pumps must be sized to overcome the system pressure of 271 kPa (39 psi). If a pump cannot overcome the system pressure, it will dead head and flows will back up in the septic tank. Eventually, the tank will overtop and lead to flooding.

In the past, instances of septic tanks in this area overtopping have occurred, and the PRRD has been contacted for support. So far, these have been isolated incidents and are not recurring.

2.1. HISTORY

Based on the GIS data provided, sewer system construction began in 1991 with most of the sewer system construction taking place in 1992, with some upgrades done in 2015. There is limited design or construction information for the various segments of the sewer system.

No condition assessments have been conducted on the system as there are no points of entrance or egress for personnel or cameras.

2.2. PRIVATELY OWNED SEWER SYSTEM INFRASTRUCTURE

The individual septic tanks in this area are likely either one chamber with a baffle wall, or two separate chambers. This allows the solids to settle in the bottom of the tank, and then the effluent enters the pump chamber where the effluent pump is housed. Once the water level reaches the pump start level in the pump chamber, the effluent is pumped into the low-pressure sewer collection system. As these systems are owned and maintained by residents, there is likely variability between lot components.

While the practice of connecting weeping tiles or downspouts to septic tanks is prohibited by Bylaw No. 2496, the PRRD suspects that many individuals may have such connections. These influent septic system flows result in increased flows during rain events, as runoff is directly entering the sewer system. Consequently, the system has less capacity for actual wastewater flows during these events.

2.2.0. Effluent Pumps

Based on conversations with a local contractor in 2023, there are two models of effluent pumps typically used by residents in the Charlie Lake area:

- Goulds WE0511HH, Submersible Effluent Pump, Model 3885, Series WE, 0.5 hP
- Goulds WE1512HH, Submersible Effluent Pump, Model 3885, Series WE, 1.5 hP

Although it is estimated that approximately 75% of the Charlie Lake's pumps are 0.5 hp, the CLES is a higher pressure zone and it is assumed that most, if not all, of the pumps are 1.5 hp in this area. If a pump was not at least 1.5 hp, the homeowner may experience difficulties with their septic tank overflowing and not being able to pump into the collection system with the head required.



2.3. COLLECTION SYSTEM

As mentioned, the CLES collection system is a low-pressure STEP system that has been operating since 1991. The collection system has been expanded over time as new homes were connected. The system infrastructure has a variety of pipe ages, materials, and sizes resulting from inconsistent connection permit approvals. See Figure 5 for a map showing the eastern most branches of the sewer service area, with Branch 24 being the focus of the CLES.

2.3.1.Pipes

The collection system consists mainly of PVC pipes with some sections of unknown material. See Table 2 for a summary of CLES Branch 24 pipes based on the existing GIS information.

Table 2. CLES Collection System – Pipes

Pipe Size (mm)	Pipe Material	Length of Pipe in CLES (m)	% of Total CLES Pipe
75	Unknown	70	3.5%
	PVC	1,522	75.4%
50	Unknown	426	21.1%
TOTAL		2.0km	

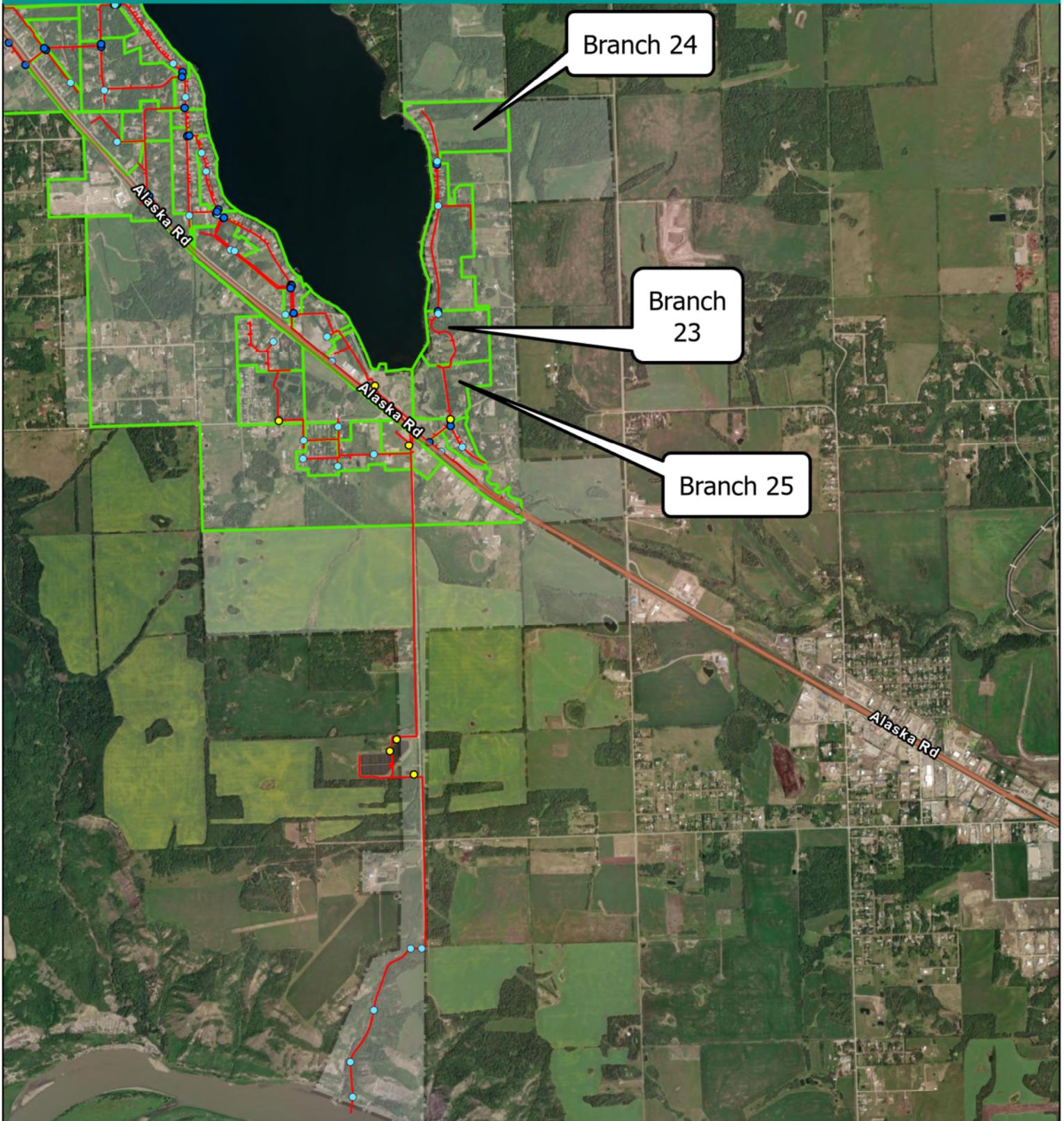
2.3.2.System Pressures

In 2020, Aquatech worked with the PRRD in preparing the Charlie Lake Collection System Component Record, that reviewed the location and condition of several areas of the sewer collection system, including the CLES area. The investigation included:

- Documenting accurate locations of blow offs, valves, manholes, and flow meters.
- Recording system pressure measurements across multiple locations.
 - The pressure recorded across the system varied between 0-7 kPa (0-1 psi).
 - However, at the CLES blow offs, pressure readings could not be obtained. This was either due to insufficient pressure levels that prevented accurate data collection, or because the isolation valve at the blow offs was in the closed position, rendering the section inaccessible for measurement during the pressure testing (see Section 2.3.6 for more details on the blow-off valves).

Based on the PCSWMM model, system pressures should range between 0-271 kPa (0-39 psi). The pressure can increase at the high points when there is a high point downstream causing flows to backup.





Charlie Lake East Side
Existing Sewer System Map

Figure 5. Charlie Lake East Side Existing Sewer System Map

1:40,000



Coordinate System: NAD 1983 UTM Zone 10N
Projection: Transverse Mercator



LEGEND

- Flow Meter
- Main Valve
- Air/Blow off Valve
- Sewer Pipe System
- Branch Zones
- Charlie Lake City Extent

2.3.3. Service Connections

The PRRD GIS has documented some of the service connections as being 38 mm PVC based on the associated sewer connection permit records. However, the majority of the service connection sizes and materials are unknown since the connections have been left to the homeowners. The size and material of the pipes may vary between connections.

The 2023 CIP recommended a field verification program to confirm the locations of existing service connections. Although the program began in 2024 as planned, not all connections were identified. As a result, verification efforts continued into 2025 and are being finalized during the preparation of this report to confirm the total number of service connections.

2.3.4. Flow Monitoring

According to the 2023 Charlie Lake CIP, all flow monitoring stations are situated on the west side of the sewer collection system. No stations are currently located within the CLES boundary.

2.3.5. End Caps

There are two end caps in the northern portion of the CLES collection system, located where the sewer main dead ends:

- One is at the far north end of Paradise St.; and
- One is at the rear property line of 13175 Sunnyside Dr.

If there is a need to extend the sewer main in these areas, the end cap can be removed, and additional piping can be added provided the downstream system has capacity for additional flows.

2.3.6. Valves

There are two blow-off valves in the CLES Branch 24 area on the north side of Paradise St., based on GIS. There are no records regarding the condition or pressure rating of these valves in the CLES. Record Drawings appear to use the phrases “blow off” and “air release” valve interchangeably, and a detail of these valves is shown in Figure 6.

Based on the original As-Built drawings, a single valve was identified within the CLES region. However, its visual condition was not documented during the 2020 Aquatech investigation. There was no additional information provided in the report on this valve, likely because the valve was buried or not housed within an accessible chamber.



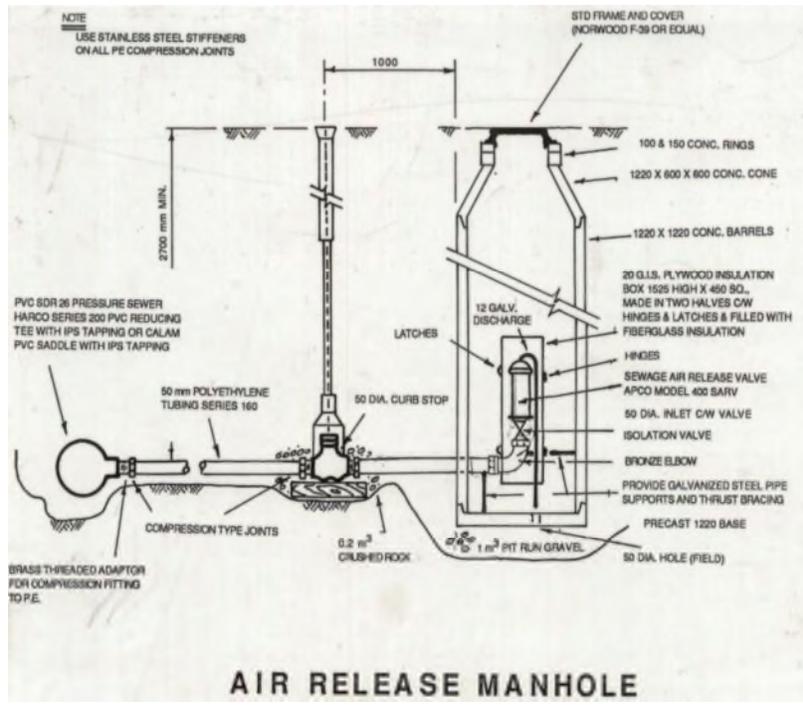


Figure 6. Air Release / Blow Off Detail from 1992 Record Drawings

Table 3 summarizes the valves and structures in the CLES area.

Table 3. CLES Branch 24 Area - Summary of GIS Documented Valves and Structures

Feature	Quantity	Feature	Quantity
Blow-off	2	Gate Valve	1
Curb Stop*	40	End Cap	2

*The number of curb stops recorded in this report may not match the number of units connected to the sewer collection system. As the GIS data will be updated based on field verification efforts to be completed after this report submission, once the field verification program is completed these numbers may change.

3. Future Connections

3.1. POPULATION AND GROWTH CONSIDERATIONS

Census data is available for the Charlie Lake area for the years 2011, 2016, and 2021. Prior to 2011, Charlie Lake population data was combined with regional data. The population was steady between 2011 and 2016, and then there was a 6% decline between 2016 and 2021 (Figure 7).

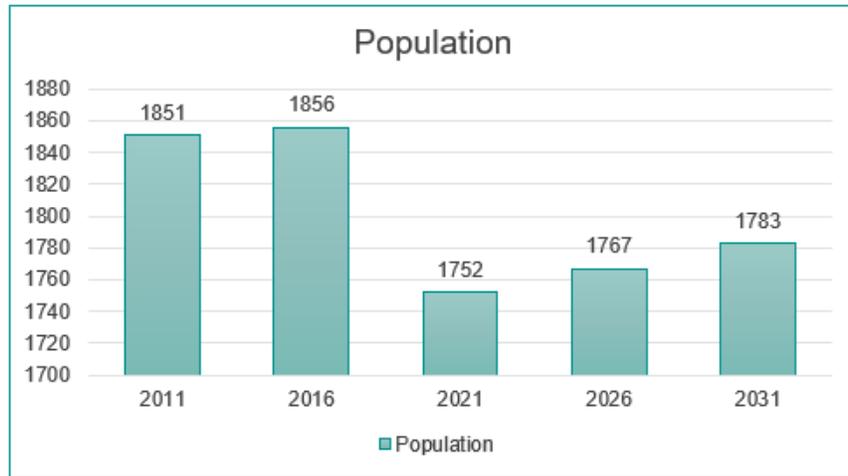


Figure 7. Census Data and Population Forecasting

However, based on developers’ interest in new housing projects in 2022 and 2023, and using an average household size of 2.7 people along with a projected annual growth rate of 0.9%, the 2023 CIP anticipates moderate population growth. This estimated that approximately 11 of the 168 proposed homes will be occupied over the next decade.

3.2. FUTURE SEWER CONNECTION PROJECTIONS

There are no plans currently for significant system expansion beyond the existing sewer service area. Within the existing CLES Sewer Service Area Boundary in Branch 24, there are currently 49 residential lots. Of these lots, 40 lots are currently connected to the sewer collection system, leaving 9 residential lots to be connected.

PRRD has reviewed previously submitted sewer connection permits and building permits to confirm these numbers, and was undertaking field verifications at the time of writing this report to identify undocumented sewer service connections in Charlie Lake.

Based on discussions with PRRD staff, there are typically 3-4 sewer connection applications submitted each year. However, some of the unconnected lots cannot connect to the system as infrastructure currently does not exist.

4. Modeling

4.1. LOW PRESSURE SEWER SYSTEMS

With STEP (Septic Tank Effluent Pump) collection systems, some biological pre-treatment of wastewater is provided in individual septic tanks at each connection (house or building) in which solids are also allowed to settle. An effluent pump is used to pump the liquid waste to the collection system. Solids in the wastewater have the potential to cause obstructions in collection systems, however, the pre-treatment of waste in the septic tanks prior to reaching the collection system reduces this risk.

Since solids settle in the septic tanks, the sewer mains and pumps need not be designed to carry solids. Rather than using larger diameter pipes designed to have uniform gradients to maintain a self-cleansing velocity (seen in gravity systems), the sewer main diameters can be smaller and slopes can be variable, following the topography of the ground.

For this type of sewer system, the ideal velocity range is 0.6 m/s to 3.0 m/s to keep the system clean and prevent cavitation of pipes. Refer to the 2023 CIP for additional details on STEP systems.

4.1.1. Level of Service

In a low-pressure sewer system, the level of service can be defined by:

- On-site septic tanks not overflowing.
- Effluent pumps being capable of overcoming the existing sewer main pressure.

To achieve the above level of service in Charlie Lake, septic tanks and effluent pumps must be appropriately sized for each individual lot. The PRRD does not have information currently available regarding the sizing of the individual septic tanks and effluent pumps as they are private property. Refer to Section 2.2 of this report for more details.

4.2. CHARLIE LAKE MODEL DEVELOPMENT

As part of the 2023 Charlie Lake CIP a model was developed for the Charlie Lake Collection System to be used as a Capacity Tool. As the model was set up using the Rational Method instead of the Probability Method, the model is conservative as it applies an average daily demand to all homes instead of using staggered pumping across the connections. Therefore, the model runs assumed that all connections were pumping simultaneously, with no probability function applied, to establish the HGL. This method was chosen as there was insufficient effluent pump information to accurately model the system using the Probability Method.

For additional information on the model development methodology, model set up and model assumptions, refer to Section 5 of the 2023 Charlie Lake CIP.



4.2.1. Field Verification

This model was updated in February 2025 to integrate the field verification work completed in 2024, per the 2023 CIP recommendations. Field verification efforts included locating and surveying the existing curb stops, system valves, and other sewer system infrastructure. Surveyed information was used to confirm which homes in the system were and were not connected to the collection system, however, some infrastructure was not able to be located in the field for various reasons.

A continuation of the field verification program was launched in 2025 and is being completed at the time of this report. Once the review of collected data is completed, the number of existing connections in this report and in the model may need to be updated to reflect surveyed information.

4.2.2. Modeling CLES

The updated model was utilized to assess the CLES and determine possible solutions to the previously documented deficiencies. These deficiencies include:

- High wet weather flow impacting sewer main capacity
 - potentially I/I of the pipe network
 - potentially weeping tile connections
- Lack of redundancy and alternative measures, indicating risk should a sewer main break occur

When modeling options for addressing the above noted deficiencies, a peak flow rate of 0.015 L/s was estimated for future flows, based on MMCD Guidelines, which assumes an average of 2.7 persons per household. A peaking factor of 2.84 was calculated from provided lift station flow data and applied to the future flow rates. This peaking factor accounts for Freshet where the system experiences an increase in flows.

To determine if the 75mm sewer main that collects and conveys flows in the CLES has capacity for the connection of the remaining lots in this area, the residential connections in Branches 23, 24, and 25 were modeled using future flow rates. By increasing the flows rates for the entire east side of the sewer collection system (not just Branch 24, CLES), the model accounts for potential impacts from the downstream portion of the system during peak flows and ensures the modeled options are not creating concerns elsewhere in the sewer collection system.

When the future flow rates were modeled, it was noted that system pressures increased in the CLES, which could result in individual effluent pumps dead heading, or not being able to push flows in the sewer collection system. This would depend on the individual effluent pump, as some might be maxed out currently, and the increase in system pressure could cause them to no longer be sufficient.

4.3. MODEL RESULTS AND OPTIONS ANALYSIS

Five options were modeled to address the high pressures in the existing 75mm sewer main servicing Branch 24, with an additional three options investigated that were not modeled. These scenarios were run using the future flow rate of 0.015 L/s for all connections on the east side of the lake estimated in the 2023 CIP. The five scenarios were:



1. Regional Lift Station with Dedicated Forcemain
2. Regional Lift Station with Shared Forcemain
3. Upsized Sewer Main
4. Twinned Sewer Main
5. Secondary Forcemain Loop

These options are discussed in more detail below. For all of the figures in the following section:

- **Green** dots (Junctions) are low pressures (0.5 hp pump is adequate),
- **Orange** dots are medium pressures (1.5hp pump required), and
- **Red** dots are high pressures (forcemains).

4.3.1.Option 1 - Regional Lift Station with Dedicated Forcemain

This option involves constructing a new wet well and pumping system at a lower elevation in the sewer collection system. This reduces the pressure in the system, therefore allowing smaller horsepower effluent pumps to easily discharge into the collection system.

The effluent would discharge into the new wet well through the existing 75mm sewer main. The wet well contents would then be pumped through a dedicated forcemain, connecting to the existing main over the hill on Krackling Cove Dr. See Figure 8. The lift station would be fitted with level sensors to automatically control the operation of the pumps.



Figure 8. Lift Station with Dedicated Forcemain Model Result

Various pump types were modeled, and based on the modeled hydraulic grade, a pump capable of producing approximately 22 m of static lift plus pipe friction losses would be required.

To reduce system head losses and the required pump rating, a new 100mm forcemain, rather than a 75mm line, would be directionally drilled parallel to the existing 75mm main and on the east side of the roadway.

Velocities in the 100mm forcemain were within the ideal range of 0.6-3.0 m/s and system pressures were reduced. See Figure 9.

Further model refinement is recommended to determine the optimal pump size, forcemain diameter, and location of the wet well. The lift station could be located anywhere along Paradise St, however installation at a low point would impact the most effluent pumps and allow the system to operate by gravity in the event of a break. It is also important to note that individual services should not be allowed to connect to the dedicated forcemain, as it would subject the effluent systems and check valves to higher pressures than intended, potentially leading to damage. Care would be necessary to ensure lot owners are aware of this prohibition.

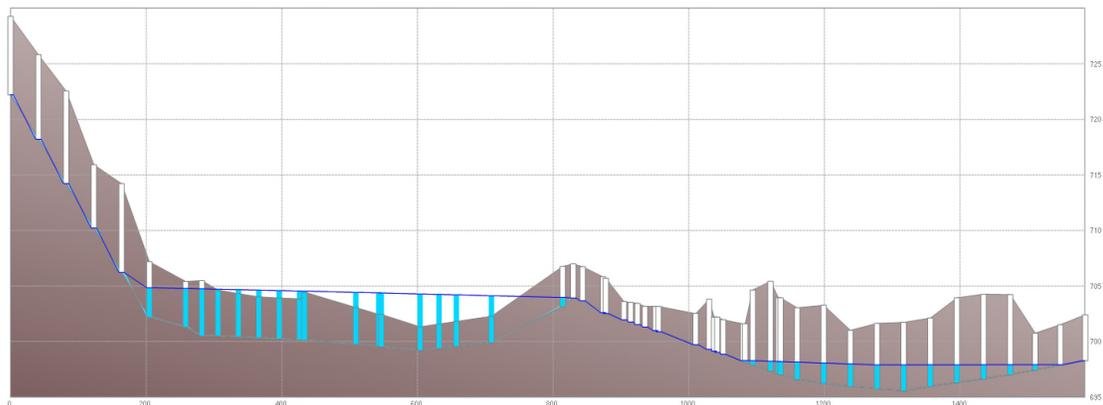


Figure 9. Existing 75mm Sewer Main Pressures with Lift Station and Dedicated Forcemain

Pros: This option provides redundancy and alleviates local system pressure as the septic pumps would no longer be required to pump over the hill, mitigating the risk of back flow into the septic tanks and of individual check valve failures. It creates a central discharge location with effluent storage. It also provides increased flexibility with lift station location and acceptable types of effluent pumps, while allowing some services able to discharge by gravity.

Cons: The high capital cost for the lift station and separate forcemain, creating usable space for the wet well, and periodic operations and maintenance requirements are the key disadvantages. There is potential for odours if ventilation and sealing system are not managed. Also, the pumps and electrical system would likely require a 3-phase power service. Investigations into available power in the area revealed that only single-phase power is available – a service upgrade or advanced VFD may be required to accommodate the pumps.

4.3.1.1. Lift Station Location

The lift station site must consider the hydraulic design as well as constructability, cost, and operational benefits. The lift station could be installed anywhere along Paradise St.; however, two ideal sites were identified:

- **Site 1:** 13265 Paradise St, on the east side of the road
- **Site 2:** 13129 Paradise St, at the dead-end turnaround.



Site 1: A lift station at Site 1 - 13265 Paradise St would result in minimal disturbance to residents (including visual, odour, and noise disturbance during construction and operations) and potentially be located out of the public right-of-way if the PRRD obtains a statutory right of way. See Figure 10.



Figure 10. Lift Station at 13265 Paradise St.

However, this site requires a forcemain approximately 1km longer than the Site 2 option, and several service connections would result in potential utility conflicts during installation of the forcemain.

Site 2: To minimize the forcemain length and capitalize on available space, a lift station could be located at 13129 Paradise St within the road's turnaround right-of-way, at an approximate ground elevation of 708 m. See Figure 11.

If needed, a dedicated right-of-way for the lift station, likely 6m x 6m, can be established with minimal impact to the road or neighbouring properties.

An existing sewer right-of-way (PGP37582) contains the existing CLES 75mm sewer main and runs directly from Krackling Cove Dr through the Paradise St turnaround, presenting an opportunity to easily utilize it for the new lift station's



Figure 11. Lift Station at 13129 Paradise St.

dedicated forcemain. The sewer right-of-way would allow construction crews access for the forcemain drill entry and exit points, as well as any necessary valve installations and tie-ins.

The pros and cons related to each Lift Station site are summarized in Table 4.

Table 4. Lift Station Site Options - Pros and Cons

Address	Pros	Cons
1) 13265 Paradise St.	<ul style="list-style-type: none"> • Not next to homes; on private land • Central location and longer pipe – more redundancy 	<ul style="list-style-type: none"> • Longer pipe – higher construction costs • Several service crossings; complexity • Coordination with other utilities • Within Ministry right-of-way
2) 13129 Paradise St.	<ul style="list-style-type: none"> • Shorter pipe – lower construction costs • Very few service crossings 	<ul style="list-style-type: none"> • Close to homes; potential for complaints • Archeological assessment and MoTT permits • Less redundancy

Both locations are local low points, and modeling for both options resulted in lower system pressures. Between the two locations, 13129 Paradise St has a larger existing public right-of-way, would have minimal service crossings, and would need a much a shorter forcemain. For these reasons, 13129 Paradise St was seen as the more favourable location and is the location the cost estimate is based on. Pricing for 13265 Paradise St is included for comparison in Appendix A in the case other external factors make this location preferable.

4.3.2. Option 2 - Regional Lift Station with Shared Forcemain

A lift station was modeled at 13177 Paradise St and connected to the existing 75mm sewer main, essentially acting as a booster pump to alleviate upstream system pressures. This location was chosen as a natural low point in the existing sewer system and similar to Option 1, various pump types were investigated.



Figure 12. On-Line Lift Station Model Result

This Option did not provide pressure relief for upstream connections, and increased pressures by a significant amount for downstream connections when the pump was running (see the red dots in Figure 12). It also increased velocities in the upstream sewer main by subjecting the flow to the pump's operating flow, often higher than the relatively low combined individual lot discharges. Overall, the model did not present this option favourably in terms of hydraulic or level of service improvements.

Pros: Reduced pressures upstream of the lift station and maintains consistent flow during peak periods. Lower cost than Option 1 as it does not require a new dedicated forcemain.

Cons: Higher pressures downstream of the lift station, resulting in additional stress on the individual check valves. If one of these check valves failed, flow would potentially be diverted into the septic tank instead of up the hill, which could result in overflows.

Additionally, effluent pumps cannot discharge when the lift station pumps are in operation, which increases the potential risk for septic tanks to backup if lift station pumps are running for an extended period of time. This Option does not provide additional redundancy in the event of a sewer main break, and the location of this lift station is also a concern as there is little public ROW space available.

4.3.3. Option 3 - Upsizing the Sewer Main

To provide a larger flow capacity and additional storage in the pipes, the existing 75mm sewer main was increased to 100mm from 13253 Paradise St to Krackling Cove Dr.



Figure 13. Upsized 100mm Sewer Main Model Result

A 100mm pipe with matching physical characteristics to the existing 75mm sewer main was modeled and results indicated that the upsized pipe did not significantly reduce pressure in the system, due mainly to the identical static head up the hill to Krackling Cove Dr. Overall, the positive hydraulic impacts were not significant enough to notably improve the level of service of the system. See Figure 13.

Pros: This option increases the system storage capacity and decreased headlosses due to the larger pipe. The upsized pipe also provided some surge capacity during the peak flows, mitigating sudden pressure increases.

Cons: The pressure relief was not enough to reduce system pressures below the 1.5 hp pump threshold (179 kPa), as seen in the figure above. Low velocities were also observed throughout Branch 24. Other disadvantages include the capital cost of replacing or bursting the sewer main, need to disconnect and reconnect all the services, and failure to provide system redundancy in the event of a main break.

4.3.4. Option 4 - Twinned Sewer Main

This option is similar to upsizing the sewer main, and involves increasing the capacity of the sewer main and providing flexibility for the system in the future with respect to redundancy and rerouting flows.

A 75 mm twin sewer main would be installed on the east side of the roadway parallel to the existing 75 mm sewer main from 13253 Paradise St to Krackling Cove Dr. This sewer main would tie into the existing system on the north and south ends of the pipe and provide a means of re-routing flows during maintenance activities or during an emergency situation. See Figure 14 for modeling results.

This twinned line would ideally remain isolated (valves closed) except during maintenance activities or emergencies to provide an alternate flow route for residents in the area. If there was an emergency and the sewer main broke, this pipe would provide alternate routing access to sewer collection system, or could provide some additional storage while emergency repairs were made.

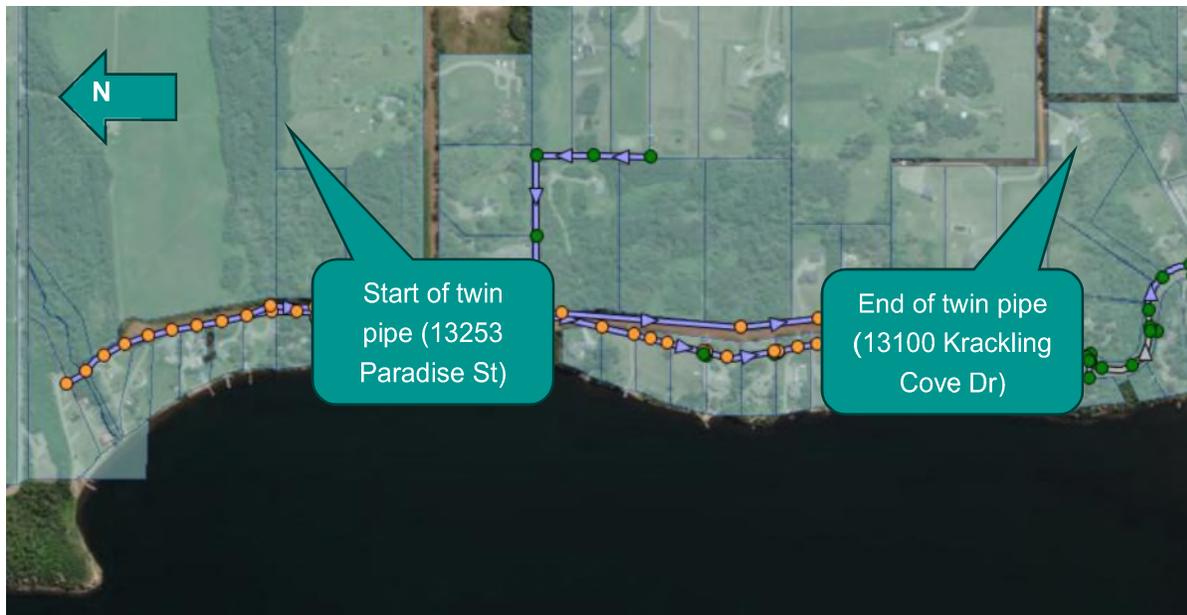


Figure 14. Twinned 75mm Sewer Main Model Result

In a worst-case scenario, during a sewer main break on the north side of the 13253 Paradise St tie in, operators could close valves and quickly isolate the system to reduce the volume of effluent leaving the system. The 33 homes south of the tie in could continue to discharge into the system and not be impacted by the break, whereas the existing system would have the entire CLES out of operation.

If there was a sewer main break between the tie in locations, valves could be opened to allow flows to equalize between the two pipes and reduce the amount of effluent leaving the system. Once equalized, the valves could be closed to isolate the broken portion of the system and allow the northern 5 connections to continue to use the sewer collection system while repairs are made.

As this line would primarily be kept closed, new sewer connections should not be made to this line as the flows would be trapped in this pipe and eventually lead to the septic tank overflowing.

Pros: This option provides system redundancy, extra surge attenuation, as well as potential for increased capacity in the future. This option also provides some support during an emergency situation with additional storage capacity and allowing some homes to continue to use the collection system.

Cons: The disadvantages are the manual operation staff intervention to divert flow to this line, the need to ensure no new connections are made to this line, and minimal reduction in system operating pressures.

4.3.5. Option 5 - Secondary Sewer Main (Loop).

Looping the system to the east was modelled to determine if a secondary flow path would alleviate pressures. This looped conduit followed topographical features on a new alignment, and the new high elevation was 740.6 m, nearly 11 m higher than the current high elevation of 729.3 m. Flows would not enter this pipe unless forced to do so by closing the existing main.

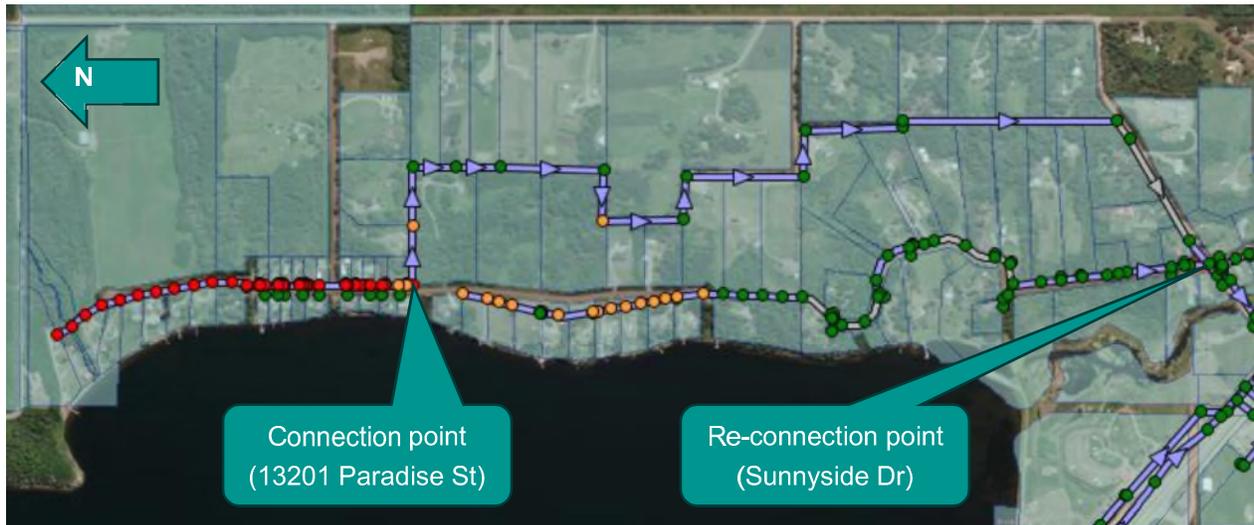


Figure 15. Secondary Sewer Main Branch Model Result

The goal for this option was to provide some system redundancy if the other line was down for maintenance or emergencies. However, as can be seen from Figure 15. Secondary Sewer Main Branch Model Result the system pressures are too high (red dots) and existing effluent pumps would not be able to overcome this higher head. If effluent pumps cannot overcome the head, then septic tanks would start to overflow.

Pros: Provides service to currently un-served properties.

Cons: Piping would be approximately twice as long as other options, and land acquisitions would likely be required. This upgrade also increases pressure in the sewer main; therefore, some septic tanks would overflow as effluent pumps would not be able to discharge at the higher pressure. Other disadvantages are the risks associated with looping a low-pressure sewer, which can result in flows not being conveyed in the desired direction, gas buildup, and effluent going septic.

This option had too many disadvantages to be considered further.

4.3.6. Potential Solutions not Modeled

Potential solutions to alleviate the capacity issues of the sewer main in Branch 24 include:

- The addition of storage tanks or surge tanks, and
- Modification of effluent pump controls. These are point of use controls that would be for future connections, as upgrading the existing connections would be expensive, challenging to coordinate with homeowners, and difficult to maintain.

These options were not modelled due to lack of septic systems details, but are discussed further below.

4.3.6.1. Option 6 - Surge Tanks

A surge (equalization) tank is an intermediate tank that temporarily stores effluent before it's pumped into the sewer main. It helps with flow equalization, collecting effluent and releasing it in controlled doses, preventing frequent pump cycling and reducing the number of homes discharging at peak times of the day. It also buffers sudden pressure changes in the sewer main, reducing water hammer and stress on pipes and fittings.

Pros: Improved resiliency of individual effluent systems and peak surge reduction for sewer network, without impacting existing pumps.

Cons: Complex to implement and retrofit on existing systems, homeowners may not be in favour, costly on per lot basis, and effective attenuation depends on how long the surge is.

4.3.6.2. Option 7 - Pump Effluent Controls

Pump effluent controls manage the timing and conditions under which the individual septic pumps operate.

- Level sensors or float switches can start the pump when a high level is reached,
- Pressure sensors in the sewer main can delay the pump from starting to avoid discharging into an over-pressurized line,
- Timers can be used to start the pumps at set time intervals regardless of tank level staggering the flows during peak times.

Pros: When combined with a surge tank, these controls can be an effective solution for balancing the flow and pressure in the sewer main. Staggered pumping maintains more consistent flow conditions through the sewer main whether it is twinned or upsized, helping prevent turbulence and potential backups. Additionally,



staggered pumping helps optimize energy use and reduce electrical demand spikes. Integrating this control system into an automated system can add another layer of resilience and efficiency.

Cons: Adding the controls for all the existing pumps would be complex, relies on homeowner compliance, and will require more maintenance and inspections.

4.3.6.3. Option 8 - Emergency Storage Tank

This option was discussed in Section 6.12 of the 2023 CIP. Emergency storage tanks strategically located at the low points of the CLES system could provide temporary relief for the system in the case of a sewer main issue. The storage tanks would be isolated until a valve is manually opened, allowing them to fill with effluent. Operations staff could manually pump out the effluent once the sewer main is repaired. A mobile storage tank as opposed to permanent tank could also be utilized if funding is an issue.

Pros: Low capital cost option to offer emergency preparedness and redundancy.

Cons: Useful only during an emergency sewer main break, manual intervention and operation required, requires mobile pumping equipment, and limited space available.



5. Upgrade Options and System Recommendations

The CLES sewer collection system has been evaluated based on available information including discussions with PRRD staff and operators, existing record drawings, and previously prepared reports. As more information is collected on the CLES in the coming years, this plan may need to be updated or revised.

The options for upgrading the CLES system are based on our 2023 CIP recommendations, and the options analysis completed herein. Modeled options were assessed for effectiveness, redundancy, and overall cost and advantages and disadvantages of each option is summarized in Table 5.

Table 5: Summary of Benefits and Limitations of CLES Upgrade Options

Option	Benefits	Limitations
1. Regional Lift Station with Dedicated Forcemain	<ul style="list-style-type: none"> Reduces system pressures by converting some low-pressure pipes to gravity feed Additional effluent storage Creates a central discharge location 	<ul style="list-style-type: none"> Requires pumps and electrical systems that need monitoring and maintenance Causes odors if ventilation and sealing systems are not managed Requires large space for wet wells, control and access
2. Regional Lift Station with Shared Forcemain	<ul style="list-style-type: none"> Maintains consistent flow during peak periods Reduces system pressures for connections upstream in Branch 24 	<ul style="list-style-type: none"> Creates increased stress and pressure at downstream service connections Downstream effluent pumps may not be able to overcome high system pressure
3. Upsizing the Sewer Main	<ul style="list-style-type: none"> Increased capacity, with some surge relief Well suited to steady high flow rather than rapid surges 	<ul style="list-style-type: none"> Possible slower velocities under low use conditions, potential sediment buildup in the main. Complexity in reconnecting existing services. No system redundancy
4. Twinned Sewer Main	<ul style="list-style-type: none"> Increases storage capacity Provides extra surge attenuation Increased system redundancy 	<ul style="list-style-type: none"> Manual operation during maintenance and emergencies only Little pressure relief
5. Secondary Sewer Main Loop	<ul style="list-style-type: none"> Potential to service new lots No change to existing sewer connections 	<ul style="list-style-type: none"> Increased pressure ⇒ overflow potential 2x longer than other twinning option Land acquisition required
6. Surge (Equalization) Tanks	<ul style="list-style-type: none"> Absorbs sudden surges No impact on pumps Buffers pressure 	<ul style="list-style-type: none"> Effective attenuation depends on how long the surge is. Reliance on homeowner's compliance.
7. Effluent Pump Controls	<ul style="list-style-type: none"> Prevents system overload via timed pumping Targeted impact on peak surges 	<ul style="list-style-type: none"> Complex programming req'd Reliance on homeowner's compliance.
8. Emergency Storage Tanks	<ul style="list-style-type: none"> Low capital cost Some system redundancy 	<ul style="list-style-type: none"> Manual valve operation and storage tank pump out Limited space available Emergency response only



Two of the above options were ruled out and removed from further analysis because they introduced new risks or did not provide any benefit.

- **Option 2 – Regional Lift Station with Shared Forcemain** was ruled out due to its increased risks to downstream connections and low feasibility of construction.
- **Option 5 – Secondary Sewer Main (Loop)** was ruled out due to its lack of use and increased system pressures.

The remaining short-listed options were analyzed further based on the following criteria:

- Surge Reduction Effectiveness
- Ease of Implementation / Construction
- O&M Costs
- Long-Term Resiliency / Redundancy
- Maintenance Requirements

Each of these criterions were assigned an **importance factor (IF)** or weighting based on how important the implementation of the criteria is to the overall system (10 being most important, 1 being least important).

Parameter ratings (PR) were assigned for each Option based on the above criteria and given a score from 1 (low / does not meet criteria) to 10 (high / fully meets criteria).

Finally, the **weighted average** was calculated by multiplying the **IF** by the score for each criterion and totalizing these numbers.

The summary of the results is presented in Table 6 below.



Table 6: CLES Options Analysis and Key Implementation Considerations

Criteria	IF	Lift Stations	PR	Twinning with 100 mm Main	PR	Upsizing the Main	PR	Emergency Storage Tanks	PR	Effluent Pump Controls and Surge Tanks	PR
Surge Reduction Effectiveness	10	Moderates elevation related surge and can regulate flow intervals	10	Provides added capacity and reduces pressure during peaks	8	Increases flow capacity and contains surges	8	Temporarily stores excess water during peak periods	8	High responsiveness to flow changes; Can stagger pump start times	9
Implementation Feasibility	9	Common practice and prefabricated units available for installation	8	Moderate complexity and requires excavation and pipe installation	7	Disruptive to existing infrastructure during implementation	3	Requires space and site design	5	Easily retrofitted in existing systems; Requires control system integration	2
Cost Efficiency (Operational Cost & Maintenance)	8	High capital cost; Mechanical & electrical costs; Energy & inspection requirements	4	Higher upfront cost and low operation cost	7	High capital cost and lower long-term operating costs	7	Upfront cost to purchase tanks	9	Low to moderate cost Minimal added infrastructure	4
Long-Term Resilience (Redundancy)	8	Customizable capacity and can be upgraded modularly	10	Extra pipe serves as backup and redundancy; needs manual operation	7	Built for future capacity needs but low flows in the interim	5	Emergency response only, needs manual operation	3	Adaptive to future flow fluctuations; Tech-upgradable	6
Maintenance Requirement	7	Pumps and systems need periodic overhaul. Medium to high general maintenance requirement	5	Low maintenance is required; Annual inspection required	8	Lower wear and clog risk	10	Requires regular cleaning and odor management	2	Routine system checks; Low physical maintenance	6
Weighted Average		319		311		273		235		230	

* Important factor (IF): 1-10; with

* Parameter Rating (PR): 1-5 is Poor; 5-7 is Moderate; 8-10 is Good

Based on the results above, the lift station with a dedicated forcemain (Option 1) and twinning of the sewer main (Option 4) scored the highest.

These options both provide redundancy and increase system capacity; however the lift station provides pressure relief and surge protection. The additional lift station benefits must be weighed against the increased construction and O&M costs.



5.1. SYSTEM UPGRADE RECOMMENDATIONS

The collection system recommendations resulting from the options analysis and evaluation of the CLES sewer collection system are summarized in Table 7.

As both options address system rerouting, emergency response, and future capacity for the sewer collection system, only one option needs to be implemented. The additional benefits of the lift station need to be weighed against the costs of construction and ongoing maintenance for the PRRD to determine which of the two options is the best overall option for the CLES.

Table 7. Collection System Recommendations

No.	Description	Benefit
ES.C.1	Lift Station with Dedicated Forcemain (see C.8.1 of 2023 CIP)	System rerouting, emergency response, reduced system pressures, overall system robustness
ES.C.2	Twinned Sewer Main	System rerouting, emergency response, future capacity

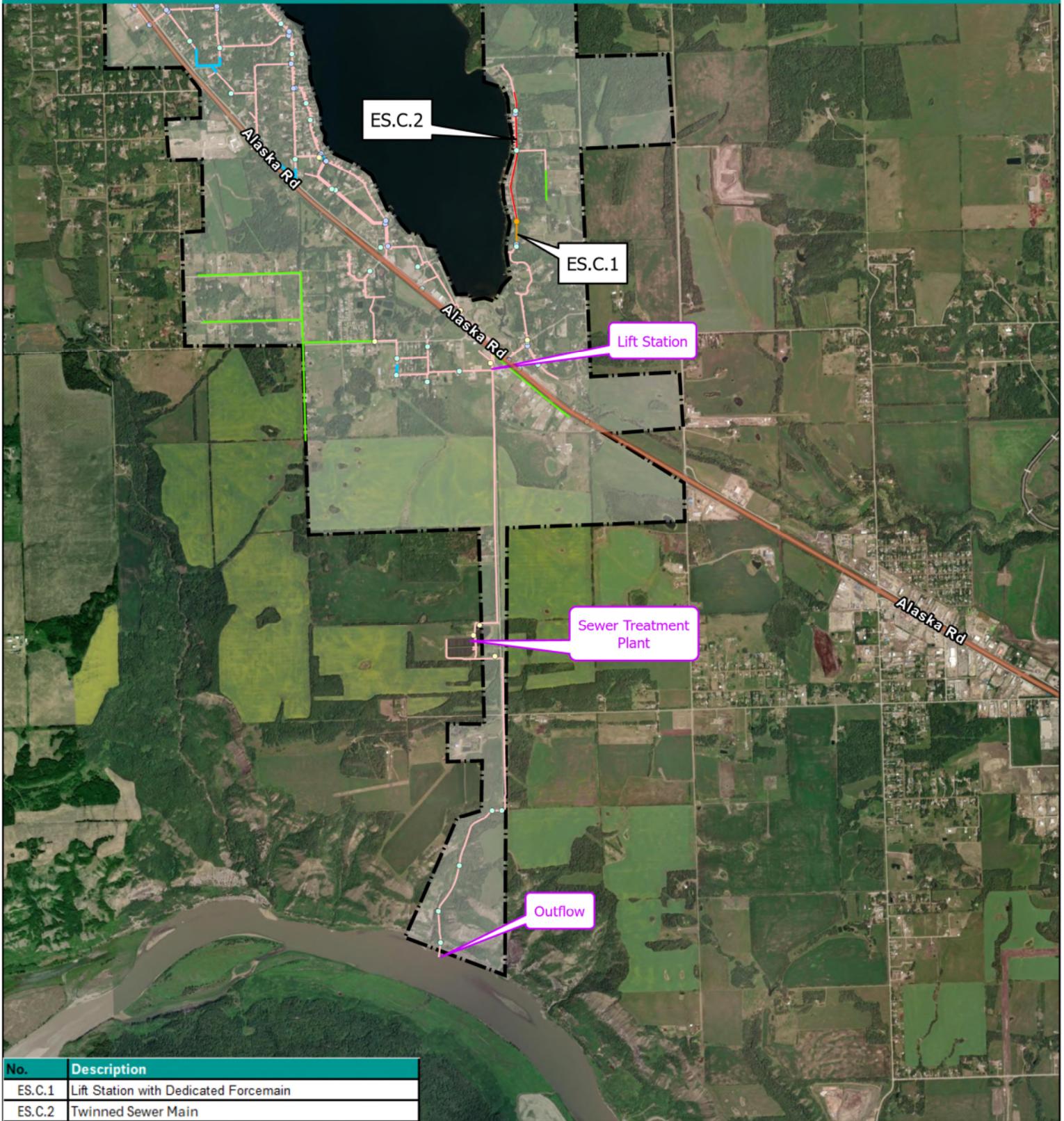
The options are summarized below for ease of reference. Refer to Figure 16 for their locations.

ES.C.1 Lift Station with Dedicated Forcemain – A lift station on Paradise St would relieve the CLES sewer collection system from having to pump up the hill to Krackling Cove Dr, reducing system pressures on the individual effluent pumps. The wet well would act as buffer and provide storage for high flows, and the dedicated lift station pumps and forcemain would effectively push flow up the hill, eventually reconnecting to the existing system. The lift station would provide overall system redundancy, capacity, and emergency resiliency.

The proposed cost-effective solution would be a package lift station which includes a prefabricated wet well, pumps, valves, piping, controls, and a kiosk to house the electrical components. There are also several ways to customize the lift station to suit the municipality’s preferences and budget. Care would be required to ensure future services are not mistakenly connected to this new forcemain.

ES.C.2 Twinned Sewer Main – The twinned sewer main would provide additional flexibility to the system. It could be used in the future if flow rates increase to provide additional storage capacity, or it can be kept closed and used for system emergency response as an alternate flow route and storage. Though the twinned line could provide increased capacity and surge protection, it will not significantly reduce system pressures as the static lift up the hill remains the same. Operations staff would be required to ensure the line is utilized properly and the status of isolation valves is known.

In Charlie Lake, there are other parts of the sewer collection system that have rerouting options installed or recommended to provide service to residents during emergencies or maintenance activities. These redundancy pipes are also not meant to be left open all the time, and require Operations staff to pay attention to valve status. If valves are incorrectly configured, the risk of effluent turning septic increases.

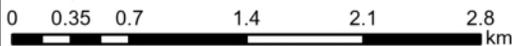


No.	Description
ES.C.1	Lift Station with Dedicated Forcemain
ES.C.2	Twinned Sewer Main

CLÉS - Collection System Recommendations Map

Figure 16. Charlie Lake East Side Collection System

1:45,000



Coordinate System: NAD 1983 UTM Zone 10N
 Projection: Transverse Mercator



LEGEND

- Regional Pump Station
- System Expansion
- Flow Meter
- ES.C.1
- Main Valve
- ES.C.2
- Blow Off/Air Valve
- Charlie Lake City Extent
- Existing Sewer System Pipes
- System Redundancy

6. Construction Feasibility & Cost Estimates

Following the identification of recommended options for upgrading the CLES sewer collection system, it is crucial to review the construction implications of each option to ensure the proposed infrastructure solutions are practical, cost-effective, and compatible with site conditions and regulatory constraints. The recommended options were evaluated based on their construction feasibility and estimated cost, to support and guide infrastructure investment decisions.

6.1. CONSTRUCTION METHODS

Horizontal directional drilling (HDD) is a non-disruptive method of pipe installation used when open-cut trenching is impractical. It allows efficient pipe installation across obstacles such as roads, landscaped areas, and service connections. HDD requires limited workspace, as the only excavations are potholing for utility conflicts, and the start and end of the sewer main.

Multiple factors must be considered when installing a twin sewer main using HDD, including soil and geological factors, utility avoidance, location of entry and exit pits, new sewer main placement, permitting and archaeological assessment, staging, and cost efficiency.

6.1.1. Soil and Geological Suitability

Although a geotechnical assessment has not been carried out on the CLES site, BC Soil Information Finder Tool (SIFT) shows that the site features predominantly silty clay, silty clay loam, and silt loam soils with around 2% coarse fragment and moderate to well-drained characteristics. See Figure 17. This is consistent with material seen elsewhere in Charlie Lake during other sewer main projects.

Installing a twin sewer main using HDD is well-suited to this soil condition. The low coarse fragment content provides minimal risk of deflecting drill or damaging drilling equipment. The fine textured soil provides suitable borehole stability and allows effective use of drilling fluids, making HDD a technically efficient method for a parallel main installation.

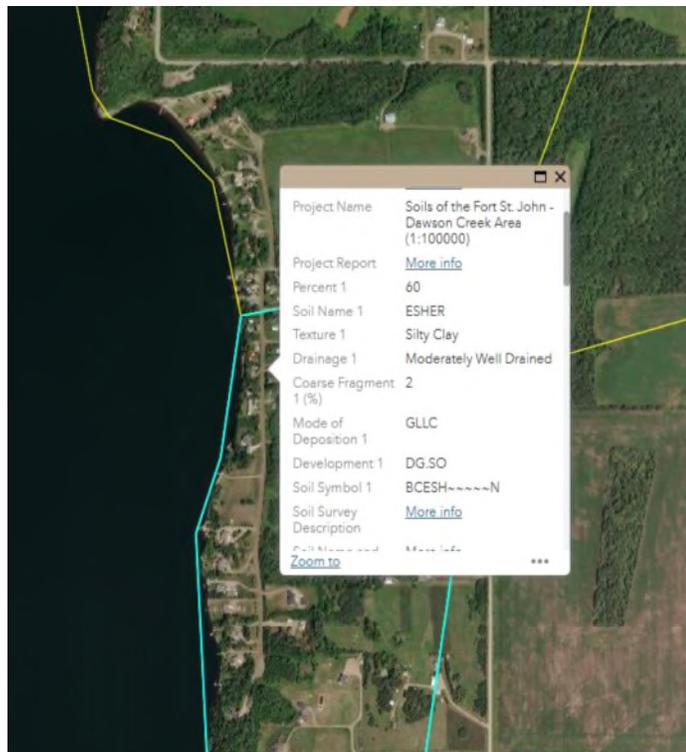


Figure 17. Charlie Lake East Side Soil Texture Profile (BC SIFT)



While general information on the soil composition at CLES is available, a geotechnical investigation may be warranted to obtain site-specific data to make informed decisions regarding placement of sewer system infrastructure.

6.2. LIFT STATION WITH DEDICATED FORCEMAIN

A lift station with a dedicated forcemain provides a robust solution to improve the sewer system's level of service, redundancy, is flexible in location, and is least disruptive during construction.

The proposed package lift station would include key mechanical and electrical components. A contractor would undertake excavation, installation, concrete, piping connections, surface restoration, and commissioning. Electrical upgrades, such as servicing and a potential new transformer, would be completed in coordination with BC Hydro.

The dedicated 100mm forcemain would be installed using HDD, avoiding tree clearing, ground disturbance, and reducing disruptions to private properties. The detailed feasibility and considerations for HDD and the lift station are discussed in the following sections.

6.2.0. Lift Station Design Options

There are several lift station options that could suit the design criteria. The essential components of the lift station can be sourced from various suppliers and include:

- Wet well – concrete or fiberglass, prefabricated or modular with waterproofing
- Piping and valves – plug valves, check valves, piping, and fittings
- Pumps – submersible or suction lift
- Floats – control operation of the pumps and low/high level alarms
- Heating & Ventilation – protect against freezing and harmful gasses
- Electrical equipment – transformer, panels, junction boxes, switches, etc.
- Backup generator – diesel or natural gas

The option of an all-in-one package system with a prefabricated wet well improves component compatibility and streamlines design, construction, and commissioning. It can feature differing levels of controls and quality of life upgrades such as:

- Prefabricated wet well, typically 6m (20ft) depth, with hatch, ladder, safety provisions, and brackets for connection of all components.
- Above-grade heated kiosk to house valves, instruments, electrical equipment, and pumps if desired
- Advanced controls and instruments to adjust and automate operation of the lift station, including a Variable Frequency Drive (VFD), Programmable Logic Controller (PLC), and level sensing technology.



The proposed solution and cost estimate includes the full package of options including above-grade kiosk for funding purposes, but can be adjusted to meet the available funds and needs of CLES operations staff.

6.2.1. Timing and Regulatory Considerations

Considerations for the lift station's design, approval, and construction would include permits, archeological assessment, electrical requirements, lead time for the lift station components, and notifications to adjacent properties.

Timelines for permit review and approval, and lead times for some components, are ranging from 3 to 12 months or more at the time of this report. Permit applications and purchasing of materials should be initiated as early as practical to avoid project delays, and may include the following:

- Permission from MoTT to construct within the road right-of-way.
- Municipal permitting, such as a plumbing permit and building permit.
- BC Hydro servicing design – the lift station may require a 3-phase service upgrade if the existing single-phase power is insufficient. An alternative may be a VFD system which can convert to 3-phase for the pumps. This alternative was utilized in the cost estimate below, as it would likely be less expensive than upgrading the pole to 3-phase power.
- Archeological assessment – A search of the Provincial Archaeological Inventory indicates no recorded archaeological sites within the Area of Interest (AOI) for the lift station. However, the proposed forcemain route crosses an area with archaeological potential. See Figure 18.

6.2.2. Construction Process

The package lift station would be delivered to site and the wet well installed at the design depth. The internal piping, mechanical and electrical components would be installed along with the kiosk. External to the wet well, the inlet and outlet piping will transition to HDPE piping for the forcemain and existing sewer main connection. The lift station's inlet would connect to the existing 75mm sewer main with a wye fitting, to be completed only once the new system has been pressure tested.



Figure 18. Archeological Potential zone (purple) in Project Vicinity

The lift station's outlet, a new 100mm forcemain, would be directionally drilled up the hill to Krackling Cove Dr within the Ministry right-of-way parallel to the existing 75mm (after being located), and will terminate at the existing sewer main high point. The existing air release valve would be replaced with a new valve chamber and air release valve. Construction access to this end point could be via the sewer right-of-way

that runs through 13100 Krackling Cove Dr. Isolation valves are proposed on the new forcemain and existing sewer main to ensure Branch 24 flows are directed to the lift station. They would also provide future flexibility should the lift station need to be bypassed.

Construction should be low impact with a package lift station and directionally drilled forcemain, particularly with the 13129 Paradise St lift station as few, if any, properties would have service connections crossing this alignment and directional drilling avoids shallow utility conflicts, tree clearing, and ground disturbance. The existing system would be kept online during construction and testing until the tie-ins and isolation valve chambers are ready to be completed, ideally in a span of one to two days. Temporary shutdowns, pump out, and trucking of sewage may be required while these works are underway. The lift station would then be commissioned and brought online as part of the CLES sewer system.

Once the components have been delivered and approvals/permits have been received, construction and commissioning of this upgrade project is expected to take two to three months to complete.

6.2.3. Future Service Connections

With the addition of a lift station and dedicated forcemain, care would be required to ensure that prospective developments in the vicinity do not mistakenly connect their service to the dedicated forcemain. The forcemain, particularly in the lower elevation of Paradise St, will be operating at high pressure and can pose serious risks to a service connection, including:

- Increased pressure on individual check valves, leading to higher risk of failure
- Pushing flows backward into the septic tank should the check valve fail
- Inability of effluent pumps to overcome system pressure, potentially backing up septic tanks

Notifications to affected homeowners of this prohibition and proper labelling of the forcemain are recommended.

6.3. TWINNED SEWER MAIN

The new sewer main would be installed on the east side of Paradise Street, parallel to the existing main. This placement aims to optimize ease of construction, minimize costs, and reduce environmental and community impacts. Since the new pipe will not be active during construction, existing connections could be maintained for most of the construction.

The only disturbance would occur during the main line tie-ins, where a valve chamber would be excavated and installed to allow for rerouting of flows. Once the chamber is in place, valves would be set to allow the existing sewer main to operate while the new sewer main is installed.

During tie-in activities, bypassing flows is essential to prevent backups. The existing pipe is PVC, and there are assumed to be no functional valves in the area. One option is to live tap into the existing pipe upstream of the tie-in location, allowing flows to be diverted into vacuum trucks. The trucks could then haul the sewage to the Charlie Lake Trucked Waste Receiving Facility (TWRF). This method would ensure uninterrupted



service while the tie-in is completed safely. Additionally, tie-ins should be scheduled during low-flow periods to reduce bypass volumes, and environmental controls should be in place to manage any potential spills during flow diversion.

6.3.0. Utility Avoidance and Risk Assessment

Throughout the project site, sewer and telecom lines run along the length of the alignment, requiring careful planning during digging and drilling activities. The drilling head must be closely monitored as it approaches utility crossings to ensure there are no utility conflicts. Sewer service connections along the proposed drilling area are typically buried 2.5 to 3.5 m underground and run perpendicular to the roadway. These lines run along Paradise Street and south of Rainbow Road, and there would be approximately 13 sewer service connections being crossed.

For telecom infrastructure, a minimum separation distance of 1 m is required when using non-destructive methods. Additionally, if possible, work should be avoided within 5 m of any fibre optic transmission line on private property near a utility right-of-way, as this may necessitate prior approval before construction.

Underground electrical power lines, natural gas, and telecom lines were identified along Paradise Street. The underground electrical and natural gas systems can be at a depth of 1 to 5 ft, depending on terrain and changes to streets and private properties. Given that the sewer entry and exit points are positioned at either end of the twin main, the overhead powerline located midway along Paradise Street is expected to remain unaffected by the installation. Coordination with all underground utility companies would be required prior to project approval.

To avoid utility strikes during the installation of the twinned sewer main, it is important that locates for public and private infrastructure are completed. Generally, it is important to hand-expose or hydro vac underground facilities before commencing excavation with mechanical equipment in areas with reported utilities, particularly telecom lines and powerlines. To avoid costly utility strikes, service outages, safety hazards, and project delays, field investigation such as potholing may be required to verify the service connections and their depth along the CLES region. In addition, a tracking system is typically used to monitor and locate the position and orientation of the drill head while underground. This provides an additional safety measure to prevent utility strikes and equipment damage.

6.3.1. Future Service Connections

Following completion of the twinned sewer main, future connections to the twinned main are not recommended to maintain system integrity. The new main would be designed to remain closed under normal conditions and only operate during specific flow conditions or maintenance events. Connecting to the main could lead to backups and trapped effluent. To prevent operational risks and protect downstream infrastructure, all future tie-ins should connect only to the original main.

6.4. COST ESTIMATE

For this report, Class “D” cost estimating was performed with additional allowances for construction projects. A Class “D” cost estimate is described as a +/-40% preliminary estimate which, with a moderate



amount of detail, indicates the approximate magnitude of cost of the proposed project, derived from lump sum or unit costs for a similar project. It may be used in developing long term capital plans or preliminary discussion of proposed capital projects.

6.4.0. Cost Estimate Allowances

McElhanney has assumed the following for planning and budgeting of construction projects:

- Construction Risks (30%)
 - Quantity and quality of pre-engineering information (5%)
 - Tender and construction schedule (5%)
 - Construction market (20%)
- Engineering Fee Allowance (10%)

Estimated construction costs are based on recent tenders for various municipal projects in the Peace Region, budget quotes from suppliers, and similar projects across western Canada. Cost estimates are likely to change during the next 10 years as the market changes. To account for this change, an inflation rate of 5% was used for each year beyond 2025.

An additional 10% Contingency was added to account for the increased prices and volatility of the market in 2025, as there is no way to know if the market will continue to be volatile or if it will settle in the next few years.

A summary of the cost estimate is provided in Table 8. See Appendix A for a detailed breakdown of the cost estimate.

Table 8. Cost Estimate for Recommended Options

No.	Description	Estimated Cost
ES.C.1	Lift Station at 13129 Paradise St with Dedicated Forcemain	\$1,377,000
ES.C.2	Twinned Sewer Main	\$1,029,000

6.4.1. Discussion

The two recommended options each present a solution to the issues faced by the CLES, with differing benefits and costs.

A lift station will provide the most pressure relief for the sewer system, but at a higher cost, and comes with specific operations and maintenance requirements. It will not provide as much redundancy as a twinned sewer main, however, the pressure reduction in the existing sewer main would help mitigate the risk of a break. The lift station location at 13129 Paradise St provides a significant cost savings over 13265 Paradise St, and features less construction risk with a shorter forcemain and fewer utility crossings. However, there are other items to consider in the location, such as noise and favourability of residents.

At a lower cost, the twinned sewer main will provide redundancy in addition to future capacity and flexibility for the system, but it will not significantly reduce the pressure experienced in the sewer main. It will not require regular operations and maintenance apart from annual valve operation.

Based on the information presented in this report and the cost estimates for both projects, the lift station project should provide the most value overall to the CLES. It is also a robust solution that will improve the level of service in CLES and reliably accommodate future connections to the system.

6.5. CONSTRUCTION SCHEDULE

Based on current permitting turnaround times, timelines for archeological assessments, and lead times on material, it is recommended the design of the selected option be completed in 2026 with tender in the fall, and construction could be completed in 2027.



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Appendix A

CLASS D COST ESTIMATE – DETAILED BREAKDOWN

Class D Cost Estimate



CLES - Twinned Sewer Main and Lift Station Recommendations

Title	Description	Quantity Estimate	Unit	Engineer's Estimate Rate	Estimated Cost (excl. GST)
Twinned Sewer Main					\$ 643,100
General Requirements					\$ 67,500
	Mob & Demob	1	Lump Sum	\$ 50,000	\$ 50,000
	Temporary Facilities	1	Lump Sum	\$ 10,000	\$ 10,000
	Environmental Protection	1	Lump Sum	\$ 7,500	\$ 7,500
Earthworks					\$ 16,500
	Clearing and Grubbing	1	Lump Sum	\$ 5,000	\$ 5,000
	Roadway Surface Restoration - 19mm minus Granular Base	80	Square metre	\$ 50	\$ 4,000
	Vegetated Surface Restoration - Topsoil and Seeding	1	Lump Sum	\$ 7,500	\$ 7,500
Utilities					\$ 559,100
	Bypassing Sewer Main during Construction	1	Lump Sum	\$ 10,000	\$ 10,000
	Supply and Install 75mm Dia. DR17 HDPE (>3 m depth)	1267	Linear meter	\$ 300	\$ 380,100
	Tie-in Proposed 75mm Dia. to Existing 75mm Sewer Main c/w Valve Chamber	2	Each	\$ 25,000	\$ 50,000
	Supply and Install 75mm Isolation Gate Valve c/w cutting of pipe, spool piping, and couplers	4	Each	\$ 5,000	\$ 20,000
	Supply and Install Air Release Valve on Sewer Main	2	Each	\$ 17,500	\$ 35,000
	Locating & Exposing Existing Service Crossings (Properties on the East Side of the Road)	32	Each	\$ 2,000	\$ 64,000
				Engineering	10% \$ 64,310
				Contingency & Construction Risk	40% \$ 257,240
				Inflation	10% \$ 64,310
Total Estimate					\$ 1,028,960

Title	Description	Quantity Estimate	Unit	Engineer's Estimate Rate	Estimated Cost (excl. GST)
Lift Station with Dedicated Forcemain					\$ 860,750
General Requirements					\$ 82,500
	Mob & Demob	1	Lump Sum	\$ 65,000	\$ 65,000
	Temporary Facilities	1	Lump Sum	\$ 10,000	\$ 10,000
	Environmental Protection	1	Lump Sum	\$ 7,500	\$ 7,500
Concrete					\$ 950
	Concrete Pad for Lift Station Kiosk (1.4m x 1.8m)	0.378	Cubic meter	\$ 2,500	\$ 950
Electrical					\$ 87,500
	BC Hydro Service Upgrade	1	Lump Sum	\$ 30,000	\$ 30,000
	Controls Setup, Programming, and Commissioning	1	Lump Sum	\$ 20,000	\$ 20,000
	Supply and Install Diesel Genset (Incl. Sub-base Diesel Tank)	1	Lump Sum	\$ 20,000	\$ 20,000
	Installation, Markup and Profit Allowance (10 + 10 + 5%)	1	Lump Sum	\$ 17,500	\$ 17,500
Earthworks					\$ 16,500
	Clearing and Grubbing	1	Lump Sum	\$ 5,000	\$ 5,000
	Roadway Surface Restoration - 19mm minus Granular Base	80	Square metre	\$ 50	\$ 4,000
	Vegetated Surface Restoration - Topsoil and Seeding	1	Lump Sum	\$ 7,500	\$ 7,500
Utilities					\$ 673,300
Lift Station					\$ 512,700
	Bypassing Sewer Main during Construction	1	Lump Sum	\$ 10,000	\$ 10,000.00
	Supply and Install 100mm FLGxPE 316 SS SCH40 Spool	6	Lineal metre	\$ 950	\$ 5,700.00
	Supply and Install Lift Station Package c/w Wet Well, Hatch, Ladder, Pumps, Kiosk, VFD, Controls, Piping, Valves, and Appurtenances	1	Lump Sum	\$ 475,000	\$ 475,000.00
*Optional	Move Lift Station Valves to Kiosk	1	Lump Sum	\$ 15,000	\$ 15,000.00
	Supply and Install Forcemain Connections and Wet Well Protrusions	2	Each	\$ 3,500	\$ 7,000.00
Sewer Forcemain - Lift Station at 13129 Paradise St					\$ 160,600
	Supply and Install 100mm Dia. DR17 HDPE (>3 m depth)	220	Lineal metre	\$ 305	\$ 67,100
	Supply and Install 75mm Isolation Gate Valve c/w cutting of pipe, spool piping,	2	Each	\$ 5,000	\$ 10,000
	Supply and Install 100mm Isolation Gate Valve c/w cutting of pipe, spool piping, reducer, and couplers	2	Each	\$ 8,000	\$ 16,000
	Supply and Install Air Release Valve on Forcemain	1	Each	\$ 17,500	\$ 17,500
	Tie-in Proposed 100mm Dia. to Existing 75mm Sewer Main c/w Valve Chamber	2	Each	\$ 25,000	\$ 50,000
Sewer Forcemain - Lift Station at 13265 Paradise St (NOT INCLUDED IN TOTAL COST)					\$ 568,450
	Supply and Install 100mm Dia. DR17 HDPE (>3 m depth)	1290	Lineal metre	\$ 305	\$ 393,450
	Supply and Install 75mm Isolation Gate Valve c/w cutting of pipe, spool piping, and couplers	2	Each	\$ 5,000	\$ 10,000
	Supply and Install 100mm Isolation Gate Valve c/w cutting of pipe, spool piping, reducer, and couplers	2	Each	\$ 8,000	\$ 16,000
	Supply and Install Air Release Valve on Forcemain	2	Each	\$ 17,500	\$ 35,000
	Tie-in Proposed 100mm Dia. to Existing 75mm Sewer Main c/w Valve Chamber	2	Each	\$ 25,000	\$ 50,000
	Locating & Exposing Existing Service Crossings (Properties on the East Side of the Road)	32	Each	\$ 2,000	\$ 64,000

Notes				Engineering	10%	\$ 86,080
1	Unit Prices are based on local market, past experience, and engineering judgement.			Contingency & Construction Risk	40%	\$ 344,300
2	Assumptions were made to develop these quantities that might change as design develops.			Inflation	10%	\$ 86,080
3	Construction Management and Material Testing are included in the Engineering item.			Total Estimate		\$ 1,377,210
4	Testing and Sampling, if applicable, is to be included in unit rate costs.					
5	Major utility relocation cost is not included.					
6	Granular base materials vary significantly based on material source and location.					
7	This construction cost estimate has been prepared using the design and technical information currently available. No geotechnical report or information on existing site soils was provided. Furthermore, McElhanney cannot predict the competitive environment, weather or other unforeseen conditions that will prevail at the time that Contractors will prepare their bids.					
8	The cost estimate is subject to factors over which McElhanney has no control, and McElhanney does not guarantee or warranty the accuracy of such estimate.					

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