URBAN SYSTEMS

MEMORANDUM

DATE: January 29, 2025
TO: Joel Clary, P.Eng.
CC: Adrien d'Andrade, P.Eng.
FROM: Kara Labelle, Alex Kempa, Mark Stafford, P.Eng.
FILE: 3275.0021.01
SUBJECT: Sanitary Sewer Asset Management Plan: Infrastructure Prioritization & Capital Planning

1.0 INTRODUCTION

The Sanitary Sewer Asset Management Plan is a comprehensive, 20-year guide for managing the utility with regard to capital and select project improvements. This memo summarizes the results of a risk-based infrastructure assessment guided by the methodology outlined in the *Esquimalt Sanitary Sewer Asset Management Plan: Risk Prioritization* (August 14, 2024), attached in Appendix A to create a list of priority renewal projects for linear infrastructure and lift stations in the Township of Esquimalt (the Township). The outcomes of the risk assessment are integrated into various funding scenarios to help facilitate discussions with Finance and Council. As recommended herein, these discussions will focus on raising infrastructure funding needs, managing risk levels, and efficiently delivering projects to support the long-term service delivery of the sanitary sewer system. In addition to capital prioritization, the Township's operation and maintenance practices for the sewer system were reviewed, with recommendations to maintain and/or enhance service delivery based on best practices or insights from Township staff. The results from this review are appended and include high level cost estimates to give an order of magnitude understanding of the funding required to align with industry standards.

2.0 ASSET MANAGEMENT

The Township owns, operates, and maintains approximately 57.3 km of gravity sewers, 3.8 km of forcemains, and 13 pump stations. Each year, Engineering and Public Works replaces or refurbishes portions of this infrastructure to maintain system performance. Approximately 23% (based on pipe length) of the Township's linear sanitary sewer network has exceeded its design life, indicating an existing backlog of asset replacement. Based on discussion with the Township, historic capital spending levels for sanitary sewer rehabilitation drastically fluctuate, as rehabilitation efforts are primarily reactive. For the purpose of setting a baseline in this report, staff recommended using $1M. Further information on capital spending for the sanitary sewer is included in Section 4.0.

The total value of the Township's gravity assets, forcemains, and pump stations, based on the unit rates reported in the *Sanitary Asset Management Plan Unit Cost Estimating* (August 12, 2024) technical memo appended to this report, are approximately $223.3 M, $6.6 M, and $15.6 M, respectively. Many municipalities use a life-cycle planning approach to support capital planning and ensure adequate funding is invested and evenly distributed, year over year. For instance, the estimated service life of linear sewer assets ranges from 50 – 85 years depending on the material type. The life-cycle planning approach evenly distributes capital investments over this 50-to-85-year period which translates to an annual investment of roughly 1-2% of the total value of linear sewer infrastructure. In comparison, lift stations have a relatively shorter service life, (typically around 35 years), which means the annual investment is relatively higher (roughly 3 – 5% annually). Applying this approach to Esquimalt's linear assets and lift stations would require a minimum annual investment of approximately $3.5 M and $0.4 M respectively, for a total average annual life cycle investment (AALCI) of $3.9 M. The AALCI becomes a key metric for comparison in Section 4.0 which explores the gap between existing spending levels, the cost of capital needs determined through the risk assessment, and sustainable funding levels based on the AALCI. Closing the gap between existing spending and funding targets is largely influenced by the existing cost recovery mechanisms funding service delivery. Therefore, the following section provides an overview of the Township's current sanitary sewer funding sources.

2.1 SANITARY SEWER FUNDING MECHANISMS

The Township currently funds sanitary sewer rehabilitation through property taxes. A portion of the Township's annual property tax revenue is allocated to the maintenance and improvement of public infrastructure, including the sanitary sewer system. These funds support capital projects like the construction of new sewer lines, pump stations, or upgrades to existing infrastructure. Currently, there is no utility fee specific to sanitary sewer use within the Township (e.g., a sanitary sewer user fee). Overall, a dedicated utility fee can help ensure there is adequate funding to address important cost pressures, leading to a more equitable and sustainable funding model for maintaining and operating a utility.

Understanding the funding sources and fee structure of Esquimalt's sanitary sewer system is essential for identifying factors that can be adjusted to meet risk-based capital requirements and achieve sustainable funding goals. Related recommendations are outlined in Section 5.0.

3.0 RISK ASSESSMENT RESULTS

Risk rankings consider and weigh an asset's likelihood to fail, which is determined by condition and capacity, and the associated consequence should it fail, informed by a triple bottom line evaluation of financial, social and environmental risks. These rankings are assigned on a scale from priority 1 through priority 3 for linear assets and lift stations, defined as follows.

- **Priority 1 (P1):** Projects that exhibit the highest level of risk, associated with an elevated likelihood of failure triggered by both condition and capacity concerns, and an elevated consequence of failure.
- **Priority 2 (P2)** Projects not already captured by P1 that have a moderately high level of risk driven by either:
    - A high likelihood of failure (triggered by condition and capacity) but less severe consequence, relative to P1 assets.
    - A moderate likelihood of failure (trigged by condition or capacity, but not both) and a high consequence of failure.
- **Priority 3 (P3):** Projects that exhibit modest risk, driven by a moderately high likelihood of failure (triggered by condition or capacity, but not both) but with less severe consequences of failure.
- **Non-Ranked:** all other projects in the sewer network.

These priority rankings are first assigned to assets based on existing conditions (e.g., existing flows), referred to as the existing scenario. Assets prioritized under the existing scenario are required to address deficiencies, driven by condition and/or capacity concerns that exist today. Typically, assets identified as priorities under the existing scenario are recommended for renewal in the next 10 years. This process is repeated for the future scenario which identifies renewal needs to accommodate increases to sewer flows from population growth, and deteriorating asset condition. Assets flagged for renewal under the future scenario are typically recommended for replacement in years 11 – 20.

In addition to priority rankings, linear assets are also assigned priority triggers, which identify the reason for asset prioritization. These triggers are further described below and are included as a field in the enclosed list of risk assessment results:

- **Capacity**: The asset is deemed capacity deficient only.
- **Condition:** The asset is deemed condition-deficient only. Condition is informed by CCTV data, or by asset age if CCTV data is not available.
- **New main**: The asset does not currently exist within the Township's network, and is proposed as a new asset to resolve a capacity deficiency elsewhere.
- **Capacity project:** The asset becomes capacity deficient as a result of an upstream upgrade that releases backlogged flows. Without upstream upgrades, assets with this trigger are otherwise operating sufficiently under existing conditions. To account for these instances, project numbers are assigned to assets required to resolve hydraulic deficiencies. All assets with the same project number must be resolved together to address deficiencies. Therefore, all assets with a common project number are assigned the same priority ranking based on the highest risk asset in the group. For example, if a project consists of two pipes, one that is not prioritized, and one that is ranked a P1, both pipes in this project receive a modified prioritization ranking of P1. A project number field is included in the enclosed risk results for gravity assets.
- **Abandon:** The asset is to be abandoned as part of a project to resolve a capacity deficiency in the network. The asset may or may not be deficient itself.
- **Capacity deficiency resolved through rerouting upstream flow:** The asset is capacity deficient but does not require upgrade as upgrades recommended elsewhere in the network will resolve its deficiency.
- **Plug**: The asset is to be deactivated ("plugged")

The existing and future prioritization results are discussed in following subsections. A more comprehensive list of individual asset prioritization ratings are included in the accompanied attachment. This file also specifies other critical and supporting information for each prioritized asset including (but not limited to):

- Likelihood of failure score – including condition and capacity scores
- Consequence of failure scores – including financial, social, and environmental scores
- Priority rating – as described above
- Priority trigger – as described above
- Existing and future replacement cost. Where existing costs reflect like-for-like replacement (i.e., no capacity upgrades) and demonstrate the existing value of the utility, and future replacement cost which accounts for pipe upsizing, where deficiencies have been identified.

3.1 EXISTING SCENARIO PRIORITY SUMMARY

The following section discusses the prioritization results for gravity mains, forcemains, and pump stations based on existing conditions. The locations of the prioritized assets are displayed in Figure 1.

3.1.1 Gravity Mains

Table 1 outlines the gravity mains recommended for renewal to address existing condition and/or capacity deficiencies. In total, approximately 13.2 km of pipe are recommended for replacement, equating to approximately 23% of the Township's total network length. It should be noted that the costs included in Table 1 reflect full asset replacement, and account for any pipe upgrades needed to resolve capacity deficiencies identified by the hydraulic model. In some cases, alternative renewal options, such as relining or point repairs, may be considered for condition-deficient pipes, granted there are no capacity deficiencies associated with that asset. Given the high number of condition-driven assets, discussed further below, alternative approaches to full replacement should be evaluated for suitability on a case-by-case basis. Therefore, to remain conservative, the recommended costs herein assume full replacement.

As shown in Table 1, P3 assets account for the majority of prioritized assets (approximately 12% of the total network length), followed by P2 assets (approximately 6% of the total network) and P1 assets (approximately 5% of the total network). Assets triggered solely by condition account for 93% and 97% of the P2 and P3 assets, respectively. Overall, approximately 75% of the prioritized assets (based on replacement cost) are triggered by condition only, emphasizing the deteriorating nature of the Township's sewer network.

It should be noted that of all assets triggered by condition, only one of these assets is triggered based on age (SGM0060, ranked as P3), the remaining condition-triggered priorities are informed by closed circuit television (CCTV) inspection. Because assets are known to both out- and under-serve their design lives, this influences the confidence of capital decisions based on age, whereas CCTV inspection offers a more accurate assessment of asset condition and therefore improves the confidence of capital decision making. Although not a major consideration for the existing scenario priorities, in general, it is recommended that any asset triggered by condition, informed by age (i.e. SGM0060), be inspected by CCTV ahead of complete replacement to confirm the extent and timing of the upgrade. As a best practice, the Township should also aim to complete point repairs or rehabilitation of assets that are structurally failing based on CCTV inspection within 1-year of inspection.

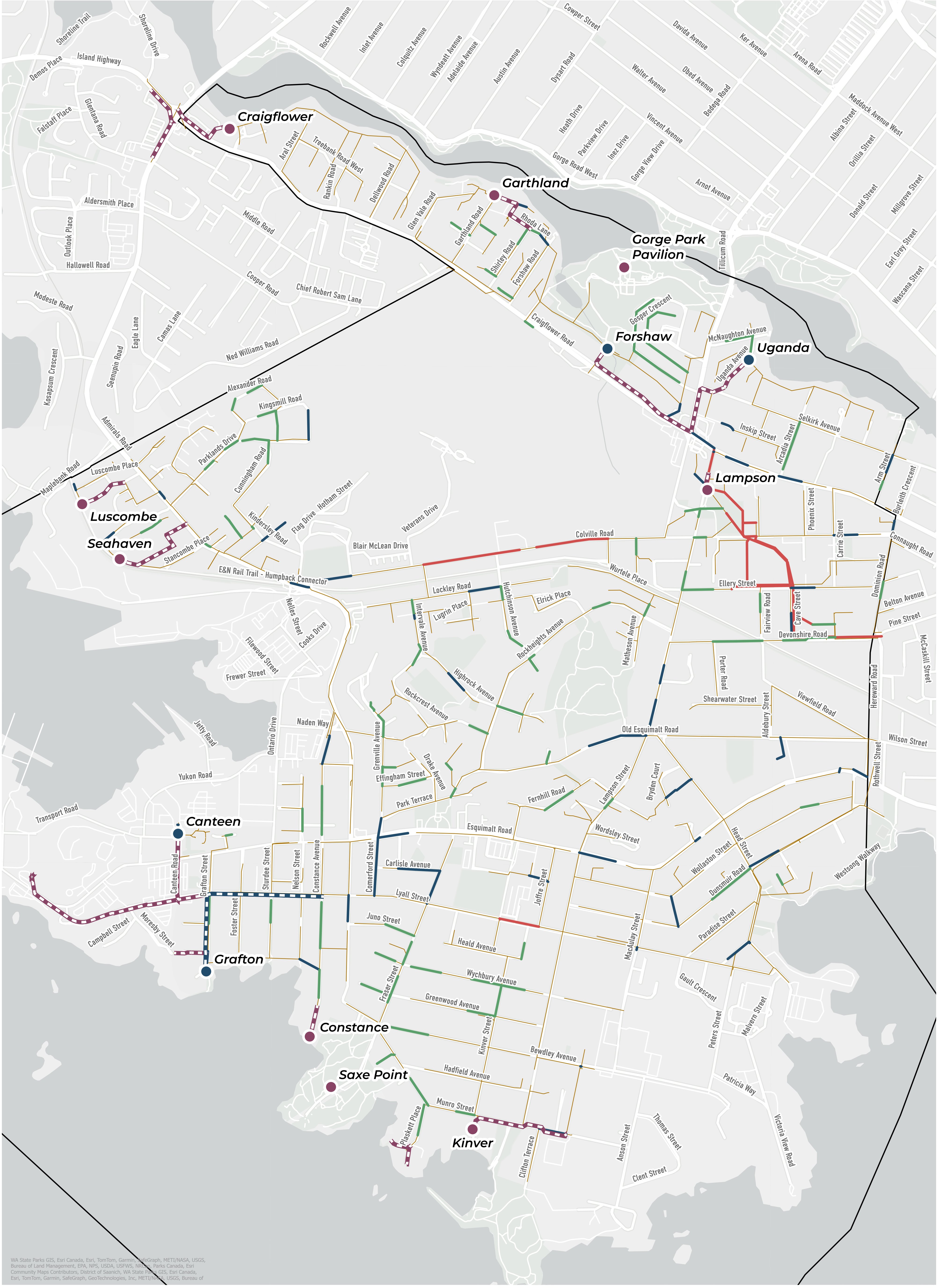
It should be noted that the following assets are trigged under the existing scenario based on condition, however, require upgrades in the future scenario to resolve capacity deficiencies: SGM0945 and SGM0037. These pipes are flagged to assist the Township in proactive planning, and to avoid a scenario where these assets undergo like-for-like replacement to resolve condition concerns, followed shortly by the need for additional capacity to accommodate future growth. Under existing conditions, these assets have prioritization rankings of P2 and P3, respectively, and total nearly 146 m in length, and $0.74 M in renewal costs (including upgrades) which are captured in the Table 1 summary.

Table 1: Existing Scenario (Years 1-10) Priorities and Triggers

EXISTING PRIORITIZATION AND TRIGGERS	ASSET COUNT	LENGTH (KM)	PERCENT OF PRIORITIZATION CATEGORY (BY LENGTH)	REPLACEMENT COST (2024 $)
P1	**39**	**2.74**		**10,574,000**
Condition and capacity	2	0.18	6.57%	883,000
Capacity[1]	9	0.58	21.17%	3,086,000
New main	10	0.71	25.91%	3,446,000
Capacity project only, no other triggers	6	0.51	18.61%	2,433,000
Abandon	11	0.62	22.63%	-
Plug[2]	1	0.13	4.74%	725,000
P2	**60**	**3.70**		**16,518,000**
Condition and capacity project	1	0.10	2.70%	536,000
Capacity	1	0.004	0.10%	21,000
Condition	56	3.44	92.97%	15,087,000
Capacity project only, no other triggers	2	0.16	4.32%	874,000
P3	**105**	**6.76**		**23,318,000**
Condition and capacity project	1	0.05	0.74%	204,000
Condition	101	6.57	97.19%	22,457,000
Capacity project only, no other triggers	2	0.07	1.04%	226,000
Condition, and capacity deficiency resolved through rerouting upstream flow	1	0.07	1.04%	431,000
TOTAL	**204**	**13.20**		**50,410,000**

[1] *Recall, P1 assets are triggered by condition and capacity deficiencies. The assets in this category (P1 capacity) are capacity-deficient (but not condition deficient), however, receive a priority ranking of P1 because they are part of a project group that contains a P1 pipe, driven by condition and capacity. As a reminder, assets in a common project group must be resolved together to resolve deficiencies and are therefore assigned the priority ranking of the highest risk asset in the group.*

[2] *Related to catchment reallocation to address CRD allocation deficiency for head connection.*



URBAN SYSTEMS

Project #: 3275.0021.01
Author: RB
Checked: KL
Status:
Revision: A
Date: 2024 / 12 / 16

0 100 200 300
Meters

Coordinate System: NAD 1983 UTM Zone 10N

Scale: 1:11,500 (When plotted at 11"x17")

Data Sources:
- Township of Esquimalt
- GeoAdvice
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Legend

Gravity Main Prioritization
- P1
- P2
- P3
- Gravity Main

Forcemain Prioritization
- P2

Force main

Pump Station Prioritization
- P2
- Pump Stations

Township Boundary

Township of ESQUIMALT

Sanitary Asset Management Plan

Existing Prioritization

3.1.2 Pump Stations and Forcemains

Table 2 outlines the pump stations recommended for renewal to address existing condition and/or capacity deficiencies. The condition of each lift station was determined through site inspections completed in 2023 that evaluated the condition of approximately 33 sub-components, typically found as part of a lift station, across four functional disciplines, including civil, mechanical, electrical, and structural components. The individual condition scores for each component along with their importance weighting (representing their criticality to station operation) were used to determine overall condition scores for each lift station. The likelihood of failure scoring ranged from 1 to 5, where 1 indicates the lowest likelihood of failure due to condition, and 5 indicates the highest likelihood of failure due to condition. Additional details on this evaluation process and the lift station condition assessments are provided in the *Lift Station Condition Assessment Report* (Urban Systems, 2025).

For stations triggered by capacity deficiencies (e.g. Grafton, Forshaw, and Canteen), the upgrade costs in Table 2 conservatively reflect full station replacement, assuming that the entirety of the station will require upgrading/replacement to accommodate additional capacity needs. This means that upgrades to any capacity-triggered station will also resolve any condition-improvements identified in the *Lift Station Condition Assessment Report*. For stations triggered solely by condition deficiencies (e.g. Uganda), the replacement cost reflects the cost of addressing the specific component deficiency identified in the *Lift Station Condition Assessment Report* (e.g. kiosk improvements, valve chamber upgrades etc.) It is understood that for the Uganda pump station, condition-related upgrades have been initiated, and costs included in Table 2 reflect budgetary pricing provided during the scope development phase of the project. For more information on component replacement needs at each station, please refer to the *Lift Station Condition Assessment Report*.

It should be noted that while the Constance station is not prioritized in the existing or future scenario (i.e. it is not considered condition or capacity deficient by the risk methodology), field inspections have identified the station as needing a Human Machine Interface (HMI) replacement. Although the criticality of this component alone is not enough to trigger the station as a priority, replacement of the HMI is recommended when funds become available, and is therefore included in Table 2. It should also be noted that while the Lampson, Luscombe, and Kinver stations also exhibit existing condition-deficiencies based on field inspections, these stations are not prioritized under the risk methodology until the future scenario (unlike Constance which is not prioritized over the next 20 years). Therefore, the replacement needs for Lampson, Luscombe, and Kinver stations (totaling $228,000) are reported with future scenario results in Section 3.2.2.

Table 2: Existing Scenario Priorities - Pump Stations

PUMP STATION	EXISTING PRIORITY	EXISTING PRIORITY TRIGGER	UPGRADE COST (2024 $)
Grafton	P2	Capacity	1,893,000
Uganda	P2	Condition	313,680
Forshaw (Nursery)	P2	Capacity	1,893,000
Canteen	P2	Capacity	1,373,000
Constance	N/A – Complete condition-based upgrades when funds become available		4,180
TOTAL			**5,477,000**

Note, for the Canteen Pump Station, an investigation regarding this station's capacity should be conducted prior to proceeding with station upgrades, as the Dockyard station (upstream of the Canteen pump station) was assumed to operate as an ideal pump, impacting the modelled capacity of Canteen. Additionally, despite this station being deemed deficient from a modeling perspective, field draw down tests indicated that the pumping capacity of the station, approximately 20L/s, greatly exceeds the future peak flow needs estimated at only 2.6 L/s. Despite this, modelling results have identified circumstances during which the Canteen station may exhibit limited or deficient capacity, such as when multiple stations (i.e. Grafton, Dockyard and Canteen) are running simultaneously (due to the high pressure in the shared forcemains along Lyall Street) and/or during periods of heavy rainfall combined with only a single pump operating. These circumstances likely represent short-lived, infrequent, and highly conservative conditions which are not anticipated to cause station flooding (however, pump capacity may be exceeded, and backup may occur). Once these conditions are relieved (i.e. lag pump turns on, and other stations drain relieving shared forcemain pressure etc.), the Canteen station is predicted to operate at a sufficient capacity. Discussions with Township staff also confirm that the Canteen station has not been known to exhibit significant capacity concerns. Therefore, while the Canteen station has been identified as a capital priority, this prioritization reflects a suite of rather conservative and unique scenarios. Therefore, further investigation into the influences of the Dockyard pump station should be confirmed, along with downstream impacts on the Canteen pump station before pursuing upgrades to Canteen. The Township should also consider developing a robust set of SCADA controls and pump station programming such that coordination between stations and pumping priority can be determined in scenarios such as this.

Table 3 outlines the forcemains recommended for renewal to address existing concerns. While the assets in Table 3 are not deficient under existing conditions in terms of capacity nor condition, the proposed upgrading of the Grafton pump station (see Table 2) will require the simultaneous upgrades to the associated forcemains (from 150mm to 250mm, as specified in the enclosed risk assessment results). As a reminder, based on the risk methodology, forcemain capacity is assessed based on forcemain velocity. While the existing velocities of all forcemains are currently sufficient, upgrading the capacity of the Grafton pump station triggers deficiencies in the Grafton forcemain requiring upgrades simultaneous with the pump station. Therefore, the Grafton pump station and forcemain share the same prioritization ranking of P2. Note that the proposed upgrade sizes of the force mains along Lyall Street (SGM0026 and SGM0027), should be confirmed to accommodate the incoming flows of the Dockyard station, prior to the replacement of these assets.

Table 3: Existing Scenario Priorities - Forcemains

ASSET ID	PUMP STATION	LENGTH (KM)	EXISTING PRIORITY	EXISTING PRIORITY TRIGGER	TOTAL UPGRADE COST (2024 $)
SFM0025	GRAFTON	0.25	P2	Upgrade with Grafton station (P2)	410,000
SFM0026	GRAFTON	0.04	P2		68,000
SFM0027	GRAFTON	0.34	P2		586,000
TOTAL		**0.63**			**1,064,000**

3.2 FUTURE SCENARIO PRIORITY SUMMARY

The following section discusses the prioritization results for gravity mains, forcemains, and pump stations based on future conditions. The locations of the prioritized assets are displayed in Figure 2.

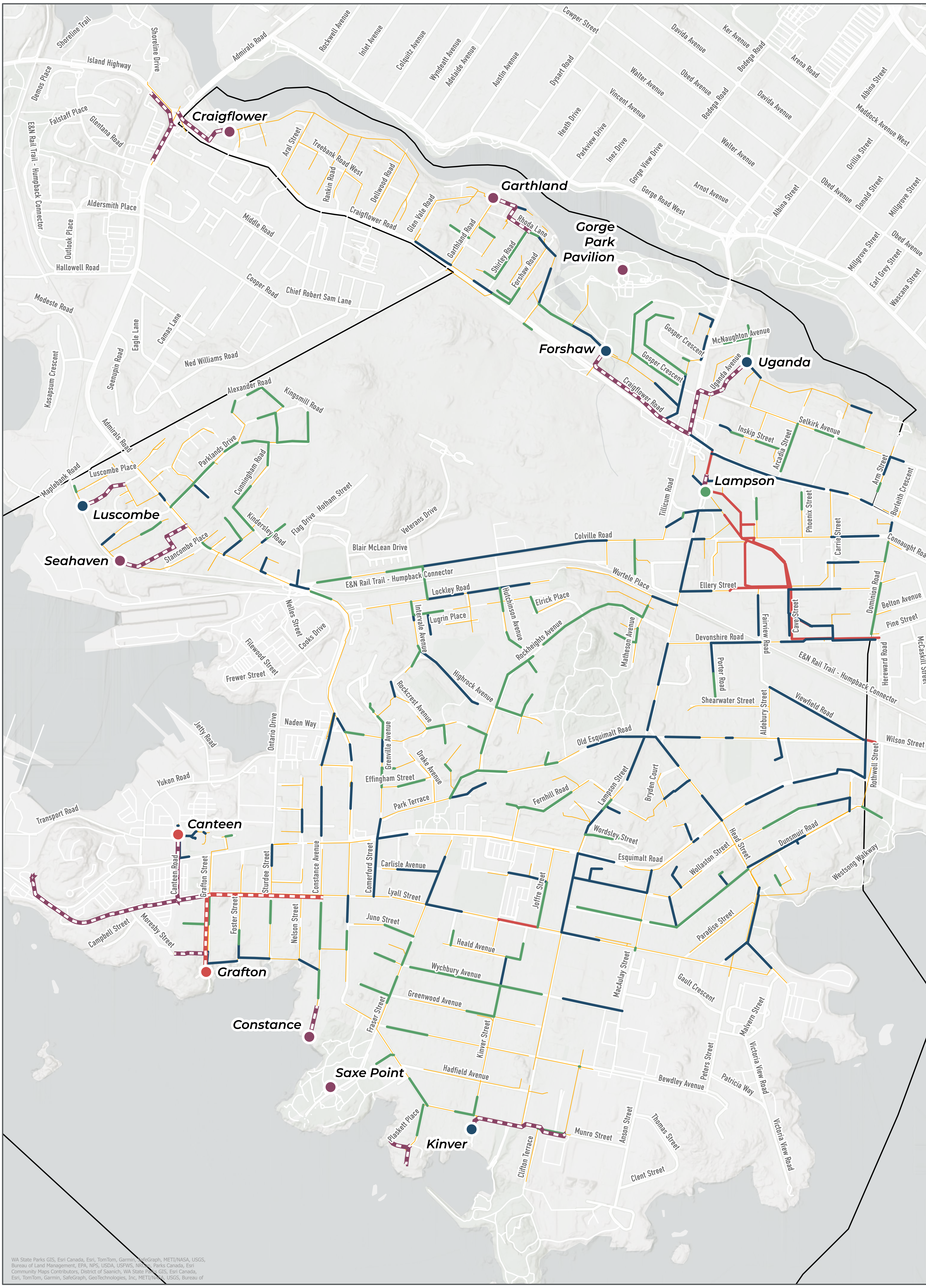
3.2.1 Gravity Mains

Table 4 outlines the gravity mains recommended for renewal to address future condition and/or capacity deficiencies driven by increases in flow from population growth and deteriorating asset condition. In total, approximately 13.1 km of additional pipe is recommended for upgrade in the future scenario, equating to approximately 22.5% of the Township's total network. Overall, the length of pipe prioritized in the future scenario is similar to that prioritized under existing conditions.

In contrast to priorities triggered under existing conditions, P2 assets account for the majority of prioritized assets in the future scenario (approximately 14% of the total network length), followed by P3 assets (approximately 9% of the total network) and P1 assets (approximately 0.1% of the total network). Approximately 96% of the prioritized assets (based on replacement cost) are triggered by condition only.

Similar to the existing scenario results, assets triggered by condition deficiencies in the future are predominately informed by CCTV, whereby existing CCTV scores are ranked on a scale of 0 – 5 (0 indicating no defects, and 5 indicating defects requiring immediate attention) and increased by a score of 1 to a maximum of 5 to account for pipe deterioration over the next 10 plus years. There are relatively more age-based priorities in the future scenario (48 pipes in total) compared to the existing scenario. These age-based priorities are distributed across priorities P2 and P3 and equate to approximately $13.9 M in replacement value. As a reminder, prioritized assets triggered solely by age should be inspected through CCTV ahead of replacement to confirm the pipe's condition. This consideration is incorporated into the recommendations presented in Section 5.0.

Costs in Table 4 conservatively reflect full asset replacement, however as stated in Section 3.1.1, alternative renewal options, such as relining, may be considered for assets deemed condition deficient, on a case-by-case basis.



URBAN SYSTEMS

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Gravity Main Prioritization
- P1
- P2
- P3
- Gravity Main

Forcemain Prioritization
- P1
- Force main

Pump Station Prioritization
- P1
- P2
- P3
- Pump Stations
- Township Boundary

Township of ESQUIMALT

Sanitary Asset Management Plan

Future Prioritization

Table 4: Future Scenario (Years 11-20) Priorities and Triggers

FUTURE PRIORITIZATION AND TRIGGERS	ASSET COUNT	LENGTH (KM)	PERCENT OF PRIORITIZATION CATEGORY (BY LENGTH)	REPLACEMENT COST (2024 $)
P1	**2**	**0.04**		**157,000**
Condition and capacity	1	0.03	75.00%	126,000
Capacity[3]	1	0.01	25.00%	31,000
P2	**116**	**8.04**		**35,512,000**
Capacity	4	0.23	2.86%	1,037,000
Condition	108	7.60	94.53%	33,496,000
Capacity project only, no other triggers	2	0.11	1.37%	456,000
Condition, no capacity upgrade recommended, minimal surcharging	1	0.04	0.50%	253,000
Condition, and capacity deficiency resolved through rerouting upstream flow	1	0.06	0.75%	270,000
P3	**74**	**4.97**		**17,431,000**
Capacity	1	0.01	0.20%	47,000
Condition and capacity project	1	0.14	2.82%	515,000
Condition	72	4.82	96.98%	16,870,000
TOTAL	**192**	**13.05**		**53,100,000**

3.2.2 Pump Stations and Forcemains

Table 5 outlines the pump stations recommended for renewal to address future deficiencies and includes the Kinver, Lampson, and Luscombe pump stations. The condition of these stations was assessed through field inspections, and like the CCTV scores, were increased by a score of 1, to a maximum of 5 to account for deteriorating condition into the future. All pump stations identified for renewal in the future scenario are triggered by condition only (i.e. no stations are capacity-deficient). As such, the replacement costs shown in Table 5 represent the estimated costs of the specific components requiring replacement as identified through the field inspections.

[3] *While linear assets which are only capacity deficient cannot achieve a P1 by the risk methodology (i.e. only condition and capacity triggered assets can achieve the highest priority), if the asset is associated with a project that has a P1 asset within it, it will be assigned a P1 ranking as well.*

As discussed in Section 3.1.2, the risk methodology has classified the Kinver, Lampson, and Luscombe pump stations as future priorities, however field inspections have revealed component-based condition deficiencies exist today. These stations were not prioritized under the existing scenario through the risk methodology as the existing condition of the deficient *components* were not critical enough to influence the *entire* station's condition score such that the full station prioritization was triggered. This is a result of either a limited number of deficient components at a station, or those components were not deemed particularly critical to station operation, corresponding to a lower weighting of their condition scores in the calculation of the station's total condition score. Additional details related to the calculation of a station's condition score are provided in the *Lift Station Condition Assessment Report*. Overall, while the stations identified in Table 5 may be prioritized in the future scenario, it is suggested that deficient components identified through the field inspections be replaced as soon as funds become available within the next 10-years. As such, the replacement cost for these three stations is allocated under the first 10-years of the capital plan in Section 4.0.

Table 5: Future Scenario Priorities - Pump Stations

PUMP STATION	FUTURE PRIORITY	FUTURE PRIORITY TRIGGER	UPGRADE COST (2024 $)
Kinver	P2	Condition	130,200
Lampson	P3	Condition	42,500
Luscombe	P2	Condition	55,090
TOTAL			**228,000**

In contrast to the existing scenario results, no force mains are recommended for upgrade within the future scenario.

4.0 CAPITAL PRIORITIZATION

This section combines the findings from Section 2.0: Asset Management, and the risk assessment results from Section 3.0 to provide an understanding of planned budgets, and how these compare to sustainable funding levels (the AALCI), and prioritized capital needs. These metrics are displayed over a 20-year time frame in Figure 3 and further discussed below. Given the high proportion of condition-triggered deficiencies, the cost of condition-triggered projects have been categorized into those informed by CCTV and those informed by asset age (i.e. lacking CCTV data). The remaining project costs represent projects driven by triggers other than condition only, as defined in Section 3.0.

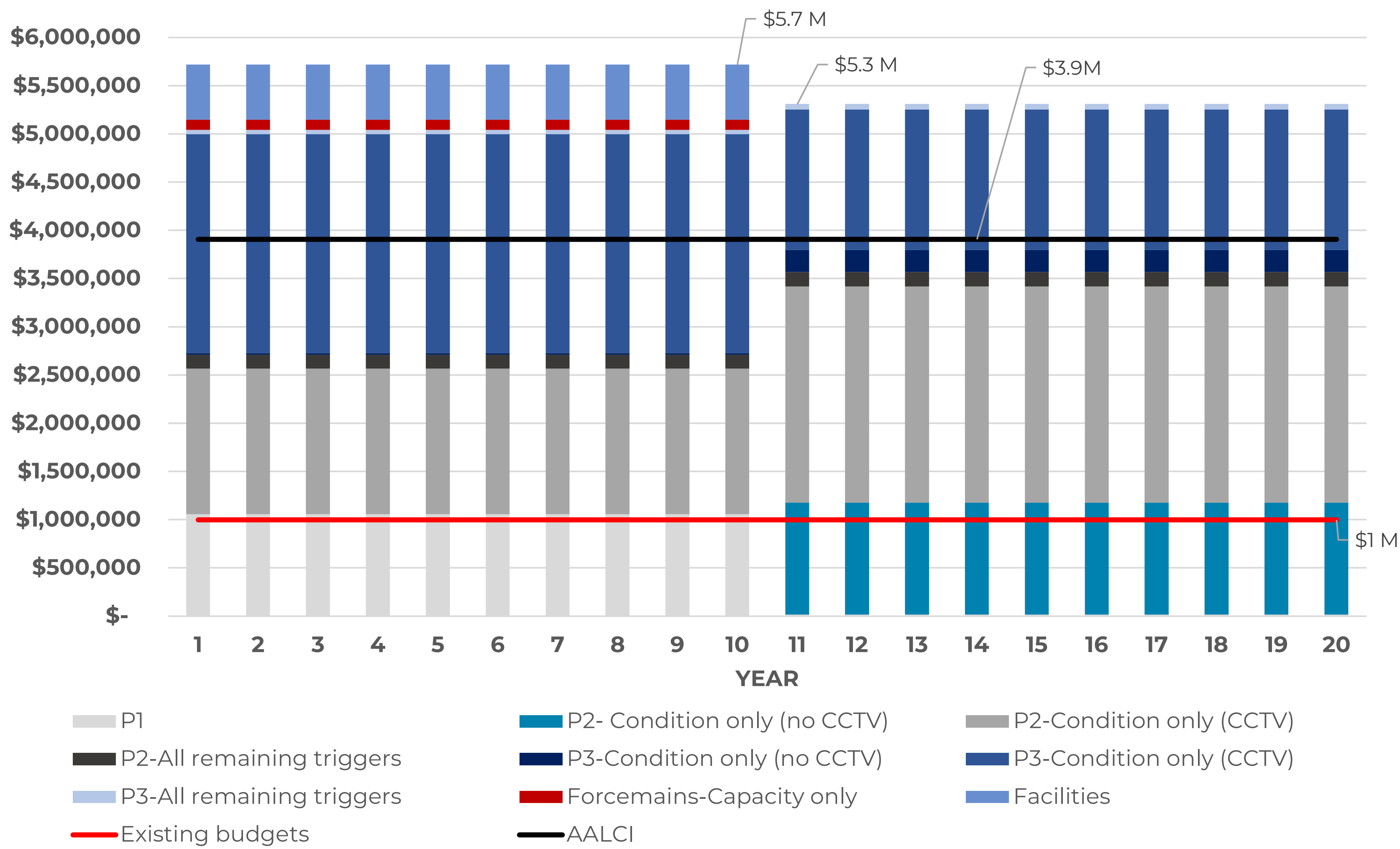

Figure 3: Capital Prioritization Summary, 20-Year Outlook

Figure 3 illustrates the following concepts:

- Existing and future deficiencies signal annual investment needs of approximately $5.7 M for years 1-10 and $5.3 M for years 11-20.
  - Note that the annual investment need of $5.7 M for the first 10-years includes the costs associated with component upgrades for the Constance, Kinver, Lampson, and Luscombe pump stations. Although not prioritized under the existing scenario, these stations have existing, component-specific condition deficiencies of approximately $232,180 (refer to Tables 2 and 5). These upgrades should be addressed following the replacement of other prioritized assets in years 1 - 10, as funds become available or as cost-saving opportunities emerge.
- Based on historic capital spending levels of roughly $1 M annually, there exists a gap in annual spending and capital replacement needs. Over the first 10-year horizon, this gap is approximately $4.7 M, annually, and approximately $4.3 M annually over the second 10-year horizon. This signals that a significant increase in funding levels is needed to mitigate deficiencies.
- The gap between existing spending levels ($1 M) and the AALCI ($ 3.9 M) is approximately $ 2.9 M annually. The $2.9 million gap indicates a funding shortfall of approximately 75% compared to the required investment. This shortfall means the Township is not currently investing sufficiently in the rehabilitation and replacement of its aging infrastructure, causing a growing backlog of deferred rehabilitation. As a result, the Township may face increasing risks associated with infrastructure failure, higher emergency repair costs, and potential service disruptions.
- The majority of P1 projects are triggered under the existing scenario (years 1-10). Total replacement costs for P1 projects equates to approximately $10.6 M and $0.2 M for the existing and future horizons, respectively.
  - Although total project costs significantly exceed existing budgets, current spending appears sufficient to complete nearly all P1 projects under the existing scenario (gap of $0.06M per year) and all future P1 projects. This means current funding levels are close to accomplishing the most critical projects over the next 20 years. As a reminder, all P1 projects over the next 20 years are focused on gravity main replacement.
- The majority of prioritized linear assets are triggered by condition deficiencies compared to capacity, for both the existing and future scenarios (75% and 96%, respectively, based on replacement value of prioritized gravity assets). In general, there exists a high-level of confidence in the prioritization of these condition-deficient assets as they are primarily informed by CCTV data, rather than asset age.
  - Recall, in Sections 3.1.1 and 3.2.1, only 0.3% of existing prioritized assets (by length), and 26% of the future prioritized assets (by length), are solely prioritized based on asset age. Age-based renewals account for roughly $0.2 M over the first 10-years and roughly $13.9 M over the second 10-year horizon.
- No forcemain upgrades are recommended in the future scenario. Overall, pump station and forcemain upgrades in the existing scenario comprise only a small portion (12%) of the total project costs.

Over time, infrastructure repair and replacement haven't kept pace with aging systems, leading to a growing backlog of needs. Current spending falls short of what's required to close the gap. Addressing this will require thoughtful increases in spending, guided by the community's tolerance for risk. Additionally, enhancing capacity to manage and deliver larger capital projects will be key as the scale of work expands.

4.1 FUNDING CONSIDERATIONS

Based on the capital needs presented herein and shown in Figure 3, several funding scenarios have been reviewed to help close the gap between existing spending levels, and capital needs. All scenarios assume an annual increase to current funding levels (~$1M) but differ by the rate of increase and the maximum funding levels achieved over 20 years. These scenarios highlight the trade-offs between capital investment and risk tolerance, with more aggressive funding approaches reducing infrastructure risk through higher annual increases, while modest increases defer investments, heightening long-term risks. Each of the scenarios are briefly described below and are displayed in Figure 4.

- **Achieve existing scenario capital needs ($5.7 M) by year 10**. This scenario reflects the second-most aggressive funding strategy and requires existing spending levels to increase by 470% over the next 10-years. This corresponds to an increase in current spending of approximately $0.52 M, or 52%, on an annual basis. Once the funding levels reach existing capital needs in year 10, this funding level remains constant for years 11 – 20. Adopting this strategy would allow all existing and future capital priorities to be funded by year 23 (assuming no projects arise reactively).
- **Achieve the AALCI ($3.9 M) by year 10.** Recall, the AALCI represents the average annual life cycle investment and evenly distributes the capital replacement needs of an asset over its service life to help build an appreciation for sustainable funding needs. This scenario reflects the least aggressive funding strategy and requires existing spending levels to increase by 290% over the next 10-years. This corresponds to an increase in current spending of approximately $0.32 M, or 32%, on an annual basis. Once the funding levels reach the AALCI in year 10, this funding level remains constant for years 11 – 20. Adopting this strategy would mean existing and future capital priorities are not fully funded until year 32 (assuming no projects arise reactively), resulting in a moderate amount of deferral and long-term risk compared to the other scenarios explored.
- **Increase property taxes by 1% annually**. This scenario reflects the current annual increase to property taxes within the Township which would result in approximately $368,000 dedicated to capital funding annually, to be distributed amongst various capital works categories, such as sewer, roads, drainage, water etc. For the purposes of this analysis, it has been assumed, conservatively, that the entirety of the $368,000 would be dedicated towards sewer capital funding only. This approach maximizes funding through tax allocation to ensure sewer capital priorities are addressed as quickly as possible. However, in reality, this annual increase in funding for capital works will be distributed to other infrastructure categories, lengthening the time to reach the maximum sanitary capital funding needs. For simplicity, we have also assumed a constant annual increase of $368,000 until the maximum capital funding need of $5.7M (annually) is reached in year 14. By this time, existing spending levels will have increased by roughly 470%. Overall, these assumptions reveal that even by allotting the full capital funding amount towards sewer alone for years 1-14, existing and future capital priorities are not fully funded until year 25 (assuming no projects arise reactively), resulting in some deferral and long-term risk, but only half the amount of the AALCI funding scenario presented above. This scenario represents the second least-

aggressive funding scenario, and offers insight on the long-term impacts of the Township's current funding practices.

- **Increase property taxes by 2% annually**. This scenario reflects the annual rate increase to property taxes explored by the Township as part of their Financial Sustainability Analysis (2024), which would result in approximately $736,000 dedicated to capital funding annually, to be distributed amongst various capital works categories, such as sewer, roads, drainage, water etc. Consistent with the previous scenario presented, it has been assumed, conservatively, that the entirety of the $736,000 would be dedicated towards sewer capital funding only, increasing existing funding levels by approximately 470% by year eight. We have also assumed that once the funding levels reach the annual capital requirements of the existing scenario ($5.7M), they remain constant. This scenario represents the most aggressive funding scenario. Adopting this strategy would allow all existing and future capital priorities to be funded by year 22 (assuming no projects arise reactively), resulting in the lowest amount of deferral and long-term risk of all the scenarios evaluated.

Table 6 compares the funding scenarios described above and displayed on Figure 4 in terms of capital projects funded and deferred. This comparison reflects a purely financial perspective and does not consider other resources necessary to complete capital works (e.g. labourers, equipment, management etc.). Additionally, these scenarios assume that no new or unexpected capital priorities arise during the subject time period.

Table 6: Financial Comparison of Funding Scenarios

Scenario	Existing Scenario (Year 1 – 10)	Future Scenario (Year 11 – 20)	Costs of Deferred Projects (Year 1 – 20)
Achieve Existing Capital Needs by Year-10	• 59% of all existing projects funded • Total funding: $33.6 M	• 108% of all future projects funded • Total funding: $57.2 M	$19.51 M
Achieve the Average Annual Life-Cycle Investment (AALCI) by Year-10	• 43% of all existing projects funded • Total funding: $24.5 M	• 74% of all future projects funded • Total funding: $39.1 M	$46.7 M
Increase Property Taxes by 1% Annually	• 46% of all existing projects funded • Total funding: $26.6 M	• 104% of all future projects funded • Total funding: $55.2 M	$28.6 M
Increase Property Taxes by 2% Annually	• 69% of all existing projects funded • Total funding: $39.6 M	• 108% of all future projects funded • Total funding: $57.2 M	$13.5 M

As expected, when funding levels increase more aggressively, fewer capital projects are deferred, leading to a reduction in future failure risks. Alternatively, more modest funding increases result in a larger backlog of deferred projects, indicating a greater acceptance of risk and a more reactive strategy for addressing capital needs. However, even the most aggressive scenarios fail to fund all capital projects within a 10-year period, nor *all* capital projects within a 20-year period. This is largely due to current spending levels relative to the existing backlog of deficient infrastructure. As such, some project deferral is inevitable from a financial perspective whereby projects identified in the existing scenario will require deferral to the future period, when funding becomes available, and/or the risk of failure becomes too high to reasonably defer any further. Similarly, some projects identified in the future scenario will require deferral past the 20-year horizon, and again, addressed when funding becomes available, or the risk of failure becomes too high.

When considering deferral, it is important to acknowledge the role of borrowing as a potential mechanism to address funding shortfalls. While this analysis does not factor in recurring borrowing as long-term strategy, it recognizes that loans may serve as a bridge for the Township to address emergency failures. This is common practice to address funding shortfalls but is not an optimal strategy to finance long-term funding needs.

Even with significantly increased funding, fully catching up on infrastructure needs within the next 10 to 15 years will be challenging. Some level of deferral is expected as part of Esquimalt's capital implementation plan, which is common for local governments in British Columbia and across Canada. Moving forward, the Township will need to focus on raising more funds for infrastructure, accepting some level of risk, and ensuring priority projects are delivered efficiently. Until a comprehensive financing discussion takes place with Finance and Council, the Township should be prepared to rely on loans for emergency failures while projects are being deferred.

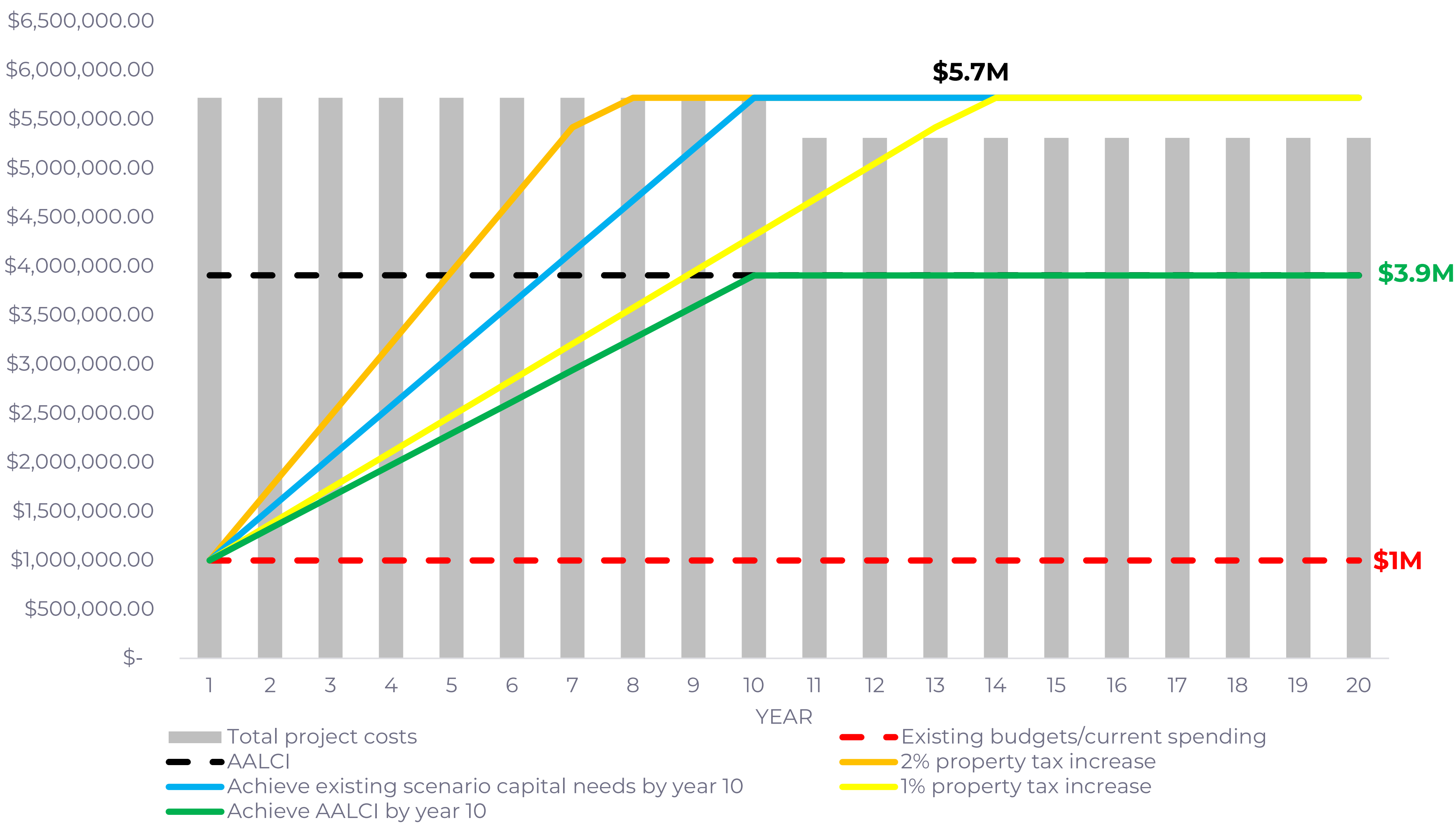

Figure 4: Funding Scenarios for Sanitary Sewer Capital Projects

5.0 RECOMMENDATIONS SUMMARY

The following recommendations arise from the findings of this risk assessment and are aimed to support the Township in making confident and consistent capital decisions, and to ensure investments are strategically dedicated towards the areas they are needed most:

- Work with the Township's Finance Department to review the sanitary sewer funding scenarios outlined in Section 4.1 along with the considerations below. Prepare to increase spending levels, balancing the trade-offs between capital investment and risk tolerance.
    - At a minimum, over the long-term, the Township should focus on achieving sustainable funding targets (the AALCI) and should account for this investment level within sanitary utility budgets. The AALCI value should be regularly reassessed to account for inflation, asset upgrades, and new assets introduced into the network,
    - Maximize funding to sewer infrastructure through the current property tax funding mechanism by increasing the property tax allocation for sanitary capital needs, raising overall property taxes and therefore the proportion dedicated to the sanitary sewer system, or implementing a combination of both strategies, and
    - Create targeted reserve values that align with anticipated capital needs.
- Address capital projects identified under the existing scenario, in order of prioritization (P1 assets, followed by P2 and P3). When projects share a common prioritization ranking and resources are limited, consider the following to help discern which project to proceed with next:
    - Align sewer priorities with other corridor upgrades (e.g., water mains, roads, etc.) to optimize resource allocation and realize cost savings. This includes reviewing local-to-regional opportunities for optimized service delivery (e.g., collaborating with the CRD on localized projects, and/or the City of Victoria vis a vis water upgrade projects),
    - Confirm with Public Works staff where there are routine maintenance issues or challenges. If clusters of assets emerge in a common area, address these together as a single project, and
    - Address condition-driven assets confirmed by CCTV inspection ahead of those prioritized based on age, as these assets are known to be condition deficient. As a reminder, prioritized assets triggered solely by age should be inspected through CCTV ahead of replacement to confirm the pipe’s condition.
- To support the delivery of higher volumes of capital projects, the Township should develop a targeted list of key stakeholders to facilitate streamlined and high-quality service delivery. This list should include project managers, administrative staff, Public Works and contractors. More specifically the Township should:
    - Define clear roles and responsibilities for staff involved in capital works to ensure accountability and clarity.

    - Assign a dedicated staff member to keep information systems up to date as work progresses, including the integration of real-time field data into project identification and delivery processes (e.g., repair records, CCTV inspections etc.),
    - Hire a dedicated capital project manager to oversee planning, delivery, and coordination of the expanded sewer program, and
    - Build internal capacity for engaging with external consultants and contractors to improve oversight and decision-making.
- Regardless of the funding scenario selected, infrastructure deferral is expected. The Township should prepare for this by:
    - Adapting current maintenance practices (refer to Appendix B - Sanitary Sewer Asset Management Plan: Operations and Maintenance Practices Review) with the aim of preserving/extending asset life as long as possible, and
    - Being prepared to borrow funds for reactive infrastructure replacement, as needed.
- Use the outcomes of this assessment to identify a list of eligible development cost charge (DCC) projects, including the appropriate benefit allocation to support fund raising for capacity-triggered capital projects.
- Retrofit lift stations to include back-up generators. The cost per generator will depend on the horsepower of the station, however, the Township should budget approximately $55,000 - $75,000 per station. The timing of these retrofits should be determined as the Township completes their emergency response plan – a recommendation from the attached Operations and Maintenance Practice review.
- Re-CCTV any pipes near the end of their service lives, or in an area with known inflow and infiltration issues every 5-years. Target complete CCTV inspection of the entire network every 10 years.
- Initiate detailed facility condition assessments every 5 years, using the results of these inspections to inform/update the prioritization of facility renewal.
- Complete sanitary sewer network model updates every 5 years and/or when network conditions change significantly, or if new information arises which is relevant to the model.
- Complete the risk-assessment process, at a minimum, every 5 years and incorporate the latest data (e.g., storm main physical inspection data, pump station condition, model results, etc.) to improve near-term decision-making confidence.

Sincerely,

PERMIT TO PRACTICE
URBAN SYSTEMS LTD.
Signature
Date 2025-04-06
PERMIT NUMBER: 1000527
Engineers and Geoscientists BC
(EGBC)

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
M. T. A. STAFFORD
51049

URBAN SYSTEMS LTD.

Kara Labelle, EIT
Civil Engineer-in-Training

Alex Kempa, EIT
Project Engineer

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Project Lead

cc: Adrien d'Andrade, P.Eng., GeoAdvice Engineering Inc.

/kl/ak
Enclosure

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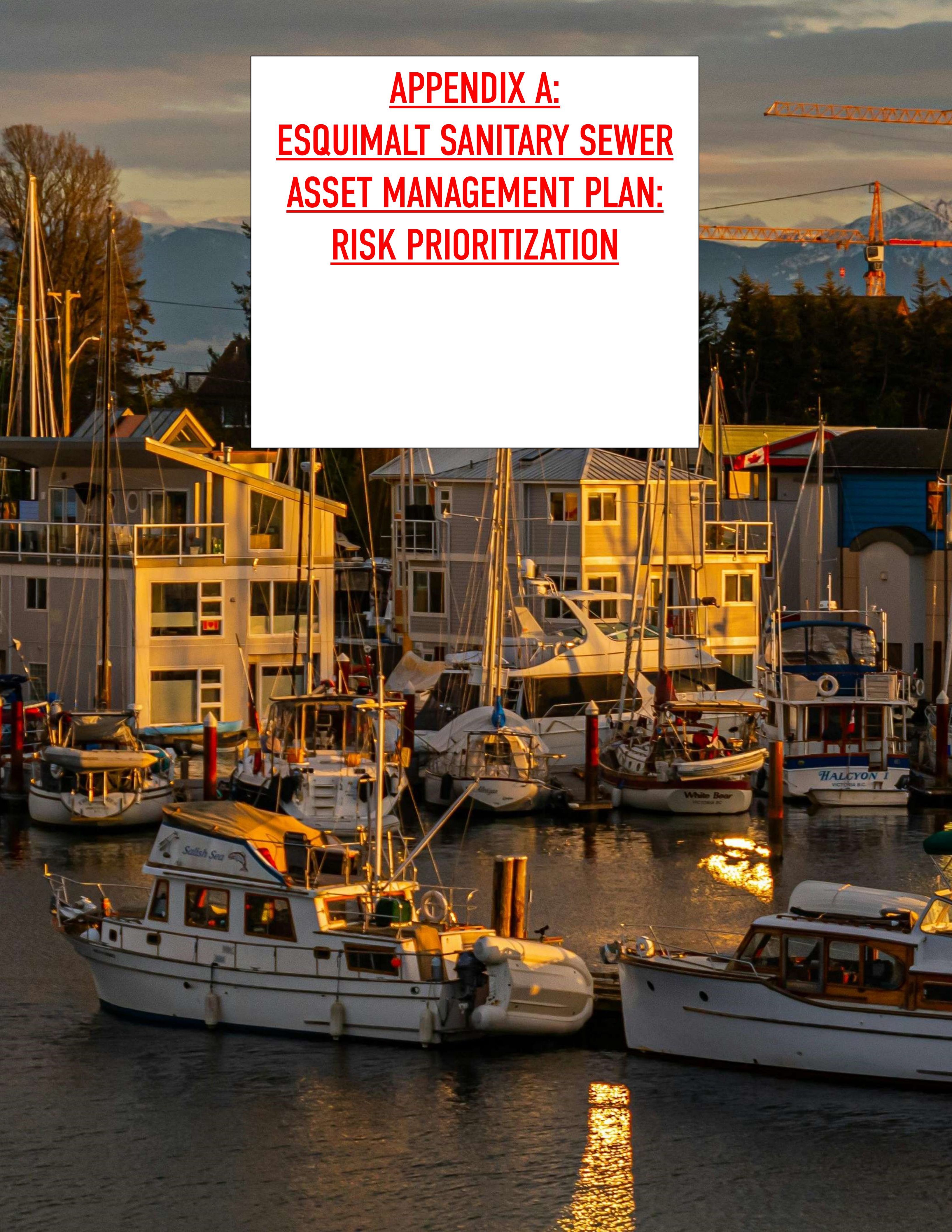
APPENDIX A:
ESQUIMALT SANITARY SEWER ASSET MANAGEMENT PLAN: RISK PRIORITIZATION



URBAN SYSTEMS MEMORANDUM

DATE: August 14, 2024
TO: Joel Clary, P.Eng, PMP
CC: Adrien d'Andrade, P.Eng
FROM: Alex Kempa, E.I.T, Kara Labelle, E.I.T, Mark Stafford, P.Eng
FILE: 3275.0021.01
SUBJECT: Esquimalt Sanitary Sewer Asset Management Plan: Risk Prioritization

1.0 INTRODUCTION

The following memo outlines the risk methodology developed for prioritizing the renewal of the Township of Esquimalt's (the Township) linear sanitary sewer assets and lift stations, as part of the Sanitary Sewer Asset Management Plan.

Risk of failure is a primary consideration for determining *when* and *why to r*enew an asset. It is determined by considering two key components:

1. **Likelihood of failure**– typically based on an asset's condition and capacity to identify the probability of failure (both structurally and hydraulically), where failure is defined as the inability to meet level of service commitments (e.g. providing adequate capacity, ensuring protection of the environment and property).
2. **Consequence of failure** – evaluates the level of impact an asset's failure would have on elements such as economics, the environment, and social considerations.

When a specific asset's likelihood and consequence of failure are both high, the risk associated with failure is high, therefore warranting a high priority ranking on the list of renewals. Alternatively, when an asset's likelihood and consequence are both low, the risks associated with failure are also low, suggesting renewal of that asset is a lower priority. The methodology outlined below specifies how likelihood and consequence of failure are each determined, and how they are combined to determine risk and arrive at a prioritization ranking for each asset. Applying this framework contributes to consistent and confident asset renewal decision-making.

The outcomes of this process are intended to be considered alongside other capital priorities to develop an integrated capital plan. This may include aligning sewer asset renewals with adjacent scheduled projects where appropriate.

2.0 GRAVITY MAIN METHODOLOGY

The methodology for assessing the risk of failure for linear sewer assets consists of three parts:

- An assessment of the combined likelihood of failure;
- An assessment of the combined consequence of failure; and
- Combining these condition and consequence assessments to produce asset risk and prioritization ratings

2.1 COMBINED LIKELIHOOD OF FAILURE

The combined likelihood of failure is a function of an asset's condition and capacity deficiencies.

2.1.1 Condition

One of the most common technologies used to evaluate the structural integrity of a gravity main includes closed-circuit television (CCTV). Currently, the Township employs a contractor (Victoria Drains) to perform CCTV inspections of the sanitary sewer system, with results reported digitally on a monthly basis.

The Township collects CCTV data in accordance with the Pipeline Assessment Certification Program (PACP) which uses a standard format and methodology for collecting CCTV data, coding, observations, and data storage. The PACP condition grades assess defects related to either pipe structure or operations and maintenance (O&M). Whereas O&M grades typically trigger routine maintenance and operational activities (e.g., pipe cleaning), the structural grades signal more urgency for replacement or rehabilitation needs which directly informs the prioritization of capital replacement projects, and will therefore be used to inform condition-based likelihood of failure scoring for this analysis. More specifically, the first two values of the structural quick rating provided by PACP will be used in this analysis:

- The **first digit** represents the highest structural defect grade of a pipe segment, where a structural defect affects the structural integrity of the pipe, such as breaks, separation, and pipe deformation, among others. These grades are assigned on a scale of 1-5, with a score of 5 indicating failure and 1 indicating minor defects with failure unlikely in the foreseeable future, as outlined by Table 1.

Table 1: PACP Scoring System—Structural Defect Grade Descriptions

Structural Defect Grade	Defect Description	Estimated Time to Failure
1	Minor defects	Unlikely in the foreseeable future
2	Minor defects	≥ 20 years
3	Moderate defects that will continue to deteriorate	10 – 20 years
4	Severe defects that will become Grade 5 in the foreseeable future	5 – 10 years
5	Defects requiring immediate attention	Has failed or will likely fail within the next 5 years

- The **second digit** represents the number of times the highest structural defect grade has occurred for a pipe segment

PACP combines these two digits, and divides by 10 to achieve a PACP-based likelihood of failure score which will be used to inform the condition rating of gravity mains, where available.

For example, a quick score of 4232 means that the highest structural defect grade of a pipe is 4 and is observed twice over the pipe segment. As a result, the PACP-based likelihood of failure score for this pipe is 4.2. Note, the last two digits of the quick score are not used for this analysis: they represent the next highest structural severity grade and occurrence of this grade over the pipe. The PACP LoF scores range from 1 to 6, however, this risk methodology uses a 1 to 5 scoring system, where 1 indicates very good condition, and 5 indicates very poor condition. Table 2 translates PACP LoF scoring into a 1 to 5 condition ranking that will later be combined with capacity considerations to determine an overall likelihood of failure score for each gravity main.

In certain cases, CCTV data is not always available for the Townships' gravity mains. Therefore, an asset's age and standard service life (based on pipe material) will be used to estimate the remaining useful life of a pipe and gauge its condition ranking. This correlation between remaining useful life and condition rating is described in Table 2. While age serves as a supplemental proxy for condition, its accuracy in representing condition is less certain relative to results from physical property technologies (e.g., CCTV), particularly considering the Township's uncertainty in install year records. For this reason, an asset's age is only recommended to gauge condition in the absence of more reliable data (CCTV). Moreover, to reduce the number of capital projects driven by age alone, the maximum possible condition ranking based on asset age is 4, also shown in Table 2.

Table 2: Condition Rank Corresponding to Estimated Remaining Life of Asset

Condition Rank	PACP Likelihood of Failure (LoF)	Asset Age Relative to Design Life (DL)	Condition Description
1	1≤ PACP LoF <1.5	Asset Age is <75% of DL	Very good condition
2	1.5 ≤ PACP LoF < 2.5	Asset age is ≥75% of DL, and <100% of DL	Good condition
3	2.5 ≤ PACP LoF < 3.5	Asset age exceed DL by 0-25%	Fair condition
4	3.5 ≤ PACP LoF < 4.5	Asset age exceed DL by >25%	Poor condition
5	4.5 ≤ PACP LoF ≤ 6	Only applicable where actual, field-level condition data is available	Very poor/failed condition

The following service life estimates will be used for evaluating pipe condition and are based on a combination of service lives from other local municipal asset management plans and Township staff recommendations:

Asbestos Concrete (AC) = 85 Years

Polyvinyl Chloride (PVC)= 80 Years

Reinforced Concrete (RC)= 50 years

Vitrified Clay (VIT)=70 Years

Resin-Lined (RL)= 60 years

Unknown= 60 years

2.1.2 Capacity

For capacity, the likelihood of asset failure is based on the hydraulic capacity, hydraulic grade line (HGL) and flow velocity of the pipe under the PWWF of a 5-year storm event. Together, Tables 4 and 5 define how these attributes correlate to an overall capacity grade from A (no concerns) to F (significant concerns). These grades will be linked with condition scoring to arrive at a combined likelihood of failure score, as detailed in section 2.1.3. It is recommended that for sewer mains showing the HGL above the crown of the sewer, that services in the area be compared to the HGL during pre-design of identified upgrades.

Table 3: Hydraulic Level of Servicing Criteria for Scoring

Criteria	Score
Hydraulic Capacity (q/Q*)	
q/Q < 0.70	1
0.70 ≤ q/Q <1.0	2
q/Q ≥ 1.0	3
Hydraulic Grade Line (HGL)	
HGL < Crown	1
Crown ≤ HGL < Rim Elevation	2
HGL > Ground Elevation	3
Velocity (v)	
v < 0.6m/s	Fail
v≥ 0.6m/s	Pass

Table 4: Gravity Main Hydraulic Level of Servicing Rating

Capacity Rank (Grade)	Capacity	HGL	Velocity	Description
A	1	1	Pass	Gravity Main performing as designed
B	1	1	Fail	Adequate capacity, low velocity indicates potential sedimentation
C	1	2 or 3	Pass or Fail[1]	Adequate capacity, backwater caused by downstream conditions
D	2	1,2, or 3	Pass or Fail	Marginal capacity, backwater caused by downstream conditions
	3	1	Pass or Fail	Capacity exceeded and surcharging unlikely
E	3	2	Pass or Fail	Capacity exceeded and surcharging likely
F	3	3	Pass or Fail	Capacity exceeded and potential flooding

[1] *ratings from ‘C’ to ‘F’ are independent of velocity criteria*

2.1.3 Likelihood of Failure: Combining Condition and Capacity

A combined likelihood of failure score is derived by linking an asset's individual condition and capacity scores. Table 5 outlines how the condition and capacity of an asset are considered together to arrive at a combined likelihood of failure score whereby 5 indicates that the probability of failure is very high and a score of 1 indicates that the likelihood of failure is very low.

Table 5: Combined Likelihood of Failure (Gravity Mains)

LoF Score	Condition Ranking	**Capacity** (hydraulic level of service rating)	**Overall Combined Score** (Start at bottom, assess if the statement is true to determine overall score. If false, continue upwards until true)
1	1—Very good condition	A/B-Adequate capacity, low velocity may indicate potential sedimentation	All remaining scores
2	2—Good condition	C-Adequate capacity, downstream condition causing backwater	Condition ***OR*** capacity scores: ≥2
3	3—Fair condition	D-marginal capacity, downstream condition causing backwater	Condition ***OR*** capacity scores : ≥3
4	4—Poor condition	E[2]- Capacity exceeded and surcharge likely	Condition ***OR*** capacity scores: ≥4
5	5—Very Poor/failed condition	F[2]-Capacity exceeded and potential flooding	Both condition ***AND*** capacity score: ≥4

2.2 COMBINED CONSEQUENCE OF FAILURE

The combined consequence of failure is typically a function of the social/community service impacts, financial liabilities (incurred directly or indirectly by the Township), and environmental impacts that might occur should the infrastructure fail. The magnitudes of these categories are respectively estimated using adjacent up and downstream land uses, road classification, and proximity to sensitive ecosystems, as further described in the following sections.

Health and safety, and reputation are among other categories sometimes considered in evaluating consequence, however, proxies of the former category are typically unknown, while proxies for the latter are already represented by existing categories. The severity of injury/illness (health and safety consequence) in the case of a sewer asset failure is difficult to accurately estimate and without accurate estimation, this category provides minimal value in the consequence assessment.

[2] *E and F capacity priorities only apply where an upgrade to that pipe addresses the deficiency (e.g., not rectified by downstream upgrade)*

2.2.1 Social/Community Service Consequences

The scale of population impacted by a service failure is the dominant driver for social/community service consequence. This is estimated based on the upstream and downstream land uses immediately adjacent to the pipe, as the repair of an asset located in a highly populated area (e.g., commercial area) is likely to inflict greater social impacts in comparison to that located within a minimally populated area (e.g. industrial area). These impacts are primarily associated with the asset repair/construction process, rather than service interruptions, which can typically be rapidly mitigated by bypass pumping. Therefore, adjacent land use designations are used to assign a baseline score for social/community service consequences on a scale from 1 to 5, as shown in Table 6, where 1 indicates minimal/ no social impacts and 5 indicates high social impacts.

A main's depth is another factor that can impact social consequence by prolonging the level of service disruption. Therefore, the baseline score for social consequence (described above) increases when a gravity main is at a depth of 3m or greater.

2.2.2 Financial Consequences

The cost to repair a sewer main is often closely linked to the type of road affected. For instance, a failure within an arterial corridor or highway presents greater traffic control and road reconstruction requirements compared to a failure within a local residential road. Road classification, therefore, serves as a proxy to establish a baseline score for financial consequence on a scale from 1 to 5, as shown in Table 6. A score of 1 indicates that the financial liabilities incurred by the Township are lower, whereas 5 indicates that financial implications are significant.

A main's proximity to neighbouring structures is another factor that can also impact financial consequence of failure. Therefore, the baseline score for financial consequence increases when a main is within 6 m of a structure.

Finally, the size and depth of a main also impacts the cost of a repair. As such, the consequence increases with mains 375 mm and larger or at depths of 3m or greater.

2.2.3 Environmental Consequences

Sewers located near sensitive ecosystems present various degrees of impact in the event of a failure. For this reason, the scoring of environmental consequence is based on a pipe's proximity to sensitive ecosystems as defined in Table 6. The baseline scoring for environmental consequence ranges from 1 to 5, where a 1 indicates that asset failure would have minimal impacts on sensitive ecosystems, whereas a 5 indicates that a sensitive ecosystem is close, and failure would have significant impacts.

2.2.4 Combined Consequence of Failure

Typically, the more significant the combined social, financial and environmental consequences, the greater the reputational impact of an asset's failure. Therefore, the combined consequence of failure scores quantified in Table 6 can also be considered the reputational consequence, whereby the greater the combined consequence, the greater the reputational risk.

Table 6: Combined Consequence of Failure Matrix for Gravity Mains

Score	**Social/Community Services**[3] Indicator: Immediate adjacent upstream land uses	**Financial**[4] Indicator**:** Road classification	**Environmental** Indicator**:** Proximity to environmental areas[5]	**Combined (Reputational) Consequence** (start at bottom, assess if the statement is true to determine overall score, continue upwards until true)
1	Agricultural land uses (lowest risk, <5 people impacted, if any)	RSV (service road)	No downstream sensitive ecosystems within 50m	All remaining scores
2	Industrial land uses (low risk, approx. 5-20 people impacted)	RLN (road lane), RRT (restricted road, not publicly accessible)	Asset is 30m to 49m from downstream sensitive ecosystem	1 category scores: 3 OR ≥ 2 categories score: 2
3	Low-density land uses (moderate risk, approx. 20-50 people impacted)	RLO (local road), RST (strata road)	Asset is 15m to 30m from downstream sensitive ecosystem[4]	1 category scores: 4 OR ≥ 2 categories score: 3
4	Medium-density land uses (high risk, approx. 50-100 people impacted)	RC1 (major collector), RC2 (minor collector), RRC (recreation road), RYL (yield lane)	Asset is 10m to 15m from downstream sensitive ecosystem or runs below water course	1 category scores: 5 OR ≥2 categories scores: 4
5	High-density and critical land uses (highest risk, approx. 100-500 people impacted)	RA1 (major arterial)	Asset is within 10m of downstream sensitive ecosystems or sanitary sewer runs above watercourse	≥ 2 categories score: 5 OR 1 category scores: 5 AND 2 categories score: 4

[3] *Increase score by 1 (to a maximum of 5) if depth of pipe is ≥3m*
[4] *Increase score by 1 (to a maximum of five) if pipe size is ≥ 375mm, or depth of pipe is ≥3m*
[5] *Where sensitive ecosystems include environmental areas identified by provincial data*

2.3 RISK FACTORS FOR CAPITAL PLANNING

Integrated capital planning is reliant on the prioritization of asset renewal. This process is driven by the risks associated with individual asset failure and derived from the asset's combined likelihood (probability) and consequence (impact) of failure. Table 7 correlates the combined likelihood and consequence of failure into a risk-based prioritization ranking for capital planning. This table uses input values resulting from the combined likelihood and consequence of failure tables above to determine a risk-based priority ranking from P1 (Priority 1, top priority) to P3 (Priority 3) whereby a P3 asset renewal is important, but less urgent in comparison to the higher risk P1 or P2 assets.

Table 7: Risk Prioritization Matrix for Gravity Mains

Combined Consequence of Failure	1	2	3	4	5
5				P2	P1
4		N/A		P2	P1
3				P3	P2
2				P3	P2
1				P3	P2

Combined Likelihood of Failure

The risk-matrix above builds off asset management best practices and is tailored to serve the unique needs and data availability of the Township. We have seen similar prioritization schemes adopted by other municipalities on Vancouver Island, all rooted in the following core principles:

- As a critical community service, the sanitary sewer system demands proactive attention and investment decisions. The goal is to replace assets before they fail and cause service disruptions and other impacts, as described above. Therefore, all assets with a likelihood of failure (LoF) of 4 or 5 (i.e., failed or failing) are prioritized, regardless of the consequence of failure (CoF) score (as asset failure is not accepted even when the consequence of failure is low).
    - Recall that assets with a LoF score of 5 are characterized by either failing (or nearing failure) in terms of condition AND capacity, while assets with a LoF score of 4 are characterized by failing (or nearing failure) in terms of condition OR capacity.
- Priority ratings are additionally differentiated by CoF scores; sewers with a high combined CoF (4 or 5) naturally presents higher risks, but such risks may be managed by performing maintenance/upgrades throughout the asset's life. The need for more extensive maintenance associated with these higher risk assets results in their prioritization over sewers with lower CoF scores (3 or lower).
- The renewal of lower priority assets may require deferral depending on funding availability. A tool is needed (e.g., the risk-matrix and methodology) to help understand which prioritized assets can be safely differed (if needed) and what this means for risk tolerance levels. Deferring the renewal of prioritized assets will be discussed on an as-needed basis in the Master Plan, pending results of the risk assessment.

It is important to recognize that an asset with a moderate or unclassified prioritization ranking may transition to having a higher risk and prioritization over time, becoming a more urgent priority due to the simple deterioration of the asset. With this in mind, there must be emphasis on keeping the risk and prioritization assessment a dynamic and living process, requiring monitoring and reviews on a regular basis. Many municipalities have CCTV inspection programs to assess their entire sewer network every 5 years, with 1/5 of the network being completed each year.

3.0 LIFT STATIONS

The methodology for assessing the risk of failure for lift stations includes three parts: an assessment of the combined likelihood of failure, an assessment of the combined consequence of failure, and the combination of these condition and consequence assessments to produce asset risk-based prioritization ratings.

3.1 COMBINED LIKELIHOOD OF FAILURE

The combined likelihood of failure is a function of a lift station condition and capacity deficiencies.

3.1.1 Condition

The condition of each lift station was determined through site inspections that evaluated the condition of approximately 33 sub-components, typically found as part of a lift station, across four functional disciplines, including civil, mechanical, electrical, and structural components. The individual condition scores for each component along with their importance weighting (representing their criticality to station operation) were used to determine overall condition and likelihood of failure scores for each lift station. The likelihood of failure scoring ranged from 1 to 5, where 1 indicates the lowest likelihood of failure due to condition, and 5 indicates the highest likelihood of failure due to condition. Additional details on this evaluation process and the lift station condition assessments will be provided in a separate report.

The condition values for lift stations will be combined with a capacity of failure score to arrive at an overall likelihood of failure score for each station.

3.1.2 Capacity

For lift station capacity, the likelihood of failure is based on three parameters: pump capacity, wet well capacity, and force main velocity as shown in Table 8. The parameters correlate to a grading scale from A to F shown in Table 9, where A indicates no capacity concerns, and F indicates significant capacity concerns.

Table 8: Lift Station Hydraulic Level of Service Criteria Scoring

Criteria	Score
Pump Capacity	
PWWF[6] ≤ Firm Capacity [7]	Pass
PWWF > Firm Capacity[8]	Fail
Wet Well Capacity	
Maximum Operating Level < Inlet Pipe Invert	1
Maximum operating Level ≥ Inlet Pipe Invert	2
Maximum Operating Level≥ Maximum Physical Depth	3
Forcemain Velocity	
v < 0.75 m/s	Fail
0.75 m/s ≤ v ≤ 3.0 m/s	Pass
v > 3.0 m/s	Fail

Table 9: Lift Station Hydraulic Level of Servicing Rating

Grade	Pump Capacity	Wet Well Capacity	Force main Velocity	Description
A	Pass	A	Pass	Pump station performing as designed
B	Pass	A	Fail	Forcemain velocity outside of design range
C	Pass	B	N/A	Inlet pipe invert within pump operating range and backup unlikely (submerged inlet)
D	Fail	A	N/A	Pump capacity exceeded but sufficient wet well capacity to attenuate additional flow
E	Fail	B	N/A	Pump capacity exceeded and backup likely
F	N/A	C	N/A	We well capacity exceeded and overflow likely

[6] *PWWF= Peak Wet Weather Flow*
[7] *Pump station firm capacity determined with the station's largest pump out of service*

3.1.3 Likelihood of Failure: Combining Condition and Capacity

A combined likelihood of failure score is derived by combining a lift station's individual condition and capacity scores. Table 10 correlate the condition and capacity of a station to arrive at a combined likelihood of failure score on a scale from 1 to 5. A 5 indicates that the probability of failure is very high, whereas a score of 1 indicates that the likelihood of facility failure is very low.

Table 10: Combined Likelihood of Failure Matrix for Lift Stations

Score	Condition	Capacity (Hydraulic Level of Service Rating)	Overall Combined Score (Start at bottom, assess if the statement is true to determine overall score. If false, continue upwards until true)	Score
1	Informed by condition inspections	HLoS = A (Adequate capacity, performing as designed)	All remaining scores	**1**
2		HLoS = B (Adequate capacity although forcemain velocity is outside design range)	Condition or capacity scores: 2	**2**
3		HLoS = C (Moderate capacity, inlet pipe invert within pump operating range, backup likely) OR HLoS = D (Pump capacity exceeded but sufficient wet well capacity to attenuate additional flows)	Condition or capacity scores: 3	**3**
4		HLoS = E (Pump capacity exceeded, backup likely)	Condition or capacity scores: ≥ 4	**4**
5		HLoS = F (wet well capacity exceeded, overflow likely)	Both condition and capacity score ≥ 4	**5**

3.2 COMBINED CONSEQUENCE OF FAILURE

The combined consequence of failure is typically a function of the social/community service impacts, financial liabilities (incurred directly or indirectly by the Township), and environmental impacts that might occur should the infrastructure fail. The magnitude of these categories are respectively estimated using Peak Wet Weather Flow (PWWF), total station horsepower, and proximity to sensitive ecosystems.

3.2.1 Social/Community Services Consequences

The social consequence of a lift station failure is proxied using the station's PWWF which typically correlates to the number of people impacted in the case of station failure: the higher the flow entering the lift station, the greater the population upstream contributing to these flows.

PWWF is scored on a scale from 1 to 5, where 1 indicates low social consequence (small population impacted) and 5 indicates high social consequence (large population impacted).

3.2.2 Financial Consequences

There are various financial implications due to lift station failure, ranging from liability costs for private property damage to environmental cleanup fees and emergency repairs. The cost to repair a lift station is closely linked to the station's total horsepower (the sum of horsepower of all pumps within the station). Total pump horsepower serves as a general indicator of the financial impact a station could impose if failure were to occur (relating to property damages, repair costs, environmental control etc.). Financial consequence is scored on a scale from 1 to 5 where 1 indicates minimal financial liabilities should the station fail, whereas a 5 indicates significant financial liabilities. The horsepower for each station has been provided by the Township and is summarized below.

Table 11: Pump Station Horsepower

Station	Total Station Horsepower	Station	Total Station Horsepower
Craigflower	6	Grafton	40
Garthland	10	Constance	5.8
Uganda	40	Kinver	40
Lampson	4.8	Forshaw	40
Canteen	20	Luscombe	20
Seahaven	20	Saxe Point	4
Gorge Park Pavilion	5		

3.2.3 Environment Consequences

Lift stations located nearby sensitive ecosystems present various degrees of impact in the event of a failure. For this reason, the scoring of environmental consequence is based on a station's proximity to environmentally sensitive areas, water bodies, water courses, and the ocean. Environmental consequence is scored on a scale from 1 to 5 where 1 indicates low environmental consequence, and 5 indicates high environmental impact.

3.2.4 Likelihood of Failure: Combining Social, Financial and Environmental Impacts

A combined consequence of failure score is derived from combining a station's individual social, financial, and environmental consequence scores, and can be used to represent reputational consequences as previously discussed in section 2.2.4. Table 14 presents the correlation of these three consequence categories to arrive at a combined consequence of failure score ranging from 1 to 5. A 5 indicates that the combined consequences of failure are significant, whereas a 1 indicates that combined consequences are minimal.

Table 12: Combined Consequence of Failure Matrix for Lift Stations

Score	**Financial** Indicator: Total Pump Station Horsepower (TH)	**Social** Indicator: Peak Wet Weather Flow	**Environmental** Indicator: Proximity to sensitive ecosystems[8]	**Combined Consequence Evaluation** (Start at bottom, assess if the statement is true to determine overall score. If false, continue upwards until true)	**Score**
1	TH < 5 HP	PWWF ≤ 2 L/s	No downstream environmental concerns within 50 m	All remaining	**1**
2	5 HP ≤ TH < 10 HP	2 L/s < PWWF ≤ 8 L/s	Asset is 30 m to 49 m from downstream sensitive ecosystem	1 category scores: 3 Or ≥ 2 categories score: 2	**2**
3	10 HP ≤ TH < 15 HP	8 L/s < PWWF ≤ 15 L/s	Asset is 15 m to 30 m from downstream sensitive ecosystem	1 category scores: 4 Or ≥ 2 categories score: 3	**3**
4	15 HP ≤ TH < 20 HP	15 L/s < PWWF 35 ≤ L/s	Asset is 10 m to 15 m from downstream sensitive ecosystem	1 category scores: 5 Or > 1 categories score: 4	**4**
5	20 HP ≤ TH	35 L/s < PWWF	Asset within 10 m of downstream sensitive ecosystems	> 1 categories score: 5 Or 1 category scores: 5 AND 1+ categories score:4	**5**

[8] Where sensitive ecosystems include environmental areas identified by provincial datasets

3.3 RISK FACTORS FOR CAPITAL PLANNING

Integrated capital planning is reliant on the prioritization of facility renewal. This process is driven by the risk of failure and informed by a station's combined likelihood and consequence of failure. Table 13 correlates the combined likelihood and consequence of failure into a prioritization ranking using input values that arise from the tables above. Priorities range from P1 (Priority 1) to P3 (Priority 3), whereby a P3 asset renewal is important, but less urgent in comparison to P1 or P2 assets.

Table 13: Lift Station Risk Prioritization Matrix

Combined Consequence of Failure	1	2	3	4	5
5				P2	P1
4				P2	P1
3		N/A		P3	P2
2				P3	P2
1				P3	P2

Combined Likelihood of Failure

The core principles described in Section 2.3 for developing the gravity-main risk-prioritization matrix also apply to the lift station prioritization matrix, with some additional considerations:

- While the risk of lift station failure is generally evaluated using the same methodology as gravity mains, the overall magnitude of lift station failure is higher in comparison to linear assets. A lift station failure presents greater risk than that of the majority of gravity mains, as these assets serve more critical roles in the function of the sanitary sewer system. When it comes to capital planning and funding is limited, a lift station with the same risk rating as a gravity main will likely be renewed first (if funding allows) due to higher relative risk. The execution of priority projects should also be aligned with other capital projects (e.g. road replacements) to optimize dedication of resources.

It is important to recognize that a facility with a moderate or unclassified prioritization may transition to having a higher risk (prioritization) over time due to the simple aging of the asset, or the introduction of new demands from growth. With this in mind, there must be emphasis on keeping the risk and prioritization assessment a dynamic and recurring process.

From a prioritization perspective, priorities and timing recommendations move from the highest risks (likelihood x consequence) through to lower risk scores.

It is recommended that the prioritization of lift station upgrades be reviewed and updated at least once every 5 years with lift station condition inspections completed as part of this cycle.

4.0 FORCE MAINS

Consistent with gravity mains and lift stations, force mains also rely on likelihood and consequence of failure to inform capital prioritization, as outlined below.

4.1 COMBINED LIKELIHOOD OF FAILURE

The combined likelihood of failure of a forcemain is a function of forcemain condition, and velocity, used as a proxy for capacity.

4.1.1 Condition

Like lift stations, a physical condition assessment of force main's is planned for 2024. The results of this work will include a separate force main condition report detailing these results which will be translated into condition scores on a 1 to 5 scale for use in this prioritization risk assessment herein.

The condition values for each forcemain will be combined with a capacity of failure score to arrive at an overall likelihood of failure score for each forcemain.

4.1.2 Capacity

Force main capacity will be evaluated by velocity, as depicted in Table 14. In contrast to gravity mains and lift stations, forcemain capacity may only be assigned a 1 or a 5, with a 1 corresponding to a sufficient velocity (a "pass" in terms of Table 14) or a 5, corresponding to an insufficient velocity (a "fail" in terms of Table 14).

Table 14: Force Main Capacity Rating

Criteria (forcemain velocity)	Score
v ≤ 3.0 m/s	Pass (1)
v > 3.0 m/s	Fail (5)

4.1.3 Likelihood of Failure: Combining Condition and Capacity

A combined likelihood of failure score is derived by combining a force main's individual condition and capacity scores. Table 15 correlate the condition and capacity of a forcemain to arrive at a combined likelihood of failure score on a scale from 1 to 5. A 5 indicates that the probability of failure is very high, whereas a score of 1 indicates that the likelihood of facility failure is very low.

Table 15: Combined Likelihood of Failure Matrix for Force Mains

Score	Condition	Capacity (Forcemain velocity, refer to **Table 14**)	**Overall Combined Score** (Start at bottom, assess if the statement is true to determine overall score. If false, continue upwards until true)	Score
1	Informed by condition inspections	v ≤ 3.0 m/s (Pass)	All remaining scores	**1**
2		N/A	Condition score = 2	**2**
3			Condition score = 3	**3**
4			Condition score ≥ 4 <u>or</u> capacity score = 5	**4**
5		v > 3.0 m/s (Fail)	Condition score ≥ 4 <u>and</u> capacity score = 5	**5**

4.2 COMBINED CONSEQUENCE OF FAILURE

For the purposes of this risk assessment, it is assumed that the consequence associated with force main failure is consistent with its respective lift station. This is based on the premise that a failure of the forcemain will have similar consequences as the pump station being out of service. Moreover, force mains typically represent a relatively small portion of any sewer system, both in terms of asset value, and physical quantity, therefore, developing a unique and complex consequence methodology for force mains often results in negligible returns when it comes to the overall capital plan.

4.3 RISK FACTORS FOR CAPITAL PLANNING

The methodology and principles for combining likelihood and consequence of failure into a risk ranking for force mains is consistent with lift stations, as described in Section 3.3, and repeated below in Table 16.

Table 16: Force Main Risk Prioritization Matrix

Combined Consequence of Failure	1	2	3	4	5
5				P2	P1
4				P2	P1
3		N/A		P3	P2
2				P3	P2
1				P3	P2

Combined Likelihood of Failure

Recall, moderate or unclassified priorities may transition to having a higher risk (prioritization) over time due to the simple aging of the asset, or the introduction of new demands from growth. With this in mind, there must be emphasis on keeping the risk and prioritization assessment a dynamic and recurring process. It is recommended that the prioritization of forcemain upgrades be reviewed and updated at least once every 5 years with condition inspections completed as part of this cycle.

Sincerely,

URBAN SYSTEMS LTD.

PROFESSIONAL
PROVINCE OF
M. T. A. STAFFORD
51049
BRITISH COLUMBIA
ENGINEER

2024-08-15

Alex Kempa, EIT
Civil Engineer

Kara Labelle, EIT
Civil Engineer

Mark Stafford, P.Eng
Project Manager

PERMIT TO PRACTICE
URBAN SYSTEMS LTD.
Signature
Date 2024-08-15
PERMIT NUMBER: 1000527
Engineers and Geoscientists BC
(EGBC)

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APPENDIX B: SANITARY SEWER ASSET MANAGEMENT PLAN: OPERATIONS AND MAINTENANCE PRACTICES REVIEW

URBAN SYSTEMS

MEMORANDUM

DATE: January 29, 2025
TO: Joel Clary, P.Eng.
CC: Adrien d'Andrade, P.Eng
FROM: Kara Labelle, Alex Kempa, Mark Stafford, P.Eng.
FILE: 3275.0021.01
SUBJECT: Sanitary Sewer Asset Management Plan: Operations and Maintenance Practices Review

1.0 BACKGROUND

Urban Systems is working with GeoAdvice and the Township of Esquimalt (the Township) to complete a Sanitary Sewer Asset Management Plan (SSAMP) which includes the identification of priority upgrade projects required in the Township's sanitary sewer system. Part of this scope includes identifying the Township's current operation and maintenance (O&M) practices for the sanitary system and comparing them to industry standards / best practices to create a list of recommended improvements. By improving O&M practices, the Township helps optimize system performance, reduces risks of infrastructure failure, and can extend the lifespan of assets.

Generally, the Township's day-to-day O&M activities are reactive in dealing with breaks, backups, root intrusion, new connections, odours and flushing. The Township relies heavily on contractors for O&M services like electrical work, CCTV inspection and Vactor truck needs.

A summary of the Township's existing O&M practices are captured in Table 1 and based on a meeting with Township staff, including Public Works on November 6, 2024. This table also includes a list of recommended actions to help align current practices with industry standards and provides high-level, order-of-magnitude cost estimates that focus on next-step funding needs.

2.0 O&M BUDGET

Annually, the Township budgets approximately $500,000 for O&M activities. Staff have noted that while the current budget is generally sufficient for existing tasks it often goes underspent, and there is a lack of staffing to manage additional work from recent developments and utility repairs. Although excess funding is available, the existing budget is not large enough to significantly expand services such as a hiring additional staff members, annual CCTV inspections or flushing programs. Furthermore, due to the absence of integrated digital systems, for tracking O&M costs, activities and infrastructure repair expenses, there is an opportunity for the Township to enhance access to detailed information in a centralized manner that would provide a clearer understanding of the breakdown of existing budgets and a more refined estimate of O&M funding needs. In the meantime, this analysis proposes high level budgetary considerations based on our understanding of existing practices, needs identified by staff and alignment with industry standards.

To meet the increasing demands of both capital project delivery and the ongoing maintenance of the existing sanitary system, additional resources will likely be required. This is driven by the dual priorities of replacing deficient infrastructure and addressing the O&M needs of the system to optimize service level and life.

If prioritized replacement projects are deferred, the risk of infrastructure failure escalates, leading to a greater reliance on reactive maintenance to sustain service levels and a lessened ability to complete proactive maintenance. This reactive approach is not only more resource-intensive but can also result in increased service disruptions, higher repair costs, and potential environmental or regulatory consequences. Conversely, timely investment in capital replacement reduces the likelihood of system failures and allows for a more proactive O&M strategy. Balancing these priorities necessitates a robust staffing plan that can effectively support both areas.

Table 1: Township O&M Practices vs. Recommendations Based on Best Practice

Recommended Practice	Current/Previous Practices	Recommended Actions
CCTV Inspection Program	No active program - temporary program (2017 – 2023) completed for the full sanitary network using the Pipeline Assessment and Certification Program (PACP) rating system.	• Aim to complete full CCTV inspection of network every 10 years. • Identify and re-CCTV any pipes near the end of their service lives, or in an area with known I&I issues, every 5 years. • Aim to complete point repairs/rehabilitation of infrastructure based on CCTV outcomes as soon as funding becomes available. Note, best practice is to complete within one year of inspection, however, this will be difficult given the Township's current backlog of capital priorities but should be a target for the future as backlog is addressed. • Continue using the PACP rating system and ensure inspection results are published in a format compatible with GIS to support future risk-assessment integration. Regularly update the internal CCTV results database as additional inspections are performed. • Continue to complete flushing prior to CCTV inspections.

Recommended Practice	Current/Previous Practices	Recommended Actions
Gravity Sewer Flushing Program	Flushing is generally preformed reactively, although there are some known problem areas with grease build-up which are flushed twice per year. A more formalized flushing program is desired by the Township.	• Identify and document hot spots requiring flushing (e.g., areas prone to grease, debris build up, odours, and/or bellied pipes). Where possible, use existing CCTV data and GIS attributes (e.g., shallow pipe-grade, land uses, average flow velocity, service record call outs etc.) to help inform this list of hot-spots. For each location, determine the frequency of flushing needs to create a flushing schedule, based on a 1, 3 or 6-month cycle.
Forcemain Cleaning	Not implemented. Based on current configuration of lift stations and forcemains, cleaning access is likely limited.	• Retrofit and install pigging chambers at the start of each forcemain to enable forcemain cleaning via polyurethane swabs, also known as poly pigs. Poly pigs are inserted into the main and pressurized behind the device which allows it to scour the inside of the pipe. • Pigging chambers may also serve as an access point for future forcemain condition inspections.
Inspection of Manholes and Laterals	Not implemented	• Create a list of high priority manholes and laterals (e.g., based on history of blockages, backups, I&I, etc.) for annual inspection. Manholes are recommended for visual inspection by public works, whereas the inspection of laterals should be included as part of the Township's CCTV planning. • Continue to install inspection chambers on sewer connections, in alignment with MMCD, and add inspection chambers during renewal of existing laterals, especially in high-priority areas.

Recommended Practice	Current/Previous Practices	Recommended Actions

Lift Station Maintenance	Stations are washed on a monthly basis with readings collected hourly. Stations are also pumped out annually, with pumps and kiosks inspected. These inspections help identify issues warranting station repair or replacement.	• Continue existing practices, as scheduled, and ensure check valves are inspected and cleaned annually as part of existing procedures.
		• Semi-annually, or quarterly:
		  o Visually inspect / manually operate each pump to ensure proper function
		  o Pump down the wet well to lowest point and visually inspect
		  o Exercise any suction and discharge isolation valves
		  o Test the back-up generator
		• Check and replace activated carbon as required.
		• Conduct recurring Arc Flash assessments of electrical components every 3-5 years or specified by electrical inspections.
		• Complete full condition assessments of the pump stations at 10 years of age and every 5-years following.
		• Annually exercise air and gate valves for all forcemains to prevent valve seizing.
		• Review SCADA controls and network-wide pump station programming such that coordination between stations (e.g., Dockyard and Canteen) and pumping priority can be determined.

Recommended Practice	Current/Previous Practices	Recommended Actions
Record Keeping/ Tracking	Fields reports are currently filled out manually and stored as paper forms with no automated system for collecting cost information on repairs. To help better forecast and plan maintenance practices and asset repair/replacement, the Township has identified a desire to adopt software to track O&M costs and activities, and costs spent on assets.	• Transition from manual, paper-based recordkeeping to specialized software for work order tracking. • Explore available software options and evaluate their complexity, integration requirements, costs, and alignment with operational needs and budget. Consider collaborating with other local governments of similar size to gather input on their experiences and challenges with software adoption.
Flow Monitoring	Hourly data collected by Township at Canteen, Constance, Forshaw, Garthland, Luscombe, Sea Haven, and Uganda pump stations. Two level readers are also used to monitor flow in key locations (see I&I practices below). Flow data also available from the CRD flow meters: Anson, Devonshire, Esquimalt Pump Station, Head, Kinver, Land Cove DND (Department of National Defence), Land Cove Esquimalt, Lyall Mag Meter and Wilson. The location of these meters are appended to this memo.	• Install 3 – 5 flow monitors per catchment and monitor for four months during the winter/spring when rainfall is likely. Aim at monitoring 2 – 3 catchments per year, so the entire Township is monitored over a 5-year period. • Use flow monitoring data to re-calibrate the hydraulic model as part of the next model update. • Complete regular maintenance activities/inspections for active flow meters to ensure good working condition (e.g. cleaning accumulated debris and silt from flow meter area, checking battery state etc.). Maintain records of such activities/inspection.

Recommended Practice	Current/Previous Practices	Recommended Actions
Asbestos Concrete Pipe Testing	Not implemented, however, Township has expressed desire to test for wall thickness and quality during breaks or exposure of asbestos concrete pipes.	• Collaborate with neighbouring communities regarding their experience with asbestos concrete pipes and results of destructive/non-destructive testing, if complete. • Where there are breaks, or known issues with asbestos concrete pipes, complete destructive/non-destructive testing, to understand pipe condition as it approaches its service life. Testing should be done selectively, where site conditions are varied, to help inform conclusions based on local characteristics.
I&I Monitoring	I&I Master Plan completed in 2021 by KWL. Two level readers are used to monitor flow in key locations. I&I issues are typically addressed reactively when problems arise, rather than through an on-going program. Temporary smoke testing program completed in 2008, covering the entire Township. Updated the sewer model as part of this SSAMP to understand existing I&I responses within the system.	• Complete a comprehensive I&I Master Plan every 5-years. • Consider completing smoke testing in alignment with areas identified by the 2021 I&I Master Plan. If funding is limited, or higher priority catchments have emerged, consider using the outcomes of the updated I&I Master Plan to target and guide key smoke testing areas. • Monitor flows annually, prior to, and following I&I initiatives/activities to help quantify impacts.

Recommended Practice	Current/Previous Practices	Recommended Actions
Standard Operating / Safe Work Procedures	Not implemented	• Create a manual outlining the protocols to perform operations and maintenance practices safely, including confined space entry requirements. These procedures are intended to standardize work processes, ensure compliance with regulatory requirements and enhance safety.
Sanitary Sewer Emergency Response Plan	Not implemented for the sanitary sewer system	• Create an Emergency Response Plan specific to the sewer system including the identification of potential emergencies (e.g., power loss) and response plan procedures.
Lifelines Assessment	Not implemented	• Complete a study to assess what sewer infrastructure needs to remain operational post disaster and incorporate results into the next scheduled risk assessment. • Incorporate the results of this study into the emergency response plan as noted above.
Develop a Maintenance Calendar	Not Implemented	• Develop a comprehensive maintenance calendar/guide that documents specific maintenance needs for the various sanitary sewer system components. • Consider dividing the utility into maintenance “zones” such that maintenance practices are completed by zone (e.g. address zones 1 and 2 in Year 1, address zones 3 and 4 in Year 3 etc.). Zones may be based on a variety of factors including infrastructure condition, type, or age, critical service areas/infrastructure, and maintenance access. There will likely be efficiencies to developing this calendar alongside the Standard Operating/Safe Work Procedures.

3.0 RECOMMENDATIONS

Proactive investment in both capital replacement and O&M is essential for managing the sanitary system effectively. While capital projects reduce long-term risks, robust O&M practices are key to maintaining system performance and mitigating immediate challenges.

Overall, the results of the sanitary sewer system risk assessment reveal that the majority of capital priorities are condition deficient, and largely confirmed by CCTV inspection. Furthermore, the funding gap between historic spending levels and capital needs indicates that some level of deferral is expected as part of Esquimalt's capital implementation plan. This emphasizes the importance of operations and maintenance practices, such as continued CCTV inspection, and flushing, among others, to help ensure Esquimalt continues to meet desired service levels.

Acknowledging the need for staffing resources, and additional funding to align with O&M best practices, the list of recommended actions below are categorized based on priority, with consideration of level of effort and staff capacity to adopt and implement.

Due to the limitations of tracking historic O&M costs, activities and infrastructure repair expenses, the budgets proposed below are high-level estimates and based on our understanding of staff O&M practices and our experience working in other communities. As outlined in the list of actions below, there is important foundational work required to finetune future O&M needs and therefore budgets. These items have been prioritized over the short-term to support the Township in advancing their understanding of O&M needs.

HIGH PRIORITY/SHORT-TERM (1 – 2 YEARS)

- Re-CCTV any prioritized pipes based on condition from the SSAMP, pipes that are near the end of their service life, or in an area with known I&I issues every 5-years,
    - **Budget:** Minimum of $60,000 annually, for the next 5-years. This is based on the SSAMP results, and assets approaching their service life (i.e., ≥95% of their design life). Over time, this level of investment will be dictated by the Township's ability to address condition-based capital priorities.
- Identify and formally document a list of known and potential hot-spots for flushing, including frequency requirements. Implement program within the next 2-years.
    - **Budget:** Estimated $20,000 investment to set up a database/system (ideally that integrates with the Township's GIS) of hot-spot locations and frequency requirements. The cost of implementation will depend on the results of the initial investigation and should consider flushing that will take place as part of CCTV investigations. Furthermore, the Township will also need to consider if this activity will be completed by Public Works staff or a contractor. To assist with planning, roughly 700m of gravity main can be flushed in a single day. If contracted out, this is equivalent to approximately $1,800 in flushing fees per day.
- Continue existing lift-station maintenance practices, including monthly washing and semi-annually:
    - Visually inspect / manually operate each pump to ensure proper pumping,
    - Pump down the wet well to lowest point and visually inspect,

- Exercise any suction and discharge isolation valves,
- Test the back-up generator,
- Replace activated carbon (annually),
- **Budget:** $25,000 annually. This assumes 2-hours per lift station for monthly maintenance and an additional 2 hours per lift station semi-annually, for one full time Public Works employee.

- Create a list of high-priority manholes and laterals for annual inspection. A budget should be determined following initial investigation, with lateral CCTV inspections added to the Township's CCTV program, and manhole inspections completed annually.
- Complete additional flow monitoring in advance of the next SSAMP, or sooner as funds become available. Additional monitoring will not only help future model updates but will also help potential I&I entry points.
  - **Budget:** $25,000 per catchment for four months of temporary monitoring. We recommend the Township monitor 2 – 3 catchments per year to capture the entire network over a 5-year period.
- Initiate software exploration/options evaluation for work order tracking, including collaboration with other local governments. While the exploration phase is recommended over the short term, software adoption and integration (e.g., training) will be a multi-year process, whose cost will depend on the outcomes of the options analysis.
  - **Budget:** $50,000
- Document Standard Operating / Safe Work Procedures and create and maintenance calendar in parallel.
  - **Budget:** $50,000 - $100,000
- Create a Sanitary Sewer Emergency Response Plan over the next 2 – 3 years.
  - **Budget:** $25,000
- Initiate discussions with neighbouring communities on testing practices for asbestos concrete pipes. Use the results of this discussion to budget for testing needs, likely to occur in the near term, or as opportunities for testing arise.
  - **Budget:** $5,000 is recommended as an interim, annual budget for sampling, assuming approximately $500/sample of AC pipe 10 times per year.
- Update Township's I&I Master Plan including recommended actions to identify and address I&I concerns.
  - **Budget:** $20,000 (excluding flow monitoring, and implementation of recommended actions). Please note, this budget is not typically included within the O&M budget profile, however, is listed here to support comprehensive utility planning and to emphasize the importance of future updates to the Master Plans.

MODERATE PRIORITY/NEAR-TERM (3 – 5 YEARS)

- Conduct recurring Arc Flash assessments of electrical components every 3-5 years,
    - **Budget:** $40,000
- Review SCADA controls and programming
    - **Budget:** $25,000
- Complete lift station condition assessments, including electrical inspections, within the next 5-years or in alignment with the next SSAMP:
    - **Budget:** $40,000 - $50,000
- Complete lifelines assessment for incorporation into the next SSAMP. This could also be included within the scope of the next SSAMP.
    - **Budget:** $5,000 - $25,000. Please note, this budget is not typically included within the O&M budget profile, however, is listed here to support comprehensive utility planning and to emphasize the importance of sustainable infrastructure planning.
- Update Township's SSAMP:
    - **Budget:** ~$200,000. Like the I&I Master Plan update and lifelines assessment, this budget is not typically included within the O&M budget profile, however, is listed here to support comprehensive utility planning and to emphasize the importance of future updates to the Master Plans.

LOWER PRIORITY/LONG TERM (+6 YEARS)

- Complete full CCTV inspection of network every 10-years,
    - **Budget:** $70,000. Please note, this value reflects CCTV of the entire network. If the Township re-CCTVs concerning pipes/areas, as proposed over the short-term, the outstanding portion of the network to be inspected accounts for approximately $10,000.
- Retrofit and install pigging launch and retrieval chambers on existing forcemains, and require pigging chambers as part of future lift station/forcemain design. Completing cleaning on a bi-annual basis (every other year) once installed.
    - **Budget:** $10,000 - $20,000 per chamber to retrofit/install, depending on depth / diameter / access / etc. We have assumed an annual budget of approximately $26,000 for forcemain cleaning, however, this should be confirmed following the District's decision to complete this service in-house or through a contractor.

BUDGET SUMMARY

Based on the recommendations proposed above, but not including the I&I Mater Plan Update, lifelines assessment, or the SSAMP update, the average annual budget needs for each of the time horizons is estimated as follows:

- High Priority, Years 1 – 2: Approximately $240,000, annually,
- Moderate Priority, Years 3 -5: Approximately $180,000, annually,
- Low Priority, Years 6 – 10: Approximately $130,000, annually.

Please note, these estimates are intended to provide an order of magnitude appreciation for budgetary needs and does not include the effort of existing staff to respond to emergency repairs, back-ups, or new connections which are understood to account for the majority of Public Works' existing day-to-day activities. Furthermore, we have not included fees associated with software adoption/integration (e.g., license fees, procurement, training etc.), smoke testing, manhole/lateral inspection, or annual flushing fees. Budgets for these practices should be determined following additional investigation as proposed above.

Overall, the reactive approach to existing O&M practices is understandable given the poor condition of the sewer system. While existing budgets are generally proportional to those in other communities, the difference primarily lies in system condition – better maintained systems allow others to adopt more proactive practices, rather than react to the demands of a more deteriorated system. The practices and preliminary budgets proposed herein help align the Township with best practices and suggest lower funding requirements than current levels; however, these values will increase as the scope of O&M practices are finetuned, and existing reactionary practices are accounted for.

With the existing resources available to the Township, it will be difficult to increase the volume of capital project delivery, continue to react to system challenges through O&M and increase the level of proactive O&M practices without additional resources. These resources may include the hiring of more staff or external contractors who will likely be needed to support a transition toward more proactive O&M practices while continuing to address the realities of a deteriorated sewer system. Before determining the level of additional resources needed, the Township should complete the investigations proposed herein to identify specific funding needs related to services such as flushing, manhole and lateral inspection, smoke testing, etc. With a cleared understanding of these needs, the Township can better assess the O&M resource gap and plan accordingly.

Sincerely,
URBAN SYSTEMS LTD.

A. Kempa

Alex Kempa, EIT
Project Manager

Mark Stafford, P.Eng.
Civil Engineer

cc: Kara Labelle, Urban Systems

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APPENDIX C: SANITARY ASSET MANAGEMENT PLAN UNIT COST ESTIMATING

URBAN SYSTEMS MEMORANDUM

DATE: August 12, 2024
TO: Joel Clary, P.Eng
CC: Adrien d'Andrade, P.Eng, Alex Kempa, E.I.T
FROM: Mark Stafford, P.Eng, Kara Labelle E.I.T
FILE: 3275.0021.01
SUBJECT: Sanitary Asset Management Plan Unit Cost Estimating

1.0 INTRODUCTION

Urban Systems is working with the Township of Esquimalt ("the Township") to complete a Sanitary Asset Management Plan (SAMP). The scope of work includes identifying upgrade projects required within the Township's sanitary system infrastructure (considering both pipes and facilities) and preparing Class D cost estimates for these projects. The following technical memorandum details the unit rate costs to be applied in developing these estimates. Insights from Urban Systems' experience with communities similar to the Township (both in location and size) to corroborate unit costs are presented herein.

2.0 COST DERIVATIONS AND BACKGROUND INFORMATION

Sanitary system construction costs have been broken out into two key components of a sanitary network:

- Linear gravity collection sewers and pressurized force mains ($/m)
- Pump Stations ($/HP)

In addition to our own project history, reference unit prices published by the City of Nanaimo were used to develop unit costs for linear infrastructure. These reference unit prices are derived from average tender prices of infrastructure replacement projects completed in the City of Nanaimo from 2020 to 2024, and therefore account for inflationary changes during this period and reflect recent market value.

For facility (pump station) unit costs, previous cost estimates completed by Urban Systems for nearby municipalities in 2021 were assumed as base values. These values were then inflated in accordance with construction cost indices published by the Engineering News Record for nearby markets, which indicate a cumulative inflation rate of approximately 16.23% since 2021. This inflation value is conservative compared to the Consumer Price Index[1] (approximately 7% from 2021 to 2023, with data for 2024 not yet available) provided by Statistics Canada for Victoria, BC.

2.1 INCLUSIONS AND ASSUMPTIONS

The following subsections introduce inclusions and assumptions related to the different types of sanitary system infrastructure. For all infrastructure types below, a 30% contingency allowance has been applied to the estimated capital cost. An additional 10% (for linear components) or 15% (for non-linear, station-type components) engineering allowance has been applied to capital and contingency costs. Detailed unit-cost derivations are appended to this memo.

[1] Statistics Canada: Consumer Price Index -- https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1810000501

2.1.1 Gravity Mains

The unit rate cost for gravity sanitary sewer mains includes typical items required for construction, such as:

- Site preparation (asphalt milling, common excavation, rock excavation, traffic control);
- Sanitary gravity works (pipe works, service connections, tie-in to existing systems, manholes); and
- Surface restoration (trench backfill, granular base/subbase, asphalt pavement).

The cost of the scope items listed above are normalized and combined to produce a linear metre unit price. These costs are then added to typical per-metre pipe costs for varying pipe diameters. Additionally, as gravity mains are typically installed within road rights-of-way, cost multipliers have been established, as exhibited in Table 1, for different cross-sectional road types. These multipliers adjust the project base cost (i.e. the cost of the project within a RLO Local Road or RST Strata Road right-of-way) by a certain factor based on road type, accounting for the changes in cost associated with the varying levels of construction complexity among different road classifications (relating to varying requirements for traffic control, removal and replacement of road structure, and removal and replacement of road features such as medians, curb & gutter, sidewalk, electrical conduit crossings, etc.).

Table 1: Cost Multipliers for Various Road Classes within Esquimalt

Road Classification	Cost Multiplier
RSV Service Road, RLN Road Lane, RRT Restricted Road	0.85x
RLO Local Road, RST Strata Road	1.00x
RC1 RC2 Major & Minor Collectors, RRC Recreation Road, RYL Yield Lane	1.25x
RA1 Major Arterial	1.50x

Additionally, since gravity sewers are required to maintain a downward slope along the collection system, installation depth ranges (typical to the Township) have been discretized as follows and costed individually to provide higher accuracy estimates:

- Shallow (<1.5m) installation depth;
- Moderate (1.5-3m) installation depth; and
- Deep (3-6m) installation depth.

The cost derivation is structured such that the volume of earthworks (excavation and backfill) required at each depth interval is factored into the unit-cost estimate.

2.1.2 Force Mains

Pricing for force mains is determined using a similar methodology as applied to gravity mains, but considers some differing components as required (i.e. including air valves but excluding manholes). Unlike gravity mains, force mains are typically installed at shallow depths (similar to watermains) so this was the only depth-scenario considered for force main cost estimating (<1.5m).

2.1.3 Pump Stations

Pump stations unit costs are based on a single parameter – total installed pump horsepower. Typical complexity and scale of pump station infrastructure has been found to be generally proportional to pump horsepower (with scale and complexity generally increasing with pump horsepower). As such, total station horsepower is considered a strong proxy for station cost.

3.0 CONCLUSION AND RECOMMENDATIONS

3.1 GRAVITY MAINS

Table 2 summarizes the estimated gravity main construction cost at the various installation depths (inclusive of manholes, service connections, roadworks, tie-ins and 30% contingency and 10% engineering for RLO Local and RST Strata roads). These road classifications were assumed as the 'base cost' scenarios; multipliers (listed in Table 1) were then applied to these base costs to produce estimated costs for other road classifications within the Township. Surface paving width was assumed to be 2m for minimum installation depths and increases to approximately 6m width as installation depth increases, assuming the use of trench boxes for the deepest parts of the trench. It is also assumed that the new main will be located in another alignment from the current main such that extensive bypass pumping will not be required. Existing mains are assumed to be capped and abandoned in place. Rock excavation has been assumed for 20% of the pipeline length.

Table 2: Gravity Main Unit Costs at Various Depths for RLO Local and RST Strata Roads

Pipe Size (mm)	Estimated Cost ($/m) Including E&C for RLO Local and RST Strata Roads		
	<1.5m	1.5m-3m	3-6m
150mm	$2,167	$3,532	$5,328
200mm	$2,282	$3,647	$5,443
250mm	$2,397	$3,762	$5,557
300mm	$2,550	$3,915	$5,710
350mm	$2,703	$4,068	$5,863
375mm	$2,779	$4,144	$5,940
400mm	$2,874	$4,257	$6,071
450mm	$2,951	$4,334	$6,148
525mm	$3,180	$4,563	$6,377
600mm	$3,371	$4,755	$6,569
675mm	$3,657	$5,059	$6,892
750mm	$3,734	$5,136	$6,968
900mm	$4,040	$5,442	$7,274
1050mm	$4,499	$5,901	$7,733
1200mm	$4,805	$6,207	$8,039
1350mm	$5,111	$6,513	$8,345
1500mm	$5,417	$6,819	$8,651

3.2 FORCE MAINS

Table 3 summarizes the estimated force main construction costs located in RLO Local Roads and RST Strata Road Roads, including 30% contingency and 10% design and construction engineering allowances (a detailed cost derivation is appended to this memo). Assumptions related to trench width, rock excavation and abandonment of existing mains are identical to those for gravity main estimates. Costs listed in Table 3 are considered to be force main base costs—road classification multipliers are then applied to estimate costs associated with force mains installed in other road types (similar to gravity mains), as exhibited in Table 4. This estimate has been compared to and confirmed to align with historical tender pricing provided by the Township.

Table 3: Force Main Unit Costs for RLO Local Roads and RST Strata Road Roads

Road Classification	Pipe Size (mm)												
	50	**75**	**100**	**150**	**200**	**250**	**300**	**350**	**400**	**450**	**600**	**750**	**900**
RLO Local Road, RST Strata Road	$1,400	$1,460	$1,560	$1,580	$1,630	$1,730	$1,980	$1,990	$2,100	$2,190	$2,500	$2,790	$3,090

Table 4 compares the estimated base-scenario cost for force mains from Table 3 above to scaled costs (applying the multipliers of Table 1) of:

- RSV Service Roads, RLN Road Lanes, and RRT Restricted Roads
- RC1 RC2 Major & Minor Collectors, RRC Recreation Roads, and RYL Yield Lanes
- RA1 Major Arterials

Table 4: Force Main Unit Costs for Various Esquimalt Street Classifications

	Road Classification	Pipe Size (mm)												
		50	**75**	**100**	**150**	**200**	**250**	**300**	**350**	**400**	**450**	**600**	**750**	**900**
Derived Cost Estimates ($/m)	**RSV Service Road, RLN Road Lane, RRT Restricted Road (0.85x)**	$1,190	$1,241	$1,326	$1,343	$1,386	$1,471	$1,683	$1,692	$1,785	$1,862	$2,125	$2,372	$2,627
	RC1 RC2 Major & Minor Collectors, RRC Recreation Road, RYL Yield Lane (1.25x)	$1,750	$1,825	$1,950	$1,975	$2,038	$2,163	$2,475	$2,488	$2,625	$2,738	$3,125	$3,488	$3,863
	RA1 Major Arterial (1.5x)	$2,100	$2,190	$2,340	$2,370	$2,445	$2,595	$2,970	$2,985	$3,150	$3,285	$3,750	$4,185	$4,635

3.3 PUMP STATIONS

Table 5 summarizes the estimated pump station replacement costs based on horsepower rating. The total costs assume replacement of all station components, including a wet-well with pumps, internal process mechanical components, and an electrical kiosk and generator of appropriate size to provide redundant power to the station. It should be noted that individual components within a pump station may require upgrading, while the remainder may have sufficient lifespan (e.g. pumps may be replaced while the wet well structure remains). Cost derivations for the values of Table 5, which include prices for the civil, mechanical and electrical components, are appended to this memo.

Table 5: Pump Station Cost Estimates for Various Station Sizes

	Pump Ratings	0-5 HP	5-20 HP	20-50 HP	50-100 HP	100+ HP
Derived Costs	Cost	$633,454	$706,679	$918,217	$1,265,745	$1,798,078
	Total Cost Incl. Engineering (15%) and Contingency (30%)	$948,000	$1,057,000	$1,373,000	$1,893,000	$2,689,000

3.4 RECOMMENDATIONS

The unit rates presented herein reflect recent market prices and inflationary changes, as well as infrastructure and construction costs typical of nearby/comparable municipalities. It is recommended that the proposed unit rates be utilized for estimating costs of projects identified in the Township's Sanitary Sewer Asset Management Plan.

Sincerely,

URBAN SYSTEMS LTD.

PROFESSIONAL PROVINCE OF M. T. A. STAFFORD # 51649 BRITISH COLUMBIA ENGINEER

PERMIT TO PRACTICE
URBAN SYSTEMS LTD.
Signature
Date 2024-08-15
PERMIT NUMBER: 1000527
Engineers and Geoscientists BC (EGBC)

Mark Stafford, P.Eng
Project Lead

Kara Labelle, E.I. T
Civil Engineer-in-Training

cc: Alex Kempa, E.I.T

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Estimated Sanitary Asset Management Plan Project Unit Costs, 2024

	Road Classification	150mm	200mm	250mm	300mm	350mm	375mm	400mm	450mm	525mm	600mm	675mm	750mm	900mm	1050mm	1200mm	1350mm	1500mm	Assumptions and Inclusions
Sanitary Main (0-1.5m depth)	RSV Service Road, RLN Road Lane, RRT Restricted Road (0.85x)	$1,842	$1,940	$2,037	$2,167	$2,297	$2,362	$2,443	$2,508	$2,703	$2,866	$3,109	$3,174	$3,434	$3,824	$4,084	$4,344	$4,605	All road classes include mains, appurtenances, tie-ins, service connections, pavement restoration, engineering (10%), contingency (30%)
	RLO Local Road, RST Strata Road (1x)	$2,167	$2,282	$2,397	$2,550	$2,703	$2,779	$2,874	$2,951	$3,180	$3,371	$3,657	$3,734	$4,040	$4,499	$4,805	$5,111	$5,417	
	RC1 RC2 Major & Minor Collectors, RRC Recreation Road, RYL Yield Lane (1.25x)	$2,709	$2,852	$2,996	$3,187	$3,378	$3,474	$3,593	$3,688	$3,975	$4,214	$4,572	$4,667	$5,050	$5,624	$6,006	$6,389	$6,771	
	RA1 Major Arterial (1.5x)	$3,251	$3,423	$3,595	$3,825	$4,054	$4,169	$4,311	$4,426	$4,770	$5,057	$5,486	$5,601	$6,060	$6,749	$7,208	$7,667	$8,126	

	Road Classification	150mm	200mm	250mm	300mm	350mm	375mm	400mm	450mm	525mm	600mm	675mm	750mm	900mm	1050mm	1200mm	1350mm	1500mm	Assumptions and Inclusions
Sanitary Main (1.5-3m depth)	RSV Service Road, RLN Road Lane, RRT Restricted Road (0.85x)	$3,002	$3,100	$3,197	$3,327	$3,457	$3,522	$3,619	$3,684	$3,879	$4,041	$4,300	$4,365	$4,625	$5,016	$5,276	$5,536	$5,796	All road classes include mains, appurtenances, tie-ins, service connections, pavement restoration, engineering (10%), contingency (30%)
	RLO Local Road, RST Strata Road (1x)	$3,532	$3,647	$3,762	$3,915	$4,068	$4,144	$4,257	$4,334	$4,563	$4,755	$5,059	$5,136	$5,442	$5,901	$6,207	$6,513	$6,819	
	RC1 RC2 Major & Minor Collectors, RRC Recreation Road, RYL Yield Lane (1.25x)	$4,415	$4,559	$4,702	$4,893	$5,084	$5,180	$5,322	$5,417	$5,704	$5,943	$6,324	$6,420	$6,802	$7,376	$7,758	$8,141	$8,523	
	RA1 Major Arterial (1.5x)	$5,298	$5,470	$5,642	$5,872	$6,101	$6,216	$6,386	$6,501	$6,845	$7,132	$7,589	$7,703	$8,162	$8,851	$9,310	$9,769	$10,228	

	Road Classification	150mm	200mm	250mm	300mm	350mm	375mm	400mm	450mm	525mm	600mm	675mm	750mm	900mm	1050mm	1200mm	1350mm	1500mm	Assumptions and Inclusions
Sanitary Main (3-6m depth)	RSV Service Road, RLN Road Lane, RRT Restricted Road (0.85x)	$4,529	$4,626	$4,724	$4,854	$4,984	$5,049	$5,161	$5,226	$5,421	$5,583	$5,858	$5,923	$6,183	$6,573	$6,833	$7,093	$7,354	All road classes include mains, appurtenances, tie-ins, service connections, pavement restoration, engineering (10%), contingency (30%)
	RLO Local Road, RST Strata Road (1x)	$5,328	$5,443	$5,557	$5,710	$5,863	$5,940	$6,071	$6,148	$6,377	$6,569	$6,892	$6,968	$7,274	$7,733	$8,039	$8,345	$8,651	
	RC1 RC2 Major & Minor Collectors, RRC Recreation Road, RYL Yield Lane (1.25x)	$6,660	$6,803	$6,947	$7,138	$7,329	$7,425	$7,589	$7,685	$7,972	$8,211	$8,614	$8,710	$9,093	$9,666	$10,049	$10,431	$10,814	
	RA1 Major Arterial (1.5x)	$7,992	$8,164	$8,336	$8,566	$8,795	$8,910	$9,107	$9,222	$9,566	$9,853	$10,337	$10,452	$10,911	$11,600	$12,059	$12,518	$12,977	

	Road Classification	50mm	75mm	100mm	150mm	200mm	250mm	300mm	350mm	400mm	450mm	600mm	750mm	900mm	Assumptions and Inclusions
Force Mains (0-1.5m depth)	RSV Service Road, RLN Road Lane, RRT Restricted Road (0.85x)	$1,190	$1,241	$1,326	$1,343	$1,386	$1,471	$1,683	$1,692	$1,785	$1,862	$2,125	$2,372	$2,627	All road classes include mains, appurtenances, tie-ins, pavement restoration, engineering (10%), contingency (30%)
	RLO Local Road, RST Strata Road (1x)	$1,400	$1,460	$1,560	$1,580	$1,630	$1,730	$1,980	$1,990	$2,100	$2,190	$2,500	$2,790	$3,090	
	RC1 RC2 Major & Minor Collectors, RRC Recreation Road, RYL Yield Lane (1.25x)	$1,750	$1,825	$1,950	$1,975	$2,038	$2,163	$2,475	$2,488	$2,625	$2,738	$3,125	$3,488	$3,863	
	RA1 Major Arterial (1.5x)	$2,100	$2,190	$2,340	$2,370	$2,445	$2,595	$2,970	$2,985	$3,150	$3,285	$3,750	$4,185	$4,635	

	Pump Ratings (HP)	0-5	5-20	20-50	50-100	100 & above	Assumptions and Inclusions
Pump Stations	$	$633,454	$706,679	$918,217	$1,265,745	$1,798,078	Estimated construction costs include 15% engineering and 30% contingency
	$ + E&C	$948,000	$1,057,000	$1,373,000	$1,893,000	$2,689,000	

SANITARY PIPE COST PER METRE (0-1.5m depth) DERIVATION									
Based on 8.5m / 11.0m RLO Local Road, RST Strata Road Scenario									
Average trench width of 2m straight down (utilize trench box)			Manhole Size	**1050mm**		**1200mm**		**1500mm**	
Top trench width of 2m			Pipe Size	**150mm-375mm**		**400mm-600mm**		**675mm- 1050mm**	
Item	**Description**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Unit Price**	**Total**	**Unit Price**	**Total**
A.	**SITE PREPARATION**								
1.01	Asphalt cutting	lin.m.	2.0	$ 8	$ 16	$ 8	$ 16	$ 8	$ 16
1.02	Common excavation and off site disposal (roads)	cu.m.	3.0	$ 35	$ 105	$ 35	$ 105	$ 35	$ 105
1.03	Rock excavation (20%)	cu.m.	0.60	$ 450	$ 270	$ 450	$ 270	$ 450	$ 270
	SUBTOTAL - SECTION A				**$ 391**		**$ 391**		**$ 391**
B.	**ROAD WORK RESTORATION**								
2.01	Trench backfill (including pipe bedding) and compaction	cu.m.	2.2	$ 58	$ 127	$ 58	$ 127	$ 58	$ 127
2.02	Granular subbase (200mm depth)	sq.m.	2.0	$ 12	$ 24	$ 12	$ 24	$ 12	$ 24
2.03	Granular base (150mm depth)	sq.m.	2.0	$ 11	$ 22	$ 11	$ 22	$ 11	$ 22
2.04	Asphalt (50mm)	sq.m.	2.0	$ 72	$ 144	$ 72	$ 144	$ 72	$ 144
	SUBTOTAL - SECTION B				**$ 317**		**$ 317**		**$ 317**
C.	**SANITARY SEWERS**								
3.01	Manhole complete (1 per 50m)	ea.	0.02	$ 6,500	$ 130	$ 9,600	$ 192	$ 15,200	$ 304
3.02	100mm Lot service connection c/w 200mm IC (1 per 10m)	ea.	0.1	$ 3,235	$ 324	$ 3,235	$ 324	$ 3,235	$ 324
3.03	Tie-in to Existing Manhole (1 per 400m)	ea.	0.0025	$ 2,000	$ 5	$ 2,000	$ 5	$ 2,000	$ 5
	SUBTOTAL - SECTION C				**$459**		**$521**		**$633**
	SUMMARY OF EXTRA COSTS				**$1,166**		**$1,228**		**$1,340**

Pipe Size (mm)	150	200	250	300	350	375	400	450	525	600	675	750	900	1050	1200	1350	1500
Pipe Cost (supply and install)	**$250**	**$325**	**$400**	**$500**	**$600**	**$650**	**$650**	**$700**	**$850**	**$975**	**$1,050**	**$1,100**	**$1,300**	**$1,600**	**$1,800**	**$2,000**	**$2,200**
Extra Costs	$1,166	$1,166	$1,166	$1,166	$1,166	$1,166	$1,228	$1,228	$1,228	$1,228	$1,340	$1,340	$1,340	$1,340	$1,340	$1,340	$1,340
Traffic Control	$99	$104	$110	$117	$124	$127	$131	$135	$145	$154	$167	$171	$185	$206	$220	$234	$248
Subtotal	$1,516	$1,596	$1,676	$1,783	$1,890	$1,944	$2,010	$2,063	$2,224	$2,358	$2,558	$2,611	$2,825	$3,146	$3,360	$3,574	$3,788
Contingency (30%)	$455	$479	$503	$535	$567	$583	$603	$619	$667	$707	$767	$783	$848	$944	$1,008	$1,072	$1,136
Engineering (10%)	$197	$207	$218	$232	$246	$253	$261	$268	$289	$306	$332	$339	$367	$409	$437	$465	$492
TOTAL UNIT COST	**$2,167**	**$2,282**	**$2,397**	**$2,550**	**$2,703**	**$2,779**	**$2,874**	**$2,951**	**$3,180**	**$3,371**	**$3,657**	**$3,734**	**$4,040**	**$4,499**	**$4,805**	**$5,111**	**$5,417**

SANITARY PIPE COST PER METRE (1.5-3m depth) DERIVATION

Based on 8.5m / 11.0m RLO Local Road, RST Strata Road Scenario
Average trench width of 2m straight down (utilize trench box)
Top trench width of 5.2m

			Manhole Size	**1050mm**		**1200mm**		**1500mm**	
			Pipe Size	**150mm-375mm**		**400mm-600mm**		**675mm- 1050mm**	
Item	**Description**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Unit Price**	**Total**	**Unit Price**	**Total**
	A. SITE PREPARATION								
1.01	Asphalt cutting	lin.m.	2.0	$ 8	$ 16	$ 8	$ 16	$ 8	$ 16
1.02	Common excavation and off site disposal (roads)	cu.m.	6.0	$ 35	$ 210	$ 35	$ 210	$ 35	$ 210
1.03	Rock excavation (20%)	cu.m.	1.20	$ 450	$ 540	$ 450	$ 540	$ 450	$ 540
	SUBTOTAL - SECTION A				**$766**		**$766**		**$766**
	B. ROAD WORK RESTORATION								
2.01	Trench backfill (including pipe bedding) and compaction	cu.m.	5.2	$ 58	$ 300	$ 58	$ 300	$ 58	$ 300
2.02	Granular subbase (200mm depth)	sq.m.	5.2	$ 12	$ 63	$ 12	$ 63	$ 12	$ 63
2.03	Granular base (150mm depth)	sq.m.	5.2	$ 11	$ 57	$ 11	$ 57	$ 11	$ 57
2.04	Asphalt (50mm)	sq.m.	5.2	$ 72	$ 374	$ 72	$ 374	$ 72	$ 374
	SUBTOTAL - SECTION B				**$794**		**$794**		**$794**
	C. SANITARY SEWERS								
3.01	Manhole complete (1 per 50m)	ea.	0.02	$ 8,500	$ 170	$ 12,200	$ 244	$ 18,400	$ 368
3.02	100mm Lot service connection c/w 200mm IC (1 per 10m)	ea.	0.1	$ 3,235	$ 324	$ 3,235	$ 324	$ 3,235	$ 324
3.03	Tie-in to Existing Manhole (1 per 400m)	ea.	0.0025	$ 2,000	$ 5	$ 2,000	$ 5	$ 2,000	$ 5
	SUBTOTAL - SECTION C				**$499**		**$573**		**$697**
	SUMMARY OF EXTRA COSTS				**$2,058**		**$2,132**		**$2,256**

Pipe Size (mm)	150	200	250	300	350	375	400	450	525	600	675	750	900	1050	1200	1350	1500
Pipe Cost (supply and install)	**$250**	**$325**	**$400**	**$500**	**$600**	**$650**	**$650**	**$700**	**$850**	**$975**	**$1,050**	**$1,100**	**$1,300**	**$1,600**	**$1,800**	**$2,000**	**$2,200**
Extra Costs	$2,058	$2,058	$2,058	$2,058	$2,058	$2,058	$2,132	$2,132	$2,132	$2,132	$2,256	$2,256	$2,256	$2,256	$2,256	$2,256	$2,256
Traffic Control	$162	$167	$172	$179	$186	$190	$195	$198	$209	$218	$231	$235	$249	$270	$284	$298	$312
Subtotal	$2,470	$2,550	$2,630	$2,737	$2,844	$2,898	$2,977	$3,031	$3,191	$3,325	$3,538	$3,591	$3,805	$4,126	$4,340	$4,554	$4,768
Contingency (30%)	$741	$765	$789	$821	$853	$869	$893	$909	$957	$997	$1,061	$1,077	$1,142	$1,238	$1,302	$1,366	$1,430
Engineering (10%)	$321	$332	$342	$356	$370	$377	$387	$394	$415	$432	$460	$467	$495	$536	$564	$592	$620
TOTAL UNIT COST	**$3,532**	**$3,647**	**$3,762**	**$3,915**	**$4,068**	**$4,144**	**$4,257**	**$4,334**	**$4,563**	**$4,755**	**$5,059**	**$5,136**	**$5,442**	**$5,901**	**$6,207**	**$6,513**	**$6,819**

SANITARY PIPE COST PER METRE (3-6m depth) DERIVATION									
Based on 8.5m / 11.0m RLO Local Road, RST Strata Road Scenario									
Average trench width of 2m straight down (utilize trench box)			Manhole Size	**1050mm**		**1200mm**		**1500mm**	
Top trench width of 5.6m			Pipe Size	**150mm-375mm**		**400mm-600mm**		**675mm- 1050mm**	
Item	**Description**	**Unit**	**Quantity**	**Unit Price**	**Total**	**Unit Price**	**Total**	**Unit Price**	**Total**
A.	**SITE PREPARATION**								
1.01	Asphalt cutting	lin.m.	2.0	$ 8	$ 16	$ 8	$ 16	$ 8	$ 16
1.02	Common excavation and off site disposal (roads)	cu.m.	12.0	$ 35	$ 420	$ 35	$ 420	$ 35	$ 420
1.03	Rock excavation (20%)	cu.m.	2.40	$ 450	$ 1,080	$ 450	$ 1,080	$ 450	$ 1,080
	SUBTOTAL - SECTION A				**$1,516**		**$1,516**		**$1,516**
B.	**ROAD WORK RESTORATION**								
2.01	Trench backfill (including pipe bedding) and compaction	cu.m.	11.2	$ 58	$ 645	$ 58	$ 645	$ 58	$ 645
2.02	Granular subbase (200mm depth)	sq.m.	5.6	$ 12	$ 68	$ 12	$ 68	$ 12	$ 68
2.03	Granular base (150mm depth)	sq.m.	5.6	$ 11	$ 61	$ 11	$ 61	$ 11	$ 61
2.04	Asphalt (50mm)	sq.m.	5.6	$ 72	$ 403	$ 72	$ 403	$ 72	$ 403
	SUBTOTAL - SECTION B				**$1,178**		**$1,178**		**$1,178**
C.	**SANITARY SEWERS**								
3.01	Manhole complete (1 per 50m)	ea.	0.02	$ 10,500	$ 210	$ 14,800	$ 296	$ 21,600	$ 432
3.02	100mm Lot service connection c/w 200mm IC (1 per 10m)	ea.	0.1	$ 3,235	$ 324	$ 3,235	$ 324	$ 3,235	$ 324
3.03	Tie-in to Existing Manhole (1 per 400m)	ea.	0.0025	$ 2,000	$ 5	$ 2,000	$ 5	$ 2,000	$ 5
	SUBTOTAL - SECTION C				**$539**		**$625**		**$761**
	SUMMARY OF EXTRA COSTS				**$3,232**		**$3,318**		**$3,454**

Pipe Size (mm)	150	200	250	300	350	375	400	450	525	600	675	750	900	1050	1200	1350	1500
Pipe Cost (supply and install)	**$250**	**$325**	**$400**	**$500**	**$600**	**$650**	**$650**	**$700**	**$850**	**$975**	**$1,050**	**$1,100**	**$1,300**	**$1,600**	**$1,800**	**$2,000**	**$2,200**
Extra Costs	$3,232	$3,232	$3,232	$3,232	$3,232	$3,232	$3,318	$3,318	$3,318	$3,318	$3,454	$3,454	$3,454	$3,454	$3,454	$3,454	$3,454
Traffic Control	$244	$249	$254	$261	$268	$272	$278	$281	$292	$301	$315	$319	$333	$354	$368	$382	$396
Subtotal	$3,726	$3,806	$3,886	$3,993	$4,100	$4,154	$4,246	$4,299	$4,460	$4,594	$4,819	$4,873	$5,087	$5,408	$5,622	$5,836	$6,050
Contingency (30%)	$1,118	$1,142	$1,166	$1,198	$1,230	$1,246	$1,274	$1,290	$1,338	$1,378	$1,446	$1,462	$1,526	$1,622	$1,687	$1,751	$1,815
Engineering (10%)	$484	$495	$505	$519	$533	$540	$552	$559	$580	$597	$627	$633	$661	$703	$731	$759	$786
TOTAL UNIT COST	**$5,328**	**$5,443**	**$5,557**	**$5,710**	**$5,863**	**$5,940**	**$6,071**	**$6,148**	**$6,377**	**$6,569**	**$6,892**	**$6,968**	**$7,274**	**$7,733**	**$8,039**	**$8,345**	**$8,651**

FORCE MAIN PIPE COST PER METRE (0-1.5m depth) DERIVATION
Based on 8.5m / 11.0m RLO Local Road, RST Strata Road Scenario
Average trench width of 2m straight down (utilize trench box)
Top trench width of 2m

Item	Description	Unit	Quantity	Unit Price	Total
A.	**SITE PREPARATION**				
1.01	Aspalt cutting	lin.m.	2.0	$ 8	$ 16
1.02	Common excavation and off site disposal (roads)	cu.m.	3.0	$ 35	$ 105
1.03	Rock excavation (20%)	cu.m.	0.6	$ 450	$ 270
	SUBTOTAL - SECTION A				**$ 391**
B.	**ROAD WORK RESTORATION**				
2.01	Trench backfill (including pipe bedding) and compaction	cu.m.	2.2	$ 58	$ 127
2.02	Granular subbase (200mm depth)	sq.m.	2.0	$ 12	$ 24
2.03	Granular base (150mm depth)	sq.m.	2.0	$ 11	$ 22
2.04	Asphalt (50mm)	sq.m.	2.0	$ 72	$ 144
	SUBTOTAL - SECTION B				**$ 317**
C.	**PIPE WORKS**				
3.01	Tie-in (1 at pump station, 1 at discharge, assumed average 500m length between pump station and discharge point)	ea.	0.004	$ 5,129	$ 21
3.02	Air/Vacuum Valve (1 per 500m)	ea.	0.002	$ 7,000	$ 14
	SUBTOTAL - SECTION C				**$ 35**
	SUMMARY OF EXTRA COSTS				**$ 742**

Pipe Size (mm)	50	75	100	150	200	250	300	350	400	450	600	750	900
Pipe Cost (supply and install)	**$170**	**$210**	**$275**	**$290**	**$320**	**$390**	**$550**	**$560**	**$630**	**$690**	**$890**	**$1,080**	**$1,280**
Extra Costs	$742	$742	$742	$742	$742	$742	$742	$742	$742	$742	$742	$742	$742
Traffic Control	$64	$67	$71	$72	$74	$79	$90	$91	$96	$100	$114	$128	$142
Subtotal	$976	$1,019	$1,089	$1,105	$1,137	$1,212	$1,383	$1,394	$1,468	$1,533	$1,747	$1,950	$2,164
Contingency (30%)	$293	$306	$327	$331	$341	$363	$415	$418	$441	$460	$524	$585	$649
Engineering (10%)	$127	$132	$142	$144	$148	$158	$180	$181	$191	$199	$227	$253	$281
TOTAL UNIT COST	**$1,400**	**$1,460**	**$1,560**	**$1,580**	**$1,630**	**$1,730**	**$1,980**	**$1,990**	**$2,100**	**$2,190**	**$2,500**	**$2,790**	**$3,090**

USL Project: 3275.0021.01

Small Sanitary Pump Station
HP < 5hp

Class D Cost Estimate

Description

This estimate has been prepared to establish budgetary costs for long range financial planning purposes only. The derived cost is an approximate magnitude of cost derived from lump sum and unit costs from recent similar projects. Design and construction engineering and contingency are included in this estimate.

Item	Description	Unit	Total Quantity	Unit Price	Total
A.	**PUMP STATION**				
1.1	Wet well (c/w Pumps and Internal Mechanical Components)	L.S.	1	135,000.00	**$ 135,000**
1.2	Valve Chamber (c/w check valves, isolation valves, air valve, bypass)	L.S.	1	45,000.00	**$ 45,000**
1.3	Flow Meter (c/w chamber)	L.S.	1	25,000.00	**$ 25,000**
	TOTAL SECTION A				**$ 205,000**
B.	**ELECTRICAL**				
2.1	Electrical Kiosk (c/w Controls, Motor Starters, Power Distribution, Automatic Transfer Switch, Termination Compartment)	L.S.	1	130,000.00	**$ 130,000**
2.2	Generator	L.S.	1	38,000.00	**$ 38,000**
2.3	General Site Work (Wet Well, Valve Chamber, Luminaire/Antenna Pole)	L.S.	1	54,000.00	**$ 54,000**
2.4	BC Hydro Service Utility	L.S.	1	9,000.00	**$ 9,000**
2.5	Testing/Commissioning/Permits	L.S.	1	39,000.00	**$ 39,000**
	TOTAL SECTION B				**$ 270,000**
C.	**CIVIL UTILITIES**				
3.1	Connection to Existing Forcemain	L.S.	1	15,000.00	**$ 15,000**
3.2	Connection to Existing Gravity Main	L.S.	1	15,000.00	**$ 15,000**
3.3	Water Service and Washdown	L.S.	1	7,500.00	**$ 7,500**
	TOTAL SECTION C				**$ 37,500**
D.	**SITE WORKS AND ACCESS**				
4.1	Earthworks, Site Grading, Paving and Landscaping	L.S.	1	25,000.00	**$ 25,000**
4.2	Fencing and Bollards	L.S.	1	7,500.00	**$ 7,500**
	TOTAL SECTION D				**$ 32,500**

SUMMARY

A.	**PUMP STATION**				$ 205,000
B.	**ELECTRICAL**				$ 270,000
C.	**CIVIL UTILITIES**				$ 37,500
D.	**SITE WORKS AND ACCESS**				$ 32,500
				SUB-TOTAL:	**$ 545,000**
	Inflation Rate (2021-2024)				16.23%
	Inflation Cost				$ 88,454
				SUB-TOTAL:	**$ 633,454**
	Contingency (30% of Const.)	L.S.	1		$ 190,036
	Design and Construction Engineering (15% of Const.)	L.S.	1		$ 123,523
				SUB-TOTAL:	**$ 313,559**
	TOTAL ESTIMATED CONSTRUCTION COST (EXCLUDING TAXES)				**$ 948,000**

ASSUMPTIONS

- Pump station will be constructed on existing lot or within road RoW and no land acquisition costs are required.
- Grading and landscaping will be required at the site, but no clearing and grubbing.
- Rock blasting is not required at the site.
- Station will include a FRP wet well and electrical kiosk. Estimates do not include costs for a building.
- Station will include glow meter in standalone below-ground chamber.
- Assumed configuration: Duplex Lift Station, Electrical Kiosk, Generator, Wet Well, Valve Chamber, Flow Meter Manhole
- Assumed voltage is 600V, 3-Phase.
- Assumed labour rate is $85/hr.
- Assumed Generator Size is 40kW.

USL Project: 3275.0021.01

Small - Medium Sanitary Pump Station
5hp <= HP < 20hp

Class D Cost Estimate
Description

This estimate has been prepared to establish budgetary costs for long range financial planning purposes only. The derived cost is an approximate magnitude of cost derived from lump sum and unit costs from recent similar projects. Design and construction engineering and contingency are included in this estimate.

Item	Description	Unit	Total Quantity	Unit Price	Total
A.	**PUMP STATION**				
1.1	Wet well (c/w Pumps and Internal Mechanical Components)	L.S.	1	157,500.00	**$ 157,500**
1.2	Valve Chamber (c/w check valves, isolation valves, air valve, bypass)	L.S.	1	52,500.00	**$ 52,500**
1.3	Flow Meter (c/w chamber)	L.S.	1	35,000.00	**$ 35,000**
	TOTAL SECTION A				**$ 245,000**
B.	**ELECTRICAL**				
2.1	Electrical Kiosk (c/w Controls, Motor Starters, Power Distribution, Automatic Transfer Switch, Termination Compartment)	L.S.	1	134,000.00	**$ 134,000**
2.2	Generator	L.S.	1	38,000.00	**$ 38,000**
2.3	General Site Work (Wet Well, Valve Chamber, Luminaire/Antenna Pole)	L.S.	1	54,000.00	**$ 54,000**
2.4	BC Hydro Service Utility	L.S.	1	12,000.00	**$ 12,000**
2.5	Testing/Commissioning/Permits	L.S.	1	40,000.00	**$ 40,000**
	TOTAL SECTION B				**$ 278,000**
C.	**CIVIL UTILITIES**				
3.1	Connection to Existing Forcemain	L.S.	1	25,000.00	**$ 25,000**
3.2	Connection to Existing Gravity Main	L.S.	1	15,000.00	**$ 15,000**
3.3	Water Service and Washdown	L.S.	1	7,500.00	**$ 7,500**
	TOTAL SECTION C				**$ 47,500**
D.	**SITE WORKS AND ACCESS**				
4.1	Earthworks, Site Grading, Paving and Landscaping	L.S.	1	30,000.00	**$ 30,000**
4.2	Fencing and Bollards	L.S.	1	7,500.00	**$ 7,500**
	TOTAL SECTION D				**$ 37,500**
	SUMMARY				
A.	**PUMP STATION**				$ 245,000
B.	**ELECTRICAL**				$ 278,000
C.	**CIVIL UTILITIES**				$ 47,500
D.	**SITE WORKS AND ACCESS**				$ 37,500
				SUB-TOTAL:	**$ 608,000**
	Inflation Rate (2021-2024)				16.23%
	Inflation Cost				$ 98,678
				SUB-TOTAL:	**$ 706,679**
	Contingency (30% of Const.)	L.S.	1		$ 212,004
	Design and Construction Engineering (15% of Const.)	L.S.	1		$ 137,802
				SUB-TOTAL:	**$ 349,806**
	TOTAL ESTIMATED CONSTRUCTION COST (EXCLUDING TAXES)				**$ 1,057,000**

ASSUMPTIONS

- Pump station will be constructed on existing lot or within road RoW and no land acquisition costs are required.
- Grading and landscaping will be required at the site, but no clearing and grubbing.
- Rock blasting is not required at the site.
- Station will include a FRP wet well and electrical kiosk. Estimates do not include costs for a building.
- Station will include glow meter in standalone below-ground chamber.
- Assumed configuration: Duplex Lift Station, Electrical Kiosk, Generator, Wet Well, Valve Chamber, Flow Meter Manhole
- Assumed voltage is 600V, 3-Phase.
- Assumed labour rate is $85/hr.
- Assumed Generator Size is 40kW.

USL Project: 3275.0021.01

Medium Sanitary Pump Station
20hp<= HP < 50hp

Class D Cost Estimate

Description

This estimate has been prepared to establish budgetary costs for long range financial planning purposes only. The derived cost is an approximate magnitude of cost derived from lump sum and unit costs from recent similar projects. Design and construction engineering and contingency are included in this estimate.

Item	Description	Unit	Total Quantity	Unit Price	Total
A.	**PUMP STATION**				
1.1	Wet well (c/w Pumps and Internal Mechanical Components)	L.S.	1	217,500.00	**$ 217,500**
1.2	Valve Chamber (c/w check valves, isolation valves, air valve, bypass)	L.S.	1	72,500.00	**$ 72,500**
1.3	Flow Meter (c/w chamber)	L.S.	1	75,000.00	**$ 75,000**
	TOTAL SECTION A				**$ 365,000**
B.	**ELECTRICAL**				
2.1	Electrical Kiosk (c/w Controls, Motor Starters, Power Distribution, Automatic Transfer Switch, Termination Compartment)	L.S.	1	145,000.00	**$ 145,000**
2.2	Generator	L.S.	1	42,000.00	**$ 42,000**
2.3	General Site Work (Wet Well, Valve Chamber, Luminaire/Antenna Pole)	L.S.	1	54,000.00	**$ 54,000**
2.4	BC Hydro Service Utility	L.S.	1	14,000.00	**$ 14,000**
2.5	Testing/Commissioning/Permits	L.S.	1	40,000.00	**$ 40,000**
	TOTAL SECTION B				**$ 295,000**
C.	**CIVIL UTILITIES**				
3.1	Connection to Existing Forcemain	L.S.	1	50,000.00	**$ 50,000**
3.2	Connection to Existing Gravity Main	L.S.	1	20,000.00	**$ 20,000**
3.3	Water Service and Washdown	L.S.	1	10,000.00	**$ 10,000**
	TOTAL SECTION B				**$ 80,000**
D.	**SITE WORKS AND ACCESS**				
4.1	Earthworks, Site Grading, Paving and Landscaping	L.S.	1	40,000.00	**$ 40,000**
4.2	Fencing and Bollards	L.S.	1	10,000.00	**$ 10,000**
	TOTAL SECTION D				**$ 50,000**

SUMMARY

A.	**PUMP STATION**				$ 365,000
B.	**ELECTRICAL**				$ 295,000
C.	**CIVIL UTILITIES**				$ 80,000
D.	**SITE WORKS AND ACCESS**				$ 50,000
				SUB-TOTAL:	**$ 790,000**
	Inflation Rate (2021-2024)				16.23%
	Inflation Cost				$ 128,217
				SUB-TOTAL:	**$ 918,217**
	Contingency (30% of Const.)	L.S.	1		$ 275,465
	Design and Construction Engineering (15% of Const.)	L.S.	1		$ 179,052
				SUB-TOTAL:	**$ 454,517**
	TOTAL ESTIMATED CONSTRUCTION COST (EXCLUDING TAXES)				**$ 1,373,000**

ASSUMPTIONS

- Pump station will be constructed on existing lot or within road RoW and no land acquisition costs are required.
- Grading and landscaping will be required at the site, but no clearing and grubbing.
- Rock blasting is not required at the site.
- Station will include a FRP wet well and electrical kiosk. Estimates do not include costs for a building.
- Station will include glow meter in standalone below-ground chamber.
- Assumed configuration: Duplex Lift Station, Electrical Kiosk, Generator, Wet Well, Valve Chamber, Flow Meter Manhole
- Assumed voltage is 600V, 3-Phase.
- Assumed labour rate is $85/hr.
- Assumed Generator Size is 60kW.

USL Project: 3275.0021.01

Medium - Large Sanitary Pump Station
50hp <= HP < 100hp

Class D Cost Estimate

Description

This estimate has been prepared to establish budgetary costs for long range financial planning purposes only. The derived cost is an approximate magnitude of cost derived from lump sum and unit costs from recent similar projects. Design and construction engineering and contingency are included in this estimate.

Item	Description	Unit	Total Quantity	Unit Price	Total
A.	**PUMP STATION**				
1.1	Wet well (c/w Pumps and Internal Mechanical Components)	L.S.	1	315,000.00	**$ 315,000**
1.2	Valve Chamber (c/w check valves, isolation valves, air valve, bypass)	L.S.	1	105,000.00	**$ 105,000**
1.3	Flow Meter (c/w chamber)	L.S.	1	125,000.00	**$ 125,000**
	TOTAL SECTION A				**$ 545,000**
B.	**ELECTRICAL**				
2.1	Electrical Kiosk (c/w Controls, Motor Starters, Power Distribution, Automatic Transfer Switch, Termination Compartment)	L.S.	1	155,000.00	**$ 155,000**
2.2	Generator	L.S.	1	63,000.00	**$ 63,000**
2.3	General Site Work (Wet Well, Valve Chamber, Luminaire/Antenna Pole)	L.S.	1	54,000.00	**$ 54,000**
2.4	BC Hydro Service Utility	L.S.	1	17,000.00	**$ 17,000**
2.5	Testing/Commissioning/Permits	L.S.	1	43,000.00	**$ 43,000**
	TOTAL SECTION B				**$ 332,000**
C.	**CIVIL UTILITIES**				
3.1	Connection to Existing Forcemain	L.S.	1	75,000.00	**$ 75,000**
3.2	Connection to Existing Gravity Main	L.S.	1	40,000.00	**$ 40,000**
3.3	Water Service and Washdown	L.S.	1	10,000.00	**$ 10,000**
	TOTAL SECTION C				**$ 125,000**
D.	**SITE WORKS AND ACCESS**				
4.1	Earthworks, Site Grading, Paving and Landscaping	L.S.	1	75,000.00	**$ 75,000**
4.2	Fencing and Bollards	L.S.	1	12,000.00	**$ 12,000**
	TOTAL SECTION D				**$ 87,000**

SUMMARY

A.	**PUMP STATION**				$ 545,000
B.	**ELECTRICAL**				$ 332,000
C.	**CIVIL UTILITIES**				$ 125,000
D.	**SITE WORKS AND ACCESS**				$ 87,000
				SUB-TOTAL:	**$ 1,089,000**
	Inflation Rate (2021-2024)				16.23%
	Inflation Cost				$ 176,745
				SUB-TOTAL:	**$ 1,265,745**
	Contingency (30% of Const.)	L.S.	1		$ 379,723
	Design and Construction Engineering (15% of Const.)	L.S.	1		$ 246,820
				SUB-TOTAL:	**$ 626,544**
	TOTAL ESTIMATED CONSTRUCTION COST (EXCLUDING TAXES)				**$ 1,893,000**

ASSUMPTIONS

- Pump station will be constructed on existing lot or within road RoW and no land acquisition costs are required.
- Grading and landscaping will be required at the site, but no clearing and grubbing.
- Rock blasting is not required at the site.
- Station will include a FRP wet well and electrical kiosk. Estimates do not include costs for a building.
- Station will include glow meter in standalone below-ground chamber.
- Assumed configuration: Duplex Lift Station, Electrical Kiosk, Generator, Wet Well, Valve Chamber, Flow Meter Manhole
- Assumed voltage is 600V, 3-Phase.
- Assumed labour rate is $85/hr.
- Assumed Generator Size is 100kW.

USL Project: 3275.0021.01

Large Sanitary Pump Station
100 <= HP

Class D Cost Estimate

Description

This estimate has been prepared to establish budgetary costs for long range financial planning purposes only. The derived cost is an approximate magnitude of cost derived from lump sum and unit costs from recent similar projects. Design and construction engineering and contingency are included in this estimate.

Item	Description	Unit	Total Quantity	Unit Price	Total
A.	**PUMP STATION**				
1.1	Wet well (c/w Pumps and Internal Mechanical Components)	L.S.	1	487,500.00	**$ 487,500**
1.2	Valve Chamber (c/w check valves, isolation valves, air valve, bypass)	L.S.	1	162,500.00	**$ 162,500**
1.3	Flow Meter (c/w chamber)	L.S.	1	150,000.00	**$ 150,000**
	TOTAL SECTION A				**$ 800,000**
B.	**ELECTRICAL**				
2.1	Electrical Kiosk (c/w Controls, Motor Starters, Power Distribution, Automatic Transfer Switch, Termination Compartment)	L.S.	1	160,000.00	**$ 160,000**
2.2	Generator	L.S.	1	101,000.00	**$ 101,000**
2.3	General Site Work (Wet Well, Valve Chamber, Luminaire/Antenna Pole)	L.S.	1	54,000.00	**$ 54,000**
2.4	BC Hydro Service Utility	L.S.	1	52,000.00	**$ 52,000**
2.5	Testing/Commissioning/Permits	L.S.	1	45,000.00	**$ 45,000**
	TOTAL SECTION B				**$ 412,000**
C.	**CIVIL UTILITIES**				
3.1	Connection to Existing Forcemain	L.S.	1	100,000.00	**$ 100,000**
3.2	Connection to Existing Gravity Main	L.S.	1	50,000.00	**$ 50,000**
3.3	Water Service and Washdown	L.S.	1	15,000.00	**$ 15,000**
	TOTAL SECTION C				**$ 165,000**
D.	**SITE WORKS AND ACCESS**				
4.1	Earthworks, Site Grading, Paving and Landscaping	L.S.	1	150,000.00	**$ 150,000**
4.2	Fencing and Bollards	L.S.	1	20,000.00	**$ 20,000**
	TOTAL SECTION D				**$ 170,000**

SUMMARY

A.	**PUMP STATION**				$ 800,000
B.	**ELECTRICAL**				$ 412,000
C.	**CIVIL UTILITIES**				$ 165,000
D.	**SITE WORKS AND ACCESS**				$ 170,000
				SUB-TOTAL:	**$ 1,547,000**
	Inflation Rate (2021-2024)				16.23%
	Inflation Cost				$ 251,078
				SUB-TOTAL:	**$ 1,798,078**
	Contingency (30% of Const.)	L.S.	1		$ 539,423
	Design and Construction Engineering (15% of Const.)	L.S.	1		$ 350,625
				SUB-TOTAL:	**$ 890,049**
	TOTAL ESTIMATED CONSTRUCTION COST (EXCLUDING TAXES)				**$ 2,689,000**

ASSUMPTIONS

- Pump station will be constructed on existing lot or within road RoW and no land acquisition costs are required.
- Grading and landscaping will be required at the site, but no clearing and grubbing.
- Rock blasting is not required at the site.
- Station will include a FRP wet well and electrical kiosk. Estimates do not include costs for a building.
- Station will include glow meter in standalone below-ground chamber.
- Assumed configuration: Duplex Lift Station, Electrical Kiosk, Generator, Wet Well, Valve Chamber, Flow Meter Manhole
- Assumed voltage is 600V, 3-Phase.
- Assumed labour rate is $85/hr.
- Assumed Generator Size is 200kW.