LADYSMITH

Infrastructure Services

Request for Proposals
No. 2025-IS-06

Sanitary Sewer Modelling Services

For further information
please contact:
Maggie Robinson, EIT
Engineering Assistant
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email mrobinson@ladysmith.ca

RFP Issue Date**: May 15, 2025**
RFP Closing Date**: June 12, 2025, 1:30 pm,**
RFP Opening: **June 12, 2025, 1:45 pm,**
Location of Bid Opening**: Ladysmith City Hall**

1. Introduction

The Town of Ladysmith is seeking qualified engineering consultants to submit proposals that encompass updating the existing sanitary sewer model (SSM) and creating a long-term asset management plan for the Town's sanitary sewer system. This plan will guide infrastructure renewal and maintenance for the next 5 to 20 years encompassing new development requirements of the Provincial Small Scale Multi-Unit Housing (SSMUH) legislation and using asset management best practices.

2. Required Project Deliverables

The expected deliverables are as follows:

- Create a Sanitary Sewer Model for the Town using the existing model (PCSWMM, 2014) and additional information.
- Utilize the created model to analyze the Town's sanitary sewer for deficiencies.
- Create a full build out scenario model using the Town's Official Community Plan.
- Inspect pump stations and force mains to create a condition report.
- Create a replacement plan for pump stations and force mains.
- Work with Town staff to develop a maintenance plan.
- Create a replacement priority matrix for all sewer mains.
- Review the Town's budgets to create a 5-year detailed project list.
- Create a Sewer Asset Management Plan.
- Maintain contact with the Town during the length of the project with monthly meetings.
- (subsequent phase, optional) Maintain the sewer model for the Town.

More detailed descriptions of each deliverable can be found in Appendix A – Project Description.

3. Response Content

All respondents should include the following information in their proposal

- Project understanding;
- Proposed scope of work;
- Schedule to complete the work;
- Cost estimate, including a breakdown of costs; and
- List of staff who will work on the project including relevant experience and rates.

As part of the submission review process, proponents may be required to present their proposal and approach to the Town staff. Proposals will be reviewed and evaluated by a committee comprised of Town staff. During the evaluation process any or all of the proponents may be asked for clarification by telephone or email.

4. Enquiries

All enquiries related to this "Request for Proposal" are to be directed to:

Maggie Robinson, EIT
mrobinson@ladysmith.ca
250-245-6414 ext. 6246

5. RFP Addenda

It is the responsibility of the proponents to check periodically for any addenda that may be issued by the Town of Ladysmith. Addenda will be posted on the Town of Ladysmith website (www.ladysmith.ca/city-hall/bid-opportunities) and on BC Bid.

6. Proposal Submission

Proponents are requested to submit their proposals **no later than 1:30 pm on June 12, 2025,** to the attention of:

Sue Bouma, Manager of Corporate Services
Town of Ladysmith
410 Esplanade – PO Box 220
Ladysmith, BC V9G 1A2

Proposals must be submitted in person or by mail or courier. All submissions must be clearly marked "Request for Proposals 2025-IS-06 – Sanitary Sewer Modelling Services"

The successful bidder will be required to obtain and provide proof of the following:

- A current business license for operating in the Town of Ladysmith
- A Clearance Letter from WorkSafe BC that confirms they are registered and in good financial standing with WorkSafe BC
- Minimum $5 million liability insurance with the Town of Ladysmith named as additional insured
- Federal, provincial and municipal permits when and where applicable

Submissions in response to this RFP will be opened publicly at the Town of Ladysmith City Hall on **June 12, 2025, at 1:45 pm.**

7. Proposal Evaluation

The Town will evaluate proposals based upon but not limited to, the following:

- Quality of the proposal
- Fee quote
- Principles of best value (see below)
- Demonstrated proven experience
- Accessibility and responsiveness
- Reference checks

The Town reserves the right to accept or reject any or all proposals either whole or in part at any time, or waive formalities in, or accept a proposal either whole or in part which is deemed most favourable in the interest of the Town. The Town will be under no obligation to proceed further with any submitted proposal and, should it decide to abandon same, it may, at any time, invite further proposals for the supply of the described services or enter into any discussions or negotiations with any party for the provision of the services. No alterations, amendments or additional information will be accepted after the closing date and time unless invited by the Town.

The lowest or any submission in response to this RFP will not necessarily be accepted. The bids will be considered on their merits and it is not the intention of the Municipality to buy on price alone.

The Town of Ladysmith Purchasing Policy entails the following Principles of "Best Value":

- Procure the goods and services requirements of all departments in an efficient, timely and cost effective manner while maintaining the necessary controls;
- Engage in an open bidding process wherever practical;
- Ensure maximum value is obtained during the acquisition of goods and services. Where applicable, the total cost of the goods and services purchased should be taken into account. Total cost may include but not be limited to acquisition cost, disposal cost, residual value, training cost, maintenance cost, product performance and environmental impact;
- Take into account wherever practical the commitment to protection of the environment, and energy conservation;
- Ensure the acquisition of goods and services meets the requirements of applicable legislation and trade agreements, including the New West Partnership Trade Agreement, and the Agreement on Internal Trade; and
- Ensure that maximum value is realized when disposing of surplus goods, materials and equipment.
- Up to five (5) percent of the evaluation score will be allocated based on the proposal's contribution to the following community benefits:
    - *Economy*

  - Demonstrate job creation within the local area, which is defined as the Cowichan Valley Regional District and the Regional District of Nanaimo.
  - Contribute to a stronger local economy (buy local)
  - Increase training and apprenticeship opportunities
  - Provide work experience and employment opportunities for youth aged 15 to 24
  - Ensure that a Living Wage for the local area is paid

- *Public Spaces*
  - Enhance community recreation, arts and/or culture infrastructure
  - Improve and enhance public spaces
  - Improve access to public spaces for people living with disabilities

- *Environment*
  - Demonstrate that work undertaken exceeds requirements for environmental standards

8. Ownership of Proposals

All Proposals and subsequent information materials shall become the property of the Town of Ladysmith after the closing date and time and will not be returned.

The Proposals will be held in confidence by the Town subject to the provisions of the *Freedom of Information and Protection of Privacy Act*. This Request for Proposals and all associated documentation is the property of the Town of Ladysmith and shall not be copied or distributed without the prior written approval of the Town.

Appendix A – Project Description

1. Background

The older areas of Town were built with a combined sanitary and storm sewer system that discharged into the harbour. As the system developed with a sanitary treatment plant and new sanitary mains, certain areas of the original combined sewer were retained as a storm drain system. There are likely situations where the storm water is still connected to the sanitary service on-site, leading to significant inflow and infiltration in the system. Additionally, there are likely areas of town where properties do not have drain infrastructure and therefore storm water drains to the sanitary system, because homeowners unwittingly connect their storm drain to the sanitary service.

The Town is currently in a phase of growth due to the changes in provincial legislation particularly Bill 44 (or SSMUH), which allows 4 dwelling units on a traditional single-family lot. With the SSMUH requirements, there will be an impact to the sanitary system including the pump stations and the Wastewater Treatment Plant (WWTP), as the Town is already seeing an increased load on at the WWTP during large rain events. The Town is working with a development exemption under SSMUH for the south end, therefore discovering sanitary system deficiencies through this project is a top priority for the Town.

2. Previous Studies

In 2014 Opus Dayton Knight Consultants Ltd prepared a draft sewer model and capacity analysis related to proposed development in the north end of Town. A PCSWWM model was created to evaluate the feasibility for the development. The development did not move forward but the Town has acquired the PCSWWM data. The model has not been updated since it was developed for the proposed development, and it does not incorporate the south end of town.

In 2017, the Town retained Opus International Consultants to prepare a Lift Station Condition report. The draft is attached as Appendix B. Town staff have been using this report to plan maintenance and upgrades.

In 2017, the Town retained WSP/Opus to complete a Flow Monitoring Program in the north end of town and a portion of the south end of town, to determine the extent of inflow and infiltration into the sanitary system. This report is available as Appendix C. The report identifies very high I&I in the system.

In 2019, the Town retained WSP Canada Group Limited (WSP) to determine the impact to the sanitary system for the Waterfront Area Development. This development has not moved forward yet. This report is available as Appendix D.

In 2024, the Town Engineering department prepared a Preliminary Sanitary Sewer Capacity Review, as part of Staff Report to Council with respect to the Provincial government's legislation for Small Scale Multi-Unit Housing (SSMUH). This report is available in Appendix E. Staff prepared the report using conservative methods to identify areas of possible restrictions resulting in surcharging or overflow in the system. The report identifies areas of concern based on a desktop review. The report stated an upgrade to the model was required to confirm or dispel these findings.

3. Existing Infrastructure

The Town owns, maintains, and operates the municipal sanitary sewer, which contains:

- Gravity sewer mains = 88.7 km
- Sewer force mains = 3.4 km
- Sewer lift station = 1
- Sewer pump stations = 7
- Service laterals = 3450
- Sewer manholes = 910

Approximately 90% of the manholes (nodes) have inverts and pipes (conduits) have slope, size and material.

Limited public access in GIS is available at https://www.ladysmith.ca/business-development/bylaws-maps.

Access to the entire sewer network in AutoCAD is available to all bidders upon request. Sewer data includes the following for a majority of the assets:

- Sewer mains
    - Elevations
    - Sub-Catchments
    - Diameter
    - Material
    - Length
    - Slope
- Sewer manholes
    - Rim elevation
    - Invert elevation
- Sewer service laterals

4. Scope

The objective of this project is to develop an updated Sanitary Sewer Model. The Sanitary Sewer Asset Management Plan (Plan) will be developed from the model and identify at least 20 years of priority projects. The Plan must identify five years of priority replacements, upgrades, and maintenance work with costing. The Plan will be based on the available information including condition, age, expected development, and I&I goals in order to maintain current service levels.

5. Required Project Deliverables

5.1. Meetings

The bidders should account for the following meetings in their proposals with Town staff:

- In person kickoff meeting at Ladysmith Public Works building = 2 hours
- Virtual recurring 1-hour monthly meeting for duration of project = 10 hours
- In person meeting with Planning Department to review OCP and expected future growth = 2 hours

5.2. Sanitary Sewer Model

Prepare an up-to-date sanitary sewer model using existing data. The consultant shall evaluate the best method to prepare the model based on the data provided.

The model shall include all aspects of the sewer system, including, but not limited to pump stations, force mains, and gravity main capacity. The Consultant will calibrate the model using dry and wet weather flow data, including the 2017 WSP Flow Monitoring Report information.

Adjust the population density to account for short term SSMUH density increases in single family residential areas identified in the Official Community Plan.

5.3. Sewer System Analysis

Utilizing the up-to-date sewer model developed above, the Consultant shall

- analyze the present-day model to identify deficient infrastructure required to bring the system operation to within acceptable levels of service and design parameters;
- provide an Esri compatible feature class with an attribute that identifies capacity for each pipe segment;
- provide the Town with a preliminary list of potential infrastructure and/or operational improvements to address any identified system deficiencies for further review and assessment by the Town; and
- incorporate input received from the Town on preliminary findings and develop a prioritized list of improvements for mains and pump stations with Class D cost estimates, to 2030.

5.4. Future Sewer System Analysis

Utilizing the Town's OCP, information gathered during an estimated 2 hour meeting with the Planning Department, and the updated sewer model from above, the Consultant will:

- model a full build out scenario based on long term SSMUH directives;

- analyze the future model to identify capacity issues;
- provide an Esri compatible future feature class with an attribute that identifies capacity for each pipe segment;
- provide the Town with a preliminary list of potential infrastructure and/or operational improvements to address any identified system deficiencies;
- produce an updated model, GIS feature class, and map that considers the improvements identified in this project (i.e. update the model to account for I&I reductions identified as part of this project); and
- Incorporate input received from the Town on preliminary findings and develop a prioritized list of improvements for mains and pump stations with Class D cost estimates. Where improvements are identified, future sizing requirements of mains and pump stations should be listed.

5.5. Pump Station and Force Main Inspections and Condition Report

The Consultant will complete a full inspection of the pump stations and corresponding force mains to produce a condition report for each station. The existing condition assessment report is now 8 years old. There is a new pump station at Gladden Road and a pump station planned as part of the Holland Creek Development, which is not in the list. The Sandy Beach pump station is at end of life.

Regular maintenance has been completed on the pump stations. Town staff will be available to discuss maintenance activities. This information will be utilized to develop portions of the asset management plan.

5.6. Pump Station and Force Main Replacement Plan

Utilizing the condition information from the inspections, the Consultant shall develop a life cycle plan for the pump stations and force mains.

5.7. Develop Maintenance Plan

Work with Town staff to review current maintenance and operating programs and identify any improvements. Examples include, but are not limited to flushing, lining, inspection chamber installations, service lateral replacements, reoccurring CCTV inspection intervals, additional flow monitoring, etc. Any improvements should be included in the 5-year project list with a corresponding year (example annual flushing program starts in year 2).

5.8. Review Existing Budgets

The Town has a limited sewer operating and capital budget. Of most significance is a new line item in 2023 for $1,110,000 for I&I. The Consultant will review the details of these budgets.

5.9. Sewer Main Replacement Priority GIS Feature Code

The Consultant will develop a priority matrix for the replacement of all sewer mains using the information described above, risk factors, best practices and input from the Town. The output will be an Esri compatible feature class with an attribute that assigns each asset segment a replacement/repair target range (0-5 years, 5-20 years, etc.). Other criteria may be included after the kickoff meeting. Included in this should be a high-level replacement class for the assets using a unit rate agreed to with the Town.

5.10. 5-Year Detailed Project List

Further to the 20-year budget planning graph, a 5-year detailed list of capital projects is required. The list should identify the asset, type of renewal (i.e. replacement or lining), and Class D cost estimate separated for detailed design and construction. The list will align with the 20-year plan for funding and be based on maintaining levels of service, meeting development demands, and reducing inflow and infiltration. A budgetary cost estimate will be provided for each project/asset.

5.11. Sewer Asset Management Plan

An overall Sewer Asset Management Plan (Plan) will be developed to summarize the key findings. Included in the Plan are the following deliverables that were listed above:

- Map of the present-day sewer model that colour codes the pipe segments and pump stations by existing capacity;
- Map of the future model that colour codes the pipe segments and pump stations by existing capacity;
- Map of the colour coded conditions of the pipe segments and pump stations;
- Map of the pipe segments and pump stations colour coded by range of replacement year;
- List of pump station and force main replacement year and cost
- Description of proposed maintenance activities
- A project list to 2030 to account for SSMUH exceptions provided to the Town by the Province with Class D estimates.
- 20-year detailed project list that includes:
    - Improvements identified in present day sewer model
    - Improvements identified in future sewer model
    - Additional projects identified to meet I&I goals
    - Projects identified in the pump station and force main replacement plan
    - Projects identified in the maintenance plan
- 20-year lifecycle cost vs planned budget graph that includes
    - 20-year plan from above

    - Maintenance, pump station, and force main projects identified as critical within the 20 years.
- The Plan should be actionable, concise, and easily digestible by Engineering staff.

5.12. Maintain Sewer Model (subsequent phase - optional)

Currently, the Town does not have capacity to maintain the sewer model as new developments come or as infrastructure is rehabilitated to remove I&I. The Town is planning to have the Consultant maintain the model and represent the Town on assessing sewer capacity on individual multi-family developments to determine if sufficient sewer capacity exists for the development. If sufficient capacity does not exist, the Consultant will identify which upgrades are needed to achieve capacity for that development. In addition, the Consultant will update the model annually with repairs completed that year. This deliverable is part of a subsequent phase and should be treated as optional. Provide hourly rate for these services.

Appendix B - Lift Station Condition Report

Town of Ladysmith

Lift Station Condition Assessment

Town of Ladysmith

Lift Station Condition Assessment

Prepared By

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Contents

Appendices

Executive Summary

Opus International Consultants Ltd. (Opus) was retained by the Town of Ladysmith to conduct a condition assessment of the Town's existing sanitary lift stations. This included a review of the civil, mechanical, and electrical components for all six sanitary lift stations. The ultimate objective is to provide the Town with a comprehensive assessment of risk ratings for each asset component from each lift station and a prioritized list of repair and replacement recommendations for these components.

The lift station condition assessment included an initial review of existing available record data provided by the Town, followed by field reviews at each site, in completing a thorough lift station inventory. The subsequent task was to develop a standardized risk assessment framework for evaluating the criticality of each sanitary lift station asset component, in order to quantify the urgency in which preventive or corrective upgrades and repairs would have to be implemented, and/or if full component replacements would be preferred. The risk rating of the lift station asset components is based on the likelihood and consequence of failure of that asset. A key aspect of the risk analysis was the field review which allowed field specific engineers to evaluate the current conditions of the civil, mechanical, and electrical components of each lift station.

Condition assessments carried out during field reviews at each lift station allowed Opus to determine the likelihood of failure of each system component based on condition, assessed age, and state of repair. Parameters affecting the consequence of failure for each lift station asset component are the technical expertise required for replacement, the replacement value of each system component, the impacts of failure to business continuity, and the impacts of failure to the environment.

Upon combining the findings of the field reviews and subsequent desktop risk analysis, risk rating scores for each lift station asset component were determined, allowing for a prioritized lift station asset component repair and replacement program. Where "Very High Risk", "High Risk", and "Medium Risk" asset components could be ideally addressed through cost-effective repairs to prolong the life of the assets, the eventual replacement of these assets would be deferred in the replacement program by their reclassification as "Low Risk" asset components after the suggested repair was made, where we have scheduled specific repair years and costs in this report. The reader should note that this lift station condition assessment study provides for the review of one repair/replacement cycle for each asset component reviewed and therefore should only be reviewed as a short term (10-15 years) plan rather than a fully-fledged repair and replacement strategy for long term (>15 years) usage. This condition assessment study should ideally be re-assessed at minimum once every 1o years to refresh understandings of condition through field reviews and re-assessment of risk ratings. The following upgrades have been identified:

- Components categorized as "Very High Risk" assets are recommended for replacement in the next 0-2 years. These assets are currently in poor condition and are at the end of their service lives. The total estimated annual repair/replacement cost of "Very High Risk" asset components is $85,000.
- Components categorized as "High Risk" assets are recommended for replacement in the next 3-10 years. These assets are currently in tolerable condition and are near the middle to the end of their service. The total estimated annual repair/replacement cost of "High Risk" asset components is $702,000.

- Components categorized as “Medium Risk” assets are recommended for replacement in the next 11-20 years depending on the category of the component (civil, mechanical, and electrical). These assets are currently in satisfactory condition and are near the middle of their service lives. The total estimated annual repair/replacement cost of ‘Medium’ risk asset components is $5,261,000.
- Components categorized as “Low Risk” assets are recommended for replacement in the 21-50 years, depending on the category of the component (civil, mechanical, and electrical). These assets are currently in satisfactory condition. The total estimated annual repair/replacement cost of “Low Risk” asset components is $1,659,500.

1 Introduction

1.1 Purpose

The objectives of the lift station condition assessment are:

- To develop an up-to-date asset inventory of the Town's lift stations;
- To develop and implement a strategic risk-based asset management approach to assess the condition and criticality of all civil, mechanical, and electrical asset components of the lift stations;
- To conduct field reviews to determine actual field conditions and identify potential repairs (as needed); and,
- To anticipate replacement schedules and costs, and to prioritize lift station asset component improvements across the Town.

The results of this report will allow the Town to have a better understanding of the current condition of its lift stations and allow Town staff to make informed decisions concerning repair and replacement schedules of asset components within its lift stations, particularly towards any critical infrastructure currently at a very high risk of failure.

1.2 Background

There has been a growing demand by municipalities in Canada and across the world to adopt an effective means of asset management to evaluate service delivery models. In general, sanitary sewer systems are one of these service delivery utilities which requires an in-depth investigation of its management and continued service due to its profound impact of failure on large groups of people. One of the goals of sanitary sewer asset management and renewal plans is to ensure the financial sustainability of the sanitary utility. A key element in achieving the goal is to measure performance and intervene at the optimum point during a given asset's service life to perform upgrades, repairs, or replacements.

1.2.1 System Description

The Town currently operates roughly 66 km of sanitary gravity sewers, 983 manholes, 6 sanitary lift stations, and 1.2 km of pressurized sewers (forcemains). The Town's sanitary sewers discharge wastewater from homes and businesses into a centralized wastewater treatment plant.

This report focuses on the Civil, Mechanical and Electrical components of the Town's sanitary lift stations from an asset condition assessment perspective. The Town does not currently have a complete documented record of its lift stations, and has retained Opus to complete an inventory and condition assessment to document the current state and condition of each lift station asset component.

1.2.2 Asset Condition Rating Approach

Measuring the performance of the Town's sanitary lift stations will require condition assessment exercises of a sufficient regularity in order to mitigate the risk of asset failure, avoid service interruption, and minimize detrimental impacts on health, environment and safety. Risk in the context of asset management is a measure of the consequence of an asset's failure combined with its likelihood of failure. The risk context is a key factor in determining the priority of capital expenditures on sanitary lift stations assets.

This report presents Opus's comprehensive study into developing a risk analysis framework in order to perform condition assessments of the Town's six sanitary lift stations, and develop a prioritized asset component repair and replacement plan. The intent of the risk assessment is to empower the Town to make informed management decisions, in order to focus resources and efforts on critical sanitary lift station assets. The risk assessment process is subjective, and should be regularly reviewed and refined with up-to-date information, in conjunction with other related issues, such as:

- Risk Management Reviews
- Levels of Service Reviews
- Renewals Planning Budgets
- Operations and Maintenance Practices
- Regular Site Visits to Further Assess Conditions (At minimum once a year)

1.3 Scope of Work

This report contains the complete condition assessment of the civil, mechanical, and electrical asset components of each of the Town's sanitary lift stations with recommendations on repairs and replacements, and consists of the following tasks:

- Information Gathering
- Risk/Condition Assessment Framework
- Field Reviews and Lift Station Inventory Development
- Criticality Assessment
- Risk Assessment & Renewal Plan

2 Information Gathering

The required relevant data was gathered for this assignment in discussion with the Town as follows:

- Latest available GIS and record drawings;
- Lift station condition assessments based on field visits and observations by Opus staff; and,
- Town of Ladysmith Sanitary Sewer Model (by Opus)

From an overall perspective, only a few critical data gaps were found, such as the actual construction/commissioning year of the Transfer Beach lift station. Where critical assumptions have been made, these are detailed in our summary of field reviews section in Chapter 4 of this report. Available record drawings were used to help complete the lift station inventories during field reviews.

3 Risk/Condition Assessment Framework

3.1 Overview of Approach

The lift station risk framework is a tool which establishes the risk management context. It attempts to standardize condition assessment and decision-making processes by categorizing each lift station asset component according to unique likelihood and consequence of failure ranking, which are then combined to determine a final Risk score. For the purposes of carrying out the lift station condition assessment, the lift station's civil, mechanical, and electrical asset components have been individually assessed. Each of these components are made of the asset groups as outlined in Table 3-1.

Table 3-1 Lift Station Components

Discipline	Asset Groups	Asset Components	Typ. Life Expectancy
Civil	Facility Buildings	• Foundation • Superstructure • Roof	75 75 25
	Facility Yard	• Fence • Access • Grounds	20 40 50
	Foundation and Hydraulic Structure	• Wet/Dry well • Valve chamber • Ladders • Platforms • Railings	50 40 30 30 30
Mechanical	Pumps	• Pump Units (make, model, serial numbers, horsepower, running number, voltage/phase/frequency, capacity, impeller number and speed)	20
	Piping & Valves	• HVAC • Discharge Piping • Suction Piping • Discharge Valve	10 25 25 25
Electrical	Power Distribution & Electrical	• Standby Generator & ATS • Electrical Panels • Service Entrance • Surge Suppressor • Starter #1 • Starter #2	30 30 30 15 20 20
	Instrumentation controls, & communication	• Controller Data (RTU) • Operational Interface • Level control System • SCADA • Radio/Modem • Antenna	15 15 15 15 15 15

3.2 Likelihood of Failure

The Likelihood of Failure (LoF) of an asset was ranked using a score of 1 to 5. For each asset, in order to determine a LoF score in a systematic and replicable way, both quantitative and qualitative assessment approaches were considered:

- Quantitative – considered the asset's repair history and remaining life estimate.
- Qualitative – involved a site visit and field review of lift stations by our civil/structural, mechanical, and electrical engineers to determine the existing conditions and the extent of repairs/replacement required.

Qualitative assessments were carried out for all asset components based on their estimated remaining useful life (= Typ. Life Expectancy - Age). Field reviews included an inventory review. Typical service life estimates used to assess lift station asset components were taken from the Ministry of Community Service's "Guide to the Amortization of Tangible Capital Assets" document published May 2008 and other commonly used values from Asset Management Best Practices. Service life estimates used for the Town's lift station asset components are also summarized in Table 3-1.

The LoF criteria are defined in Table 3-2.

Table 3-2 Likelihood of Failure Criteria

QUANTITATIVE		QUALITATIVE	
Score	Estimated Remaining Useful Life (eRUL)	Score	Repairs required based on current condition / Field review
5	eRUL > 10 years past Typ. Life Expectancy	5	Critical
4	eRUL = 0-10 years past Typ. Life Expectancy	4	Major repairs required
3	eRUL within last 15% of Typ. Life Expectancy	3	Moderate repairs required
2	15% of Typ. Life Expectancy ≤ eRUL ≤ 50% of Typ. Life Expectancy	2	Minor servicing required
1	eRUL ≥ 50% of Typ. Life Expectancy	1	None required

The quantitative (see Table 3-2) and qualitative scores (see condition field scores) for each asset component were used to generate the LoF score using the matrix in Table 3-3.

Table 3-3 Likelihood of Failure Scoring Matrix

		Qualitative				
		1	2	3	4	5
Quantitative	1	1	1	2	3	4
	2	1	2	3	4	4
	3	2	3	4	4	5
	4	3	4	4	5	5
	5	4	4	5	5	5

Table 3-4 provides a description of the LoF scores.

Table 3-4 Likelihood of Failure Scoring Description

LoF Score	Description
1	Rare, may occur in rare circumstances, more than 20 years
2	Unlikely, could occur at some stage, within 10-20 years
3	Possible, could occur at some stage, within 3-5 years
4	Likely, will probably occur at some stage, within 2 years
5	Almost Certain, is expected to occur within a year

3.3 Consequence of Failure

The Consequence of Failure (CoF) of an asset was ranked using a score of 1 to 5. The implications of each lift station failure were assessed against four categories including Technical, Financial, Business Continuity, and Environmental. Other categories considered but not assessed include the population and strategic planning factors, as they were deemed to have similar and inconsequential effects on CoF scoring if used. Impacts to each of the categories due to an asset failure were ranked based on the criteria set out in Table 3-5 and given scores from 1 to 5.

Each of the asset components were assessed individually to capture the relative impacts to each of the categories. For example, the technical expertise required for replacing pump units is different to setting up the SCADA system. The following data was reviewed to help determine the appropriate CoF score:

- Lift station condition assessment notes from site visits
- Population and Peak Wet Weather Flow estimates for each lift station catchment
- Pumping capacity of each station
- Land use parcels
- Proximity of lift stations to the Ladysmith Harbour and other watercourses
- Financial estimates of replacement costs of asset components

The final consequence of failure score for each asset was selected based on the average category score from the four categories assessed.

Table 3-5: Consequence of Failure Categories & Criteria

	Technical	Financial	Population	Business Continuity	Environmental	Strategic Planning
Questions to Ask	What is the level of effort or available resources required to deal with a complete failure of asset. Are there risks due to specific critical technologies and or the overall technical complexity of pump station components replacements (has it been done successfully before? Any design and/or implementation complexity? Specialised technical skill required? Speed of technology change, etc)	What is the estimated financial cost of replacement of the asset? What is the risk that there is inadequate funding for replacement?	What is the estimated number of customers that will affected by the failure of the asset? Are there risks related to health and safety? *Not used for this study as all lift station service approximately the same amount of people across the Town (i.e. all <2%).*	What is the risk to day-to-day community businesses, activities and systems? What effect on stakeholders and community? What will be the impact on the level of service provided by the Town?	What is the risk to the environment (ecology, soil contamination, water quality, noise levels, odour, dust, etc) due to the effects of asset failure?	What is the risk at the corporate and strategic planning level due to possible impact to the Town's core business objectives? *Not used for this study as continued operations of all lift stations have similar impact on the Town's strategic planning objectives. Where Ludlow Lift Station is concerned for maintained capacity supply to service the future waterfront area development, that is been considered from the Business Continuity Point-of-View*

Consequence of Failure	Score	Technical	Score	Financial	Score	Population	Score	Business Continuity	Score	Environmental	Score	Political
Catastrophic	5	Local support not available. In general, limited resources or expertise are available.	5	Financial cost > $350,000 (Insufficient funding / requires financing)	5	Service disruption to more than 50% of the Town's population. Service disruption to hospitals and schools.	5	Significant effects to day to day business function with prolonged and significant impact on levels of service (e.g. prolonged service disruption to industrial and/or critical commercial activities)	5	Overflow direct discharge to the harbour with significant and wide spread adverse effects on living organisms and environment by effluents, emissions, wastes, resource depletion, etc	5	Considerable impact on the Town's ability to meet business objectives across multiple years.
Major	4	Local technical support not available. Out of province/country expertise available and required.	4	Financial cost of $200,000 to $350,000 (Significant portion of Town's annual sewer budget)	4	Service disruption to 35-50% of population.	4	Major effects to day to day business function with significant short term impact on levels of service (e.g. short term service disruption to industrial and/or high density residential and commercial areas)	4	Overflow direct discharge to the harbour with major but localised adverse effects on living organisms and environment by effluents, emissions, wastes, resource depletion, etc	4	Impact on the Town ahieving core business objectives within one given year.
Moderate	3	Local technical support available. Requires onsite review from external parties (e.g. consultants).	3	Financial cost of $100,000 to $200,000 (Moderate portion of Town's annual sewer budget)	3	Service disruption to 15-35% of population.	3	Moderate effects to day to day business function with moderate short term impact on levels of service (e.g. temporary service disruption to medium density residential and commercial areas)	3	Overflow discharge to creek then to the Ladysmith harbour, with moderate localised adverse effects on living organisms and environment by effluents, emissions, wastes, resource depletion, etc	3	Minor impact on strategic planning and the Town achieving business objectives.
Minor	2	Local technical support available. May also be resolved in-house.	2	Financial costs of $35,000 to $100,000 (Minor portion of Town's annual sewer budget)	2	Service disruption to < 15% of population.	2	Minor effects to day to day business function with minor impact on levels of service (e.g. temporary service disruption to residential and limited commercial properties)	2	Overflow discharge to creek then to ocean (not via harbour), with minimal localised adverse effects on living organisms and environment by effluents, emissions, wastes, resource depletion, etc	2	Negligable impact on business objectives and strategic planning.
Insignificant	1	Available in-house knowledge or experience.	1	Financial costs < $35,000 (Low impact on Town's annual sewer budget)	1	Negligible (< 2% population affected)	1	Negligible effects to day to day business function with insignificant impact on levels of service	1	Overflow direct discharge to the ocean (not via harbour) with negligible or no localised adverse effects on living organisms and environment by effluents, emissions, wastes, resource depletion, etc	1	No impact to core business objective and strategic planning.

3.4 Risk Analysis

The results of the likelihood and consequence of failure rankings were then combined to develop a risk rating for each lift station asset component, according to the matrix in Table 3-6.

Table 3-6 Risk Rating Matrix

'Level of Risk' - Risk Rating					
Likelihood	Consequences				
	Insignificant	Minor	Moderate	Major	Catastrophic
Rare	L	L	M	M	H
Unlikely	L	L	M	M	H
Possible	L	M	M	H	H
Likely	M	M	H	H	VH
Almost Certain	M	H	H	VH	VH

As outlined in Table 3-7, the level of risk of an asset component determines the action required in terms of managing the risk as well as providing a gauge for urgency to implement either preventive or corrective measures.

Table 3-7 'Level of Risk' and 'Action Required'

Risk Rating	Action Required
Very High Risk (VH)	Immediate corrective action (i.e. action is required now)
High Risk (H)	Prioritized action required (i.e. make safe and program in current/next program)
Medium Risk (M)	Planned action required (i.e. make safe and include in forward programs)
Low Risk (L)	Manage by routine procedures

Replacement periods are based on the risk rating score of each asset: Very High Risk – within 0-2 years; High Risk 3-10 years; Medium Risk– within 11-20 years; and Low Risk- within 21-50 years.

4 Field Review and Lift Station Inventory

This section of the report summarizes the findings of the field reviews in development of asset component inventories and condition scores for each of the Town's six lift stations. The inventory and condition assessment forms filled out for each lift station have been included in Appendix A.

4.1 Gill Road Lift Station

Gill Road lift station is one of the oldest Town of Ladysmith lift stations constructed in 1982.

4.1.1 Civil Components

Based on notes from the record drawings, the reinforced concrete (RC) wet well structure was constructed before 1982. During the inspection, the wet well was fully operational and no major structural defect was observed in the RC wet well. The rebar arrangements within the walls of wet well are unknown based on the drawings. There is also no information about the rebar arrangement within the surrounding concrete slab on the top of wet well. During inspection, a crack was observed from the corner of the wet well to the retaining pony wall. The wet well contains existing ladder rungs cast into the concrete structure which would have led to a midlevel platform which no longer exists. As mentioned further below, a new platform and ladder will be installed as part of the upgrade project. The ladder, platform frames and railing inside the wet well are severely corroded and need to be replaced.

Access to the lift station is difficult during high tides for service vehicles. The yard is a raised platform adjacent to the harbour and poses some safety concerns. Thereby, installation of railing around the pump station is recommended.

Electrical and control equipment as well as a self-priming pump (P3) are located in a reinforced masonry building. The control room is separated from the pump room by a partition stud. The partition is in an adequate condition. The masonry building's rebar arrangement as well as height to thickness ratio of the masonry block meet the design standards. However, the first two rows of masonry blocks need to be grouted in order to meet the seismic requirements. The asphalt shingle roof is past its life service and needs to be replaced. No evaluation of roof's trusses condition was carried out during inspection as they could not be accessed. There is also no information about the condition of the foundation of the building based on the drawings.

There is an unretained wall of soil adjacent to the wet well and pump building. Surcharge underneath the unretained wall of soil will increase lateral active and seismic soil pressures exerted on the wet well walls. In the case of the potential collapse of unretained wall of soil, the pump building does not have the capacity to withstand the imposed loading of the soil. Apart from the physical improvements reviewed to improve existing asset components of the lift stations from this assignment, a geotechnical assessment is recommended in order to investigate the capacity and stability of the unretained wall of soil during the seismic and ground saturation events at a cost of $6,000.

4.1.2 Mechanical Components

The mechanical system consists of two pumps (P1 and P2) located in the wet well, one self-priming pump (P3) located in the above ground masonry building, and related wet well appurtenances, piping, valves and ventilation. The P3 pump was installed after original construction of the station in 1982 but the date is unknown. New pumps, P1 and P2, were installed in 1982. The remaining equipment was installed at the time of construction.

Pumps No. 1 (P1) and No. 2 (P2) are located in the wet well. Since the date of our site inspection, the following has occurred:

- One of the pump bases blew out and as a result the Town has ordered a new base for each pump. The bases were from the original construction.
- Each pump has been serviced and motor cooling jackets were replaced which fixed the leaking cooling jacket issue.

- Opus has been retained to provide a mechanical and structural upgrade to the pump station. This will include the replacement of piping, valves, pump bases, intermediate platform, and the installation of a new ventilation system.

The self-priming pump (P3) located in the control building has not operated for a number of years. The Town has spent resources on trying to fix the pump with zero results. It is recommended to remove the pump from the station and recondition the room as a new electrical room.

Wet well pump operation was not confirmed with a drawdown test due to the lack of a level transducer. The pumps were in serious need of maintenance but, as mentioned, each pump has been serviced and issues were remedied. The pump guide rails are in good condition. Pump chains are looped around the pump hook and a new link should be installed. Pump chain hooks are installed at the top of the wet well but are not used. Short older chain lengths from the original pumps are hanging from the chain hooks. The pump cables are loosely looped through the wet well. Cables are recommended to have cable grips and be suspended from hooks near the access hatches.

Piping, isolation and check valves have moderate to severe corrosion. The majority of fasteners used at flanged connections have been replaced with stainless steel fasteners due to corrosion. The remaining fasteners are original and have heavy corrosion. As mentioned above, all piping and valves will be replaced as part of an upgrade project.

There is no powered ventilation system at this location. Two goosenecks are provided which passively ventilate the wet well. As part of the upgrade project it is recommended to modify one gooseneck for the installation of a rated/classified air supply fan (i.e. the same as the one required for the Ludlow site). The remaining gooseneck would then become the exhaust duct.

4.1.3 Electrical Components

The overall condition of electrical components was found to be in adequate working condition (although past their typical service life expectancies). Electrical and control equipment is housed in an above ground masonry building. The installed equipment is old and most equipment is from the original construction. A plan to upgrade this old equipment should be budgeted.

The wet well is not ventilated and therefore requires the installation of electrical equipment that is rated for Class 1, Zone 1. No intrinsically safe relays were installed for the float level switches. Therefore, intrinsically safe relays shall be installed for all float level switches.

No EYS seal for one of the pump cables was identified on the conduit between the wet well and the control panel, and should be installed. Due to the age of the station, it is recommended to review the electrical grounding installation and perform ground resistance tests to ensure the electrical grounding system is still in an acceptable condition and provides adequate performance.

4.2 Sandy Beach Lift Station

Sandy Beach is one of the oldest Town of Ladysmith lift stations constructed in 1982.

4.2.1 Civil Components

Based on notes from the record drawings, the reinforced concrete (RC) wet well structure was constructed before 1982. No structural defects were observed in the RC wet well structure. The station's current hatches do not provide access to the ladder inside the wet well. The hatch frame is also mildly corroded and needs maintenance. This corrosion should be removed and a new corrosion protection layer should be applied on the surface. The wet well contains ladder rungs cast into the concrete structure which would have led to a midlevel platform which no longer exists. These should be removed and a new ladder, platform, and railing installed (if required).

The yard is a raised platform adjacent to the harbour and poses some safety concerns. Thereby, installation of railing around the pump station is recommended.

The electrical kiosk base is not in a good condition and may require replacement. There is no vehicular access to the lift station and operations staff currently access the lift station through a residential yard. During low tide, the lift station can also be accessed from the beach. There is limited space for the installation of a genset.

4.2.2 Mechanical Components

The mechanical system consists of two submersible pumps and related appurtenances, piping, and valves. New pumps were installed in 2009. The remaining equipment was installed at the time of construction.

The operation of Pumps No. 1 (P1) and No. 2 (P2) was not confirmed with a drawdown test due to lack of a level transducer. Each pump was run and appeared to perform adequately. The pump guide rails, pump chains and hooks are in good condition. The pump cables are zip-tied to the guide rail supports, whereas cable grips would be a better installation.

Piping, isolation and check valves have moderate to severe corrosion and should be recoated to arrest further corrosion. The majority of fasteners used at flanged connections have been replaced with stainless steel fasteners due to corrosion. The remaining fasteners should be replaced to reduce corrosion. All valves are located in the wet well.

There is no powered ventilation system at this location. Two goosenecks are provided which passively ventilate the wet well. It is recommended to modify one gooseneck for the installation of a rated/classified air supply fan (i.e. the same as the one required for the Ludlow site). The remaining gooseneck would then become the exhaust duct.

4.2.3 Electrical Components

The overall condition of electrical components was found to be in adequate working condition (although past their typical service life expectancies). However, the interior panel requires general cleaning. The installed equipment is old and most equipment is from the original construction. A plan to upgrade this old equipment should be budgeted.

The incoming Hydro service is from a 240V, three phase Delta system overhead line, and terminates at the main fused disconnect switch which is then routed via the existing electrical panel. The existing electrical panel should not be a pull box for this purpose. The station is also ungrounded due to the three phase Delta connected secondary service from Hydro, and no ground fault monitoring device is installed. A ground fault monitoring device must be installed at the station to monitor any ground fault conditions as required by the current code. The system's electrical grounding (ground connection) seems to be damaged. Due to the age of the station, it is recommended to review the electrical grounding installation and perform ground resistance tests to ensure the electrical grounding system is still in an acceptable condition and provides adequate performance.

The wet well is not ventilated and requires the installation of equipment that is rated for Class 1, Zone 1. No EYS seals were observed on the conduit installation between the wet well and the electrical panel. No intrinsically safe relays were installed for the float level switches. This installation would not meet the current codes and standard practices for wet wells. Our recommendation would be to plan for the overall station upgrade at the earliest date.

4.3 Ludlow Road Lift Station

The Ludlow Road Lift station was constructed in 1999, and was fully upgraded electrically in 2015.

4.3.1 Civil Components

The Fiberglass Reinforced Plastic (FRP) wet well is in a good condition and no defects were observed during inspection. The structural components inside the wet well such as the platform, railing, and ladder are in a good condition. Chain link fencing is provided around the facility. Fence connections are minorly corroded in some locations and the barbed wires on the top of the fences are starting to rust. Fence posts are attached to unreinforced concrete bases which are not structurally reliable to provide support against imposed loads to the fences. The replacement of the barbed wire and repair of the post fences are recommended.

The wet well contains a ladder and safety posts which appear to be in good condition.

Moreover, the slope (10%) and proximity of the road adjacent to the lift station presents some safety concerns. The installation of bollards is recommended. Some corrosion of the anchor bolts has been observed for the electrical kiosk base which needs maintenance in order to prevent malfunction during the seismic event. The site elevation is 1500 mm higher than the Ladysmith marine service yard to the northeast. The difference of elevation is retained by concrete blocks. These blocks are filled with soil. No drawing of the retaining wall has been provided based on our records.

A geotechnical assessment is recommended in order to investigate the stability of the retaining concrete blocks during the seismic event at a cost of $6,000. The construction cost of a lock block wall is recommended at a cost of $5,500.

4.3.2 Mechanical Components

The mechanical system consists of two submersible pumps and related appurtenances, piping, valves and ventilation. New pumps were installed in 2016. A new ARI D-020 combination air valve was installed on the wet well discharge pipe at that same time. The remaining equipment was installed at time of construction.

In 2016, new Flygt pumps were installed onto existing Pump Nos. 1 and 2 Myers bases with adapters. Drawdown tests were performed on our site visit and the pumped flows were approximately equal. The pump guide rails are in good condition. The pump cables are zip-tied to the guide rail supports, whereas cable grips would be a better installation. Hooks are provided to support pump chains but the pumps do not have chains installed for pump installation and removal.

Piping, isolating and check valves are in an acceptable condition, but moderate corrosion is present and should be recoated to arrest further corrosion. All valves are located in the wet well.

The ventilation system does not operate as the fan no longer works. A replacement fan should be installed as soon as possible to avoid classification issues as described below. The existing fan is no longer available from the fan supplier but an updated fan is available. This new rated/classified air supply fan will require modifications to the air supply duct or a transition duct will need to be fabricated as the new fan's mounting flange is square.

4.3.3 Electrical Components

The Ludlow Road lift station has been in operation since 1999, however, the electrical panel including the control system was upgraded in 2015, which included a ScadaPack32 RTU, Operator Interface and pump motor starters.

Random issues related to the ultrasonic level monitoring device not responding or being frozen at a certain level until the unit is reset, are reported. The existing installation, the settings (level range, blanking distance, fail safe output etc.) and echo profile mapping of the level monitor should be reviewed to isolate the probable cause of the issues. Also, the installed level transducer does not seem to have the approval for installation in the Class 1, Zone 2 area, and therefore the level transducer should be replaced.

Currently, the wet well ventilation fan is not working. This wet well fan should be replaced as soon as possible because without the fan operating, the wet well would be classified as Class 1, Zone 1 area, which would critically cause all mechanical and electrical equipment currently in the station to be off specification.

Although the electrical panel and control system was upgraded in 2015, a plan to upgrade or relocate the existing control panel into a new kiosk or building should be budgeted for. The existing control panel is directly mounted in a skin tight outdoor enclosure, which, without any enclosure insulation, is subjected to direct heat and cold. In a hot summer day, the inside enclosure temperature may reach above 40 Degrees Celsius which is the maximum operating limit of most solid state electronic equipment. The high operating temperatures may reduce the life of the electronic equipment and may create erratic operations of the equipment. Enclosure or kiosk insulation should generally be specified to minimize temperature fluctuations, especially if solid state electronic equipment is used.

4.4 Park Drive Lift Station

Park Drive is one of the newer Town of Ladysmith lift stations constructed in 2011.

4.4.1 Civil Components

The Fiberglass Reinforced Plastic (FRP) wet well is in a good condition and no defects were observed during inspection. The structural components inside the wet well such as the platform and ladder are in a good condition and no replacement is needed. Fence post bases are not reliable to provide support against imposed loads and repair is recommended. The barbed wire on top of the fence is completely corroded and replacement with a galvanized barbed wire is recommended. The plywood sheets attached to the south side of the fences should be removed due to excessive induced forces during the wind load.

The wet well contains a ladder and safety posts which appear to be in good condition. Grease buildup is visible on piping, guiderails and around the interior of the wet well. Operations staff clean the wet well which removes buildup.

Some of the existing anchor bolts attached to the genset base are corroded and replacement is required. Stainless steel bolts are recommended. Moss should be removed from the genset steel tie beam in order to prevent any further rust and deterioration.

4.4.2 Mechanical Components

The mechanical system consists of two submersible pumps and related appurtenances, piping, valves and ventilation. All equipment was installed at the time of construction.

Pump operation appears to be good. A drawdown test was performed for Pump No. 1 and the result was close to the design condition. The pumps at Swettenham are 3 years older and since one pump at the site has had an impeller replaced with the 2nd pump currently in need of an impeller replacement, it is likely that the Park Drive pumps will need impeller replacements in the next 5-10 years. The pump guide rails and pump chain hooks are in good condition. The pump cables are zip-tied to the guide rail supports, whereas cable grips would be a better installation.

Piping, isolating and check valves look are in an acceptable condition, but light corrosion is observed so these components should be recoated/touched up to arrest further corrosion. A small air bleed ball valve is installed on the piping just prior to existing the wet well. The lever handle is very corroded and should be replaced with a more corrosion resistant lever (SS or GS). All valves are located in the wet well. The ventilation system operates well.

4.4.3 Electrical Components

The overall condition of electrical components was found to be in good condition; however, the interior of the electrical kiosk requires general cleaning. Light rust was observed in the fan section around the fan guard, and should be cleaned and touched up with paint to prevent further rust. The kiosk and generator concrete bases are almost flush with the grade of the site, which could allow rain water to enter underneath the kiosk or genset, thus, in turn, accelerating the rust buildup under the kiosk/genset support frame over time. Lower concrete bases will also hinder the kiosk door from opening under light snow accumulation conditions around the kiosk. Kiosk bases should be sealed using a marine grade silicone sealant. A wet well ventilation fan positive pressure monitoring sensor should be installed to monitor the operational condition of the ventilation fan in order to ensure that wet well area classification is maintained. This sensor should be connected to the station alarm dialer.

Phase B of the Square-D surge suppressor in the electrical kiosk was not functioning and will need to be checked and replaced. One of the EYS seals was found not sealed and must be filled with a proper sealing compound to prevent potentially hazardous and explosive gases from entering the electrical kiosk. A new low-level float switch was added but not connected to an intrinsically safe relay. This float switch must be connected to an intrinsically safe relay to meet the installation requirements of a float switch in a wet well Class 1, Zone 2 area. The Milltronics level transducer cable must also be installed in a metallic conduit and sealed with a EYS seal as per the manufacturer's installation guide.

4.5 Swettenham Lift Station

Swettenham is one of the newer Town of Ladysmith lift stations constructed in 2008.

4.5.1 Civil Components

The Fiberglass Reinforced Plastic (FRP) wet well is in a good condition and no defects were observed during inspection. The structural components inside the wet well are in a good condition and no replacement is required. Unreinforced concrete fence post bases do not provide sufficient support against imposed loads and repair is recommended. The barbed wire on top of the fence is completely corroded. The slope and proximity of the road adjacent to the lift station presents some safety concerns. The installation of bollards is recommended. The kiosk base and genset foundation are in good condition, however some of the corroded genset anchor bolts should be replaced with stainless steel bolts.

The wet well contains a ladder and safety posts which appear to be in good condition. Significant grease buildup is visible on piping, guiderails and around the interior of the wet well. Operations staff clean the wet well which removes buildup.

4.5.2 Mechanical Components

The mechanical system consists of two submersible pumps and related appurtenances, piping, valves and ventilation. All equipment was installed at the time of construction.

Pump No. 1 operation is good as it recently had a new impeller installed and now has a higher flowrate than Pump No. 2 based on a drawdown test and accumulated pump running times. It is recommended to replace the impeller for Pump No.2 as the flowrate is significantly lower, resulting in much higher run times. The pump guide rails and pump chain hooks are in good condition. The pump cables are supported with cable grips to hangers.

Piping, isolating and check valves look are in an acceptable condition, but light corrosion is observed and these components should be recoated/touched up to arrest further corrosion. A small air bleed ball valve is installed on the piping just prior to existing the wet well. The lever handle is very corroded and should be replaced with a more corrosion resistant lever (SS or GS). All valves are located in the wet well. The ventilation system operates well.

4.5.3 Electrical Components

The overall condition of electrical components was found to be in good condition; however, the interior of the electrical kiosk requires general cleaning. Light rust was observed in the fan section around the kiosk fan louvres, and should be cleaned and touched up with paint to prevent further rust. The kiosk and generator concrete bases are almost flush with the grade of the site, which could allow rain water to enter underneath the kiosk or genset, thus, in turn, accelerating the rust buildup under the kiosk/genset support frame over time. Lower concrete bases will also hinder the kiosk door from opening under light snow accumulation conditions around the kiosk. Kiosk bases should be sealed using a marine grade silicone sealant. A kiosk ventilation fan positive pressure monitoring sensor is installed. Town staff should confirm that this sensor is connected to the station alarm dialer.

The genset fuel leak or low fuel alarm wiring is broken and should be checked and tested. Backup low and high-level float switches must be connected to intrinsically safe relays to meet the installation requirements of float switches in a wet well Class 1, Zone 2 area. The Milltronics level transducer cable must also be installed in a metallic conduit and sealed with a EYS seal as per the manufacturer's installation guide.

4.6 Transfer Beach Lift Station

Transfer Beach is estimated to have been constructed in 1991 from faded prints of dates on electrical drawings found on site; however, record drawings of this station have not been available for this study.

4.6.1 Civil Components

No replacement of the wet well is recommended. No drawings have been provided for the wet well structure. The hatch frame is moderately corroded and requires replacement. No defect of the electrical kiosk base is observed. No recommendation for fencing is provided since the station is located near a children's park and the presence of the fences may pose safety hazards.

The wet well contains existing ladder rungs cast into the concrete structure which appear to be in good condition.

4.6.2 Mechanical Components

The mechanical system consists of two submersible pumps and related appurtenances, piping and valves. The pumps were upgraded in 2010. The remaining equipment was likely installed at the time of construction.

Pump operation was not confirmed with a drawdown test due to lack of a level transducer. The pump guide rails and pump chains are in good condition. The pump cables are zip-tied to the access ladder, whereas cable grips would be a better installation. The pump chains are looped around the top of the guide rail support.

Piping, isolation and check valves have light to moderate corrosion and should be recoated or galvanized to arrest further corrosion. All connections are threaded so no corroded fasteners are present. All valves are located in the wet well.

There is no powered or passive ventilation system at this location. No goosenecks are provided. Due to the park setting, ventilation exhaust was likely not desired so equipment would have had been rated accordingly.

4.6.3 Electrical Components

The overall condition of electrical components was found to be in adequate working condition. The installed equipment is old; however, it appears that the original motor starters have been replaced at some time (est. 2000).

The wet well is not ventilated and requires the installation of equipment that is rated for Class 1, Zone 1. No intrinsically safe relays were installed for the float level switches. Intrinsically safe relays shall be installed for all float level switches.

No EYS seal was identified for one of the pump cables conduits between the wet well and the control panel, and should be installed.

The electrical kiosk is powered from the nearby washroom. Due to the age of the station, it is recommended to review the electrical grounding installation and perform the ground resistance tests to ensure the electrical grounding system is still in an acceptable condition and provides adequate performance.

This site is small and primarily services the adjacent park washroom.

5 Risk Assessment & Renewal Plan

5.1 Likelihood of Failure Scores

Table 5-1 summarizes the LoF scores for each lift station asset component based on the LoF Criteria laid out in Section 3.2.

Table 5-1 Likelihood of Failure Scores

Gill Road Lift Station: Likelihood of Failure Score					
System	**Sub-System**	**Component**	**Quantitative Score (Age)**	**Qualitative Score (Urgency)**	**Likelihood of Failure**
Civil	Facility	Building-Foundation	1	1	1 - Rare
Civil	Facility	Building-Superstructure	1	3	2 - Unlikely
Civil	Facility	Building-Roof	4	4	5 - Almost Certain
Civil	Facility	Yard-Fence/Railing	-	-	-
Civil	Facility	Yard-Access	1	1	1 - Rare
Civil	Facility	Yard-Grounds	2	5	4 - Likely
Civil	Foundation & Hydraulic Structure	Wet/Dry Well	2	2	2 - Unlikely
Civil	Foundation & Hydraulic Structure	Valve Chamber	3	4	4 - Likely
Civil	Foundation & Hydraulic Structure	Ladders	4	4	5 - Almost Certain
Civil	Foundation & Hydraulic Structure	Platforms	4	4	5 - Almost Certain
Civil	Foundation & Hydraulic Structure	Railing	4	4	5 - Almost Certain
Mechanical	Pump Unit	P1	5	1	4 - Likely
Mechanical	Pump Unit	P2	5	1	4 - Likely
Mechanical	Pump Unit	P3	5	5	5 - Almost Certain
Mechanical	Piping & Valves	HVAC	-	-	-
Mechanical	Piping & Valves	Discharge Piping	4	5	5 - Almost Certain
Mechanical	Piping & Valves	Suction Piping	-	-	-
Mechanical	Piping & Valves	Discharge Valves	4	4	5 - Almost Certain
Electrical	Power Distribution	Standby Generator & ATS	4	2	4 - Likely
Electrical	Power Distribution	Electrical Panels	4	1	3 - Possible
Electrical	Power Distribution	Service Entrance	4	3	4 - Likely

Gill Road Lift Station: Likelihood of Failure Score					
System	**Sub-System**	**Component**	**Quantitative Score (Age)**	**Qualitative Score (Urgency)**	**Likelihood of Failure**
Electrical	Power Distribution	Starter #1	5	1	4 - Likely
Electrical	Power Distribution	Starter #2	5	1	4 - Likely
Electrical	Instrumentation & Controls	Controller Data (RTU/PLC)	-	-	-
Electrical	Instrumentation & Controls	Operational Interface	-	-	-
Electrical	Instrumentation & Controls	Level Control System	5	3	5 - Almost Certain
Electrical	Instrumentation & Controls	SCADA	5	1	4 - Likely
Electrical	Instrumentation & Controls	Radio/Modem	-	-	-
Electrical	Instrumentation & Controls	Antenna	-	-	-

Sandy Beach Lift Station: Likelihood of Failure Score					
System	**Sub-System**	**Component**	**Quantitative Score (Age)**	**Qualitative Score (Urgency)**	**Likelihood of Failure**
Civil	Facility	Building-Foundation	-	-	-
Civil	Facility	Building-Superstructure	-	-	-
Civil	Facility	Building-Roof	-	-	-
Civil	Facility	Yard-Fence/Railing	-	-	-
Civil	Facility	Yard-Access	-	-	-
Civil	Facility	Yard-Grounds	2	3	3 - Possible
Civil	Foundation & Hydraulic Structure	Wet/Dry Well	2	2	2 - Unlikely
Civil	Foundation & Hydraulic Structure	Valve Chamber	-	-	-
Civil	Foundation & Hydraulic Structure	Ladders	4	4	5 - Almost Certain
Civil	Foundation & Hydraulic Structure	Platforms	4	4	5 - Almost Certain
Civil	Foundation & Hydraulic Structure	Railing	4	4	5 - Almost Certain
Mechanical	Pump Unit	P1	1	1	1 - Rare
Mechanical	Pump Unit	P2	1	1	1 - Rare
Mechanical	Piping & Valves	HVAC	-	-	-

Sandy Beach Lift Station: Likelihood of Failure Score

System	Sub-System	Component	Quantitative Score (Age)	Qualitative Score (Urgency)	Likelihood of Failure
Mechanical	Piping & Valves	Discharge Piping	4	3	4 - Likely
Mechanical	Piping & Valves	Suction Piping	-	-	-
Mechanical	Piping & Valves	Discharge Valves	4	3	4 - Likely
Electrical	Power Distribution	Standby Generator & ATS	-	-	-
Electrical	Power Distribution	Electrical Panels	4	2	4 - Likely
Electrical	Power Distribution	Service Entrance	4	3	4 - Likely
Electrical	Power Distribution	Surge Suppressor	-	-	-
Electrical	Power Distribution	Starter #1	5	1	4 - Likely
Electrical	Power Distribution	Starter #2	5	1	4 - Likely
Electrical	Instrumentation & Controls	Controller Data (RTU/PLC)	-	-	-
Electrical	Instrumentation & Controls	Operational Interface	-	-	-
Electrical	Instrumentation & Controls	Level Control System	5	3	5 - Almost Certain
Electrical	Instrumentation & Controls	SCADA	2	1	1 - Rare
Electrical	Instrumentation & Controls	Radio/Modem	2	1	1 - Rare
Electrical	Instrumentation & Controls	Antenna	-	-	-

Ludlow Road Lift Station: Likelihood of Failure Score

System	Sub-System	Component	Quantitative Score (Age)	Qualitative Score (Urgency)	Likelihood of Failure
Civil	Facility	Building-Foundation	-	-	-
Civil	Facility	Building-Superstructure	-	-	-
Civil	Facility	Building-Roof	-	-	-
Civil	Facility	Yard-Fence	3	2	3 - Possible
Civil	Facility	Yard-Access	-	-	-
Civil	Facility	Yard-Grounds	1	3	2 - Unlikely
Civil	Foundation & Hydraulic Structure	Wet/Dry Well	1	1	1 - Rare
Civil	Foundation & Hydraulic Structure	Valve Chamber	-	-	-

Ludlow Road Lift Station: Likelihood of Failure Score					
System	**Sub-System**	**Component**	**Quantitative Score (Age)**	**Qualitative Score (Urgency)**	**Likelihood of Failure**
Civil	Foundation & Hydraulic Structure	Ladders	2	1	1 - Rare
Civil	Foundation & Hydraulic Structure	Platforms	2	1	1 - Rare
Civil	Foundation & Hydraulic Structure	Railing	-	-	-
Mechanical	Pump Unit	P1	1	2	1 - Rare
Mechanical	Pump Unit	P2	1	2	1 - Rare
Mechanical	Piping & Valves	HVAC	4	5	5 - Almost Certain
Mechanical	Piping & Valves	Discharge Piping	2	2	2 - Unlikely
Mechanical	Piping & Valves	Suction Piping	-	-	-
Mechanical	Piping & Valves	Discharge Valves	2	2	2 - Unlikely
Electrical	Power Distribution	Standby Generator & ATS	2	1	1 - Rare
Electrical	Power Distribution	Electrical Panels	2	1	1 - Rare
Electrical	Power Distribution	Service Entrance	2	1	1 - Rare
Electrical	Power Distribution	Surge Suppressor	-	-	-
Electrical	Power Distribution	Starter #1	1	1	1 - Rare
Electrical	Power Distribution	Starter #2	1	1	1 - Rare
Electrical	Instrumentation & Controls	Controller Data (RTU/PLC)	1	1	1 - Rare
Electrical	Instrumentation & Controls	Operational Interface	1	1	1 - Rare
Electrical	Instrumentation & Controls	Level Control System	1	3	2 - Unlikely
Electrical	Instrumentation & Controls	SCADA	2	1	1 - Rare
Electrical	Instrumentation & Controls	Radio/Modem	2	1	1 - Rare
Electrical	Instrumentation & Controls	Antenna	-	-	-

Park Drive Lift Station: Likelihood of Failure Score					
System	**Sub-System**	**Component**	**Quantitative Score (Age)**	**Qualitative Score (Urgency)**	**Likelihood of Failure**
Civil	Facility	Building-Foundation	-	-	-
Civil	Facility	Building-Superstructure	-	-	-
Civil	Facility	Building-Roof	-	-	-

Park Drive Lift Station: Likelihood of Failure Score					
System	**Sub-System**	**Component**	**Quantitative Score (Age)**	**Qualitative Score (Urgency)**	**Likelihood of Failure**
Civil	Facility	Yard-Fence	1	2	1 - Rare
Civil	Facility	Yard-Access	-	-	-
Civil	Facility	Yard-Grounds	1	2	1 - Rare
Civil	Foundation & Hydraulic Structure	Wet/Dry Well	1	1	1 - Rare
Civil	Foundation & Hydraulic Structure	Valve Chamber	-	-	-
Civil	Foundation & Hydraulic Structure	Ladders	1	1	1 - Rare
Civil	Foundation & Hydraulic Structure	Platforms	1	1	1 - Rare
Civil	Foundation & Hydraulic Structure	Railing	-	-	-
Mechanical	Pump Unit	P1	1	1	1 - Rare
Mechanical	Pump Unit	P2	1	1	1 - Rare
Mechanical	Piping & Valves	HVAC	2	1	1 - Rare
Mechanical	Piping & Valves	Discharge Piping	1	1	1 - Rare
Mechanical	Piping & Valves	Suction Piping	-	-	-
Mechanical	Piping & Valves	Discharge Valves	1	1	1 - Rare
Electrical	Power Distribution	Standby Generator & ATS	1	1	1 - Rare
Electrical	Power Distribution	Electrical Panels	1	2	1 - Rare
Electrical	Power Distribution	Service Entrance	1	1	1 - Rare
Electrical	Power Distribution	Surge Suppressor	1	2	1 - Rare
Electrical	Power Distribution	Starter #1	1	1	1 - Rare
Electrical	Power Distribution	Starter #2	1	1	1 - Rare
Electrical	Instrumentation & Controls	Controller Data (RTU/PLC)	1	1	1 - Rare
Electrical	Instrumentation & Controls	Operational Interface	-	-	-
Electrical	Instrumentation & Controls	Level Control System	1	3	2 - Unlikely
Electrical	Instrumentation & Controls	SCADA	1	1	1 - Rare
Electrical	Instrumentation & Controls	Radio/Modem	1	1	1 - Rare
Electrical	Instrumentation & Controls	Antenna	-	-	-

Swettenham Lift Station: Likelihood of Failure Score					
System	**Sub-System**	**Component**	**Quantitative Score (Age)**	**Qualitative Score (Urgency)**	**Likelihood of Failure**
Civil	Facility	Building-Foundation	-	-	-
Civil	Facility	Building-Superstructure	-	-	-
Civil	Facility	Building-Roof	-	-	-
Civil	Facility	Yard-Fence	1	2	1 - Rare
Civil	Facility	Yard-Access	1	3	2 - Unlikely
Civil	Facility	Yard-Grounds	1	3	2 - Unlikely
Civil	Foundation & Hydraulic Structure	Wet/Dry Well	1	1	1 - Rare
Civil	Foundation & Hydraulic Structure	Valve Chamber	-	-	-
Civil	Foundation & Hydraulic Structure	Ladders	1	1	1 - Rare
Civil	Foundation & Hydraulic Structure	Platforms	1	1	1 - Rare
Civil	Foundation & Hydraulic Structure	Railing	1	1	1 - Rare
Mechanical	Pump Unit	P1	1	1	1 - Rare
Mechanical	Pump Unit	P2	1	3	2 - Unlikely
Mechanical	Piping & Valves	HVAC	2	1	2 - Unlikely
Mechanical	Piping & Valves	Discharge Piping	1	1	1 - Rare
Mechanical	Piping & Valves	Suction Piping	-	-	-
Mechanical	Piping & Valves	Discharge Valves	1	1	1 - Rare
Electrical	Power Distribution	Standby Generator & ATS	1	3	2 - Unlikely
Electrical	Power Distribution	Electrical Panels	1	2	1 - Rare
Electrical	Power Distribution	Service Entrance	1	1	1 - Rare
Electrical	Power Distribution	Surge Suppressor	2	1	1 - Rare
Electrical	Power Distribution	Starter #1	1	1	1 - Rare
Electrical	Power Distribution	Starter #2	1	1	1 - Rare
Electrical	Instrumentation & Controls	Controller Data (RTU/PLC)	2	3	3 - Possible
Electrical	Instrumentation & Controls	Operational Interface	-	-	-
Electrical	Instrumentation & Controls	Level Control System	2	3	3 - Possible
Electrical	Instrumentation & Controls	SCADA	2	1	1 - Rare

Swettenham Lift Station: Likelihood of Failure Score					
System	**Sub-System**	**Component**	**Quantitative Score (Age)**	**Qualitative Score (Urgency)**	**Likelihood of Failure**
Electrical	Instrumentation & Controls	Radio/Modem	-	-	-
Electrical	Instrumentation & Controls	Antenna	-	-	-

Transfer Beach Lift Station: Likelihood of Failure Score					
System	**Sub-System**	**Component**	**Quantitative Score (Age)**	**Qualitative Score (Urgency)**	**Likelihood of Failure**
Civil	Facility	Building-Foundation	-	-	-
Civil	Facility	Building-Superstructure	-	-	-
Civil	Facility	Building-Roof	-	-	-
Civil	Facility	Yard-Fence	-	-	-
Civil	Facility	Yard-Access	-	-	-
Civil	Facility	Yard-Grounds	1	1	1 - Rare
Civil	Foundation & Hydraulic Structure	Wet/Dry Well	2	2	2 - Unlikely
Civil	Foundation & Hydraulic Structure	Valve Chamber	-	-	-
Civil	Foundation & Hydraulic Structure	Ladders	2	1	1 - Rare
Civil	Foundation & Hydraulic Structure	Platforms	-	-	-
Civil	Foundation & Hydraulic Structure	Railing	-	-	-
Mechanical	Pump Unit	P1	1	1	1 - Rare
Mechanical	Pump Unit	P2	1	1	1 - Rare
Mechanical	Piping & Valves	HVAC	-	-	-
Mechanical	Piping & Valves	Discharge Piping	4	2	4 - Likely
Mechanical	Piping & Valves	Suction Piping	-	-	-
Mechanical	Piping & Valves	Discharge Valves	4	2	4 - Likely
Electrical	Power Distribution	Standby Generator & ATS	-	-	-
Electrical	Power Distribution	Electrical Panels	3	1	2 - Unlikely
Electrical	Power Distribution	Service Entrance	3	1	2 - Unlikely
Electrical	Power Distribution	Surge Suppressor	-	-	-
Electrical	Power Distribution	Starter #1	3	1	2 - Unlikely
Electrical	Power Distribution	Starter #2	3	1	2 - Unlikely

Transfer Beach Lift Station: Likelihood of Failure Score					
System	**Sub-System**	**Component**	**Quantitative Score (Age)**	**Qualitative Score (Urgency)**	**Likelihood of Failure**
Electrical	Instrumentation & Controls	Controller Data (RTU/PLC)	-	-	-
Electrical	Instrumentation & Controls	Operational Interface	-	-	-
Electrical	Instrumentation & Controls	Level Control System	4	3	4 - Likely
Electrical	Instrumentation & Controls	SCADA	4	1	3 - Possible
Electrical	Instrumentation & Controls	Radio/Modem	-	-	-
Electrical	Instrumentation & Controls	Antenna	-	-	-

5.2 Consequence of Failure Scores

Table 5-2 summarizes the CoF scores for each lift station asset component based on the CoF Criteria laid out in Section 3.3.

Table 5-2 Consequence of Failure Scores

Gill Road Lift Station: Consequence of Failure Score

System	Sub-System	Component	Sub-System	Technical Score	Financial Score	Business Continuity Score	Environmental Score	Consequence of Failure
Civil	Facility	Building-Foundation	Facility	3	1	4	4	3 - Moderate
Civil	Facility	Building-Superstructure	Facility	3	2	4	4	4 - Major
Civil	Facility	Building-Roof	Facility	3	1	4	4	3 - Moderate
Civil	Facility	Yard-Fence/Railing	Facility	-	-	-	-	-
Civil	Facility	Yard-Access	Facility	2	1	4	4	3 - Moderate
Civil	Facility	Yard-Grounds	Facility	3	2	4	4	4 - Major
Civil	Foundation & Hydraulic Structure	Wet/Dry Well	Foundation & Hydraulic Structure	3	5	4	4	4 - Major
Civil	Foundation & Hydraulic Structure	Valve Chamber	Foundation & Hydraulic Structure	3	1	4	4	3 - Moderate
Civil	Foundation & Hydraulic Structure	Ladders	Foundation & Hydraulic Structure	3	1	4	4	3 - Moderate
Civil	Foundation & Hydraulic Structure	Platforms	Foundation & Hydraulic Structure	3	1	4	4	3 - Moderate
Civil	Foundation & Hydraulic Structure	Railing	Foundation & Hydraulic Structure	3	1	4	4	3 - Moderate
Mechanical	Pump Unit	P1	Pump Unit #1	3	2	4	4	4 - Major
Mechanical	Pump Unit	P2	Pump Unit #2	3	2	4	4	4 - Major
Mechanical	Pump Unit	P3	Pump Unit #3	3	2	4	4	4 - Major
Mechanical	Piping & Valves	HVAC	Piping & Valves	-	-	-	-	-
Mechanical	Piping & Valves	Discharge Piping	Piping & Valves	3	2	4	4	4 - Major
Mechanical	Piping & Valves	Suction Piping	Piping & Valves	-	-	-	-	-
Mechanical	Piping & Valves	Discharge Valves	Piping & Valves	3	2	4	4	4 - Major
Electrical	Power Distribution	Standby Generator & ATS	Power Distribution	3	2	4	4	4 - Major
Electrical	Power Distribution	Electrical Panels	Power Distribution	2	3	4	4	4 - Major
Electrical	Power Distribution	Service Entrance	Power Distribution	2	3	4	4	4 - Major
Electrical	Power Distribution	Surge Suppressor	Power Distribution	-	-	-	-	-
Electrical	Power Distribution	Starter #1	Power Distribution	2	3	4	4	4 - Major
Electrical	Power Distribution	Starter #2	Power Distribution	2	3	4	4	4 - Major
Electrical	Instrumentation & Controls	Controller Data (RTU/PLC)	Instrumentation & Controls	-	-	-	-	-
Electrical	Instrumentation & Controls	Operational Interface	Instrumentation & Controls	-	-	-	-	-
Electrical	Instrumentation & Controls	Level Control System	Instrumentation & Controls	2	2	4	4	3 - Moderate
Electrical	Instrumentation & Controls	SCADA	Instrumentation & Controls	2	2	4	4	3 - Moderate
Electrical	Instrumentation & Controls	Radio/Modem	Instrumentation & Controls	-	-	-	-	-
Electrical	Instrumentation & Controls	Antenna	Instrumentation & Controls	-	-	-	-	-

Sandy Beach Lift Station: Consequence of Failure Score

System	Sub-System	Component	Sub-System	Technical Score	Financial Score	Business Continuity Score	Environmental Score	Consequence of Failure
Civil	Facility	Building-Foundation	Facility	-	-	-	-	-
Civil	Facility	Building-Superstructure	Facility	-	-	-	-	-
Civil	Facility	Building-Roof	Facility	-	-	-	-	-
Civil	Facility	Yard-Fence/Railing	Facility	-	-	-	-	-
Civil	Facility	Yard-Access	Facility	-	-	-	-	-
Civil	Facility	Yard-Grounds	Facility	2	1	1	4	2 - Minor
Civil	Foundation & Hydraulic Structure	Wet/Dry Well	Foundation & Hydraulic Structure	3	5	1	4	4 - Major
Civil	Foundation & Hydraulic Structure	Valve Chamber	Foundation & Hydraulic Structure	-	-	-	-	-
Civil	Foundation & Hydraulic Structure	Ladders	Foundation & Hydraulic Structure	3	1	1	4	3 - Moderate
Civil	Foundation & Hydraulic Structure	Platforms	Foundation & Hydraulic Structure	3	1	1	4	3 - Moderate
Civil	Foundation & Hydraulic Structure	Railing	Foundation & Hydraulic Structure	3	1	1	4	3 - Moderate
Mechanical	Pump Unit	P1	Pump Unit #1	3	1	1	4	3 - Moderate
Mechanical	Pump Unit	P2	Pump Unit #2	3	1	1	4	3 - Moderate
Mechanical	Piping & Valves	HVAC	Piping & Valves	-	-	-	-	-
Mechanical	Piping & Valves	Discharge Piping	Piping & Valves	3	2	1	4	3 - Moderate
Mechanical	Piping & Valves	Suction Piping	Piping & Valves	-	-	-	-	-
Mechanical	Piping & Valves	Discharge Valves	Piping & Valves	3	2	1	4	3 - Moderate
Electrical	Power Distribution	Standby Generator & ATS	Power Distribution	-	-	-	-	-
Electrical	Power Distribution	Electrical Panels	Power Distribution	3	3	1	N/A	3 - Moderate
Electrical	Power Distribution	Service Entrance	Power Distribution	3	3	1	4	3 - Moderate
Electrical	Power Distribution	Surge Suppressor	Power Distribution	-	-	-	-	-
Electrical	Power Distribution	Starter #1	Power Distribution	3	3	1	4	3 - Moderate
Electrical	Power Distribution	Starter #2	Power Distribution	3	3	1	4	3 - Moderate
Electrical	Instrumentation & Controls	Controller Data (RTU/PLC)	Instrumentation & Controls	-	-	-	-	-
Electrical	Instrumentation & Controls	Operational Interface	Instrumentation & Controls	-	-	-	-	-
Electrical	Instrumentation & Controls	Level Control System	Instrumentation & Controls	3	2	1	4	3 - Moderate
Electrical	Instrumentation & Controls	SCADA	Instrumentation & Controls	3	2	1	4	3 - Moderate
Electrical	Instrumentation & Controls	Radio/Modem	Instrumentation & Controls	3	2	1	4	3 - Moderate
Electrical	Instrumentation & Controls	Antenna	Instrumentation & Controls	-	-	-	-	-

Ludlow Lift Station: Consequence of Failure Score

System	Sub-System	Component	Sub-System	Technical Score	Financial Score	Business Continuity Score	Environmental Score	Consequence of Failure
Civil	Facility	Building-Foundation	Facility	-	-	-	-	-
Civil	Facility	Building-Superstructure	Facility	-	-	-	-	-
Civil	Facility	Building-Roof	Facility	-	-	-	-	-
Civil	Facility	Yard-Fence	Facility	2	1	1	4	2 - Minor
Civil	Facility	Yard-Access	Facility	-	-	-	4	-
Civil	Facility	Yard-Grounds	Facility	3	1	1	4	3 - Moderate
Civil	Foundation & Hydraulic Structure	Wet/Dry Well	Foundation & Hydraulic Structure	3	5	1	4	4 - Major
Civil	Foundation & Hydraulic Structure	Valve Chamber	Foundation & Hydraulic Structure	-	-	-	-	-
Civil	Foundation & Hydraulic Structure	Ladders	Foundation & Hydraulic Structure	3	1	1	4	3 - Moderate
Civil	Foundation & Hydraulic Structure	Platforms	Foundation & Hydraulic Structure	3	1	1	4	3 - Moderate
Civil	Foundation & Hydraulic Structure	Railing	Foundation & Hydraulic Structure	0	1	1	4	2 - Minor
Mechanical	Pump Unit	P1	Pump Unit #1	3	2	1	4	3 - Moderate
Mechanical	Pump Unit	P2	Pump Unit #2	3	2	1	4	3 - Moderate
Mechanical	Piping & Valves	HVAC	Piping & Valves	2	1	1	4	2 - Minor
Mechanical	Piping & Valves	Discharge Piping	Piping & Valves	3	2	1	4	3 - Moderate
Mechanical	Piping & Valves	Suction Piping	Piping & Valves	-	-	-	-	-
Mechanical	Piping & Valves	Discharge Valves	Piping & Valves	3	1	1	4	3 - Moderate
Electrical	Power Distribution	Standby Generator & ATS	Power Distribution	3	2	1	4	3 - Moderate
Electrical	Power Distribution	Electrical Panels	Power Distribution	3	3	1	4	3 - Moderate
Electrical	Power Distribution	Service Entrance	Power Distribution	3	3	1	4	3 - Moderate
Electrical	Power Distribution	Surge Suppressor	Power Distribution	-	-	-	-	-
Electrical	Power Distribution	Starter #1	Power Distribution	3	3	1	4	3 - Moderate
Electrical	Power Distribution	Starter #2	Power Distribution	3	3	1	4	3 - Moderate
Electrical	Instrumentation & Controls	Controller Data (RTU/PLC)	Instrumentation & Controls	3	2	1	4	3 - Moderate
Electrical	Instrumentation & Controls	Operational Interface	Instrumentation & Controls	3	2	1	4	3 - Moderate
Electrical	Instrumentation & Controls	Level Control System	Instrumentation & Controls	3	2	1	4	3 - Moderate
Electrical	Instrumentation & Controls	SCADA	Instrumentation & Controls	3	2	1	4	3 - Moderate
Electrical	Instrumentation & Controls	Radio/Modem	Instrumentation & Controls	3	2	1	4	3 - Moderate
Electrical	Instrumentation & Controls	Antenna	Instrumentation & Controls	-	-	-	-	-

Park Drive Lift Station: Consequence of Failure Score

System	Sub-System	Component	Sub-System	Technical Score	Financial Score	Business Continuity Score	Environmental Score	Consequence of Failure
Civil	Facility	Building-Foundation	Facility	-	-	-	-	-
Civil	Facility	Building-Superstructure	Facility	-	-	-	-	-
Civil	Facility	Building-Roof	Facility	-	-	-	-	-
Civil	Facility	Yard-Fence	Facility	2	1	1	3	2 - Minor
Civil	Facility	Yard-Access	Facility	-	-	-	-	-
Civil	Facility	Yard-Grounds	Facility	2	1	2	3	2 - Minor
Civil	Foundation & Hydraulic Structure	Wet/Dry Well	Foundation & Hydraulic Structure	3	5	2	3	4 - Major
Civil	Foundation & Hydraulic Structure	Valve Chamber	Foundation & Hydraulic Structure	-	-	-	-	-
Civil	Foundation & Hydraulic Structure	Ladders	Foundation & Hydraulic Structure	3	1	2	3	3 - Moderate
Civil	Foundation & Hydraulic Structure	Platforms	Foundation & Hydraulic Structure	3	1	2	3	3 - Moderate
Civil	Foundation & Hydraulic Structure	Railing	Foundation & Hydraulic Structure	3	1	2	3	3 - Moderate
Mechanical	Pump Unit	P1	Pump Unit #1	3	2	2	3	3 - Moderate
Mechanical	Pump Unit	P2	Pump Unit #2	3	2	2	3	3 - Moderate
Mechanical	Piping & Valves	HVAC	Piping & Valves	2	1	2	3	2 - Minor
Mechanical	Piping & Valves	Discharge Piping	Piping & Valves	3	2	2	3	3 - Moderate
Mechanical	Piping & Valves	Suction Piping	Piping & Valves	-	-	-	-	-
Mechanical	Piping & Valves	Discharge Valves	Piping & Valves	3	1	2	3	3 - Moderate
Electrical	Power Distribution	Standby Generator & ATS	Power Distribution	3	2	2	3	3 - Moderate
Electrical	Power Distribution	Electrical Panels	Power Distribution	3	3	2	3	3 - Moderate
Electrical	Power Distribution	Service Entrance	Power Distribution	3	3	2	3	3 - Moderate
Electrical	Power Distribution	Surge Suppressor	Power Distribution	3	3	2	3	3 - Moderate
Electrical	Power Distribution	Starter #1	Power Distribution	3	3	2	3	3 - Moderate
Electrical	Power Distribution	Starter #2	Power Distribution	3	3	2	3	3 - Moderate
Electrical	Instrumentation & Controls	Controller Data (RTU/PLC)	Instrumentation & Controls	3	2	2	3	3 - Moderate
Electrical	Instrumentation & Controls	Operational Interface	Instrumentation & Controls	-	-	-	-	-
Electrical	Instrumentation & Controls	Level Control System	Instrumentation & Controls	3	2	2	3	3 - Moderate
Electrical	Instrumentation & Controls	SCADA	Instrumentation & Controls	3	2	2	3	3 - Moderate
Electrical	Instrumentation & Controls	Radio/Modem	Instrumentation & Controls	3	2	2	3	3 - Moderate
Electrical	Instrumentation & Controls	Antenna	Instrumentation & Controls	-	-	-	-	-

Swettenham Lift Station: Consequence of Failure Score

System	Sub-System	Component	Sub-System	Technical Score	Financial Score	Business Continuity Score	Environmental Score	Consequence of Failure
Civil	Facility	Building-Foundation	Facility	-	-	-	-	-
Civil	Facility	Building-Superstructure	Facility	-	-	-	-	-
Civil	Facility	Building-Roof	Facility	-	-	-	-	-
Civil	Facility	Yard-Fence	Facility	2	1	2	3	2 - Minor
Civil	Facility	Yard-Access	Facility	2	1	2	3	2 - Minor
Civil	Facility	Yard-Grounds	Facility	2	1	2	3	2 - Minor
Civil	Foundation & Hydraulic Structure	Wet/Dry Well	Foundation & Hydraulic Structure	3	5	2	3	4 - Major
Civil	Foundation & Hydraulic Structure	Valve Chamber	Foundation & Hydraulic Structure	-	-	-	-	-
Civil	Foundation & Hydraulic Structure	Ladders	Foundation & Hydraulic Structure	2	1	2	3	2 - Minor
Civil	Foundation & Hydraulic Structure	Platforms	Foundation & Hydraulic Structure	2	1	2	3	2 - Minor
Civil	Foundation & Hydraulic Structure	Railing	Foundation & Hydraulic Structure	-	-	-	-	-
Mechanical	Pump Unit	P1	Pump Unit #1	3	2	2	3	3 - Moderate
Mechanical	Pump Unit	P2	Pump Unit #2	3	2	2	3	3 - Moderate
Mechanical	Piping & Valves	HVAC	Piping & Valves	2	1	2	3	2 - Minor
Mechanical	Piping & Valves	Discharge Piping	Piping & Valves	3	2	2	3	3 - Moderate
Mechanical	Piping & Valves	Suction Piping	Piping & Valves	-	-	-	-	-
Mechanical	Piping & Valves	Discharge Valves	Piping & Valves	2	1	2	3	2 - Minor
Electrical	Power Distribution	Standby Generator & ATS	Power Distribution	3	3	2	3	3 - Moderate
Electrical	Power Distribution	Electrical Panels	Power Distribution	3	3	2	3	3 - Moderate
Electrical	Power Distribution	Service Entrance	Power Distribution	3	3	2	3	3 - Moderate
Electrical	Power Distribution	Surge Suppressor	Power Distribution	3	3	2	3	3 - Moderate
Electrical	Power Distribution	Starter #1	Power Distribution	3	3	2	3	3 - Moderate
Electrical	Power Distribution	Starter #2	Power Distribution	3	3	2	3	3 - Moderate
Electrical	Instrumentation & Controls	Controller Data (RTU/PLC)	Instrumentation & Controls	3	2	2	3	3 - Moderate
Electrical	Instrumentation & Controls	Operational Interface	Instrumentation & Controls	-	-	-	-	-
Electrical	Instrumentation & Controls	Level Control System		3	2	2	3	3 - Moderate
Electrical	Instrumentation & Controls	SCADA		3	2	2	3	3 - Moderate
Electrical	Instrumentation & Controls	Radio/Modem	Instrumentation & Controls	-	-	-	-	-
Electrical	Instrumentation & Controls	Antenna	Instrumentation & Controls	-	-	-	-	-

Transfer Beach Lift Station: Consequence of Failure Score

System	Sub-System	Component	Sub-System	Technical Score	Financial Score	Business Continuity Score	Environmental Score	Consequence of Failure
Civil	Facility	Building-Foundation	Facility	-	-	-	-	-
Civil	Facility	Building-Superstructure	Facility	-	-	-	-	-
Civil	Facility	Building-Roof	Facility	-	-	-	-	-
Civil	Facility	Yard-Fence	Facility	-	-	-	-	-
Civil	Facility	Yard-Access	Facility	-	-	-	-	-
Civil	Facility	Yard-Grounds	Facility	2	1	1	3	2 - Minor
Civil	Foundation & Hydraulic Structure	Wet/Dry Well	Foundation & Hydraulic Structure	3	5	1	2	3 - Moderate
Civil	Foundation & Hydraulic Structure	Valve Chamber	Foundation & Hydraulic Structure	-	-	-	-	-
Civil	Foundation & Hydraulic Structure	Ladders	Foundation & Hydraulic Structure	-	-	-	-	-
Civil	Foundation & Hydraulic Structure	Platforms	Foundation & Hydraulic Structure	-	-	-	-	-
Civil	Foundation & Hydraulic Structure	Railing	Foundation & Hydraulic Structure	-	-	-	-	-
Mechanical	Pump Unit	P1	Pump Unit #1	3	1	1	3	2 - Minor
Mechanical	Pump Unit	P2	Pump Unit #2	3	1	1	3	2 - Minor
Mechanical	Piping & Valves	HVAC	Piping & Valves	-	-	-	-	-
Mechanical	Piping & Valves	Discharge Piping	Piping & Valves	3	1	1	3	2 - Minor
Mechanical	Piping & Valves	Suction Piping	Piping & Valves	-	-	-	-	-
Mechanical	Piping & Valves	Discharge Valves	Piping & Valves	2	1	1	3	2 - Minor
Electrical	Power Distribution	Standby Generator & ATS	Power Distribution	-	-	-	-	-
Electrical	Power Distribution	Electrical Panels	Power Distribution	3	3	1	3	3 - Moderate
Electrical	Power Distribution	Service Entrance	Power Distribution	0	3	1	3	2 - Minor
Electrical	Power Distribution	Surge Suppressor	Power Distribution	-	-	-	-	-
Electrical	Power Distribution	Starter #1	Power Distribution	3	3	1	3	3 - Moderate
Electrical	Power Distribution	Starter #2	Power Distribution	3	3	1	3	3 - Moderate
Electrical	Instrumentation & Controls	Controller Data (RTU/PLC)	Instrumentation & Controls	-	-	-	-	-
Electrical	Instrumentation & Controls	Operational Interface	Instrumentation & Controls	-	-	-	-	-
Electrical	Instrumentation & Controls	Level Control System	Instrumentation & Controls	3	2	1	3	3 - Moderate
Electrical	Instrumentation & Controls	SCADA	Instrumentation & Controls	3	2	1	3	3 - Moderate
Electrical	Instrumentation & Controls	Radio/Modem	Instrumentation & Controls	-	-	-	-	-
Electrical	Instrumentation & Controls	Antenna	Instrumentation & Controls	-	-	-	-	-

5.3 Risk Rating Assessment

The following sub-sections provide Risk Ratings tables for each lift station, highlighting the likelihood of failure, consequence of failure, risk rating, estimated repair costs and estimated replacement costs for each asset component evaluated as part of the condition assessment program. A description of the history and location of each lift station is also provided, along with accompanying aerial photos.

5.3.1 Gill Road Lift Station

The Gill Road lift station, is located behind the property at 298 Gill Road. The original construction year of the wet well is unknown though noted as older than the station in the record drawings. The other structures of the lift station, such as the masonry building, hatches, and reinforced concrete slab on top of the wet well surrounding the hatches were constructed in 1982. The lift station is equipped with a duplex pump system. It consists of two Flygt Model CP3201.180 pumps with 454 impellers and 230V, 3Ph, 60Hz motors.

Figure 5-1 Gill road Lift Station - Site Location

Table 5-3 provides the risk score established for the lift station asset components.

Table 5-3 Gill Road Lift Station – Risk Ratings

Town of Ladysmith - Lift Station Condition Assessment

							First Treatment / Repair			Eventual Recommended Replacement			
Lift Station	System	Sub-System	Component	Likelihood of Failure	Consequence of Failure	Risk Score	Repair Period	Repair cost (2017 Dollars)	Notes (Refer to Condition Assessment Form for more details)	Retained Risk after Repair (Sub-System)	Estimated Replacement Period (Sub-System)	Total Estimated Replacement Cost (2017 Dollars)	Notes (Refer to Condition Assessment Form for more details)
Gill Road LS	Civil	Facility	Building-Foundation	1 - Rare	3 - Moderate	Medium Risk	-	-	-	Medium Risk	11-20 Years	$70,000	Replacement
Gill Road LS	Civil	Facility	Building-Superstructure	2 - Unlikely	4 - Major	Medium Risk	-	-	-	Medium Risk			
Gill Road LS	Civil	Facility	Building-Roof	5 - Almost Certain	3 - Moderate	High Risk	3-10 Years	$7,000	Repair: Asphalt shingle repairs	Low Risk			
Gill Road LS	Civil	Facility	Yard-Fence/Railing	-	-	-	3-10 Years	$60,000	Repair: add railing	Low Risk	21-50 Years	$60,000	Replacement
Gill Road LS	Civil	Facility	Yard-Access	1 - Rare	3 - Moderate	Medium Risk	-	-	-	Medium Risk	11-20 Years	$30,000	Replacement
Gill Road LS	Civil	Facility	Yard-Grounds	4 - Likely	4 - Major	High Risk	3-10 Years	$85,000	Repair: Construction of a retaining wall	Low Risk	21-50 Years	$90,000	Replacement
Gill Road LS	Civil	Foundation & Hydraulic Structure	Wet/Dry Well	2 - Unlikely	4 - Major	Medium Risk	-	-	-	Medium Risk	11-20 Years	$1,100,000	-'Replacement: The total replacement cost of the wet well break down into: mobilization / demobilization at a cost of $35,000, temporary bypass pumping system at a cost of $350,000, decommissioning of existing wet well at a cost of $6,500, demolition/removal at a cost of $20,000, clearing and grubbing at a cost of $2,000,excavation at a cost of $12,000, dewatering and shoring at a cost of $75,000, backfill at a cost of $12,000, wet well at a cost of $112,000, wet well foundation at a cost of $5,000, wet well hatches at a cost of $10,000, wet well lid slab at a cost of $10,000, valve chamber including hatch at a cost of $30,000, genset Kiosk foundation at a cost of $2,000, start-up/testing and commissioning at a cost of $8,000, connection into Force main at a cost of $10,000, new hydro connection at a cost of $30,000, and landscaping at a cost of $5,000
Gill Road LS	Civil	Foundation & Hydraulic Structure	Valve Chamber	4 - Likely	3 - Moderate	High Risk	3-10 Years	$5,000	Repair: decommissioning and removal	Low Risk			
Gill Road LS	Civil	Foundation & Hydraulic Structure	Ladders	5 - Almost Certain	3 - Moderate	High Risk	3-10 Years	$2,000	Repair: ladder repairs	Low Risk			
Gill Road LS	Civil	Foundation & Hydraulic Structure	Platforms	5 - Almost Certain	3 - Moderate	High Risk	3-10 Years	$3,000	Repair: platform repairs	Low Risk			
Gill Road LS	Civil	Foundation & Hydraulic Structure	Railing	5 - Almost Certain	3 - Moderate	High Risk	3-10 Years	$4,000	Repairs: railing repairs	Low Risk			
Gill Road LS	Mechanical	Pump Unit	P1	4 - Likely	4 - Major	High Risk	-	-	-	High Risk	3-10 Years	$70,000	Replacement
Gill Road LS	Mechanical	Pump Unit	P2	4 - Likely	4 - Major	High Risk	-	-	-	High Risk	3-10 Years	$70,000	Replacement
Gill Road LS	Mechanical	Pump Unit	P3	5 - Almost Certain	4 - Major	Very High Risk	0-2 Years	$5,000	Repair: Labour costs to remove and dispose P3	Low Risk	21-50 Years	-	Replacement
Gill Road LS	Mechanical	Piping & Valves	HVAC	-	-	-	3-10 Years	$20,000	Repair: Add Fan	Low Risk	21-50 Years	$20,000	Replacement
Gill Road LS	Mechanical	Piping & Valves	Discharge Piping	5 - Almost Certain	4 - Major	Very High Risk	-	-	-	Very High Risk	0-2 Years	$80,000	Replacement
Gill Road LS	Mechanical	Piping & Valves	Suction Piping	-	-	-	-	-	-	-			
Gill Road LS	Mechanical	Piping & Valves	Discharge Valves	5 - Almost Certain	4 - Major	Very High Risk	-	-	-	Very High Risk			
Gill Road LS	Electrical	Power Distribution	Standby Generator & ATS	4 - Likely	4 - Major	High Risk	3-10 Years	$4,000	Repair: Generator connection cable and manual transfer switch repair	Low Risk	21-50 Years	$70,000	Replacement
Gill Road LS	Electrical	Power Distribution	Electrical Panels	3 - Possible	4 - Major	High Risk	-	-	-	High Risk	3-10 Years	$60,000	Replacement
Gill Road LS	Electrical	Power Distribution	Service Entrance	4 - Likely	4 - Major	High Risk	3-10 Years	$5,000	Repair: Install ground fault monitoring device, test the grounding system, and replace the conductor with appropriate color	Low Risk			
Gill Road LS	Electrical	Power Distribution	Surge Suppressor	-	-	-	-	-	-	-			
Gill Road LS	Electrical	Power Distribution	Starter #1	4 - Likely	4 - Major	High Risk	-	-	-	High Risk			
Gill Road LS	Electrical	Power Distribution	Starter #2	4 - Likely	4 - Major	High Risk	-	-	-	High Risk			
Gill Road LS	Electrical	Instrumentation & Controls	Controller Data (RTU/PLC)	-	-	-	-	-	-	-	3-10 Years	$40,000	Replacement
Gill Road LS	Electrical	Instrumentation & Controls	Operational Interface	-	-	-	-	-	-	-			
Gill Road LS	Electrical	Instrumentation & Controls	Level Control System	5 - Almost Certain	3 - Moderate	High Risk	3-10 Years	$3,000	Repair: Level control system repairs	Low Risk			
Gill Road LS	Electrical	Instrumentation & Controls	SCADA	4 - Likely	3 - Moderate	High Risk	-	-	-	High Risk			
Gill Road LS	Electrical	Instrumentation & Controls	Radio/Modem	-	-	-	-	-	-	-			
Gill Road LS	Electrical	Instrumentation & Controls	Antenna	-	-	-	-	-	-	-			

The reader should note that the above table also illustrates some occurrences in which repair and replacement have been identified for asset components which do not currently exist at the lift station (thus do not have a risk score). These projects have been identified to add new infrastructure to the stations as "repair" which are then eventually considered for replacement.

The total cost of the wet well replacement (Class "D" Cost Estimate) breaks down into the following:

- mobilization/demobilization at a cost of $35,000,
- temporary bypass pumping system at a cost of $350,000,
- decommissioning of existing wet well at a cost of $6,500,
- demolition/removal at a cost of $20,000,
- Clearing and grubbing at a cost of $2,000,
- Excavation at a cost of $12,000,
- dewatering and shoring at a cost of $75,000,
- backfill at a cost of $12,000,
- wet well at a cost of $112,000,
- wet well foundation at a cost of $5,000,
- wet well hatches at a cost of $10,000,
- wet well lid slab at a cost of $10,000,
- valve chamber including hatch at a cost of $30,000,
- genset and kiosk foundation at a cost of $2,000,
- start-up/testing and commissioning at a cost of $8,000,
- connection into Force main at a cost of $10,000,
- new hydro connection at a cost of $30,000, and
- landscaping at a cost of $5,000

There appears to be significant costs for replacement of the wet well and lift station at Gill Road due to the proximity of the lift station to the ocean and the significant construction effort and bypassing costs required. Opus identifies two alternate approaches to address renewal of the lift station in the future (though not fully assessed in this study), which may allow the Town to prolong the current service life of the stations in-situ, while improvements to the overall sanitary sewer servicing strategy are made. With these alternate approaches, the eventual decommissioning of the Gill Road lift station would be recommended.

The alternate approaches consist of: 1) relocation of the lift station away from the waterfront and near Town roads, which may likely require new gravity and forcemains in the system, and would require waterfront residences to have grinder pumps installed for future servicing to the lift station above the waterfront, and 2) rehabilitation of the current wet well through structural bracing improvements internally to the wet well, combined with a relining system. These two alternate approaches will allow the Town to push back the eventual higher replacement cost and may extend the estimated useful life of these stations up to 50 years or more. Considering the above, we have identified that the replacement schedule for the Gill Road lift station is not expected until about 20 years, and advise a more detailed study to completed closer to the replacement date. The refresh of this condition assessment study should be completed in 10 years time, at which a better assessment and better knowledge of improved technologies to be available will allow a better review of the potential alternate replacement strategies at the lift station.

5.3.2 Sandy Beach Lift Station

The Sandy Beach lift station, is located behind 350 Chemainus road. The original construction year of the wet well is unknown, but the other structures of the lift station, such as reinforced concrete slab and hatches were constructed in 1982. The lift station is equipped with a duplex pump system. It consists of two Flygt Model CP3085.183 pumps with 462 impellers and 230V, 3Ph, 60Hz motors which were upgraded in 2009.

Figure 5-2 Sandy Beach Lift Station - Site Location

Table 5-4 provides the risk score established for the lift station asset components.

Table 5-4 Sandy Beach Lift Station - Risk Ratings

Town of Ladysmith - Lift Station Condition Assessment

							First Treatment / Repair			Eventual Recommended Replacement			
Lift Station	System	Sub-System	Component	Likelihood of Failure	Consequence of Failure	Risk Score	Repair Period	Repair cost (2017 Dollars)	Notes (Refer to Condition Assessment Form for more details)	Retained Risk after Repair (Sub-System)	Estimated Replacement Period (Sub-System)	Total Estimated Replacement Cost (2017 Dollars)	Notes (Refer to Condition Assessment Form for more details)
Sandy Beach LS	Civil	Facility	Building-Foundation	-	-	-	-	-	-	-	-	-	Replacement
Sandy Beach LS	Civil	Facility	Building-Superstructure	-	-	-	-	-	-	-	-		
Sandy Beach LS	Civil	Facility	Building-Roof	-	-	-	-	-	-	-	-		
Sandy Beach LS	Civil	Facility	Yard-Fence/Railing	-	-	-	3-10 Years	$30,000	Repair: Add railing	Low Risk	21-50 Years	$30,000	Replacement
Sandy Beach LS	Civil	Facility	Yard-Access	-	-	-	-	-		-	-	-	
Sandy Beach LS	Civil	Facility	Yard-Grounds	3 - Possible	2 - Minor	Medium Risk	11-20 Years	$5,000	Repair: Kiosk Foundation repairs	Low Risk	21-50 Years	$5,000	Replacement
Sandy Beach LS	Civil	Foundation & Hydraulic Structure	Wet/Dry Well	2 - Unlikely	4 - Major	Medium Risk	-	-	-	Medium Risk	11-20 Years	$720,000	Replacement: The total replacement cost of the wet well break down into: mobilization / demobilization at a cost of $35,000, temporary bypass pumping system at a cost of $150,000, decommissioning of existing wet well at a cost of $6,500, demolition/removal at a cost of $20,000, clearing and grubbing at a cost of $2,000, excavation at a cost of $11,000, dewatering and shoring at a cost of $75,000, backfill at a cost of $12,000, wet well at a cost of $94,000, wet well foundation at a cost of $5,000, wet well lid slab at a cost of $10,000, wet well hatches at a cost of $10,000, valve chamber including hatch at a cost of $30,000, genset Kiosk foundation at a cost of $2,000, start-up/testing and commissioning at a cost of $8,000, connection into Force main at a cost of $10,000, new hydro connection at a cost of $30,000, and landscaping at a cost of $5,000.
Sandy Beach LS	Civil	Foundation & Hydraulic Structure	Valve Chamber	-	-	-	-	-	-	-			
Sandy Beach LS	Civil	Foundation & Hydraulic Structure	Ladders	5 - Almost Certain	3 - Moderate	High Risk	3-10 Years	$2,000	Repair: ladder repairs	Low Risk			
Sandy Beach LS	Civil	Foundation & Hydraulic Structure	Platforms	5 - Almost Certain	3 - Moderate	High Risk	3-10 Years	$2,000	Repair: platform repairs	Low Risk			
Sandy Beach LS	Civil	Foundation & Hydraulic Structure	Railing	5 - Almost Certain	3 - Moderate	High Risk	3-10 Years	$4,000	Repair: railing repairs	Low Risk			
Sandy Beach LS	Mechanical	Pump Unit	P1	1 - Rare	3 - Moderate	Medium Risk	-	-	-	Medium Risk	11-20 Years	$16,000	Replacement
Sandy Beach LS	Mechanical	Pump Unit	P2	1 - Rare	3 - Moderate	Medium Risk	-	-	-	Medium Risk	11-20 Years	$16,000	Replacement
Sandy Beach LS	Mechanical	Piping & Valves	HVAC	-	-	-	3-10 Years	$20,000	Repair: add HVAC	Low Risk	21-50 Years	$20,000	Replacement
Sandy Beach LS	Mechanical	Piping & Valves	Discharge Piping	4 - Likely	3 - Moderate	High Risk	3-10 Years	$10,000	Repair: Recoat discharge piping	Low Risk	3-10 Years	$80,000	Replacement
Sandy Beach LS	Mechanical	Piping & Valves	Suction Piping	-	-	-	-	-	-	-			
Sandy Beach LS	Mechanical	Piping & Valves	Discharge Valves	4 - Likely	3 - Moderate	High Risk	-	-	-	High Risk			
Sandy Beach LS	Electrical	Power Distribution	Standby Generator & ATS	-	-	-	-	-	-	-	21-50 Years	$50,000	Replacement
Sandy Beach LS	Electrical	Power Distribution	Electrical Panels	4 - Likely	3 - Moderate	High Risk	3-10 Years	$400	-	Low Risk	3-10 Years	$100,000	Replacement
Sandy Beach LS	Electrical	Power Distribution	Service Entrance	4 - Likely	3 - Moderate	High Risk	3-10 Years	$4,000	Repair: Install ground fault monitoring device, test the grounding system, and replace the conductor with appropriate color	Low Risk			
Sandy Beach LS	Electrical	Power Distribution	Surge Suppressor	-	-	-	-	-	-	-			
Sandy Beach LS	Electrical	Power Distribution	Starter #1	4 - Likely	3 - Moderate	High Risk	-	-	-	High Risk			
Sandy Beach LS	Electrical	Power Distribution	Starter #2	4 - Likely	3 - Moderate	High Risk	-	-	-	High Risk			
Sandy Beach LS	Electrical	Instrumentation & Controls	Controller Data (RTU/PLC)	-	-	-	-	-	-	-	11-20 Years	$40,000	Replacement
Sandy Beach LS	Electrical	Instrumentation & Controls	Operational Interface	-	-	-	-	-	-	-			
Sandy Beach LS	Electrical	Instrumentation & Controls	Level Control System	5 - Almost Certain	3 - Moderate	High Risk	3-10 Years	$3,000	Repair: Level control system repairs	Low Risk			
Sandy Beach LS	Electrical	Instrumentation & Controls	SCADA	1 - Rare	3 - Moderate	Medium Risk	-	-	-	Medium Risk			
Sandy Beach LS	Electrical	Instrumentation & Controls	Radio/Modem	1 - Rare	3 - Moderate	Medium Risk	-	-	-	Medium Risk			
Sandy Beach LS	Electrical	Instrumentation & Controls	Antenna	-	-	-	-	-	-	-			

The reader should note that the above table also illustrates some occurrences in which repair and replacement have been identified for asset components which do not currently exist at the lift station (thus do not have a risk score). These projects have been identified to add new infrastructure to the stations as “repair” which are then eventually considered for replacement.

The total cost of the wet well replacement (Class “D” Cost Estimate) breaks down into the following:

- mobilization/demobilization at a cost of $35,000,
- temporary bypass pumping system at a cost of $150,000,
- decommissioning of existing wet well at a cost of $6,500,
- demolition/removal at a cost of $20,000,
- clearing and grubbing at a cost of $2,000,
- excavation at a cost of $11,000,
- dewatering and shoring at a cost of $75,000,
- backfill at a cost of $12,000,
- wet well at a cost of $94,000,
- wet well foundation at a cost of $5,000,
- wet well lid slab at a cost of $10,000,
- wet well hatches at a cost of $10,000,
- valve chamber including hatch at a cost of $30,000,
- genset and kiosk foundation at a cost of $2,000,
- start-up/testing and commissioning at a cost of $8,000,
- connection into force main at a cost of $10,000,
- new hydro connection at a cost of $30,000, and
- landscaping at a cost of $5,000.

There appears to be significant costs for replacement of the wet well and lift station at Sandy Beach due to the proximity of the lift station to the ocean and the significant construction effort and bypassing costs required. Opus identifies two alternate approaches to address renewal of the lift station in the future (though not fully assessed in this study), which may allow the Town to prolong the current service life of the stations in-situ, while improvements to the overall sanitary sewer servicing strategy are made. With these alternate approaches, the eventual decommissioning of the Sandy Beach lift station would be recommended.

The alternate approaches consist of: 1) relocation of the lift station away from the waterfront and near Town roads, which may likely require new gravity and forcemains in the system, and would require waterfront residences to have grinder pumps installed for future servicing to the lift station above the waterfront, and 2) rehabilitation of the current wet well through structural bracing improvements internally to the wet well, combined with a relining system. These two alternate approaches will allow the Town to push back the eventual higher replacement cost and may extend the estimated useful life of these stations up to 50 years or more. Considering the above, we have identified that the replacement schedule for the Sandy Beach lift station is not expected until about 20 years, and advise a more detailed study to completed closer to the replacement date. The refresh of this condition assessment study should be completed in 10 years time, at which a better assessment and better knowledge of improved technologies to be available will allow a better review of the potential alternate replacement strategies at the lift station.

5.3.3 Ludlow Road Lift Station

The Ludlow Road lift station, originally constructed in 1999, is located on Ludlow Road adjacent to "Ladysmith Marine Services". The lift station is equipped with a duplex pump system. It consists of two Flygt Model NP3127.160 pumps with 248 impellers, and 600V, 3Ph, 60Hz motors which were upgraded in 2016.

Figure 5-3 Ludlow Road Lift Station - Site Location

Table 5-5 provides the risk score established for the lift station asset components.

Table 5-5 Ludlow Road Lift Station - Risk Ratings

Town of Ladysmith - Lift Station Condition Assessment

							First Treatment / Repair			Eventual Recommended Replacement			
Lift Station	System	Sub-System	Component	Likelihood of Failure	Consequence of Failure	Risk Score	Repair Period	Repair cost (2017 Dollars)	Notes (Refer to Condition Assessment Form for more details)	Retained Risk after Repair (Sub-System)	Estimated Replacement Period (Sub-System)	Total Estimated Replacement Cost (2017 Dollars)	Notes (Refer to Condition Assessment Form for more details)
Ludlow LS	Civil	Facility	Building-Foundation	-	-	-	-	-	-	-	-	-	
Ludlow LS	Civil	Facility	Building-Superstructure	-	-	-	-	-	-	-	-	-	Replacement
Ludlow LS	Civil	Facility	Building-Roof	-	-	-	-	-	-	-	-	-	
Ludlow LS	Civil	Facility	Yard-Fence	3 - Possible	2 - Minor	Medium Risk	-	-	-	Medium Risk	11-20 Years	$17,000	Replacement
Ludlow LS	Civil	Facility	Yard-Access	-	-	-				-	3-10 Years	$10,000	Replacement
Ludlow LS	Civil	Facility	Yard-Grounds	2 - Unlikely	3 - Moderate	Medium Risk	11-20 Years	$7,000	Repair: Construction of a lock wall block and anchor bolts repair	Low Risk	21-50 Years	$10,500	Replacement
Ludlow LS	Civil	Foundation & Hydraulic Structure	Wet/Dry Well	1 - Rare	4 - Major	Medium Risk	-	-	-	Medium Risk			
Ludlow LS	Civil	Foundation & Hydraulic Structure	Valve Chamber	-	-	-	-	-	-	-			
Ludlow LS	Civil	Foundation & Hydraulic Structure	Ladders	1 - Rare	3 - Moderate	Medium Risk	-	-	-	Medium Risk	11-20 Years	$600,000	'Replacement: The total replacement cost of the wet well break down into: mobilization / demobilization at a cost of $35,000, temporary bypass pumping system at a cost of $50,000, decommissioning of existing wet well at a cost of $6,500, demolition/removal at a cost of $20,000, clearing and grubbing at a cost of $2,000, Excavation at a cost of $5,000, dewatering and shoring at a cost of $75,000, Backfill at a cost of $5,000, wet well at a cost of $120,000, wet well foundation at a cost of $6,000, wet well lid slab at a cost of $10,000, wet well hatches at a cost of $10,000, valve chamber including hatch at a cost of $30,000, genset Kiosk foundation at a cost of $2,000, start-up/testing and commissioning at a cost of $8,000, Connection into Force main at a cost of $10,000, new hydro connection at a cost of $30,000, and landscaping at a cost of $5,000.
Ludlow LS	Civil	Foundation & Hydraulic Structure	Platforms	1 - Rare	3 - Moderate	Medium Risk	-	-	-	Medium Risk			
Ludlow LS	Civil	Foundation & Hydraulic Structure	Railing	-	2 - Minor	-	-	-	-	-			
Ludlow LS	Mechanical	Pump Unit	P1	1 - Rare	3 - Moderate	Medium Risk	-	-	-	Medium Risk	11-20 Years	$40,000	Replacement
Ludlow LS	Mechanical	Pump Unit	P2	1 - Rare	3 - Moderate	Medium Risk	-	-	-	Medium Risk	11-20 Years	$40,000	Replacement
Ludlow LS	Mechanical	Piping & Valves	HVAC	5 - Almost Certain	2 - Minor	High Risk	3-10 Years	$4,000	Repair: replace Fan	Low Risk			
Ludlow LS	Mechanical	Piping & Valves	Discharge Piping	2 - Unlikely	3 - Moderate	Medium Risk	11-20 Years	$5,000	Repair: Recoat discharge piping	Low Risk	11-20 Years	$84,000	Replacement
Ludlow LS	Mechanical	Piping & Valves	Suction Piping	-	-	-	-	-	-	-			
Ludlow LS	Mechanical	Piping & Valves	Discharge Valves	2 - Unlikely	3 - Moderate	Medium Risk	-	-	-	Medium Risk			
Ludlow LS	Electrical	Power Distribution	Standby Generator & ATS	1 - Rare	3 - Moderate	Medium Risk	-	-	-	Medium Risk	11-20 Years	$50,000	Replacement
Ludlow LS	Electrical	Power Distribution	Electrical Panels	1 - Rare	3 - Moderate	Medium Risk	-	-	-	Medium Risk			
Ludlow LS	Electrical	Power Distribution	Service Entrance	1 - Rare	3 - Moderate	Medium Risk	-	-	-	Medium Risk			
Ludlow LS	Electrical	Power Distribution	Surge Suppressor	-	-	-	-	-	-	-	11-20 Years	$100,000	Replacement
Ludlow LS	Electrical	Power Distribution	Starter #1	1 - Rare	3 - Moderate	Medium Risk	-	-	-	Medium Risk			
Ludlow LS	Electrical	Power Distribution	Starter #2	1 - Rare	3 - Moderate	Medium Risk	-	-	-	Medium Risk			
Ludlow LS	Electrical	Instrumentation & Controls	Controller Data (RTU/PLC)	1 - Rare	3 - Moderate	Medium Risk	-	-	-	Medium Risk			
Ludlow LS	Electrical	Instrumentation & Controls	Operational Interface	1 - Rare	3 - Moderate	Medium Risk	-	-	-	Medium Risk			
Ludlow LS	Electrical	Instrumentation & Controls	Level Control System	2 - Unlikely	3 - Moderate	Medium Risk	11-20 Years	$7,000	Repair: Level control system repairs	Low Risk	11-20 Years	$40,000	Replacement
Ludlow LS	Electrical	Instrumentation & Controls	SCADA	1 - Rare	3 - Moderate	Medium Risk	-	-	-	Medium Risk			
Ludlow LS	Electrical	Instrumentation & Controls	Radio/Modem	1 - Rare	3 - Moderate	Medium Risk	-	-	-	Medium Risk			
Ludlow LS	Electrical	Instrumentation & Controls	Antenna	-	-	-	-	-	-	-			

The reader should note that the above table also illustrates some occurrences in which repair and replacement have been identified for asset components which do not currently exist at the lift station (thus do not have a risk score). These projects have been identified to add new infrastructure to the stations as “repair” which are then eventually considered for replacement.

The total cost of the wet well replacement (Class “D” Cost Estimate) breaks down into the following:

- mobilization/demobilization at a cost of $35,000,
- temporary bypass pumping system at a cost of $50,000,
- decommissioning of existing wet well at a cost of $6,500,
- demolition/removal at a cost of $20,000,
- clearing and grubbing at a cost of $2,000,
- excavation at a cost of $5,000,
- dewatering and shoring at a cost of $75,000,
- backfill at a cost of $5,000,
- wet well at a cost of $120,000,
- wet well foundation at a cost of $6,000,
- wet well lid slab at a cost of $10,000,
- wet well hatches at a cost of $10,000,
- valve chamber including hatch at a cost of $30,000,
- genset and kiosk foundation at a cost of $4,000,
- start-up/testing and commissioning at a cost of $8,000,
- connection into force main at a cost of $10,000,
- new hydro connection at a cost of $30,000, and
- landscaping at a cost of $5,000.

5.3.4 Park Drive Lift Station

The Park Drive lift station, originally constructed in 2011, is located within the Jim Cram Drive Mobile Park. The lift station is equipped with a duplex pump system. It consists of two Myers 4Vx50M4-03 pumps with 6.75" impellers and 208V, 3Ph, 60Hz motors which were installed in 2011.

Figure 5-4 Park Drive Lift Station - Site Location

Table 5-6 provides the risk score established for the lift station asset components.

Table 5-6 Park Drive Lift Station - Risk Ratings

Town of Ladysmith - Lift Station Condition Assessment

							First Treatmant / Repair			Eventual Recommended Replacement			
Lift Station	System	Sub-System	Component	Likelihood of Failure	Consequence of Failure	Risk Score	Repair Period	Repair cost (2017 Dollars)	Notes (Refer to Condition Assessment Form for more details)	Retained Risk after Repair (Sub-System)	Estimated Replacement Period (Sub-System)	Total Estimated Replacement Cost (2017 Dollars)	Notes (Refer to Condition Assessment Form for more details)
Park Drive LS	Civil	Facility	Building-Foundation	-	-	-	-	-	-	-	-	-	Replacement
Park Drive LS	Civil	Facility	Building-Superstructure	-	-	-	-	-	-	-	-	-	
Park Drive LS	Civil	Facility	Building-Roof	-	-	-	-	-	-	-	-	-	
Park Drive LS	Civil	Facility	Yard-Fence	1 - Rare	2 - Minor	Low Risk	-	-	-	Low Risk	21-50 Years	$17,000	Replacement
Park Drive LS	Civil	Facility	Yard-Access	-	-	-	-	-	-	-	-	-	Replacement
Park Drive LS	Civil	Facility	Yard-Grounds	1 - Rare	2 - Minor	Low Risk	-	-	-	Low Risk	21-50 Years	$5,000	Replacement
Park Drive LS	Civil	Foundation & Hydraulic Structure	Wet/Dry Well	1 - Rare	4 - Major	Medium Risk	-	-	-	Medium Risk	11-20 Years	$570,000	'Replacement: The total replacement cost of the wet well break down into: mobilization / demobilization at a cost of $35,000, temporary bypass pumping system at a cost of $50,000, decommissioning of existing wet well at a cost of $6,500, demolition/removal at a cost of $20,000, clearing and grubbing at a cost of $2,000, excavation at a cost of $5,000, dewatering and shoring at a cost of $50,000, backfill at a cost of $5,000, wet well at a cost of $120,000, wet well foundation at a cost of $6,000, wet well lid slab at a cost of $10,000, wet well hatches at a cost of $10,000, valve chamber including hatch at a cost of $30,000, genset kiosk foundation at a cost of $2,000, start-up/testing and commissioning at a cost of $8,000, Connection into Force main at a cost of $10,000, newhydro connection at a cost of $30,000, and landscaping at a cost of $5,000.
Park Drive LS	Civil	Foundation & Hydraulic Structure	Valve Chamber	-	-	-	-	-	-	-			
Park Drive LS	Civil	Foundation & Hydraulic Structure	Ladders	1 - Rare	3 - Moderate	Medium Risk	-	-	-	Medium Risk			
Park Drive LS	Civil	Foundation & Hydraulic Structure	Platforms	1 - Rare	3 - Moderate	Medium Risk	-	-	-	Medium Risk			
Park Drive LS	Civil	Foundation & Hydraulic Structure	Railing	-	3 - Moderate	-	-	-	-	-			
Park Drive LS	Mechanical	Pump Unit	P1	1 - Rare	3 - Moderate	Medium Risk	-	-	-	Medium Risk	11-20 Years	$50,000	Replacement
Park Drive LS	Mechanical	Pump Unit	P2	1 - Rare	3 - Moderate	Medium Risk	-	-	-	Medium Risk	11-20 Years	$50,000	Replacement
Park Drive LS	Mechanical	Piping & Valves	HVAC	1 - Rare	2 - Minor	Low Risk	-	-	-	Low Risk	11-20 Years	$80,000	Replacement
Park Drive LS	Mechanical	Piping & Valves	Discharge Piping	1 - Rare	3 - Moderate	Medium Risk	-	-	-	Medium Risk			
Park Drive LS	Mechanical	Piping & Valves	Suction Piping	-	-	-	-	-	-	-			
Park Drive LS	Mechanical	Piping & Valves	Discharge Valves	1 - Rare	3 - Moderate	Medium Risk	-	-	-	Medium Risk			
Park Drive LS	Electrical	Power Distribution	Standby Generator & ATS	1 - Rare	3 - Moderate	Medium Risk	-	-	-	Medium Risk	11-20 Years	$50,000	Replacement
Park Drive LS	Electrical	Power Distribution	Electrical Panels	1 - Rare	3 - Moderate	Medium Risk	11-20 Years	$2,000	Repair: Install kiosk ventilation fan operation	Low Risk	11-20 Years	$100,000	Replacement
Park Drive LS	Electrical	Power Distribution	Service Entrance	1 - Rare	3 - Moderate	Medium Risk	-	-	-	Medium Risk			
Park Drive LS	Electrical	Power Distribution	Surge Suppressor	1 - Rare	3 - Moderate	Medium Risk	11-20 Years	$600	Repair: Replace surge suppressor	Low Risk			
Park Drive LS	Electrical	Power Distribution	Starter #1	1 - Rare	3 - Moderate	Medium Risk	-	-	-	Medium Risk			
Park Drive LS	Electrical	Power Distribution	Starter #2	1 - Rare	3 - Moderate	Medium Risk	-	-	-	Medium Risk			
Park Drive LS	Electrical	Instrumentation & Controls	Controller Data (RTU/PLC)	1 - Rare	3 - Moderate	Medium Risk	-	-	-	Medium Risk	11-20 Years	$40,000	Replacement
Park Drive LS	Electrical	Instrumentation & Controls	Operational Interface	-	-	-	-	-	-	-			
Park Drive LS	Electrical	Instrumentation & Controls	Level Control System	2 - Unlikely	3 - Moderate	Medium Risk	11-20 Years	$3,000	Repair: Level control system repairs	Low Risk			
Park Drive LS	Electrical	Instrumentation & Controls	SCADA	1 - Rare	3 - Moderate	Medium Risk	-	-	-	Medium Risk			
Park Drive LS	Electrical	Instrumentation & Controls	Radio/Modem	1 - Rare	3 - Moderate	Medium Risk	-	-	-	Medium Risk			
Park Drive LS	Electrical	Instrumentation & Controls	Antenna	-	-	-	-	-	-	-			

The reader should note that the above table also illustrates some occurrences in which repair and replacement have been identified for asset components which do not currently exist at the lift station (thus do not have a risk score). These projects have been identified to add new infrastructure to the stations as “repair” which are then eventually considered for replacement.

The total cost of the wet well replacement (Class “D” Cost Estimate) breaks down into the following:

- mobilization/demobilization at a cost of $35,000,
- temporary bypass pumping system at a cost of $50,000,
- decommissioning of existing wet well at a cost of $6,500,
- demolition/removal at a cost of $20,000,
- clearing and grubbing at a cost of $2,000,
- excavation at a cost of $5,000,
- dewatering and shoring at a cost of $50,000,
- backfill at a cost of $5,000,
- wet well at a cost of $120,000,
- wet well foundation at a cost of $6,000,
- wet well lid slab at a cost of $10,000,
- wet well hatches at a cost of $10,000,
- valve chamber including hatch at a cost of $30,000,
- genset and kiosk foundation at a cost of $4,000,
- start-up/testing and commissioning at a cost of $8,000,
- connection into force main at a cost of $10,000,
- new hydro connection at a cost of $30,000, and
- landscaping at a cost of $5,000.

5.3.5 Swettenham Lift Station

The Swettenham lift station, originally constructed in 2008, is located at the southern end of the Swettenham Place on Sanderson Road. The lift station is equipped with a duplex pump system. It consists of two Myers 4RHX150M2-53 pumps with 5.75" impellers and 575V, 3Ph, 60Hz motors which were installed in 2008.

Figure 5-5 Swettenham Lift Station - Site Location

Table 5-7 provides the risk score established for the lift station asset components.

Table 5-7 Swettenham Lift Station - Risk Ratings

Town of Ladysmith - Lift Station Condition Assessment

							First Treatment / Repair			Eventual Recommended Replacement			
Lift Station	System	Sub-System	Component	Likelihood of Failure	Consequence of Failure	Risk Score	Repair Period	Repair cost (2017 Dollars)	Notes (Refer to Condition Assessment Form for more details)	Retained Risk after Repair (Sub-System)	Estimated Replacement Period (Sub-System)	Total Estimated Replacement Cost (2017 Dollars)	Notes (Refer to Condition Assessment Form for more details)
Swettenham LS	Civil	Facility	Building-Foundation	-	-	-	-	-	-	-	-	-	Replacement
Swettenham LS	Civil	Facility	Building-Superstructure	-	-	-	-	-	-	-	-	-	
Swettenham LS	Civil	Facility	Building-Roof	-	-	-	-	-	-	-	-	-	
Swettenham LS	Civil	Facility	Yard-Fence	1 - Rare	2 - Minor	Low Risk	-	-	-	Low Risk	21-50 Years	$17,000	Replacement
Swettenham LS	Civil	Facility	Yard-Access	2 - Unlikely	2 - Minor	Low Risk	-	-	-	Low Risk	21-50 Years	$10,000	Replacement
Swettenham LS	Civil	Facility	Yard-Grounds	2 - Unlikely	2 - Minor	Low Risk	-	-	-	Low Risk	21-50 Years	$5,000	Replacement
Swettenham LS	Civil	Foundation & Hydraulic Structure	Wet/Dry Well	1 - Rare	4 - Major	Medium Risk	-	-	-	Medium Risk	11-20 Years	$570,000	'Replacement : The total replacement cost of the wet well break down into: mobilization / demobilization at a cost of $35,000, temporary bypass pumping system at a cost of $50,000, decommissioning of existing wet well at a cost of $6,500, demolition/removal at a cost of $20,000, clearing and grubbing at a cost of $2,000, excavation at a cost of $4,500, dewatering and shoring at a cost of $50,000, backfill at a cost of $4,000, wet well at a cost of $120,000, wet well foundation at a cost of $2,000, wet well lid slab at a cost of $10,000, wet well hatches at a cost of $10,000, valve chamber including hatch at a cost of $30,000, genset kiosk foundation at a cost of $2,000, start-up/testing and commissioning at a cost of $8,000, Connection into Force main at a cost of $10,000, new hydro connection at a cost of $30,000, and landscaping at a cost of $5,000.
Swettenham LS	Civil	Foundation & Hydraulic Structure	Valve Chamber	-	-	-	-	-	-	-			
Swettenham LS	Civil	Foundation & Hydraulic Structure	Ladders	1 - Rare	2 - Minor	Low Risk	-	-	-	Low Risk			
Swettenham LS	Civil	Foundation & Hydraulic Structure	Platforms	1 - Rare	2 - Minor	Low Risk	-	-	-	Low Risk			
Swettenham LS	Civil	Foundation & Hydraulic Structure	Railing	1 - Rare	-	-	-	-	-	-			
Swettenham LS	Mechanical	Pump Unit	P1	1 - Rare	3 - Moderate	Medium Risk	-	-	-	Medium Risk	11-20 Years	$50,000	Replacement
Swettenham LS	Mechanical	Pump Unit	P2	2 - Unlikely	3 - Moderate	Medium Risk	11-20 Years	$5,000	Repair: Replace pump impeller	Low Risk	21-50 Years	$50,000	Replacement
Swettenham LS	Mechanical	Piping & Valves	HVAC	2 - Unlikely	2 - Minor	Low Risk	-	-	-	Low Risk	11-20 Years	$80,000	Replacement
Swettenham LS	Mechanical	Piping & Valves	Discharge Piping	1 - Rare	3 - Moderate	Medium Risk	-	-	-	Medium Risk			
Swettenham LS	Mechanical	Piping & Valves	Suction Piping	-	-	-	-	-	-	-			
Swettenham LS	Mechanical	Piping & Valves	Discharge Valves	1 - Rare	2 - Minor	Low Risk	-	-	-	Low Risk			
Swettenham LS	Electrical	Power Distribution	Standby Generator & ATS	2 - Unlikely	3 - Moderate	Medium Risk	11-20 Years	$2,000	Repair: Level control system repairs	Low Risk	21-50 Years	$50,000	Replacement
Swettenham LS	Electrical	Power Distribution	Electrical Panels	1 - Rare	3 - Moderate	Medium Risk	11-20 Years	$400	Repair: Clean kiosk fan and junction box	Low Risk	11-20 Years	$100,000	Replacement
Swettenham LS	Electrical	Power Distribution	Service Entrance	1 - Rare	3 - Moderate	Medium Risk	-	-	-	Medium Risk			
Swettenham LS	Electrical	Power Distribution	Surge Suppressor	1 - Rare	3 - Moderate	Medium Risk	-	-	-	Medium Risk			
Swettenham LS	Electrical	Power Distribution	Starter #1	1 - Rare	3 - Moderate	Medium Risk	-	-	-	Medium Risk			
Swettenham LS	Electrical	Power Distribution	Starter #2	1 - Rare	3 - Moderate	Medium Risk	-	-	-	Medium Risk			
Swettenham LS	Electrical	Instrumentation & Controls	Controller Data (RTU/PLC)	3 - Possible	3 - Moderate	Medium Risk	-	-	-	Medium Risk	11-20 Years	$40,000	Replacement
Swettenham LS	Electrical	Instrumentation & Controls	Operational Interface	-	-	-	-	-	-	-			
Swettenham LS	Electrical	Instrumentation & Controls	Level Control System	3 - Possible	3 - Moderate	Medium Risk	11-20 Years	$2,000	Repair: Level control system repairs	Low Risk			
Swettenham LS	Electrical	Instrumentation & Controls	SCADA	1 - Rare	3 - Moderate	Medium Risk	-	-	-	Medium Risk			
Swettenham LS	Electrical	Instrumentation & Controls	Radio/Modem	-	-	-	-	-	-	-			
Swettenham LS	Electrical	Instrumentation & Controls	Antenna	-	-	-	-	-	-	-			

The reader should note that the above table also illustrates some occurrences in which repair and replacement have been identified for asset components which do not currently exist at the lift station (thus do not have a risk score). These projects have been identified to add new infrastructure to the stations as "repair" which are then eventually considered for replacement.

The total cost of the wet well replacement (Class "D" Cost Estimate) breaks down into the following:

- mobilization/demobilization at a cost of $35,000,
- temporary bypass pumping system at a cost of $50,000,
- decommissioning of existing wet well at a cost of $6,500,
- demolition/removal at a cost of $20,000,
- clearing and grubbing at a cost of $2,000,
- excavation at a cost of $4,500,
- dewatering and shoring at a cost of $50,000,
- backfill at a cost of $4,000,
- wet well at a cost of $120,000,
- wet well foundation at a cost of $6,000,
- wet well lid slab at a cost of $10,000,
- wet well hatches at a cost of $10,000,
- valve chamber including hatch at a cost of $30,000,
- genset and kiosk foundation at a cost of $4,000,
- start-up/testing and commissioning at a cost of $8,000,
- connection into force main at a cost of $10,000,
- new hydro connection at a cost of $30,000, and
- landscaping at a cost of $5,000.

5.3.6 Transfer Beach Lift Station

The Transfer Beach lift station, originally estimated to be constructed in 1991, is located within Transfer Beach Park at the end of the Wharf Road. The lift station is equipped with a duplex pump system. It consists of two Flygt Model 3102.170 pumps with 267 impellers and 230V, 1Ph, 60Hz motors which were installed in 2010.

Figure 5-6 Transfer Beach Lift Station - Site Location

Table 5-8 provides the risk score established for the lift station asset components.

Table 5-8 Transfer Beach Lift Station - Risk Ratings

Town of Ladysmith - Lift Station Condition Assessment

							First Treatment / Repair			Eventual Recommended Replacement			
Lift Station	System	Sub-System	Component	Likelihood of Failure	Consequence of Failure	Risk Score	Repair Period	Repair cost (2017 Dollars)	Notes (Refer to Condition Assessment Form for more details)	Retained Risk after Repair (Sub-System)	Estimated Replacement Period (Sub-System)	Total Estimated Replacement Cost (2017 Dollars)	Notes (Refer to Condition Assessment Form for more details)
Transfer Beach LS	Civil	Facility	Building-Foundation	-	-	-	-	-	-	-	-	-	Replacement
Transfer Beach LS	Civil	Facility	Building-Superstructure	-	-	-	-	-	-	-	-	-	
Transfer Beach LS	Civil	Facility	Building-Roof	-	-	-	-	-	-	-	-	-	
Transfer Beach LS	Civil	Facility	Yard-Fence	-	-	-	-	-	-	-	-	-	Replacement
Transfer Beach LS	Civil	Facility	Yard-Access	-	-	-	-	-	-	-	-	-	Replacement
Transfer Beach LS	Civil	Facility	Yard-Grounds	1 - Rare	2 - Minor	Low Risk	-	-	-	Low Risk	21-50 Years	$5,000	Replacement
Transfer Beach LS	Civil	Foundation & Hydraulic Structure	Wet/Dry Well	2 - Unlikely	3 - Moderate	Medium Risk	-	-		Medium Risk	11-20 Years	$700,000	The total replacement cost of the wet well break down into: mobilization / demobilization at a cost of $35,000, temporary bypass pumping system at a cost of $50,000, decommissioning of existing wet well at a cost of $6,500, demolition/removal at a cost of $20,000, clearing and grubbing at a cost of $2,000, Excavation at a cost of $12,000, dewatering and shoring at a cost of $75,000, Backfill at a cost of $12,000, wet well at a cost of $112,000, wet well foundation at a cost of $5,000, wet well lid slab at a cost of $10,000, wet well hatches at a cost of $10,000, valve chamber including hatch at a cost of $30,000, genset Kiosk foundation at a cost of $2,000, start-up/testing and commissioning at a cost of $8,000, connection into force main at a cost of $10,000, new hydro connection at a cost of $30,000, and landscaping at a cost of $5,000.
Transfer Beach LS	Civil	Foundation & Hydraulic Structure	Valve Chamber	-	-	-	-	-	-	-			
Transfer Beach LS	Civil	Foundation & Hydraulic Structure	Ladders	1 - Rare	-	-	-	-	-	-			
Transfer Beach LS	Civil	Foundation & Hydraulic Structure	Platforms	-	-	-	-	-	-	-			
Transfer Beach LS	Civil	Foundation & Hydraulic Structure	Railing	-	-	-	-	-	-	-			
Transfer Beach LS	Mechanical	Pump Unit	P1	1 - Rare	2 - Minor	Low Risk	-	-	-	Low Risk	21-50 Years	$10,000	Replacement
Transfer Beach LS	Mechanical	Pump Unit	P2	1 - Rare	2 - Minor	Low Risk	-	-	-	Low Risk	21-50 Years	$10,000	Replacement
Transfer Beach LS	Mechanical	Piping & Valves	HVAC	-	-	-	-	-	-	-	11-20 Years	$10,000	Replacement
Transfer Beach LS	Mechanical	Piping & Valves	Discharge Piping	4 - Likely	2 - Minor	Medium Risk	11-20 Years	$1,000	Repair: Recoat discharge piping	Low Risk			
Transfer Beach LS	Mechanical	Piping & Valves	Suction Piping	-	-	-	-	-	-	-			
Transfer Beach LS	Mechanical	Piping & Valves	Discharge Valves	4 - Likely	2 - Minor	Medium Risk	-	-	-	Medium Risk			
Transfer Beach LS	Electrical	Power Distribution	Standby Generator & ATS	-	-	-	-	-	-	-	21-50 Years	$50,000	Replacement
Transfer Beach LS	Electrical	Power Distribution	Electrical Panels	2 - Unlikely	3 - Moderate	Medium Risk	-	-	-	Medium Risk	11-20 Years	$100,000	Replacement
Transfer Beach LS	Electrical	Power Distribution	Service Entrance	2 - Unlikely	2 - Minor	Low Risk	-	-	-	Low Risk			
Transfer Beach LS	Electrical	Power Distribution	Surge Suppressor	-	-	-	-	-	-	-			
Transfer Beach LS	Electrical	Power Distribution	Starter #1	2 - Unlikely	3 - Moderate	Medium Risk	-	-	-	Medium Risk			
Transfer Beach LS	Electrical	Power Distribution	Starter #2	2 - Unlikely	3 - Moderate	Medium Risk	-	-	-	Medium Risk			
Transfer Beach LS	Electrical	Instrumentation & Controls	Controller Data (RTU/PLC)	-	-	-	-	-	-	-	11-20 Years	$40,000	Replacement
Transfer Beach LS	Electrical	Instrumentation & Controls	Operational Interface	-	-	-	-	-	-	-			
Transfer Beach LS	Electrical	Instrumentation & Controls	Level Control System	4 - Likely	3 - Moderate	High Risk	3-10 Years	$3,000	Repair: Level control system repairs	Low Risk			
Transfer Beach LS	Electrical	Instrumentation & Controls	SCADA	3 - Possible	3 - Moderate	Medium Risk	-	-	-	Medium Risk			
Transfer Beach LS	Electrical	Instrumentation & Controls	Radio/Modem	-	-	-	-	-	-	-			
Transfer Beach LS	Electrical	Instrumentation & Controls	Antenna	-	-	-	-	-	-	-			

The reader should note that the above table also illustrates some occurrences in which repair and replacement have been identified for asset components which do not currently exist at the lift station (thus do not have a risk score). These projects have been identified to add new infrastructure to the stations as "repair" which are then eventually considered for replacement.

The total cost of the wet well replacement (Class "D" Cost Estimate) breaks down into the following:

- mobilization/demobilization at a cost of $35,000,
- temporary bypass pumping system at a cost of $50,000,
- decommissioning of existing wet well at a cost of $6,500,
- demolition/removal at a cost of $20,000,
- clearing and grubbing at a cost of $2,000,
- excavation at a cost of $12,000,
- dewatering and shoring at a cost of $75,000,
- backfill at a cost of $12,000,
- wet well at a cost of $112,000,
- wet well foundation at a cost of $5,000,
- wet well lid slab at a cost of $10,000,
- wet well hatches at a cost of $10,000,
- valve chamber including hatch at a cost of $30,000,
- genset and kiosk foundation at a cost of $2,000,
- start-up/testing and commissioning at a cost of $8,000,
- connection into force main at a cost of $10,000,
- new hydro connection at a cost of $30,000, and
- landscaping at a cost of $5,000.

There appears to be significant costs for replacement of the wet well and lift station at Transfer Beach due to the proximity of the lift station to the ocean and the significant construction effort and bypassing costs required. Opus identifies two alternate approaches to address renewal of the lift station in the future (though not fully assessed in this study), which may allow the Town to prolong the current service life of the stations in-situ, while improvements to the overall sanitary sewer servicing strategy are made. With these alternate approaches, the eventual decommissioning of the Transfer Beach lift station would be recommended. Additionally, with the Waterfront Area Plan soon to be implemented by the Town, there are opportunities to combine the Transfer Beach lift station replacement with the new lift station to be constructed as part of the development at Slag Point (Waterfront Area Plan, 1997).

The alternate approaches consist of: 1) relocation of the lift station away from the waterfront and near Town roads, which may likely require new gravity and forcemains in the system, and would require waterfront residences to have grinder pumps installed for future servicing to the lift station above the waterfront, and 2) rehabilitation of the current wet well through structural bracing improvements internally to the wet well, combined with a relining system. These two alternate approaches will allow the Town to push back the eventual higher replacement cost and may extend the estimated useful life of these stations up to 50 years or more. Considering the above, we have identified that the replacement schedule for the Transfer Beach lift station is not expected until about 20 years, and advise a more detailed study to completed closer to the replacement date.

5.4 Prioritized Repair and Replacement Plan

Table 5-9 summarizes the detailed priority replacement program identified through the lift station condition assessment and risk analysis along with cost estimates and approximate time horizons. While risk ratings for individual subcomponents may vary within a lift station, and therefore their replacement priorities may be different, it may be efficient to address less critical repairs and replacements within a given lift station at the same time as when addressing "High Risk" components. Gill Road lift station and Sandy Beach lift station asset component repairs and replacements are at the beginning of the list as they require the most attention.

Where available, Opus has provided temporary repair costs, which may push back the anticipated replacement costs of certain asset components. Where the Town can make repairs to its system, the evaluation of the component repaired will inform the deferral of asset replacement but will need to be assessed on a case-by-case basis. In order to do so, for any component Opus will review the current (as inspected in 2017) risk assessment score. Based on the risk assessment score, if a component is categorized as "Very High Risk" or "High Risk", Opus will identify the immediate corrective action to be taken by the Town to repair this component at a 2017 repair cost. The eventual replacement cost and year of the same component or set of components, will be based on either extended life of the repaired component or the next highest risk assessment score identified for the group of components to be replaced together. For the electrical subcomponents, since the repair does not improve the functionality of whole system, therefore the replacement time is identified based on the highest risk score of the group.

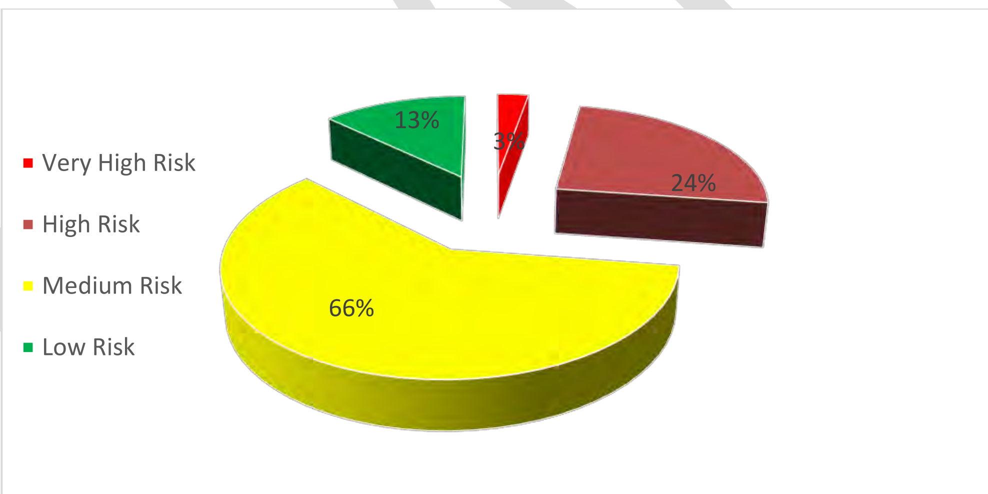


Figure 5.7 **Risk Score of the Ladysmith's Lift Station**

Figure 5-7 shows that 3% of the lift stations asset have the score of "Very High Risk". Approximately, 24% of the lift stations assets have the score of "High Risk" and require prioritized action in order to improve the condition the assets. Currently, the 66% and 13% of the lift station components are classified as "Medium Risk" and "Low Risk", respectively. A summary of the site-specific breakdown of repair and maintenance recommendations are presented in Appendix B.

Table 5-9 Prioritized Repair and Replacement Plan

Lift Station	System	Sub-System	Component	Risk Score	Repair/Replacement Period	Estimated Repair/Replacement cost (2017 Dollars)	Notes (Refer to Condition Assessment Form for more details)
Gill Road LS	Mechanical	Pump Unit	P3	Very High Risk	0-2 Years	$5,000	Repair: Labour costs to remove and dispose P3
Gill Road LS	Mechanical	Piping & Valves		Very High Risk		$80,000	Replacement
Gill Road LS	Electrical	Power Distribution	Service Entrance	High Risk	3-10 Years	$5,000	Repair: Install ground fault monitoring device, test the grounding system, and replace the conductor with appropriate color
Gill Road LS	Civil	Facility	Building-Roof	High Risk		$7,000	Repair: Asphalt shingle repairs
Gill Road LS	Civil	Facility	Yard-Grounds	High Risk		$85,000	Repair: Construction of a retaining wall
Gill Road LS	Civil	Foundation & Hydraulic Structure	Valve Chamber	High Risk		$5,000	Repair: decommisioning and removal
Gill Road LS	Civil	Foundation & Hydraulic Structure	Ladders	High Risk		$2,000	Repair: ladder repairs
Gill Road LS	Civil	Foundation & Hydraulic Structure	Platforms	High Risk		$3,000	Repair: platform repairs
Gill Road LS	Mechanical	Pump Unit	P1	High Risk		$70,000	Replacement
Gill Road LS	Mechanical	Pump Unit	P2	High Risk		$70,000	Replacement
Gill Road LS	Electrical	Power Distribution		High Risk		$60,000	Replacement
Gill Road LS	Electrical	Instrumentation & Controls	Level Control System	High Risk		$3,000	Repair: Level control system repairs
Gill Road LS	Electrical	Instrumentation & Controls		High Risk		$40,000	Replacement
Sandy Beach LS	Civil	Foundation & Hydraulic Structure	Ladders	High Risk		$2,000	Repair: ladder repairs
Sandy Beach LS	Civil	Foundation & Hydraulic Structure	Platforms	High Risk		$2,000	Repair: platform repairs
Sandy Beach LS	Civil	Foundation & Hydraulic Structure	Railing	High Risk		$4,000	Repair: railing repairs
Sandy Beach LS	Mechanical	Piping & Valves	Discharge Piping	High Risk		$10,000	Repair: Recoat discharge piping
Sandy Beach LS	Mechanical	Piping & Valves		High Risk		$80,000	Replacement
Sandy Beach LS	Electrical	Power Distribution		High Risk		$100,000	Replacement
Sandy Beach LS	Electrical	Power Distribution	Service Entrance	High Risk		$4,000	Repair: Install ground fault monitoring device, test the grounding system, and replace the conductor with
Transfer Beach LS	Electrical	Instrumentation & Controls	Level Control System	High Risk		$3,000	Repair: Level control system repairs
Sandy Beach LS	Electrical	Instrumentation & Controls	Level Control System	High Risk		$3,000	Repair: Level control system repairs
Ludlow LS	Mechanical	Piping & Valves	HVAC	High Risk		$4,000	Repair: Replace Fan
Gill Road LS	Civil	Facility	Yard-Fence/Railing	-		$60,000	Repair: Add railing
Ludlow LS	Civil	Facility	Yard-Access	-		$10,000	Replacement
Gill Road LS	Mechanical	Piping & Valves	HVAC	-		$20,000	Repair: Add Fan
Sandy Beach LS	Civil	Facility	Yard-Fence/Railing	-		$30,000	Repair: Add railing
Sandy Beach LS	Mechanical	Piping & Valves	HVAC	-		$20,000	Repair: Add HVAC
Gill Road LS	Civil	Facility	Building	Medium Risk	11-20 Years	$70,000	Replacement
Gill Road LS	Mechanical	Pump Unit	P1	Medium Risk		$70,000	Replacement
Gill Road LS	Mechanical	Pump Unit	P2	Medium Risk		$70,000	Replacement
Gill Road LS	Civil	Facility	Yard-Access	Medium Risk		$30,000	Replacement
Sandy Beach LS	Civil	Facility	Yard-Ground	Medium Risk		$5,000	Repair: Kiosk Foundation repairs
Sandy Beach LS	Electrical	Instrumentation & Controls		Medium Risk		$40,000	Replacement
Ludlow LS	Civil	Facility	Yard-Grounds	Medium Risk		$7,000	Repair: Construction of a lock wall block and anchor bolts repair
Ludlow LS	Civil	Facility	Yard-Fence	Medium Risk		$17,000	Replacement
Ludlow LS	Civil	Foundation & Hydraulic Structure		Medium Risk		$600,000	Replacement
Ludlow LS	Mechanical	Pump Unit	P1	Medium Risk		$40,000	Replacement
Ludlow LS	Mechanical	Pump Unit	P2	Medium Risk		$40,000	Replacement
Ludlow LS	Mechanical	Piping & Valves	Discharge Piping	Medium Risk		$5,000	Repair: Recoat discharge piping
Ludlow LS	Mechanical	Piping & Valves		Medium Risk		$84,000	Replacement
Ludlow LS	Electrical	Power Distribution	Standby Generator & ATS	Medium Risk		$50,000	Replacement
Ludlow LS	Electrical	Power Distribution		Medium Risk		$100,000	Replacement
Sandy Beach LS	Mechanical	Pump Unit	P1	Medium Risk		$16,000	Replacement
Sandy Beach LS	Mechanical	Pump Unit	P2	Medium Risk		$16,000	Replacement
Ludlow LS	Electrical	Instrumentation & Controls		Medium Risk		$40,000	Replacement
Ludlow LS	Electrical	Instrumentation & Controls	Level Control System	Medium Risk		$7,000	Repair: Level control system repairs
Park Drive LS	Civil	Foundation & Hydraulic Structure		Medium Risk		$570,000	Replacement
Park Drive LS	Mechanical	Pump Unit	P1	Medium Risk		$50,000	Replacement
Park Drive LS	Mechanical	Pump Unit	P2	Medium Risk		$50,000	Replacement
Park Drive LS	Mechanical	Piping & Valves	Discharge Piping	Medium Risk		$80,000	Replacement
Park Drive LS	Electrical	Power Distribution	Standby Generator & ATS	Medium Risk		$50,000	Replacement
Park Drive LS	Electrical	Power Distribution	Electrical Panels	Medium Risk		$2,000	Repair: Install kiosk ventilation fan operation
Park Drive LS	Electrical	Power Distribution	Surge Suppressor	Medium Risk		$600	Repair: Replace surge suppressor
Park Drive LS	Electrical	Power Distribution		Medium Risk		$100,000	Replacement
Park Drive LS	Electrical	Instrumentation & Controls	Level Control System	Medium Risk		$3,000	Repair: Level control system repairs
Park Drive LS	Electrical	Instrumentation & Controls		Medium Risk		$40,000	Replacement
Swettenham LS	Mechanical	Pump Unit	P2	Medium Risk		$5,000	Repair: Replace pump impeller

Table 5-9 Prioritized Repair and Replacement Plan							
Lift Station	System	Sub-System	Component	Risk Score	Repair/Replacement Period	Estimated Repair/Replacement cost (2017 Dollars)	Notes (Refer to Condition Assessment Form for more details)
Swettenham LS	Mechanical	Pump Unit	P1	Medium Risk		$50,000	Replacement
Swettenham LS	Mechanical	Piping & Valves		Medium Risk		$80,000	Replacement
Swettenham LS	Electrical	Power Distribution	Standby Generator & ATS	Medium Risk	11-20 Years	$2,000	Repair: Level control system repairs
Swettenham LS	Electrical	Power Distribution	Electrical Panels	Medium Risk		$400	Repair: Clean kiosk fan and junction box
Swettenham LS	Electrical	Power Distribution		Medium Risk		$100,000	Replacement
Swettenham LS	Electrical	Instrumentation & Controls		Medium Risk		$40,000	Replacement
Swettenham LS	Electrical	Instrumentation & Controls	Level Control System	Medium Risk		$2,000	Repair: Level control system repairs
Transfer Beach LS	Civil	Foundation & Hydraulic Structure	Wet/Dry Well	Medium Risk		$58,000	Repair: Wet well rehabilitation via relining solution
Transfer Beach LS	Mechanical	Piping & Valves	Discharge Piping	Medium Risk		$1,000	Repair: Recoat discharge piping
Transfer Beach LS	Electrical	Instrumentation & Controls		Medium Risk		$40,000	Replacement
Transfer Beach LS	Mechanical	Piping & Valves		Medium Risk		$10,000	Replacement
Transfer Beach LS	Civil	Foundation & Hydraulic Structure		Medium Risk		$700,000	Replacement
Sandy Beach LS	Civil	Foundation & Hydraulic Structure		Medium Risk		$720,000	Replacement
Gill Road LS	Civil	Foundation & Hydraulic Structure		Medium Risk		$1,100,000	Replacement
Transfer Beach LS	Electrical	Power Distribution		Medium Risk		$100,000	Replacement
Transfer Beach LS	Civil	Facility	Yard-Grounds	Low Risk	21-50 Years	$5,000	Replacement
Gill Road LS	Civil	Facility	Yard-Grounds	Low Risk		$90,000	Replacement
Gill Road LS	Civil	Foundation & Hydraulic Structure		Low Risk		$1,100,000	Replacement
Ludlow LS	Civil	Facility	Yard-Grounds	Low Risk		$10,500	Replacement
Park Drive LS	Civil	Facility	Yard-Fence	Low Risk		$17,000	Replacement
Park Drive LS	Civil	Facility	Yard-Ground	Low Risk		$5,000	Replacement
Swettenham LS	Civil	Facility	Yard-Fence	Low Risk		$17,000	Replacement
Swettenham LS	Civil	Facility	Yard-Access	Low Risk		$10,000	Replacement
Swettenham LS	Civil	Facility	Yard-Grounds	Low Risk		$5,000	Replacement
Swettenham LS	Mechanical	Pump Unit	P2	Low Risk		$50,000	Replacement
Transfer Beach LS	Civil	Facility	Yard-Grounds	Low Risk		$5,000	Replacement
Transfer Beach LS	Mechanical	Pump Unit	P1	Low Risk		$10,000	Replacement
Transfer Beach LS	Mechanical	Pump Unit	P2	Low Risk		$10,000	Replacement
Swettenham LS	Electrical	Power Distribution	Standby Generator & ATS	Low Risk		$50,000	Replacement
Sandy Beach LS	Civil	Facility	Yard-Ground	Low Risk		$5,000	Replacement
Gill Road LS	Electrical	Power Distribution	Standby Generator & ATS	Low Risk		$70,000	Replacement
Sandy Beach LS	Mechanical	Piping & Valves	HVAC	Low Risk		$20,000	Replacement
Sandy Beach LS	Civil	Facility	Yard-Fence/Railing	Low Risk		$30,000	Replacement
Gill Road LS	Mechanical	Piping & Valves	HVAC	Low Risk		$20,000	Replacement
Sandy Beach LS	Electrical	Power Distribution	Standby Generator & ATS	Low Risk		$50,000	Replacement
Transfer Beach LS	Electrical	Power Distribution	Standby Generator & ATS	Low Risk		$50,000	Replacement
Gill Road LS	Civil	Facility	Yard-Fence/Railing	Low Risk		$30,000	Replacement

5.5 Further Recommendations

Apart from the repair and replacement projects identified through the condition and risk assessment sections above, Opus has identified a few additional projects that should be completed by Town staff based on the condition reviews and our knowledge of the Town's sanitary sewer system. The following projects and project costs are provided as they are not included in the final lift station repair and renewal schedule presented in Table 5-9.

- There is an unretained wall of soil adjacent to the wet well and pump building at the Gill Road lift station. A retaining wall has been recommended and costed out in the repair and renewal schedule, but an additional geotechnical assessment is recommended in order to investigate the capacity and stability of the unretained wall of soil during the seismic and ground saturation events at a cost of $6,000.
- The Ludlow Road lift station site elevation is 1500 mm higher than the Ladysmith marine service yard to the northeast. The difference of elevation is retained by concrete blocks. These blocks are filled with soil. No drawings of the retaining wall has been provided based on our records. A geotechnical assessment is recommended in order to investigate the stability of the retaining concrete blocks during the seismic event at a cost of $6,000.
- Grease build up has been observed inside the Swettenham and Sandy Beach lift stations. Regular annual wet well cleansing is required and recommended in order to avoid the obstruction of pipes, reduction of pump service life and subsequent forcemain backups and SSOs.
- The Town desires to implement a proper communications connection of all six lift stations to the Town's SCADA system. There are significant upgrades required including a Comprehensive Master Plan for the electrical communications system, a Radio Path Study, SCADA upgrades at the Public Works Yard, upgrades to the SCADA system at the Town's WWTP to provide backup, incl. antennae and remote site integrations, and SCADA improvements and antennae at all six lift stations. The budgetary cost for all these upgrades are in the range of $500,000.

6 Conclusion

The purpose of the condition assessment is to provide a risk analysis of the Town of Ladysmith's six sanitary lift stations in which a list of prioritized actions would be developed along with budgets for the repair or/and replacement of critical station asset components.

Over the course of completing the condition assessments, Opus has also compiled an up-to-date lift station asset inventory, complete with pertinent information on the current condition and criticality of all civil, mechanical, and electrical components of the lift stations. Health and Safety concerns were also documented for each component as observed.

A prioritized Repair and Replacement Plan for the Town of Ladysmith sanitary lift stations has been developed for a 50-year horizon (in 2017 dollars) though the reader should note that all asset components reviewed in this report have been reviewed for one repair and one replacement cycle. This, in essence, means that the provided repair and replacement plan is likely relatively accurate for the short term (i.e. the next 10-15 years), after which the Town is highly encouraged to update this plan. The recommended condition assessment review frequency is 10 years, wherein this plan should be reviewed with more up-to-date condition site reviews.

This report provides a foundation for the effective risk management of the Town's lift stations. The prioritized repair and replacement program and the lift station asset inventory will allow Town staff to make informed decisions in developing future capital expenditure programs addressing this critical municipal infrastructure.

APPENDIX A | FIELD REVIEW FORMS

GILL ROAD LIFT STATION

(note that all condition ratings, life estimates, and repair and replacement Class "D" costs estimates have been prepared as of best engineering judgment through site inspections carried out with Town staff in August 2017)

Inspection Date: August 24th, 2017
Inspected By: Michael Levin, Matt McCartney,Tjandra Tjondrotekodjojo, and Omid Saragazi
Accompanied By: Martin Barney

			Component	Make / Model / Material	General / H&S Comments	Commissioning Year	Rebuild Year	Typ. Life Expectancy (yrs)	Revised Life Expectancy (yrs)	Est. Remaining Life (yrs)	Condition Score (1-5)	Repair Cost Estimate (2017$)	Replacement Value (2017$)
Civil	Layout		Conforms to Dwgs?	-Yes	- Drawing No. : 34-4922-4-2 and 34-4922-4-3	-	-	-	-	-	-	-	-
Civil	Facility	Building	Foundation	- Reinforced concrete slab footings underlain with polyethylene sheet on compacted and graded gravel base.	- No detailed information regarding the pump building foundation or native soils	1982	-	75	-	40	1	-	
Civil	Facility	Building	Superstructure	- The building is 2300x3900 mm in plan by 2400 mm height. -The exterior wall consists of inner and outer walls. The inner wall is reinforced masonary and the outer wall is unreinforced masonry wall which surrounds the building. - Partition studs filled with fiberglass insulation. Separates the panel room and the pump room.	- No visible crack in masonry block wall and mortar. - Adequate rebar arrangement and acceptable height to thickness ratio of the masonry block. - In the case of collapse of the adjacent unretained wall of soil (e.g. during seismic or extreme ground saturation events), the building does not have enough capacity to withstand the imposed loading of the soil. (Immediate occupancy would not be achieved.) - Seismic requirements for masonry walls in seismic areas: the first two rows must be fully grouted - The partition is in an adequate condition. - The floor inside the building is in a good condition and no defect or crack were observed.	1982	-	75	-	40	3	-	$70,000
Civil	Facility	Building	Roof	- Asphalt shingles	- The asphalt shingle roof is past its life service and needs to be replaced. No evaluation of roof's trusses condition was carried out during inspection. Replacement of the roof will be at a cost of $7,000	1982	-	25	-	0	4	$7,000	
Civil	Facility	Yard	Fence	- Proximity of the lift station to the ocean. - No site fencing or railing is provided.	- Railing around the building and pump station is recommended for safety at a cost of $60,000. (Yard is a raised platform adjacent to the harbour.)	-	-	-	-	-	-	$60,000	$60,000
Civil	Facility	Yard	Access	- Aluminium staircase for operations staff. - Operations staff have no vehicular access.	- Difficult access during high tide for service vehicles. - Replacement of stairway including footing and handrails is at a cost of $30,000.	Unk*	-	40	25	25	1	-	$30,000
Civil	Facility	Yard	Grounds	- Existence of unretained wall of soil adjacent to the wet well.	- Surcharge underneath the unretained wall of soil will increase lateral active and seismic soil pressure exerted on the wet well walls - Collapse of unretained wall of soil on the pump building may causes severe damage and prevent immediate occupancy criteria - A geotechnical assessment is needed in order to investigate the capacity and the stability of the adjacent unretained wall of soil during the seismic or ground saturation events at a cost of $6,000 - Construction of a retaining wall of the soil is recommended at a cost of $85,000 - Kiosk foundation replacement is at a cost of $5,000	1982	-	50	-	15	5	$85,000	$90,000
Civil	Foundations & Hydraulic Structures		Wet/Dry Well	- Concrete wet well with RC walls. - Dimensions: 2950x2950 mm in plan and 5120 mm deep. -The top of the wet well (around the hatch) is surrounded by 200mm concrete slab.	- Unknown rebar arrangement within the walls of the wet well. A crack on the surrounding concrete slab was observed from the corner of the wet well to the retaining pony wall. The concrete crack repair is at a cost of $5,000 - No detailed information regarding the wet well foundation or native soils	Unk**	-	50	20	20	2	-	
Civil	Foundations & Hydraulic Structures		Valve Chamber	- RC valve chamber buried underground. Flygt check valve and terminal city gate valve are located inside the cast in-place reinforced concrete slab with the Flygt access door and frame on the top. - Dimensions: 1900x1200 mm - Concrete foundation	- No information regarding the condition of the valve chamber	1982	-	40	-	5	4	-	$1,100,000
Civil	Foundations & Hydraulic Structures		Ladders	-Aluminuim ladder rungs	- The ladder is severely corroded and needs to be replaced	1982	-	30	-	0	4	$2,000	
Civil	Foundations & Hydraulic Structures		Platforms	- Steel framing covered by Armco Grating type BB removable panels. - Dimension: 2438x1525mm in plan.	-The intermediate level platform no longer exists and the platform frames are severely corroded and damaged. The replacement is recommended.	1982	-	30	-	0	4	$3,000	
Civil	Foundations & Hydraulic Structures		Railings	- Aluminium railing on top of the platform	-The railing is corroded and in a poor condition and needs to be replaced.	1982	-	30	-	0	4	$4,000	
Civil					**Civil Overall Average Score:**						**3.2**	**$161,000**	**$1,350,000**
Mechanical	Pumps		Pump Units										
Mechanical	Pumps	P1	Duty Pump		- Flygt CP3201HT with a 454 impeller - Design condition: Unknown - Drawdown test not done due to cooling jacket leakage. - pump rails appear to be in good condition. Pumps and bases were not visible. - pump chains are not connected to pump with ring. - since the inspection, the P1 base started leaking excessively in a hole caused by corrosion and wear. New bases have been ordered for each pump. - total running dial indicates 1109 hours. previous total was 3207.9 hours. - Pump has been serviced. The service date is unknown. motor c/w external cooling jacket. At the time of inspection, each pump's motor cooling jackets leaked profusely . Since the inspection, each jacket has been replaced.	1982	-	20	-	0	1	-	$70,000
Mechanical	Pumps	P2	Duty Pump		- Flygt CP3201HT with a 454 impeller - Design condition: unknown - Drawdown test not done due to cooling jacket leakage. - pump rails appear to be in good condition. Pumps and bases were not visible. - pump chains are not connected to pump with ring. - total running dial indicates 5456 hours. previous total was 3556.2 hours. - Pump has been serviced. The service date is unknown. motor c/w external cooling jacket. At the time of inspection, each pump's motor cooling jackets leaked profusely . Since the inspection, each jacket has been replaced.	1982	-	20	-	0	1	-	$70,000
Mechanical	Pumps	P3	Backup Pump		- self-priming, engine driven pump located in the control building. pump does not work. The Town has put considerable time attempting to make the pump work. - operating condition not known - budget $5,000 to remove this pump	Unk*	-	20	0	0	5	$5,000	-
Mechanical	Piping / Valves		HVAC	- N/A	- two goosenecks are provided with wet well - HVAC is recommended in the wet well. Installation of a fan onto one air vent, similar to Ludlow LS, is recommended	-	-	-	-	-	-	$20,000	$20,000
Mechanical	Piping / Valves		Discharge Piping	- piping connected to Flygt pumps consists of cast ductile iron flanged tees and stainless steel piping with roban-type couplings - piping connected to the self-priming pump is coated carbon steel piping	- cast ductile iron fittings are heavily corroded. - some fasteners on flanges have been replaced. Other fasteners are extremely corroded.	1982	-	25	-	0	5	-	
Mechanical	Piping / Valves		Suction Piping	- N/A	- No suction piping as pumps are installed in wet well.	-	-	-	-	-	-	-	$80,000
Mechanical	Piping / Valves		Discharge Valves	- 150mm ball type check valves - 150mm isolating plug valves	- check valves make and model not known. Heavy corrosion on exterior of valves - plug valves make and model not known. Heavy corrosion on exterior of valves	1982	-	25	-	0	5	-	
Mechanical	Piping / Valves		Sumps	- N/A		-	-	-	-	-	-	-	
Mechanical					**Mechanical Overall Average Score:**						**3.4**	**$25,000**	**$240,000**
	Power Distribution & Electrical		Standby Generator & ATS	- Cutler Hammer manual transfer switch, 200A, 240V	- Manual Transfer switch size may be to small and not protected if loads ex+M15ceed 200A. Generator connection cable is run along the access stairs but not terminated in a genset connection box.	1982	-	30	-	0	2	$4,000	$70,000
	Power Distribution & Electrical		Electrical Panels	- Service entrance equipment and Electrical panels in the building		1982	-	30	-	0	1	-	
	Power Distribution & Electrical		Service Entrance	- Westinghouse Circuit Breaker, 400A	-The station is an ungrounded system. Ground fault monitoring device should be installed. System grounding does appear damaged and not connected. Review grounding installation and test the grounding system. White coloured conductor is used for phase wiring, replace the conductor with the appropriate colour.	1982	-	30	-	0	3	$5,000	$60,000
	Power Distribution & Electrical		Surge Suppressor	- N/A		-	-	-	-	-	-	-	
	Power Distribution & Electrical		Starter #1	- Klockner Moeller manual starter NZM 6b-100-CNA with contactor DIL 3-22-NA	- Overload set at approximately 75 Amps	1982	-	20	-	0	1	-	

Pump Units		*Manufacturer*	*Serial #*	*Pump Model*	*Impeller #*	*Running Hours*	*Power (HP)*	*Voltage/ Phase/ Frequency*	*Speed (RPM)*
P1	Duty Pump	Flygt	3201.180-0910011	3201.180-0106	454	1109	30	230/3/60	1750
P2	Duty Pump	Flygt	3201.180-0910012	3201.180-0106	454	5456	30	230/3/60	1750
P3	Backup Pump	Monarch Industries	960	T774GV					

GILL ROAD LIFT STATION

(note that all condition ratings, life estimates, and repair and replacement Class "D" costs estimates have been prepared as of best engineering judgment through site inspections carried out with Town staff in August 2017)

Inspection Date: August 24th, 2017

Inspected By: Michael Levin, Matt McCartney,Tjandra Tjondrotekodjojo, and Omid Saragazi

Accompanied By: Martin Barney

		Component	Make / Model / Material	General / H&S Comments	Commissioning Year	Rebuild Year	Typ. Life Expectancy (yrs)	Revised Life Expectancy (yrs)	Est. Remaining Life (yrs)	Condition Score (1-5)	Repair Cost Estimate (2017$)	Replacement Value (2017$)
Electrical	P.	Starter #2	- Klockner Moeller manual starter PKZM 3-10 with contactor DIL 3-22-NA	- Overload set at approximately 80 Amps	1982	-	20	-	0	1	-	
	Instrumentation, Controls, & Communications	Controller Data (RTU/PLC)	- N/A		-	-	-	-	-	-	-	$40,000
		Operational Interface	- N/A		-	-	-	-	-	-	-	
		Level Control System	- Prosonic FMU 860 Relay Logic float level swicthes	- Level switches should be connected to intrinsically safe relays. No EYS seal for one of the pump cables was identified for conduit between wet well and control panel.	1982	-	15	-	0	3	$3,000	
		SCADA	- Alarm dialer (DSC system)		1982	2009	15	-	7	1	-	
		Radio / Modem	- N/A		-	-	-	-	-	-	-	
		Antenna	- N/A		-	-	-	-	-	-	-	
				Electrical Overall Average Score:						**1.7**	**$12,000**	**$170,000**
				PS TOTAL SCORE:	**CIVIL**	**3.2**	**MECH**	**3.4**	**ELEC**	**1.7**	**$198,000**	**$1,760,000**

* Structure installed prior to 1982

** Structure installed post-1982

SANDY BEACH LIFT STATION

(note that all condition ratings, life estimates, and repair and replacement Class "D" costs estimates have been prepared as of best engineering judgment through site inspections carried out with Town staff in August 2017)

Inspection Date: August 24th, 2017
Inspected By: Michael Levin, Matt McCartney,Tjandra Tjondrotekodjojo, and Omid Saragazi
Accompanied By: Martin Barney

			Component	Make / Model / Material	General / H&S Comments	Commissioning Year	Rebuild Year	Typ. Life Expectancy (yrs)	Revised Life Expectancy (yrs)	Est. Remaining Life (yrs)	Condition Score (1-5)	Repair Cost Estimate (2017$)	Replacement Value (2017$)
Civil	Layout		Conform to Dwgs?	- Yes	- Drawing No. : 34-4922-4-4	-	-	-	-	-	-	-	-
Civil	Facility	Building	Foundation	- N/A		-	-	-	-	-	-	-	-
Civil	Facility	Building	Superstructure	- N/A		-	-	-	-	-	-	-	-
Civil	Facility	Building	Roof	- N/A		-	-	-	-	-	-	-	-
Civil	Facility	Yard	Fence	- Proximity of the lift station to the ocean - No site fencing or railing is provided	- Railing around the pump station is recommended for safety at a cost of $30,000. (Yard is a raised platform adjacent to the harbour)	-	-	-	-	-	-	$30,000	$30,000
Civil	Facility	Yard	Access	- Operations staff have no vehicular access - Operations staff access is via the tidal zone of the beach	- Access to lift station during high tide is through neighbour's yard and during low tide is from beach - Limited space for potential genset installation	-	-	-	-	-	-	-	-
Civil	Facility	Yard	Grounds	- Kiosk base: screw control panel box to the adjacent power pole with screw supplied at rear, top and bottom plates	- Proper support and base should be provided for kiosk base. Kiosk base replacement is recommended at a cost of $5,000	1982	-	50	-	15	3	$5,000	$5,000
Civil	Foundations & Hydraulic Structures		Wet/Dry Well	- Concrete wet well with 200 mm thick RC walls - Dimensions: 2930x2425 mm in plan and 5120mm deep - The top of the wet well (around the hatch) is surrounded by 200mm concrete slab - Concrete foundation	-The existing hatch does not provide access to the ladder inside the wet well - Hatch frame is mildly corroded and needs maintenance. Corrosion needs to be removed and new corrosion protection layer should be applied on the surface at a cost of $2000. - Grease build-up inside the wet well has been observed. The grease may clog pipes and reduces the service life of pumps leading to forcemain backups and SSO. - No detailed information regarding the wet well foundation or native soils	Unk*	-	50	20	20	2	-	$720,000
Civil	Foundations & Hydraulic Structures		Valve Chamber	- N/A		-	-	-	-	-	-	-	
Civil	Foundations & Hydraulic Structures		Ladders	- Aluminuim ladder rungs	- The ladder is corroded and needs to be replaced at a cost of $2,000 - Not accessible through the hatch	1982	-	30	-	0	4	$2,000	
Civil	Foundations & Hydraulic Structures		Platforms	- Steel framing covered by Armco Grating type BB removable panels - Dimension: 1985x955mm in plan	- The intermediate level platform no longer exists and the platform frames are severely corroded and damaged. The replacement is recommended. At a cost of $2,000.	1982	-	30	-	0	4	$2,000	
Civil	Foundations & Hydraulic Structures		Railings	- Aluminium railing on top of the platform	-The railing is corroded and in a poor condition and needs to be replaced at a cost of $4,000	1982	-	30	-	0	4	$4,000	
					Civil Overall Average Score:						**3.4**	**$43,000**	**$755,000**
Mechanical	Pumps		Pump Units	*Manufacturer / Serial # / Pump Model / Impeller # / Running Hours / Power (HP) / Voltage/ Phase/ Frequency / Speed (RPM)*									
Mechanical	Pumps	P1	Duty Pump	Flygt / 3085.183-0841518 / 3085.183-4438 / 462 / 9010 / 3 / 230/3/60 / 1700	- Flygt NP3085MT with a 248 impeller - Design condition unknown - no drawdown test was performed due to lack of ultrasonic level transducer - pump rails and chains appear to be in good condition. Pumps and bases not visible	1982	2009	20	-	12	1	-	$16,000
Mechanical	Pumps	P2	Duty Pump	Flygt / 3085.183-0841519 / 3085.183-4438 / 462 / 9455 / 3 / 230/3/60 / 1700	- Flygt NP3085MT with a 248 impeller - Design condition unknown - no drawdown test was performed due to lack of ultrasonic level transducer - pump rails and chains appear to be in good condition. Pumps and bases not visible	1982	2009	20	-	12	1	-	$16,000
Mechanical	Piping / Valves		HVAC	- N/A	- two goosenecks are installed to provide ventilation - HVAC is recommended in the wet well. Installation of a fan onto one air vent, similar to Ludlow LS, is recommended	-	-	-	-	-	-	$20,000	$20,000
Mechanical	Piping / Valves		Discharge Piping	- mixture of steel and ductile iron piping. No exterior coatings are visible due to exterior corrosion.	- all piping is the wet well has moderate to severe exterior corrosion	1982	-	25	-	0	3	$10,000	$80,000
Mechanical	Piping / Valves		Suction Piping	- N/A	- No suction piping required as pumps are installed in wet well	-	-	-	-	-	-	-	
Mechanical	Piping / Valves		Discharge Valves	- ball check valves - level actuated plug valves	- exterior corrosion on all valves - make and model of plug and check valve not known - some new SS fasteners visible on some of the flanged connections in the wet well - older bolts and nuts have some heavy corrosion	1982	-	25	-	0	3	-	
Mechanical	Piping / Valves		Sumps	- N/A		-	-	-	-	-	-	-	
					Mechanical Overall Average Score:						**2**	**$30,000**	**$132,000**
Electrical	Power Distribution & Electrical		Standby Generator & ATS	- N/A		-	-	-	-	-	-	-	$50,000
Electrical	Power Distribution & Electrical		Electrical Panels	- Pedestal mounted electrical equipment.	- General cleaning of the electrical panels should be conducted. Equipment should be replaced and installed in a new kiosk.	1982	-	30	-	0	2	$400	$100,000
Electrical	Power Distribution & Electrical		Service Entrance	- Incoming service from BC Hydro overhead is 240V, 3 phase delta to the main fused disconnect switch routed via the control panel. This incoming service also feeds the Distribution Transformer 6kVA, 240V-120/208V three phase.	- The station is an ungrounded system. Ground fault monitoring device should be installed. - System grounding does appear damaged and not connected. Review grounding installation and test the grounding system. - White coloured conductor is used for phase wiring, replace the conductor with the appropriate colour.	1982	-	30	-	0	3	$4,000	
Electrical	Power Distribution & Electrical		Surge Suppressor	- N/A		-	-	-	-	-	-	-	
Electrical	Power Distribution & Electrical		Starter #1	- Klockner Moeller manual starter PKZM 3-10 with contactor DIL 0-11-NA		1982	-	20	-	0	1	-	
Electrical	Power Distribution & Electrical		Starter #2	- Klockner Moeller manual starter PKZM 3-10 with contactor DIL 0-11-NA		1982	-	20	-	0	1	-	
Electrical	Instrumentation, Controls, & Communications		Controller Data (RTU)	- N/A		-	-	-	-	-	-	-	$40,000
Electrical	Instrumentation, Controls, & Communications		Operational Interface	- N/A		-	-	-	-	-	-	-	
Electrical	Instrumentation, Controls, & Communications		Level Control System	- Relay Logic float level switches	- Level switches should be coonected to connected to intrinsically safe . No EYS seals are identified for conduits between wet well and control panel.	1982	-	15	-	0	3	$3,000	
Electrical	Instrumentation, Controls, & Communications		SCADA	- Alarm dialler (DSC system)		1982	2009	15	-	7	1	-	
Electrical	Instrumentation, Controls, & Communications		Radio / Modem	- Arris Shaw modem for telephone connection		1982	2009	15	-	7	1	-	
Electrical	Instrumentation, Controls, & Communications		Antenna	- N/A		-	-	-	-	-	-	-	
					Electrical Overall Average Score:						**1.7**	**$7,400**	**$190,000**
					PS TOTAL SCORE:	**CIVIL**	**3.4**	**MECH**	**2**	**ELEC**	**1.7**	**$80,400**	**$1,077,000**

* Structure installed prior to 1982

LUDLOW ROAD LIFT STATION

(note that all condition ratings, life estimates, and repair and replacement Class "D" costs estimates have been prepared as of best engineering judgment through site inspections carried out with Town staff in August 2017)

Inspection Date: August 24th, 2017
Inspected By: Michael Levin, Matt McCartney,Tjandra Tjondrotekodjojo, and Omid Saragazi
Accompanied By: Martin Barney and Curtis Baker

			Component	Make / Model / Material	General / H&S Comments	Commissioning Year	Rebuild Year	Typ. Life Expectancy (yrs)	Revised Life Expectancy (yrs)	Est. Remaining Life (yrs)	Condition Score (1-5)	Repair Cost Estimate (2017$)	Replacement Value (2017$)
Civil	Layout		Conform to Dwgs?	- N/A	- No drawings provided	-	-	-	-	-	-	-	-
Civil	Facility	Building	Foundation	- N/A		-	-	-	-	-	-	-	-
Civil	Facility	Building	Superstructure	- N/A		-	-	-	-	-	-	-	-
Civil	Facility	Building	Roof	- N/A		-	-	-	-	-	-	-	-
Civil	Facility	Yard	Fence	- Galvanized fence and barbed wire on top - Fences gate for vehicular access	- Fences are not designed to withstand vehicular collision - Fences are minorly corroded in some locations and the barbed wires are rusted. The replacement cost of the site fencing is $13,000. - Fence posts are attached to unreinforced concrete bases which are not reliable to provide support against imposed loads to the fences. The replacement cost of barbed wires with galvanized one and repair of the post bases as well as fence anti-corrosion are estimated at the cost of $4000.	1999	-	20	-	2	2	$4,000	$17,000
Civil	Facility	Yard	Access	- Operations staff have vehicular access	- The slope (10%) of the adjacent road to the lift station presents some safety concerns - Use of bollards are recommended at a cost of $10,000	-	-	-	-	-	-	$10,000	$10,000
Civil	Facility	Yard	Grounds	- The site elevation is 1500 mm higher than the Ladysmith marine service yard to the northeast - Kiosk base : 2100x1450 mm in plan, unknown thickness	- The difference of elevation is retained by concrete blocks. These blocks are filled with soil. No drawing of the retaining wall has been provided. A geotechnical assessment is recommended in order to investigate the stability of the retaining concrete blocks during the seismic event at a cost of $6000. The construction cost of a lock wall block is at a cost of $5500. - Anchor bolts are minorly corroded. The maintenance is required to prevent malfunction during earthquake at a cost of $1500. The replacement of Genset and kiosk foundation will be at a cost of $5,000.	1999	-	50	-	32	3	$7,000	$10,500
Civil	Foundations & Hydraulic Structures		Wet/Dry Well	- Fibreglass Reinforced Plastic (FRP) wet well - Concrete foundation	- No observation of defect during inspection. No repair/replacement is required - No detailed information regarding the wet well foundation or native soil requirments	1999	-	50	-	32	2	-	$600,000
Civil	Foundations & Hydraulic Structures		Valve Chamber	- N/A		-	-	-	-	-	-	-	
Civil	Foundations & Hydraulic Structures		Stairs/Ladders	- Aluminium ladder	- No observation of defect during inspection. No repair/replacement is required	1999	-	30	-	12	1	-	
Civil	Foundations & Hydraulic Structures		Platforms	- Aluminium frame and grating	- No observation of defect during inspection. No repair/replacement is required	1999	-	30	-	12	1	-	
Civil	Foundations & Hydraulic Structures		Railings	- N/A		-	-	-	-	-	-	-	
					Civil Overall Average Score:						**1.8**	**$21,000**	**$637,500**

			Pump Units	Manufacturer	Serial #	Model	Impeller #	Running Hours	Power (HP)	Voltage/ Phase/ Frequency	Speed (RPM)	General / H&S Comments	Commissioning Year	Rebuild Year	Typ. Life Expectancy (yrs)	Revised Life Expectancy (yrs)	Est. Remaining Life (yrs)	Condition Score (1-5)	Repair Cost Estimate (2017$)	Replacement Value (2017$)
Mechanical	Pumps	P1	Duty Pump	Flygt	Unknown	3127.160	248 (155mm)	563	11	600/3/60	3500	- Flygt NP3127SH - Design condition: unknown - Drawdown test calculated flowrate at 16.8 L/s. This is with an assumed 155mm diameter impeller. - pump rails appear to be in good condition. Pumps and bases were not visible. - Flygt pump is installed onto a Myers base with an adapter - no nameplate available	1999	2016	20	-	19	2	-	$40,000
Mechanical	Pumps	P2	Duty Pump	Flygt	Unknown	3127.160	248 (155mm)	758	11	600/3/60	3500	- Flygt NP3127SH - Design condition: unknown - Drawdown test calculated flowrate at 14.2 L/s. This is with an assumed 155mm diameter impeller. - pump rails appear to be in good condition. Pumps and bases were not visible. - Flygt pump is installed onto a Myers base with an adapter - no nameplate available	1999	2016	20	-	19	2	-	$40,000

			Component	Make / Model / Material	General / H&S Comments	Commissioning Year	Rebuild Year	Typ. Life Expectancy (yrs)	Revised Life Expectancy (yrs)	Est. Remaining Life (yrs)	Condition Score (1-5)	Repair Cost Estimate (2017$)	Replacement Value (2017$)
Mechanical	Piping / Valves		HVAC	- Dexon Canada Fan model V03-1	- The fan is broken and does not work. The wet well does not get forced ventilation. - The fan should be replaced	1999	-	10	-	0	5	$4,000	$84,000
Mechanical	Piping / Valves		Discharge Piping	- Coated steel piping	- Piping exterior coating is in good condition with spots of corrosion	1999	-	25	-	7	2	$5,000	
Mechanical	Piping / Valves		Suction Piping	- N/A	- No suction piping required as pumps are installed in wet well	-	-	-	-	-	-	-	
Mechanical	Piping / Valves		Discharge Valves	- 100mm Flomatic Model 78 rubber flapper type check valve - 100mm Isolating plug valve: Hosemstead Series 120 - SS ball valve where piping comes together prior to existing wet well - 50mm ARI D-020 combination air valve for sewage	- check valve has moderate exterior corrosion - plug valves has moderate exterior corrosion - new SS fasteners are visible on all flanged connections - combination air valve in good condition	1999	-	25	-	7	2	-	
Mechanical	Piping / Valves		Sumps	- N/A		-	-	-	-	-	-	-	
					Mechanical Overall Average Score:						**2.6**	**$9,000**	**$164,000**
Electrical	Power Distribution & Electrical		Standby Generator & ATS	- Manual Transfer Switch Square-D C82343		1999	-	30	-	12	1	-	$50,000
Electrical	Power Distribution & Electrical		Electrical Panels	- Pedestal mounted electrical equipment	- Equipment should be replaced and installed in a new kiosk	1999	-	30	-	12	1	-	$100,000
Electrical	Power Distribution & Electrical		Service Entrance	- Square-D Fused Disconnect Switch, 100A, 600V, 3 phase		1999	-	30	-	12	1	-	
Electrical	Power Distribution & Electrical		Surge Suppressor	- N/A		-	-	-	-	-	-	-	
Electrical	Power Distribution & Electrical		Starter #1	- Cutler hammer MCP 30A with Siemens motor starter Sirius 3RT2026-1AK60 and O/L relay 3AU2126-1kB0	- Overload set at 10 Amps	1999	2015	20	-	18	1	-	
Electrical	Power Distribution & Electrical		Starter #2	- Cutler hammer MCP 30A with Siemens motor starter Sirius 3RT2026-1AK60 and O/L relay 3AU2126-1kB0	- Overload set at 12 Amps	1999	2015	20	-	18	1	-	
Electrical	Instrumentation, Controls & Communications		Controller Data (RTU)	- ScadaPack32		1999	2015	15	-	13	1	-	$40,000
Electrical	Instrumentation, Controls & Communications		Operational Interface	- Beijer T150		1999	2015	15	-	13	1	-	
Electrical	Instrumentation, Controls & Communications		Level Control System	- Endress Hauser FMU90 s/n 9A020A010E6 with ultrasonic transducer FDU91-UN3AA, and Low Level, Off, On, High Level float switches	- Operator reported issue with the ultrasonic monitoring not responding (freezing) until the unit is reset. All float level switches should be connected to intrinsically safe relays. The level transducer is not rated for wet well class 1, zone 2 application. Note that without wet well ventilation operating, the wet well would be classified as class 1, zone 1.	1999	2015	15	-	13	3	$7,000	
Electrical	Instrumentation, Controls & Communications		SCADA	- Alarm dialer (DSC system)		1999	2009	15	-	7	1	-	
Electrical	Instrumentation, Controls & Communications		Radio / Modem	- Arris Shaw modem for telephone connection		1999	2009	15	-	7	1	-	
Electrical	Instrumentation, Controls & Communications		Antenna	- N/A		-	-	-	-	-	-	-	
					Electrical Overall Average Score:						**1.2**	**$7,000**	**$190,000**
					PS TOTAL SCORE:	**CIVIL**	**1.8**	**MECH**	**2.6**	**ELEC**	**1.2**	**$37,000**	**$991,500**

PARK DRIVE LIFT STATION

(note that all condition ratings, life estimates, and repair and replacement Class "D" costs estimates have been prepared as of best engineering judgment through site inspections carried out with Town staff in August 2017)

Inspection Date: August 24th, 2017
Inspected By: Michael Levin, Matt McCartney,Tjandra Tjondrotekodjojo, and Omid Saragazi
Accompanied By: Martin Barney

			Component	Make / Model / Material	General / H&S Comments	Commissioning Year	Rebuild Year	Typ. Life Expectancy (yrs)	Revised Life Expectancy (yrs)	Est. Remaining Life (yrs)	Condition Score (1-5)	Repair Cost Estimate (2017$)	Replacement Value (2017$)
Civil	Layout		Conform to Dwgs?	- Yes	- Drawing No. : 10-356-M1	-	-	-	-	-	-	-	-
	Facility	Building	Foundation	- N/A		-	-	-	-	-	-	-	-
			Superstructure	- N/A		-	-	-	-	-	-	-	-
			Roof	- N/A		-	-	-	-	-	-	-	-
		Yard	Fence	- Galvanized fence and barbed wire on top - Fences gate for vehicular access	- Fence connection at the entrance gate is moderately corroded. The replacement cost of the site fencing is $13,000. - Fence posts are attached to unreinforced concrete bases which are not reliable to provide support against imposed loads to the fences. The replacement cost of barbed wires with galvanized one and repair of the post bases as well as fence anti-corrosion are estimated at the cost of $4000. - Plywood sheets attached to the south side fence should be removed due to excessive induced force during the wind load. The removal of plywood sheets is at a cost of $2,000.	2011	-	20	-	14	2	$4,000	$17,000
			Access	- Operations staff have vehicular access		-	-	-	-	-	-	-	-
			Grounds	- Grounds are clear of vegetation and shrubbery. - Evenly prepared gravel surface. - The control panel kiosk base: Concrete base design, 1220x2890 mm in plan, unknown thickness. - The genset foundation: Concrete base, 1220x2450 mm in plan, unknown thickness - Moss on genset steel tie beam.	- Kiosk base: general good condition. Kiosk base should be sealed using a marine grade silicone sealant. - Genset foundation: general good condition. The replacement of Genset and kiosk foundation will be at a cost of $5,000. - Observation of corrosion on genset anchor bolts and maintenance is required at a cost of $1500. - Remove moss to prevent damage on Genset steel tie beam.	2011	-	50	-	44	2	$1,500	$5,000
	Foundations & Hydraulic Structures		Wet/Dry Well	- Fibreglass Reinforced Plastic (FRP) wet well with FRP roof and aluminum hatch and anti-floatation flange. - Dimensions: 1830mm DIA x 4200mm deep - Concrete foundation	- No observation of defect during inspection. - No detailed information regarding the wet well foundation or native soils	2011	-	50	-	44	2	-	$570,000
			Valve Chamber	- N/A		-	-	-	-	-	-	-	
			Ladders	- Aluminum ladder. (Featherlite series 4000 extra heavy duty) - Upper lower and intermediate ladder support brackets	- No observation of defect during inspection. No repair/replacement is required.	2011	-	30	-	24	1	-	
			Platforms	- Aluminum support frames and Shur Grip aluminum safety gratings plank	- No observation of defect during inspection. No repair/replacement is required.	2011	-	30	-	24	1	-	
			Railings	- N/A		-	-	-	-	-	-	-	
					Civil Overall Average Score:						**1.6**	**$5,500**	**$592,000**
Mechanical	Pumps		Pump Units	*Manufacturer; Serial #; Model; Impeller Diameter; Running Hours; Power (HP); Voltage/ Phase/ Frequency; Speed (RPM)*									
		P1	Duty Pump	Myers; 4Vx50M4-03; 4VX; 6.75"; 177; 5; 208/3/60; 1750	- Design condition: 8.2 L/s at 10.5 m - Drawdown test calculated flowrate at 8.1 L/s	2011	-	20	-	14	1	-	$50,000
		P2	Duty Pump	Myers; 4Vx50M4-03; 4VX; 6.75"; 496; 5; 208/3/60; 1750	- Design condition: 8.2 L/s at 10.5 m - Drawdown test not done	2011	-	20	-	14	1	-	$50,000
	Piping / Valves		HVAC	- Fan with explosionproof motor installed in end section of kiosk	- The fan is left operating continuously as it should - Filters were once installed over the punched louvres but were removed due to blockage	2011	-	10	-	4	1	-	$80,000
			Discharge Piping	- Coated steel piping	- Piping exterior coating is in good condition	2011	-	25	-	19	1	-	
			Suction Piping	- N/A	- No suction piping required as pumps are installed in wet well	-	-	-	-	-	-	-	
			Discharge Valves	- Flomatic Model 745 rubber flapper type check valve - Isolating plug valve: Homestead - SS ball valve where piping comes together prior to existing wet well	- check valve exterior coating is good. - plug valves has light exterior corrosion. - SS ball valve is in good condition. The valve's lever is corroding. This should be noted so the lever can be replaced in the future.	2011	-	25	-	19	1	-	
			Sumps	- N/A		-	-	-	-	-	-	-	
					Mechanical Overall Average Score:						**1**	**$0**	**$180,000**
Electrical	Power Distribution & Electrical		Standby Generator & ATS	- Cummins DSKCA - 6038093, serial No. I100159108, 25kW, 120/208V, 3 phase - Thomson Technology ATS, TS-883A0100A1BE2AKKAA, 100Amp	- Running hours: 26.9 hours	2011	-	15	-	9	1	-	$50,000
			Electrical Panels	- Engineered Pump Systems	- Generally in good condition, general cleaning of the kiosk especially in the fan and junction box required - Kiosk ventilation fan operation should be installed and connected to the alarm dialer	2011	-	30	-	24	2	$2,000	$100,000
			Service Entrance	- Federal Pioneer Fused Disconnect Switch, 100A, 120/208V, 3 phase		2011	-	30	-	24	1	-	
			Surge Suppressor	- Square-D SDSA3650	- Phase B surge suppressor is not functioning, Check the wiring or replace the surge suppressor	2011	-	15	-	9	2	$600	
			Starter #1	- Allen Bradley manual starter 140M-C2E-C25 plus Allen Bradley contactor 100-C30	- Overload set at 18 Amps	2011	-	20	-	14	1	-	
			Starter #2	- Allen Bradley manual starter 140M-C2E-C25 plus Allen Bradley contactor 100-C30	- Overload set at 18 Amps	2011	-	20	-	14	1	-	
	Instrumentation, Controls & Communications		Controller Data (RTU/PLC)	- Schneider SR3B101FU smart relay for each pump		2011	-	15	-	9	1	-	$40,000
			Operational Interface	- N/A		-	-	-	-	-	-	-	
			Level Control System	- Siemens Milltronic Multiranger 100 with XPS15 transducer, and High and Low level float switches as backup	- It appears that a new Low level float switch was added, which the EYS was not sealed. EYS must be sealed to prevent hazardous gases from wet well escaping to the electrical panel. This new level switch was also not connected through a intrinsically safe relay. Milltronics transducer installation does not meet the Class 1, Zone 2 area installation requirements as recommended by the manufacturer.	2011	-	15	-	9	3	$3,000	
			SCADA	- Barnet ProTalk Plus Alarm Dialer with battery backup		2011	-	15	-	9	1	-	
			Radio / Modem	- Arris Shaw modem for telephone connection		2011	-	15	-	9	1	-	
			Antenna	- N/A		-	-	-	-	-	-	-	
					Electrical Overall Average Score:						**1.4**	**$5,600**	**$190,000**
					PS TOTAL SCORE:	**CIVIL**	**1.6**	**MECH**	**1**	**ELEC**	**1.4**	**$11,100**	**$962,000**

SWETTENHAM LIFT STATION

(note that all condition ratings, life estimates, and repair and replacement Class "D" costs estimates have been prepared as of best engineering judgment through site inspections carried out with Town staff in August 2017)

Inspection Date: August 24th, 2017
Inspected By: Michael Levin, Matt McCartney,Tjandra Tjondrotekodjojo, and Omid Saragazi
Accompanied By: Martin Barney

			Component	Make / Model / Material	General / H&S Comments	Commissioning Year	Rebuild Year	Typ. Life Expectancy (yrs)	Revised Life Expectancy (yrs)	Est. Remaining Life (yrs)	Condition Score (1-5)	Repair Cost Estimate (2017$)	Replacement Value (2017$)
Civil	Layout		Conform to Dwgs?	- Yes	- Drawing No. : 07-139-M1	-	-	-	-	-	-	-	-
Civil	Facility	Building	Foundation	- N/A		-	-	-	-	-	-	-	-
Civil	Facility	Building	Superstructure	- N/A		-	-	-	-	-	-	-	-
Civil	Facility	Building	Roof	- N/A		-	-	-	-	-	-	-	-
Civil	Facility	Yard	Fence	- Galvanized fence and barbed wire on top. - Fences gate for vehicular access.	- Fences connection elements at the entrance gate are slightly corroded. The replacement cost of the site fencing is $13,000. - Fence posts are attached to unreinforced concrete bases which are not reliable to provide support against imposed loads to the fences. The replacement cost of barbed wires with galvanized one and repair of the post bases as well as fence anti-corrosion are estimated at the cost of $4000.	2008	-	20	-	11	2	$4,000	$17,000
Civil	Facility	Yard	Access	- Operation staff have vehicular access. - Existing barrier at the front gate.	- The slope (15%) of the adjacent road to the lift station presents some safety concerns. - Installation of bollards are recommended at a cost of $10,000.	2008	-	50	-	41	3	$10,000	$10,000
Civil	Facility	Yard	Grounds	- Grounds are clear of vegetation and shrubbery - The control panel kiosk base: 1200x2500 mm in plan, unknown thickness -The genset foundation: 1300x2400 mm in plan, unknown thickness	- Kiosk base: general good condition. No replacement is required. Kiosk base should be sealed using a marine grade silicone sealant.The replacement of genset and kiosk foundation will be at a cost of $5,000. - No information about the sufficiency of genset anchor bolts during seismic event is provided. Maintanence is recommended at a cost of $1,500. - Genset foundation: general good condition. No repair/replacement is required.	2008	-	50	-	41	3	$1,500	$5,000
Civil	Foundations & Hydraulic Structures		Wet/Dry Well	- Fibreglass Reinforced Plastic (FRP) wet well with FRP roof and hatch cover with anti-floatation flange. - Dimensions: 1830 mm DIA x 3680 mm deep - Concrete foundation	- No observation of defect during inspection. No repair/replacement is required. - Grease build-up inside the wet well has been observed. The grease clogs the pipes and reduces the service life of pumps leading to forcemain backups and SSO's. - No detailed information regarding the wet well foundation or native soils	2008	-	50	-	41	2	-	$570,000
Civil	Foundations & Hydraulic Structures		Valve Chamber	- N/A		-	-	-	-	-	-	-	
Civil	Foundations & Hydraulic Structures		Ladders	- Aluminum ladder (Featherlite series 4000 extra heavy duty)	- No observation of defect during inspection. No repair/replacement is required.	2008	-	30	-	21	1	-	
Civil	Foundations & Hydraulic Structures		Platforms	- Aluminum support frames and Shur Grip aluminum safety gratings plank	- No observation of defect during inspection. No repair/replacement is required.	2008	-	30	-	21	1	-	
Civil	Foundations & Hydraulic Structures		Railings	- N/A		-	-	-	-	-	-	-	
					Civil Overall Average Score:						**2**	**$15,500**	**$602,000**
Mechanical	Pumps		Pump Units	*Manufacturer* / *Serial #* / *Model* / *Impeller Diameter* / *Running Hours* / *Power (HP)* / *Voltage/ Phase/ Frequency* / *Speed (RPM)*									
Mechanical	Pumps	P1	Duty Pump	FE Myers / 4RHX150M2-53 / 4VX / 5.75" / 759 / 15 / 575/3/60 / 3450	- Design condition: 8.2 L/s at 24.7 m - Drawdown test calculated flowrate at 9.8 L/s - Impeller was recently replaced with same size	2008	-	20	-	11	1	-	$50,000
Mechanical	Pumps	P2	Duty Pump	FE Myers / 4RHX150M2-53 / 4VX / 5.75" / 985 / 15 / 575/3/60 / 3450	- Design condition: 8.2 L/s at 24.7 m - Drawdown test calculated flowrate at 5.9 L/s - Impeller has not been replaced resulting in the pump discharging at about 40% of the other pump	2008	-	20	-	11	3	$5,000	$50,000
Mechanical	Piping / Valves		HVAC	- Fan with explosionproof motor installed in end section of kiosk	- The fan is left operating continuously as it should. - Filters were once isntalled over the punched louvres but were removed due to blockage.	2008	-	10	5	5	1	-	$80,000
Mechanical	Piping / Valves		Discharge Piping	- Coated steel piping	- Piping exterior coating is in good condition	2008	-	25	-	16	1	-	
Mechanical	Piping / Valves		Suction Piping	- N/A	- No suction piping required as pumps are installed in wet well	-	-	-	-	-	-	-	
Mechanical	Piping / Valves		Discharge Valves	- 100mm Flomatic Model 78 rubber flapper type check valve. - 100mm Isolating plug valve: Hosemstead Series 120. - SS ball valve where piping comes together prior to existing wet well.	- check valve exterior coating is good. - plug valves has light exterior corrosion. - SS ball valve is in good condition. The valve's lever is corroding. This should be noted so the lever can be replaced in the future.	2008	-	25	-	16	1	-	
Mechanical	Piping / Valves		Sumps	- N/A		-	-	-	-	-	-	-	
					Mechanical Overall Average Score:						**1.4**	**$5,000**	**$180,000**
Electrical	Power Distribution & Electrical		Standby Generator & ATS	- Cummins DGGD - 5935382, serial No. I070109273, 35kW, 347/600V, 3 phase - Thomson Technology ATS, TS-883A0100A1BW2AKKAA, 100Amp, s/n W-046490	- Generator running hours: 75.2 hours. Genset wiring either for Fuel Leak or Low Fuel alarm appears to be broken..	2008	-	20	-	11	3	$2,000	$50,000
Electrical	Power Distribution & Electrical		Electrical Panels	- Engineered Pump Systems electrical kiosk s/n 07-138-1	- Generally in good condition, general cleaning of the kiosk especially in the fan and junction box required	2007	-	30	-	20	2	$400	$100,000
Electrical	Power Distribution & Electrical		Service Entrance	- Federal Pioneer Fused Disconnect Switch, 100A, 600V, 3 phase		2008	-	30	-	21	1	-	
Electrical	Power Distribution & Electrical		Surge Suppressor	- Square-D SDSA3650		2008	-	15	-	6	1	-	
Electrical	Power Distribution & Electrical		Starter #1	- Allen Bradley manual starter 140M-C2E-C20 plus Allen Bradley contactor 100-C23	- Overload set at 20 Amps	2008	-	20	-	11	1	-	
Electrical	Power Distribution & Electrical		Starter #2	- Allen Bradley manual starter 140M-C2E-C20 plus Allen Bradley contactor 100-C23	- Overload set at 20 Amps	2008	-	20	-	11	1	-	
Electrical	Instrumentation, Controls & Communications		Controller Data (RTU/PLC)	- Milltronics controls and relay logic		2008	-	15	-	6	1	-	$40,000.0
Electrical	Instrumentation, Controls & Communications		Operational Interface	- N/A		-	-	-	-	-	-	-	
Electrical	Instrumentation, Controls & Communications		Level Control System	- Siemens Milltronic Multiranger 100 with XPS15 transducer, and High and Low level float switches as backup	- Milltronics controls with Low and High level float switches backup. Float level switches should be connected to intrinsically safe relays. Milltronics transducer installation does not meet the Class 1, Zone 2 area installation requirements as recommended by the manufacturer.	2008	-	15	-	6	3	$2,000	
Electrical	Instrumentation, Controls & Communications		SCADA	- Barnet ProTalk Plus Alarm Dialer with battery backup		2008	-	15	-	6	1	-	
Electrical	Instrumentation, Controls & Communications		Radio / Modem	- N/A		-	-	-	-	-	-	-	
Electrical	Instrumentation, Controls & Communications		Antenna	- N/A		-	-	-	-	-	-	-	
					Electrical Overall Average Score:						**1.6**	**$4,400**	**$190,000**
					PS TOTAL SCORE:	**CIVIL**	**2**	**MECH**	**1.4**	**ELEC**	**1.6**	**$24,900**	**$972,000**

TRANSFER BEACH LIFT STATION

(note that all condition ratings, life estimates, and repair and replacement Class "D" costs estimates have been prepared as of best engineering judgment through site inspections carried out with Town staff in August 2017)

Inspection Date: August 24th, 2017
Inspected By: Michael Levin, Matt McCartney,Tjandra Tjondrotekodjojo, and Omid Saragazi
Accompanied By: Martin Barney

			Component	Make / Model / Material	General / H&S Comments	Commissioning Year	Rebuild Year	Typ. Life Expectancy (yrs)	Revised Life Expectancy (yrs)	Est. Remaining Life (yrs)	Condition Score (1-5)	Repair Cost Estimate (2017$)	Replacement Value (2017$)
Civil	Layout		Conform to Dwgs?	- N/A	- No drawings provided	-	-	-	-	-	-	-	-
	Facility	Building	Foundation	- N/A		-	-	-	-	-	-	-	-
			Superstructure	- N/A		-	-	-	-	-	-	-	-
			Roof	- N/A		-	-	-	-	-	-	-	-
		Yard	Fence	- No fences	- Close to crowded public beach and adjacent to children's water park. Installation of fences may pose additional hazard to children. No recommendation for fencing is provided.	-	-	-	-	-	-	-	-
			Access	- Operations staff have no vehicular access. - Operation staff access in park	- Adjacent to children's water park	-	-	-	-	-	-	-	-
			Grounds	- Adjacent to tree and bushes - Kiosk base :1400x1830 mm in plan, unknown depth	- No observation of defect during inspection. No repair/replacement is required. The replacement cost of kiosk foundation is at a cost of $5000	1991	-	50	-	24	1	-	$5,000
	Foundations & Hydraulic Structures		Wet/Dry Well	- Concrete wet well - Concrete foundation	- Hatch frame and lid are moderately corroded. The anti-corrosion of the hatch is at a cost of $2000. - No detailed information regarding the wet well foundation or native soils.	1991	-	50	-	24	2	$58,000	$700,000
			Valve Chamber	- N/A		-	-	-	-	-	-	-	
			Ladders	- Aluminium ladder	- No replacement is required	1991	-	30	10	10	1	-	
			Platforms	- N/A	- Platform is recommended	-	-	-	-	-	-	-	
			Railings	- N/A	- Railings are recommended	-	-	-	-	-	-	-	
					Civil Overall Average Score:						1.3	$58,000	$705,000
Mechanical	Pumps	P1	Duty Pump	(see pump units below)	- Design condition: unknown - Drawdown test not performed - pump rails appear to be in good condition. Pumps and bases were not visible. - pump chains appear to be in good condition	1991	2010	20	-	13	1	-	$10,000
		P2	Duty Pump	(see pump units below)	- Design condition: unknown - Drawdown test calculated flowrate at 16.8 L/s. This is with an assumed 155mm diameter impeller - pump rails appear to be in good condition. Pumps and bases were not visible. - pump chains appear to be in good condition	1991	2010	20	-	13	1	-	$10,000
	Piping / Valves		HVAC	- N/A	- no goosenecks are provided due to park setting.	-	-	-	-	-	-	-	$10,000
			Discharge Piping	- threaded galvanized steel piping and fittings	- some piping heavily corroded where pipe threads are visible. - remainer of piping has spots of corrosion.	1991	-	25	-	0	2	$1,000	
			Suction Piping	- No suction piping as pumps are installed in wet well		-	-	-	-	-	-	-	
			Discharge Valves	- 50mm ball type check valves, - 50mm isolating gate valves, threaded	- check valves make and model not known - gate valves make and model not known - have corrosion on exterior of valves - gate valves do not have handwheels. Shaft is in contact with wet well wall	1991	-	25	-	0	2	-	
			Sumps	- N/A		-	-	-	-	-	-	-	
					Mechanical Overall Average Score:						1.5	$1,000	$30,000
Electrical	Power Distribution & Electrical		Standby Generator & ATS	- N/A		-	-	-	-	-	-	-	$50,000
			Electrical Kiosk	- Allied Controls Control panel		1991	-	30	-	4	1	-	$100,000
			Service Entrance	- N/A	- Siemens EQ Load Centre 40A	1991	-	30	-	4	1	-	
			Surge Suppressor	- N/A		-	-	-	-	-	-	-	
			Starter #1	- Klockner Moeller manual starter ZM-25-PKZ2 with contactor DIL 3-22-NA	- Overload set at 25 Amps	1991	2000	20	-	3	1	-	
			Starter #2	- Klockner Moeller manual starter PKZM 3-10 with contactor DIL 3-22-NA	- Overload set at 25 Amps	1991	2000	20	-	3	1	-	
	Instrumentation, Controls, & Communications		Controller Data (RTU)	- N/A		-	-	-	-	-	-	-	$40,000
			Operational Interface	- N/A		-	-	-	-	-	-	-	
			Level Control System	- Relay Logic float level swicthes	- Level switches should be connected to intrinsically safe relays. No EYS seals are identified for conduits between wet well and control panel.	1991	-	15	-	0	3	$3,000	
			SCADA	- Alarm dialer (DSC system)	- Alarm panel is not easily acceesible due to very small kiosk	1991	-	15	-	0	1	-	
			Radio / Modem	- N/A		-	-	-	-	-	-	-	
			Antenna	- N/A		-	-	-	-	-	-	-	
					Electrical Overall Average Score:						1.3	$3,000	$190,000
					PS TOTAL SCORE:	CIVIL	1.333333	MECH	1.5	ELEC	1.3	$62,000	$925,000

Pump Units		Manufacturer	Serial #	Pump Model	Impeller #	Running Hours	Power (HP)	Voltage/ Phase/ Frequency	Speed (RPM)
P1	Duty Pump	Flygt	3102.170-1080016	3102.170-0742	267	754	5.4	230/1/60	3490
P2	Duty Pump	Flygt	3102.170-1080017	3102.170-0742	267	710	5.4	230/1/60	3490

APPENDIX B | SITE-SPECIFIC BREAKDOWN OF REPAIRS AND MAINTENANCE RECOMMENDATIONS

Lift Stations:

1. Gill Road Lift Station
    - The pump house asphalt shingle roof should be repaired: $7,000
    - The station is proximate to the Ocean. The railing around the facility is recommended for safety during high tide: $60,000
    - Geotechnical assessment of the unretained wall of soil: $6,000
    - Construction of the retaining wall of soil adjacent to the station: $85,000
    - A crack on the surrounding concrete slab was observed from the corner of the wet well to the retaining pony wall. The concrete crack repair is at a cost of $5,000
    - Structural components inside the wet well including railing, platforms and Ladder: $11,000
    - Level Control System: Level switches should be connected to intrinsically safe relays. No EYS seals are identified for conduits between wet well and control panel: $3,000.
    - Manual Transfer switch size may be to small and not protected if loads exceed 200A :$4,000.
    - Service entrance: the station is an ungrounded system. Ground fault monitoring device should be installed: $5,000.

2. Sandy Beach Lift Station
    - The station is proximate to the Ocean. The railing around the facility is recommended for safety during high tide: $30,000.
    - Proper support and base should be provided for kiosk base: $5,000.
    - The hatch frames are corroded. Corrosion needs to be removed and new corrosion protection layer should be applied on the surface: $2,000.
    - Removal of the grease build-up: $30,000
    - Structural components inside the wet well including railing, platforms and Ladder: $8,000
    - Recoat check valve, piping and isolation due to moderate to severe corrosion: $12,500
    - General cleaning of the electrical panels should be conducted: $400.
    - Service Entrance: the station is an ungrounded system. Ground fault monitoring device should be installed: $5,000.
    - Level Control System: Level switches should be connected to intrinsically safe relays. No EYS seals are identified for conduits between wet well and control panel: $3,000.
3. Ludlow Lift Station
    - Repairing the unreinforced concrete bases of the fence posts and replacing the barbed wires with galvanized ones and the fence anti-corrosion: $4,000.
    - Use of bollards are recommended at the entrance gate: $10,000.
    - The site elevation is 1.5m higher than the marine yard to the northeast. The difference of elevation is retained by concrete blocks. A geotechnical assessment of the stability and capacity of the retaining concrete blocks during earthquake is recommended: $6,000.
    - Construction of lock wall block: $5,500.
    - Kiosk base: anchor bolts anti corrosion: $1,500.
    - HVAC: the fan is broken and should be replaced: $4,000.

- Anti-corrosion of piping, isolations and check valves: $5,000.
- Level Control System: Operator reported issue with the ultrasonic monitoring not responding (freezing) until the unit is reset. All float level switches should be connected to intrinsically safe relays and the ventilation fan is not working and should be replaced: $7,000.

4. Park Drive Lift Station
    - Repairing the unreinforced concrete bases of the fence posts and replacing the barbed wires with galvanized ones and the fence anti-corrosion: $4,000.
    - The removal of plywood sheets at the southside fences: $2,000.
    - Genset anchor bolts maintenance: $1,500.
    - Control Level System: It appears that a new low level float switch was added, which the EYS was not sealed. EYS must be sealed to prevent hazardous gases from wet well escaping to the electrical panel. This new level switch was also not connected through a intrinsically safe relay: $3,000.
    - Electrical panel: General cleaning of the kiosk especially in the fan and junction box required. Kiosk ventilation fan operation should be installed and connected to the alarm dialer: $2,000.
    - Surge Suppressor: Phase B surge suppressor is not functioning, Check the wiring or replace the surge suppressor: $600.

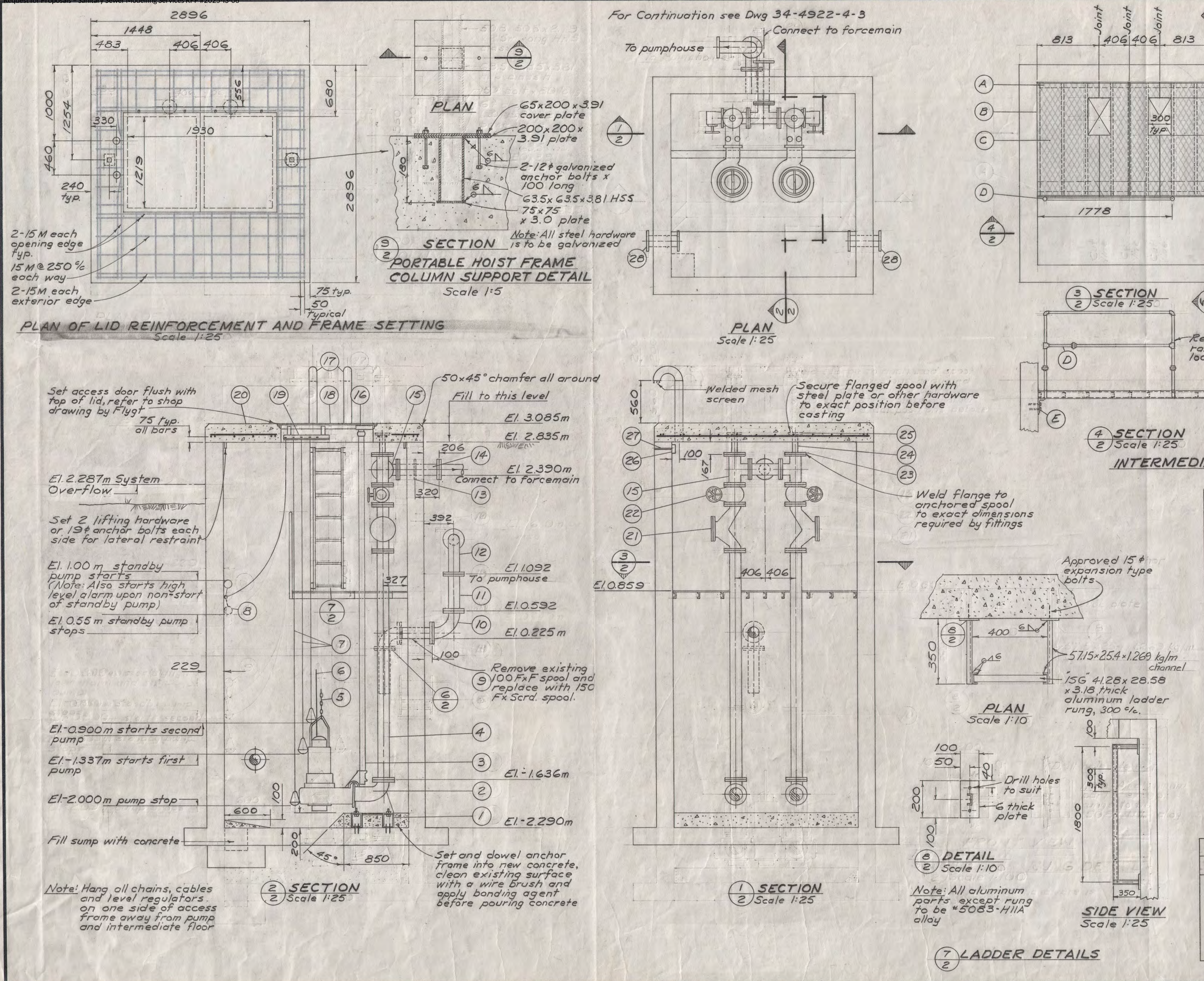
5. Swettenham Lift Station
    - Repairing the unreinforced concrete bases of the fence posts and replacing the barbed wires with galvanized ones and the fence anti-corrosion: $4,000.
    - Use of bollards are recommended at the entrance gate for safety issues: $10,000.
    - Genset anchor bolts maintenance: $1,500.
    - Removal of the grease build-up: $30,000.
    - Pump 2: The impeller has not been replaced resulting in the pump discharging about the %40 of the other pump: $5,000.
    - Milltronics controls with Low and high level float switches backup. Float level switches should be connected to intrinsically safe relays: $2,000.
    - General cleaning of the kiosk: $400.
    - Genset wiring either for fuel leak or low fuel alarm appears to be broken. Repair cost: $2,000.

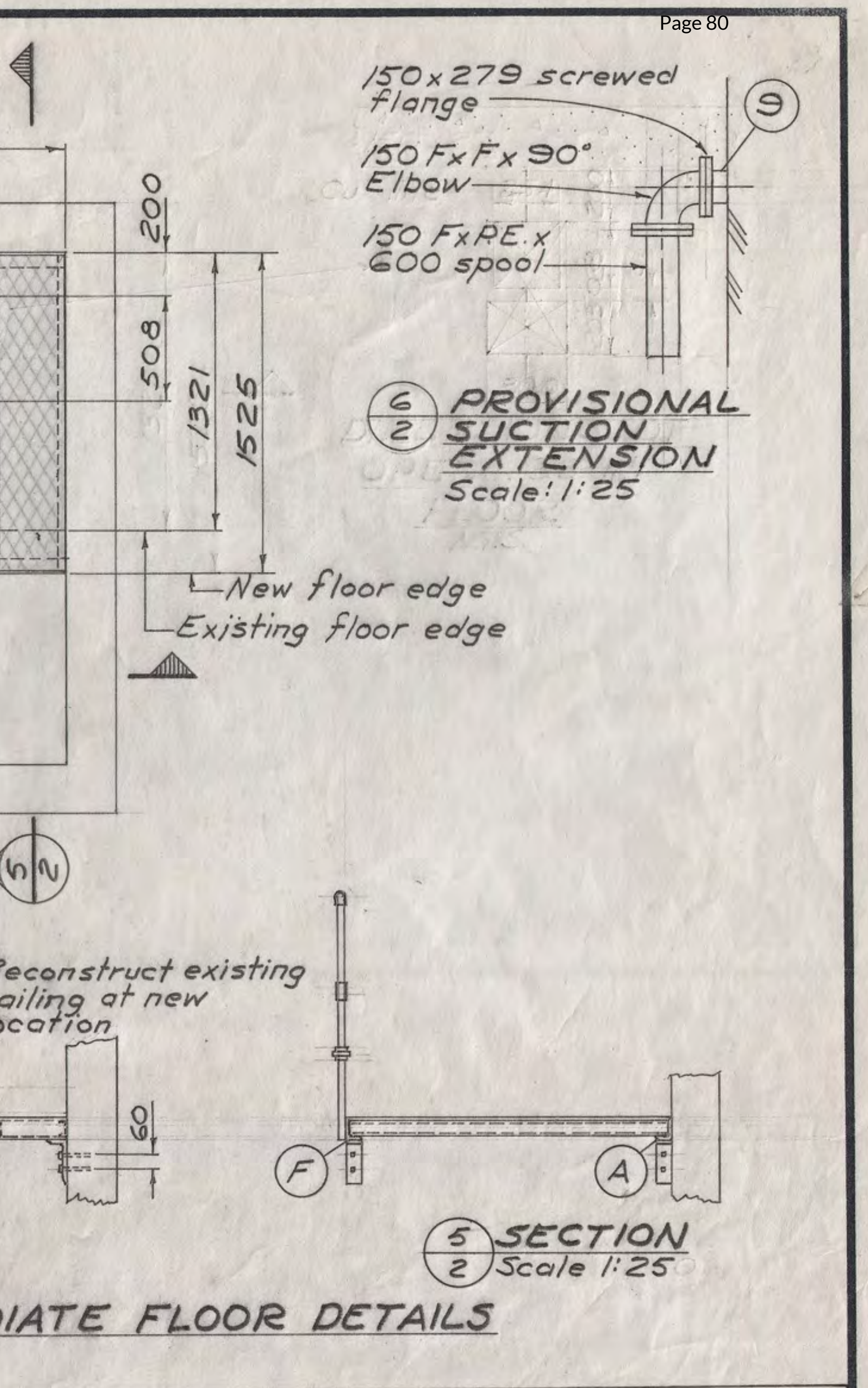
6. Transfer Beach Lift Station

    - Level switches should be connected to intrinsically safe relays. No EYS seals are identified for conduits between wet well and control panel: $3,000.
    - Some piping heavily corroded. Anti-corrosion is required: $1,000.
    - The hatch frames and lid are corroded. Corrosion needs to be removed and new corrosion protection layer should be applied on the surface: $2,000.

APPENDIX C | LIFT STATION AS-BUILT DRAWINGS PROVIDED BY THE TOWN

For Continuation see Dwg 34-4922-4-3





Pump Station Materials List			
No.	Quantity	Item	Supplier
1	2	Flygt anchor frame No.13-052-00-77	Flygt
2	2	Flygt pump CP 3201 HT impeller 454 with 150 mm discharge connections	Flygt
3	4	75 diam. galvanized schedule 40 guide bars, length to suit	Contractor
4	2	150 diam. F x F cast iron pipe, length to suit	Contractor
5	2	6 m chain with shackle	Flygt
6	2	6 m of No. 4/8 cabtire cable	Flygt
7	3	Level regulators	Flygt
8	1	Mercury double action level regulator	Contractor
9	1	150 F x S x 430 long cast iron spool	Contractor
10	1	150 F x F x 90° cast iron long radius elbow	Contractor
11	1	160 F x F x 500 long Sclair pipe series 80 spool	Contractor
12	1	160 F x F x 90° long radius Sclair pipe elbow, Series 80	Contractor
13	1	279 welded flange	Contractor
14	1	150 F x F x 558 long spool	Contractor
15	3	150 F x F x F Tee	Contractor
16	2	Upper guide holders No.319-59-00	Flygt
17	2	100 galvanized iron vent	Contractor
18	2	Flygt access frame and door No.13-052 01-00 c/w connecting bar	Flygt
19	1	Level regulator hanger No.13-052-00-06	Flygt
20	1	Precast conrete manhole lid 2896 x 2896 x 250	Contractor
21	2	Flygt 150 check valve type 2016	Flygt
22	2	150 X-Centric gate valve	Flygt
23	2	279 blind flange	Contractor
24	2	75 diam. x 290 long galvanized iron pipe welded to 279 blind flange	Contractor
25	2	191 x 75 screwed flange	Contractor
26	3	Explosion proof junction box	Contractor
27	1	Electrical duct through wall	Contractor
28	2	150 F x F x 432 long spool	Existing

Intermediate Floor Materials List			
No.	Quantity	Item	Supplier
A	1	102 x 76 x 6 angle	Existing
B	9	75 x 6 channel	Contractor
C	1	Armco Grating type BB with 19 x 5 straight bars and 16 x 3 cross bars and standard black paint (4 sections)	Contractor
D	1	Handrail (welded to angle)	Existing
E	2	89 x 200 x 8 x 76 wide bracket (installed at new position c/w 19 diam. expansion type anchor bolts)	Existing
F	1	100 x 75 x 6 angle	Contractor

Gill Road

No.	REVISION DESCRIPTION	DATE	BY

DESIGN S.N.
DRAWN J.S.D.
CHECKED SN / MM
APPROVED
DATE: 18 MAR. 82
FIELD BOOK No.
SEAL

Willis Cunliffe Tait | DeLCan
CONSULTING ENGINEERS & PLANNERS

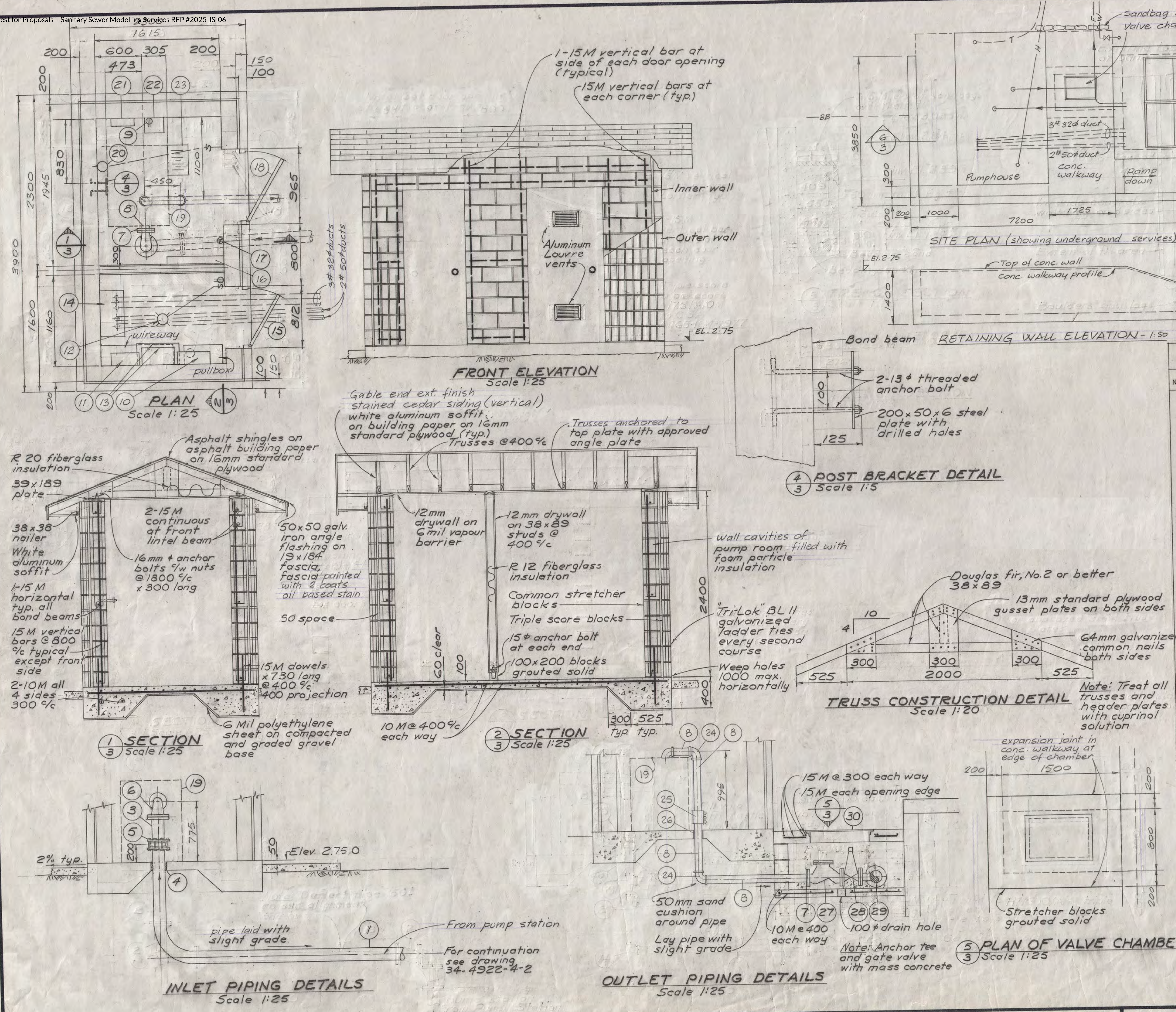
TOWN OF LADYSMITH
SEWERAGE PROGRAM 1982
SEWAGE PUMP STATION NO. 45 - DETAILS

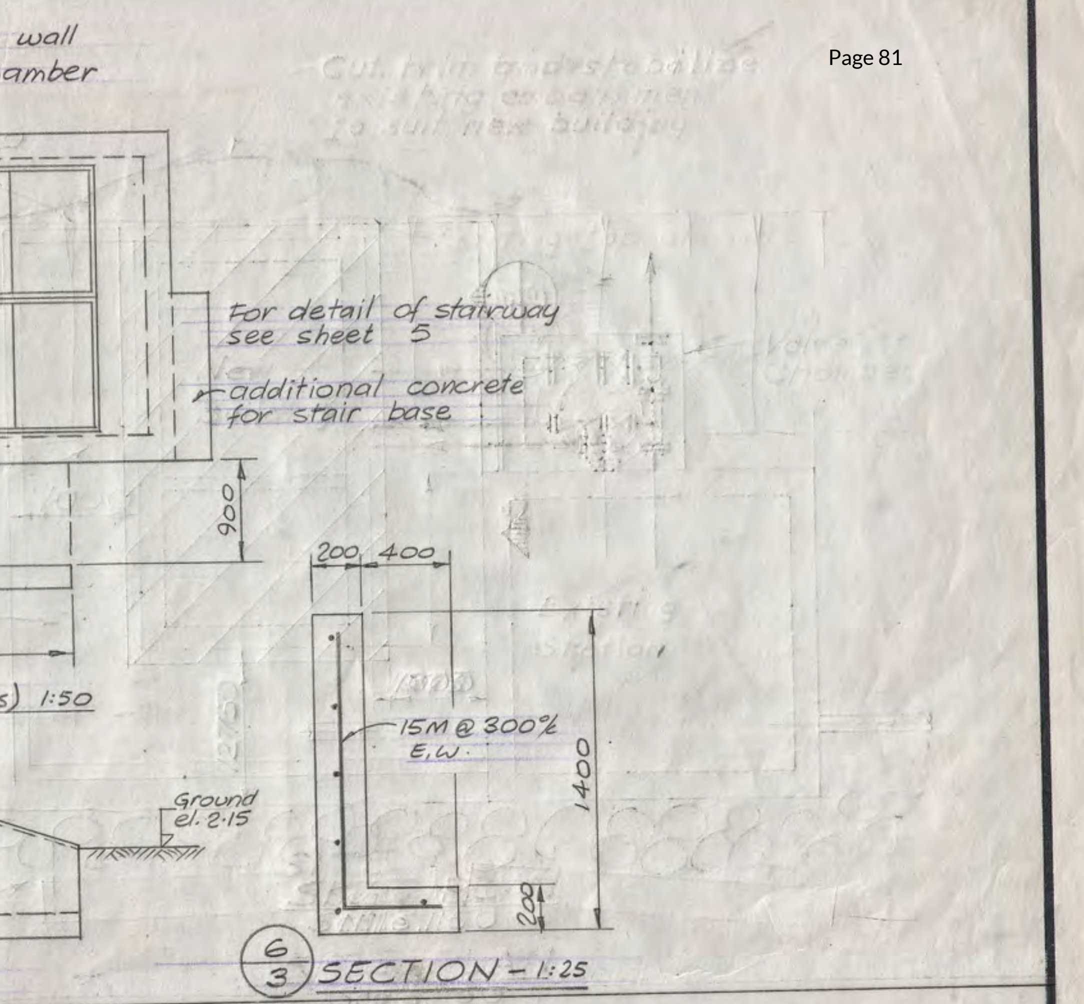
SUPERCEDED

SHEET No. 2 OF 4
REV.
DRAWING No. 34-4922-4-2

SHEET No. ___ OF ___
DRAWING No.
VANCAL-7181A1

DRAWING No. SHEET No. OF





STANDBY PUMP STATION MATERIALS LIST

No.	Quantity	Item	Supplier
1	1	150 diam. F x P.E. galvanized schedule 40 pipe	Contractor
2			
3	1	150 F x P.E. galvanized schedule 40 pipe length 375 mm	Contractor
4	1	Expansion joint	Contractor
5	1	Smith Blair stainless steel coupling	Contractor
6	1	150 F x 100 F x 90° cast iron reducing elbow	Contractor
7	2	229 Screwed cast iron flange	Contractor
8	5	100 S x S galvanized cast iron pipe, length to suit	Contractor
9	2	duplex receptable	Contractor
10	1	400 Amp circuit breaker	Contractor
11	1	4-circuit breaker distribution panel	Contractor
12	1	110 volt incandescent ceiling light fixture	Contractor
13	1	Electrical meter cabinets (meter by B.C.Hydro)	Contractor-
14	1	Flygt Duplex Control Panel	Flygt
15	1	762 x 1954 mahogany solid wooden door c/w brass hinge hardware, Weiser dead bolt lock, pull handle	Contractor
16	1	Chromalex 500 watt baseboard heater	Contractor
17	1	Electric baseboard heater thermostat	Contractor
18	1	914 x 1954 mahogany solid wooden door c/w brass hinge hardware, upper and lower aluminum louver vent each with 200 x 300 opening and Weiser dead bolt lock, pull handle	Contractor
19	1	Monarch self-priming trash pump model E774GV c/w electric start	Woodland Supplies
20	1	12 volt D.C. marine light fixture	Woodland Supplies
21	1	Automatic Control Panel for Standby Pump	Woodland Supplies
22	1	6 Amp battery charger with overload protection	Woodland Supplies
23	1	Heavy Duty 12 volt battery	Woodland Supplies
24	2	100 S x S x 90° galvanized iron bend	Contractor
25	1	Stainless steel Smith Blair coupling	Contractor
26	1	Expansion joint	Contractor
27	1	Flygt HDL 100 diam. Check valve	Flygt
28	1	Terminal City 100 F x F gate valve, NRS	Contractor
29	1	Terminal City 150 F x F x 100 F Tee	Contractor
30	1	Flygt access frame and door 13-052-00-67 set into cast-in-place concrete slab	Flygt

Concrete and Masonry Notes

1. Concrete to be designed, mixed, placed and cured in accordance with CSA Standards CAN3-A 23.1-M77 and CAN 3-A 23.2-M77
   Type 50 cement
   Minimum compressive strength of 25 MPa at 28 days
   Maximum aggregate size of 19 mm
   Maximum slump of 50 mm ± 12 mm
   Air entrainment of 5 ± 1%
2. Reinforcing steel to be grade 300 deformed bars in accordance with CSA Standard G.30.12
3. Masonry blocks to be H/7.5/A/O units to C.S.A. A.165.1-M-1977
4. Masonry grout to have minimum strength of 15 MPa at 28 days. Maximum slump of 150 mm, and maximum aggregate of 19 mm
5. Grouting to be done in maximum lift of 1200 mm

Interior wall and ceiling finish :

2 coats of white, oil base semi-gloss paint on sanded smooth drywall

Door Finish: 2 coats of approved marine brown stain and 3 coats of marine varnish

Floor slab finish: Smooth trowel finish

Walkway finish : broomed skid resistant finish

No.	REVISION DESCRIPTION	DATE	BY
A	Record drawing	8 Mar 83	KC

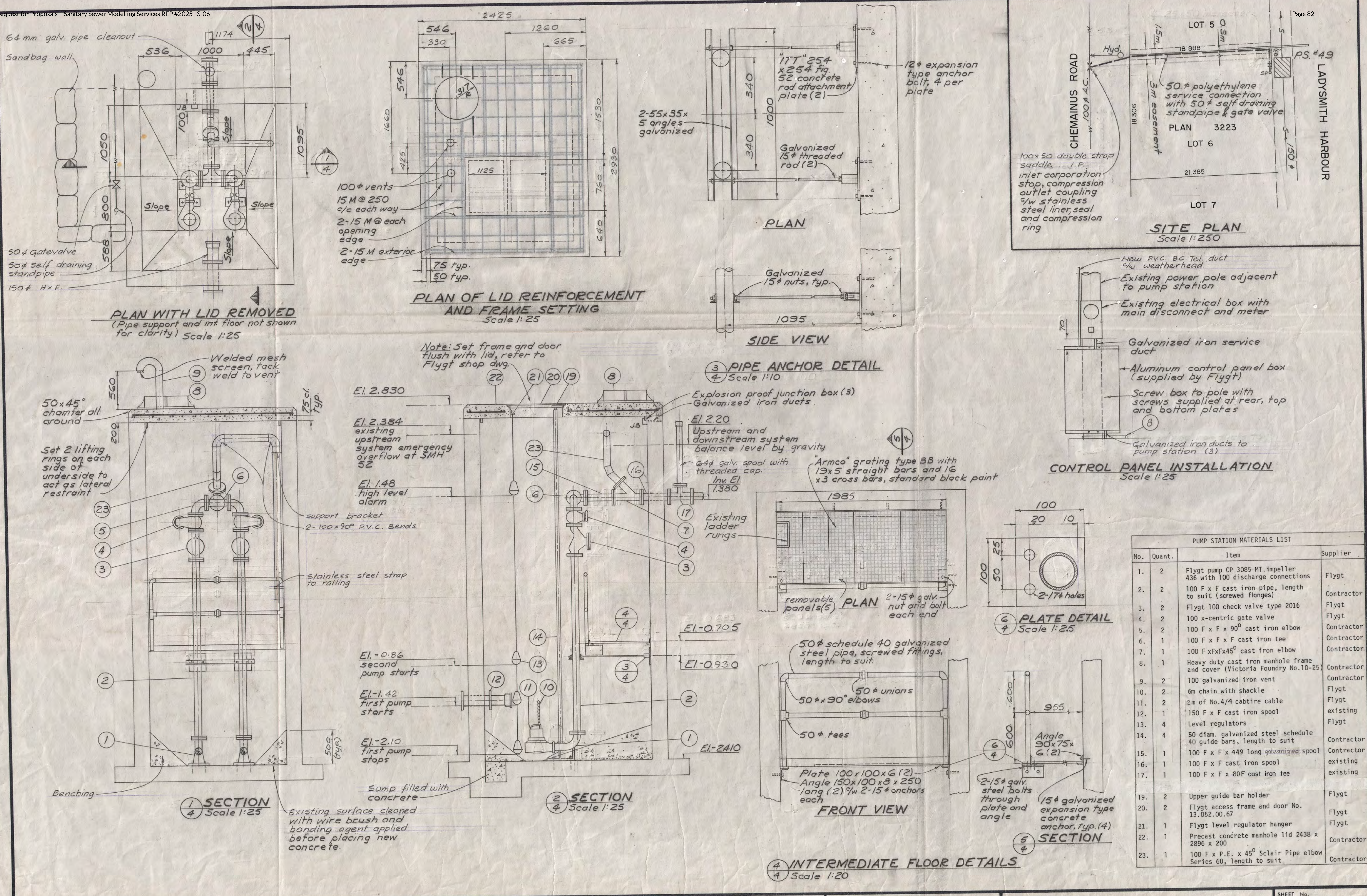
DESIGN S. N.
DRAWN J.S.D.
CHECKED
APPROVED
DATE 16 MAR. 82
FIELD BOOK No. 2-1980

SEAL

Willis Cunliffe Tait | DelCan
CONSULTING ENGINEERS & PLANNERS

TOWN OF LADYSMITH
SEWERAGE PROGRAM 1982
STANDBY PUMPHOUSE — DETAILS

SHEET No. 3 OF 5 REV. A
DRAWING No. 34-4922-4-3



PUMP STATION MATERIALS LIST			
No.	Quant.	Item	Supplier
1.	2	Flygt pump CP 3085 MT. impeller 436 with 100 discharge connections	Flygt
2.	2	100 F x F cast iron pipe, length to suit (screwed flanges)	Contractor
3.	2	Flygt 100 check valve type 2016	Flygt
4.	2	100 x-centric gate valve	Flygt
5.	2	100 F x F x 90° cast iron elbow	Contractor
6.	1	100 F x F x F cast iron tee	Contractor
7.	1	100 F xFxFx45° cast iron elbow	Contractor
8.	1	Heavy duty cast iron manhole frame and cover (Victoria Foundry No.10-25)	Contractor
9.	2	100 galvanized iron vent	Contractor
10.	2	6m chain with shackle	Flygt
11.	2	12m of No.4/4 cabtire cable	Flygt
12.	1	150 F x F cast iron spool	existing
13.	4	Level regulators	Flygt
14.	4	50 diam. galvanized steel schedule 40 guide bars, length to suit	Contractor
15.	1	100 F x F x 449 long galvanized spool	Contractor
16.	1	100 F x F cast iron spool	existing
17.	1	100 F x F x 80F cast iron tee	existing
19.	2	Upper guide bar holder	Flygt
20.	2	Flygt access frame and door No. 13.052.00.67	Flygt
21.	1	Flygt level regulator hanger	Flygt
22.	1	Precast concrete manhole lid 2438 x 2896 x 200	Contractor
23.	1	100 F x P.E. x 45° Sclair Pipe elbow Series 60, length to suit	Contractor

Sandy Beach

No.	REVISION DESCRIPTION	DATE	BY
A	RECORD DRAWING	30 MAR 83	KC

DESIGN S.N.
DRAWN J.S.D.
CHECKED
APPROVED
DATE 30 MAR 1982
FIELD BOOK No.
SEAL

Willis Cunliffe Tait | DeLCan
CONSULTING ENGINEERS & PLANNERS

TOWN OF LADYSMITH
SEWERAGE PROGRAM 1982
SEWAGE PUMP STATION NO. 49 - DETAILS

SHEET No. 4 OF 5 REV. A
DRAWING No. 34-4922-4-4

SHEET No. ___ OF ___
DRAWING No. ___

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w: www.opusdaytonknight.com

Appendix C -Flow Monitoring Program Report

Town of Ladysmith

2017 Flow Monitoring Program

Final Report

April 9, 2018

Town of Ladysmith

2017 Flow Monitoring Program

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Canada

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PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
C. W. LEUNG
41265
April 9, 2018

Approved for Release By:
Paramjeet Mankoo, C.Eng.

Reference: D-21810.00
Status: Final

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1 Introduction

1.1 Background

The Town of Ladysmith ("Town") has retained Opus International Consultants (Canada) Ltd. ("WSP | Opus") to implement a Flow Monitoring Program to characterize Inflow and Infiltration (I&I) in the Town's existing sanitary system with the key object of developing an I&I Reduction Program.

It has been identified that, although the majority of the Town's sanitary and storm sewers are already separated, there exists higher than expected flows within the sanitary sewer system, which in turn increases flows to the wastewater treatment facility.

It was suspected that the system possesses high inflow and infiltration (I&I), though the Town has not been able to pinpoint the exact sources to reduce peak flows in the recent past. A Flow Monitoring Program was implemented to characterize the I&I in the existing sanitary system with the key objective of developing an I&I reduction program. This study reviews the sanitary flow monitoring and rainfall data to determine the extent of I&I from each of the monitored catchments.

1.2 Project Objectives

Driven by the need for a I&I reduction program, the Town wishes to achieve the following objectives during the flow monitoring and I&I characterization:

- Gather information on the existing sewer system conditions; and,
- Monitor sewer system flows during wet weather conditions to establish if the system is subject to excessive flows and I&I.

Indirectly, the rehabilitation projects which will be eventually borne out of the reduction program should allow the Town to ultimately:

- Reduce energy costs as well as operation and maintenance costs; and,
- Delay costly capital upgrades by targeting catchments with high inflows.

2 Data Collection and Review

2.1 Catchment Identification

In order to determine I&I in the Town's sewer system, six (6) flow monitoring sites were selected. The extent and characteristics of the flow monitoring catchments are shown in Figure 2-1.

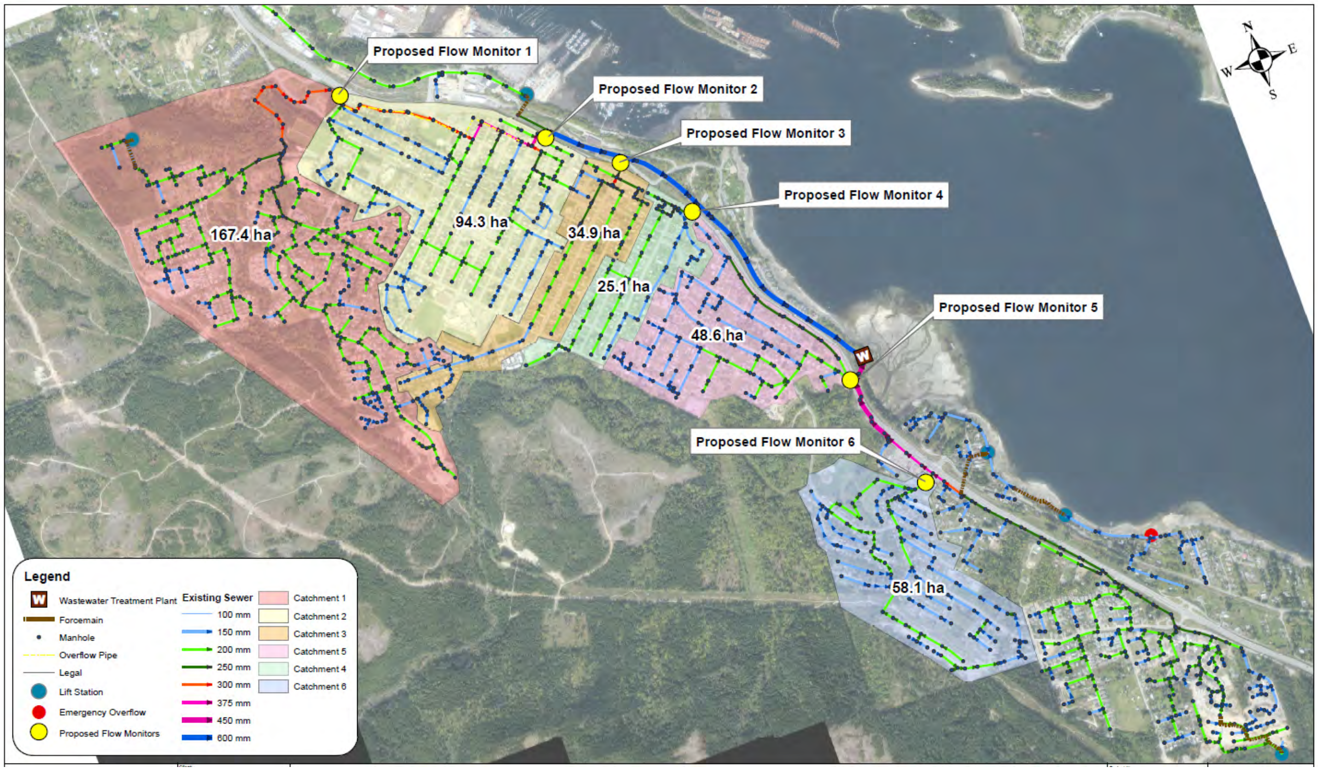


Figure 2-1: Proposed Catchments for Flow Monitoring

The flow meters at the six monitoring sites were installed and monitored by SFE Global for a total of 61 days from November 1, 2017 to December 31, 2017 (inclusive) and the flows were recorded every 5 minutes for 24 hours a day. A single rain gauge was installed by SFE Global at the Town's Works Yard to measure rainfall during the flow monitoring period.

2.2 Flow Components

The sanitary flows conveyed in the sewer system can generally be categorized into three components as illustrated in Figure 2-2:

1) Ground Water Infiltration (GWI) – Extraneous flow from the ambient long-term water table, not influenced by individual rainfall events.
2) Base Sanitary Flow (BSF) – Average flow generated from domestic, commercial, institutional, industrial and agricultural sources.
3) Rainfall Derived Inflow & Infiltration (RDII) – Rainfall that follows a path to the sanitary sewer through the soil, and/or through direct connections to runoff surface, and/or from short-term, rainfall-based increases in water table elevation.

Dry Weather Flow (DWF) is composed of Base Sanitary Flow (BSF) plus Ground Water Infiltration (GWI).

- DWF = GWI + BSF

Wet Weather Flow (WWF) is all sanitary flow contributions made during wet weather consisting of Dry Weather Flows plus Rainfall Derived Inflow & Infiltration (RDII).

- WWF = DWF + RDII

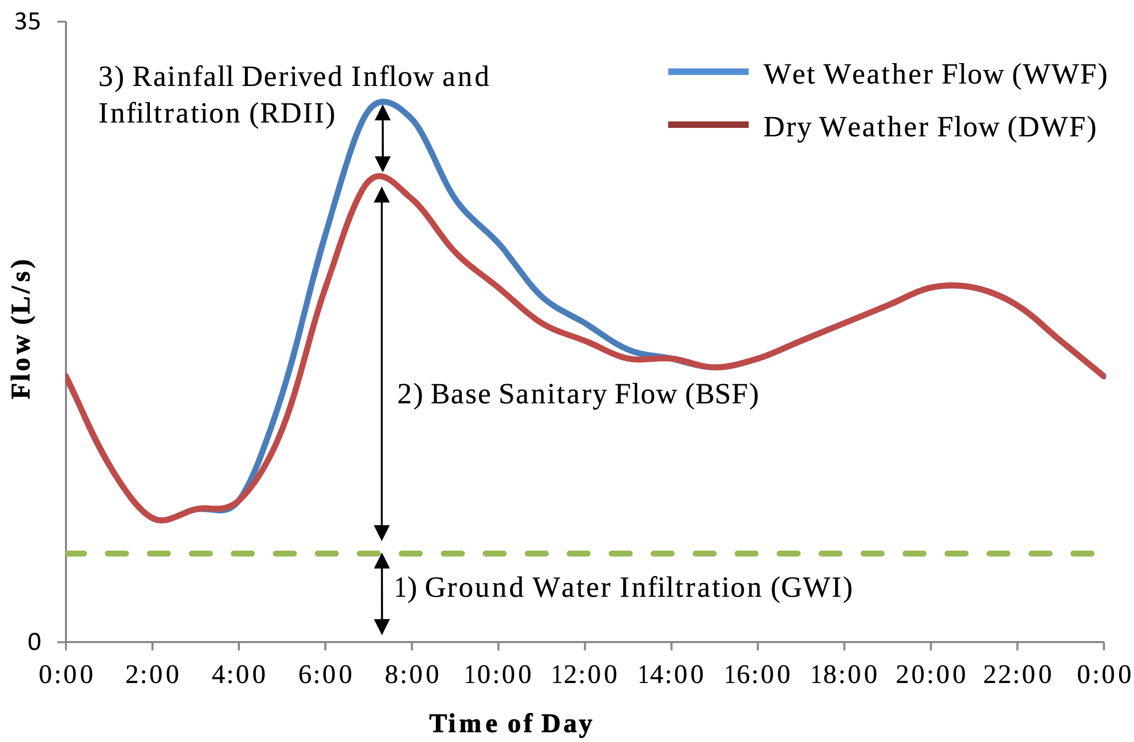


Figure 2-2: Typical Sanitary Flow Components Hydrograph

2.3 Rainfall Data Collection

Rainfall data was collected in 5-minute intervals during for the entire duration of the flow monitoring period. It should be noted that measured rainfall events were not compared to daily rainfall data recorded by other Environment Canada weather stations. Figure 2-3 shows the rolling 24-hour rainfall volumes.

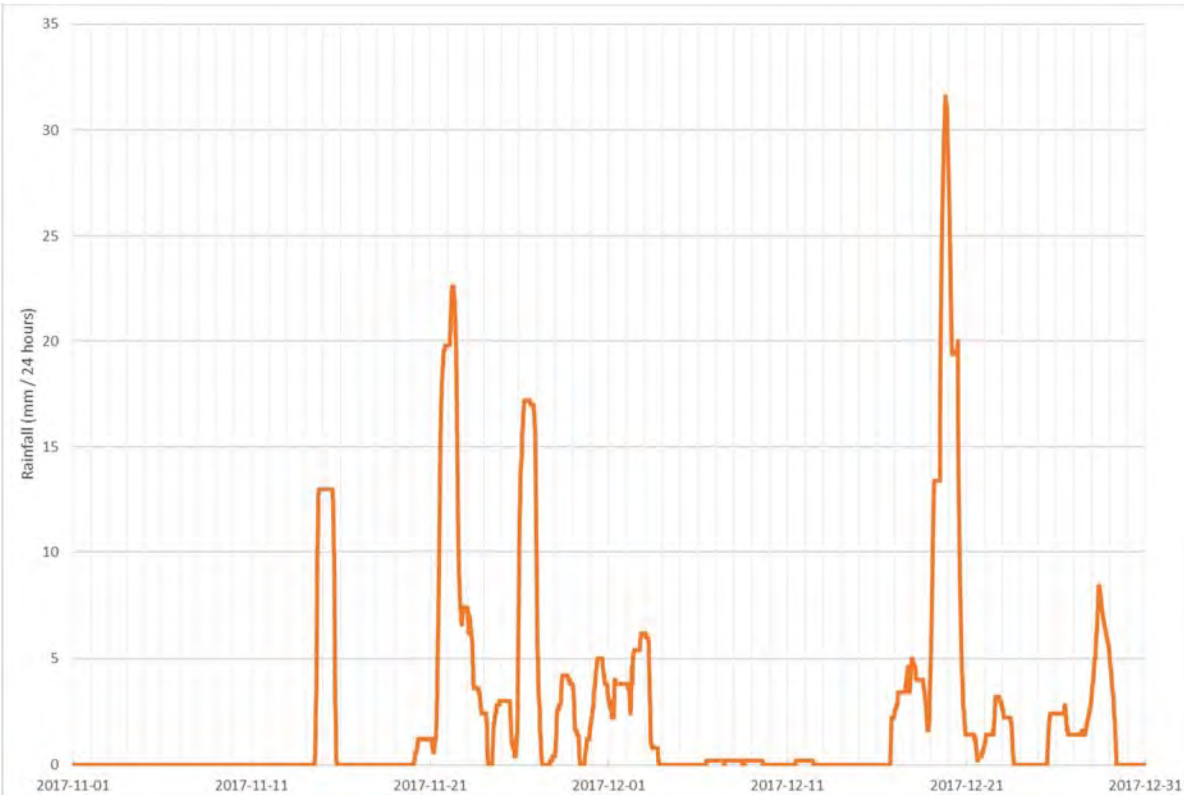


Figure 2-3: Rolling 24-Hr Total Rainfall

It should be noted that an ideal storm would result in a total rainfall depth > 5 mm and a peak intensity > 5 mm / hr. However, within the short-term flow survey data available for this study, an event selection according to these guidelines only resulted in three (3) events, which did not provide a strong correlation for analysis. Therefore, a rainfall intensity criteria of > 2.9 mm / hr, based on a 5-year 24-hour storm event was adopted in the analysis criteria. A total of 8 rainfall events were identified and are summarized in Table 2-1.

Table 2-1: Selected Rainfall Events for Analysis

From	To	Duration (hr)	24-Hour Rainfall (mm)
2017-11-14 12:50	2017-11-14 18:40	5.8	13.0
2017-11-21 5:35	2017-11-21 20:00	14.4	19.8
2017-11-22 2:30	2017-11-22 10:20	7.8	22.6
2017-11-23 3:15	2017-11-23 5:40	2.4	7.0
2017-11-25 14:15	2017-11-26 6:15	16.0	17.2
2017-12-02 1:30	2017-12-02 9:45	8.2	5.4
2017-12-18 20:20	2017-12-19 4:50	8.5	13.4
2017-12-19 12:50	2017-12-19 22:50	10.0	31.6

2.4 Dry Weather Flow (DWF) Analysis

Using the flow survey data, a period of dry weather was first identified to determine the Average Dry Weather Flows (ADWF) and to generate the diurnal Dry Weather Flow (DWF) patterns for the six (6) sites. The ADWFs for each catchment area are summarized in Table 2-2 and the patterns are illustrated in Figure 2-4.

Table 2-2: Town of Ladysmith Surveyed Average Dry Weather Flows

Site	ADWF (L/s) [1]
1	6.33
2	14.98
3	0.93
4	1.67
5	1.63
6	1.79

1. DWF period analysed was from November 1, 2017, to November 12, 2017.

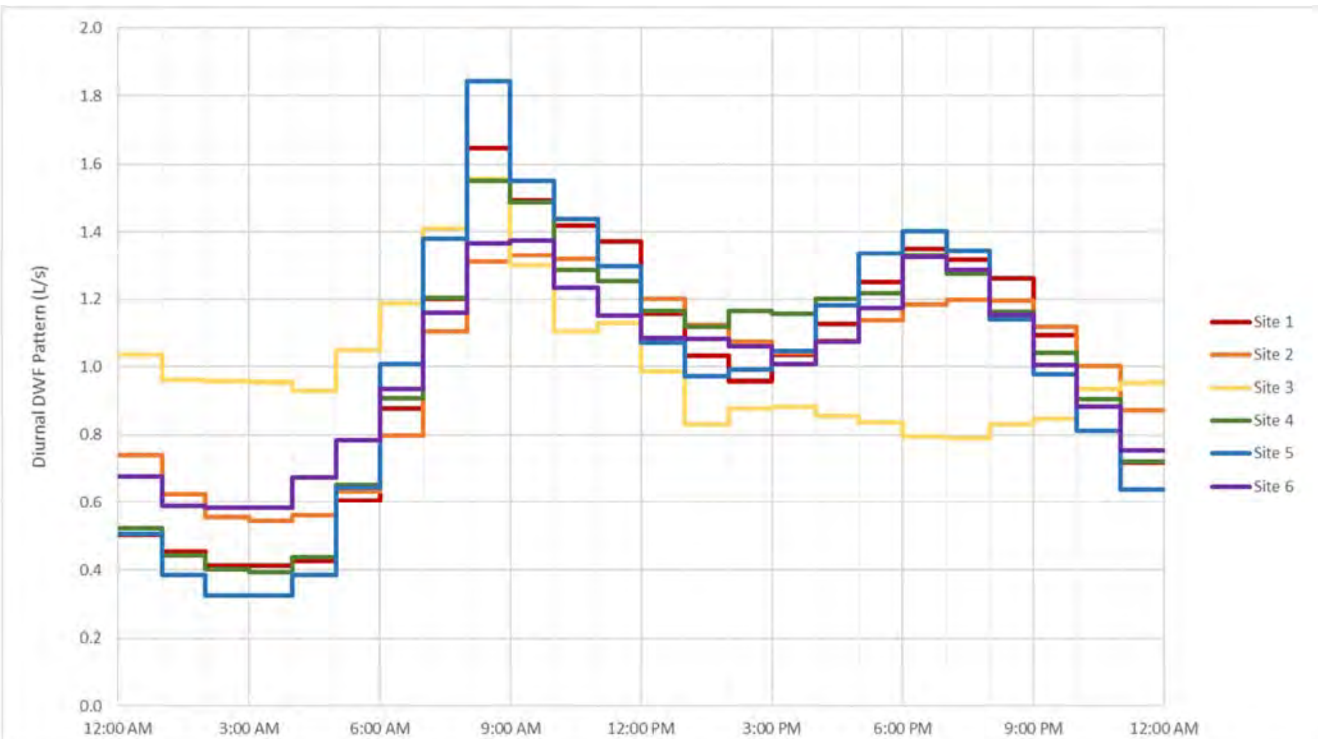


Figure 2-4: Diurnal Dry Weather Flow Patterns

3 Inflow & Infiltration Characterization

3.1 Inflow & Infiltration

Inflow is defined as the rainfall or snowmelt that enters the sanitary sewer system through direct sources such as yards, roofs, downspouts, cross-connections with storm drains, foundation drains, and manhole covers, whereas infiltration is the groundwater that enters through holes and cracks in manholes, laterals, and sewer pipes.

In addition to the quantity of I&I, it is imperative to determine the I&I character, inflow- vs infiltration-driven, to better understand the source of I&I of which is key to a robust I&I Reduction Strategy. While catchments with higher inflows warrant field inspections to discover direct and cross connections with storm mains, infiltration-driven catchments are likely abundant of structural issues such as manhole and pipe cracks.

3.2 Envelope Method

In order to analyze the rainfall and flow monitoring data, the Envelope Method was used to provide peak 5-year 24-hour RDII rates on a per hectare basis. The Envelope Method calculates the peak RDII for a design storm with a set IDF curve by extrapolating the trendline of the rainfall durations' plot out to the rainfall volume (mm) for the design storm. It then translates the trendline upwards so that it intersects the storm event that is positioned furthest above the trendline creating an "Upper Bound".

The flowrate given from the upper bound at the design storm's rainfall volume is then considered the peak RDII flowrate for that design storm. For the purposes of this study, a design storm with a 5-year return period is used. Plots were generated to show the correlation between the rainfall and the peak RDII at each flow monitoring site.

A target RDII rate of 11,200 L/ha/day is the suggested allowance for regional sewer systems. Although it does not necessarily reflect the I&I related characteristics of aging sewer systems, it has been used as an acceptable design standard by Metro Vancouver for several decades[1], particularly for storms with a 5-year return period or less[2].

[1] Biennial Report: 2015-2016, Integrated Liquid Waste and Resource Management, Metro Vancouver
[2] Greater Vancouver Regional District, Liquid Waste Management Plan, 2001

3.3 Inflow and Infiltration Envelopes

3.3.1 Catchment 1 – Strathcona

Catchment 1 (Strathcona) is approximately 167.4 ha in size and includes approximately 14.1 km of sanitary mains. A running 24-hour average of measured flows and calculated RDII for the catchment are shown in Figure 3-1.

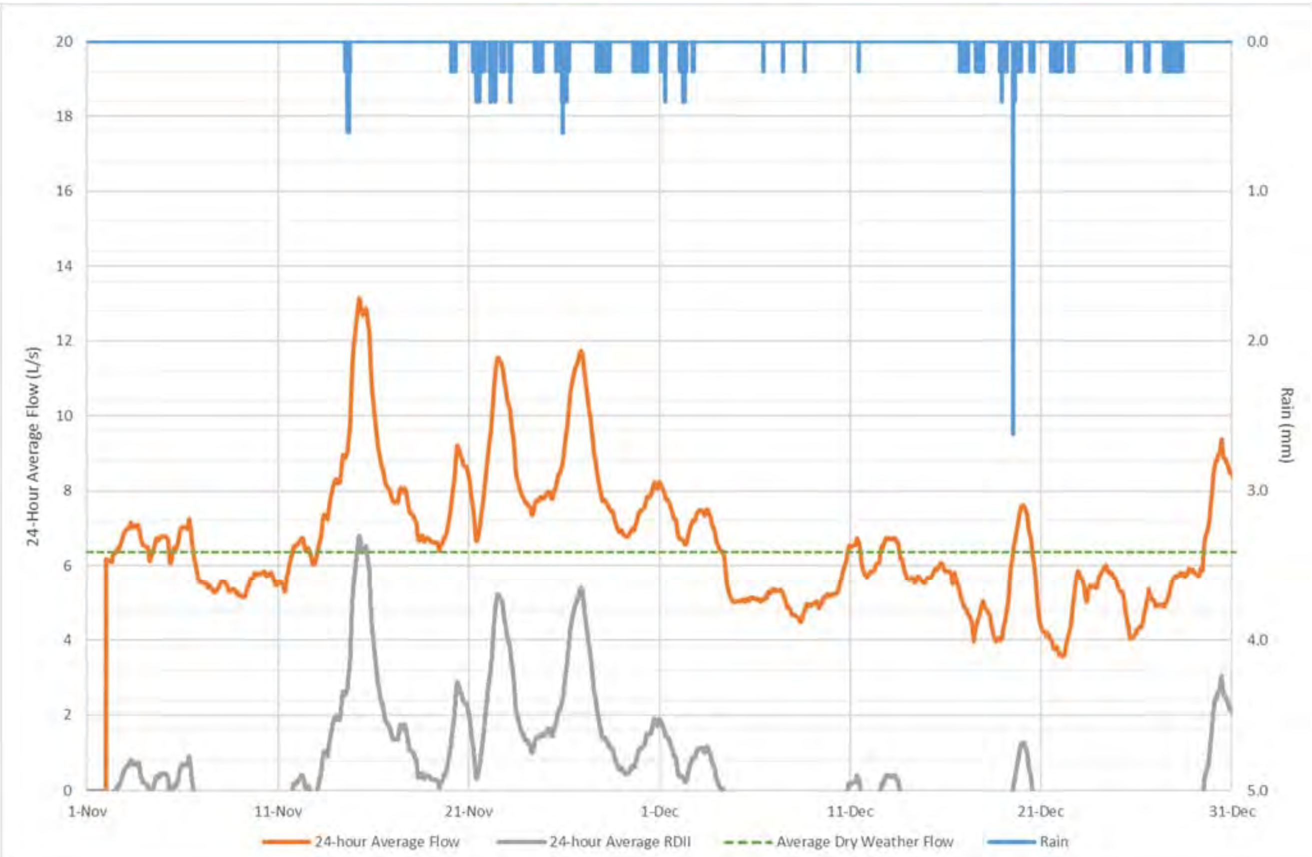


Figure 3-1: 24-Hour Average Flows from Catchment 1 – Strathcona

From the figure above, sewer flows in Catchment 1 are responsive to many low intensity rainfall events during the November flow monitoring period, with a smaller response seen coincident to the high intensity rainfall event in mid-December. In all, a good correlation between rainfall and system response has been found through the recorded data and most of the data has been used.

For Catchment 1, six of the eight rainfall events identified were used to derive the peak RDII Rate, as the others were determined to be outliers and were excluded from the correlation. As shown in Figure 3-2, the derived 5-year 24-hour Peak RDII rate for Catchment 1 is 8,439 L/ha/d.

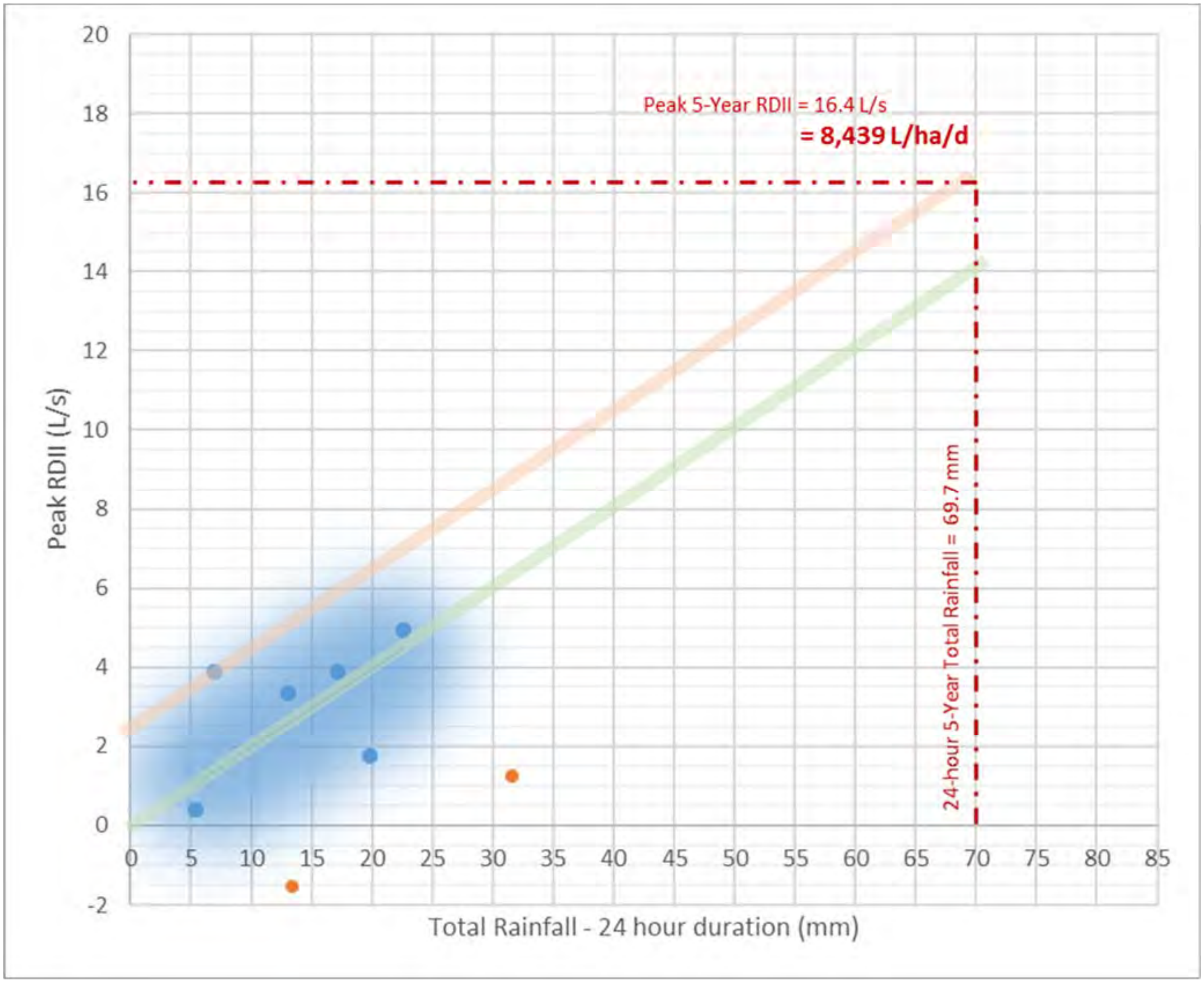


Figure 3-2: 24-hour Total Rainfall vs Peak RDII Plot for Catchment 1 – Strathcona

3.3.2 Catchment 2 – Esplanade

Catchment 2 (Esplanade) is approximately 94.3 ha in size and includes approximately 10.2 km of sanitary mains. A running 24-hour average of measured flows and calculated RDII for the catchment are shown in Figure 3-3.

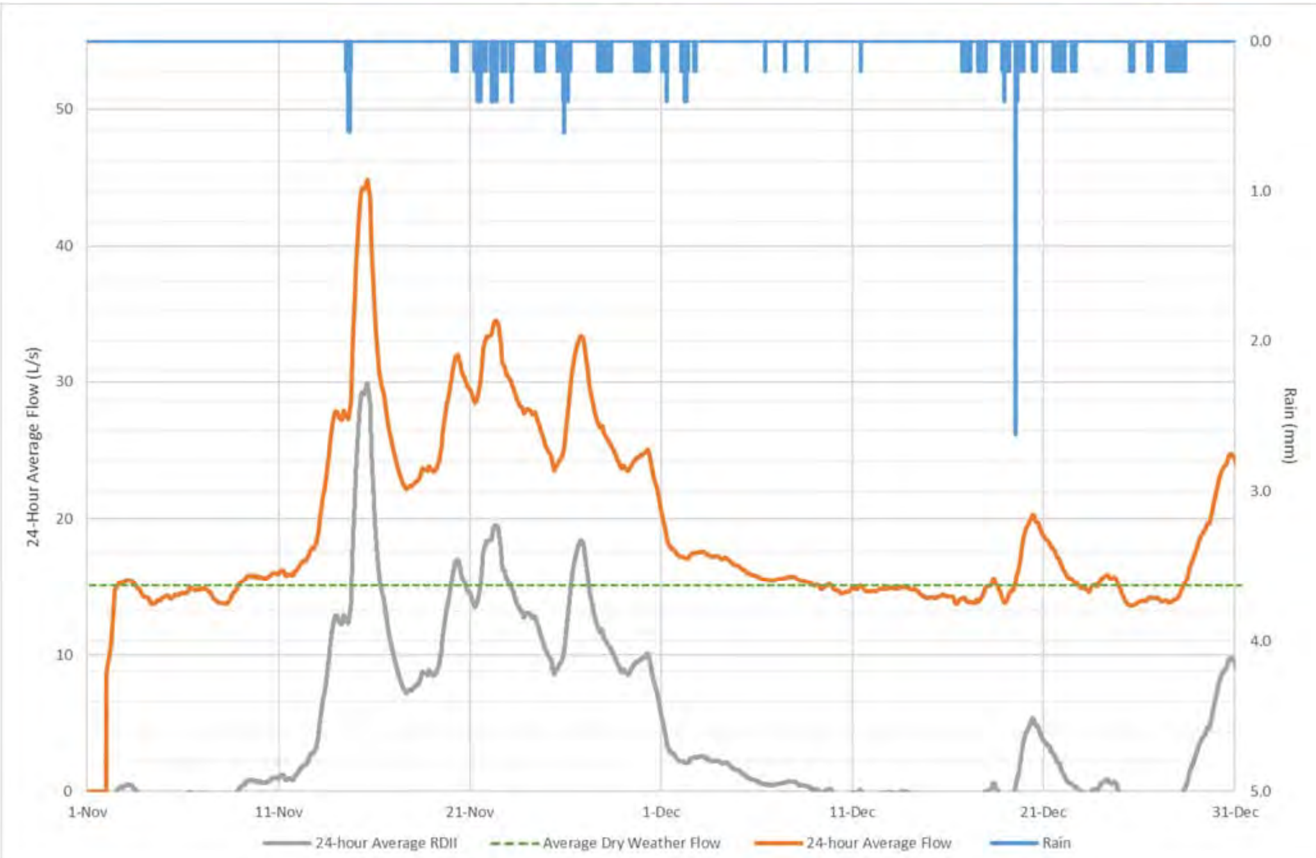


Figure 3-3: 24-Hour Average Flows from Catchment 2 – Esplanade

From the figure above, sewer flows in Catchment 2 are especially responsive to many low intensity rainfall events during the November flow monitoring period, with a smaller response seen coincident to the high intensity rainfall event in mid-December. In all, a good correlation between rainfall and system response has been found through the recorded data and most of the data has been used.

For Catchment 2, six of the eight rainfall events identified were used to derive the peak RDII Rate, as the others were determined to be outliers and were excluded from the correlation. As shown in Figure 3-4, the derived 5-year 24-hour Peak RDII rate for Catchment 2 is 67,308 L/ha/d.

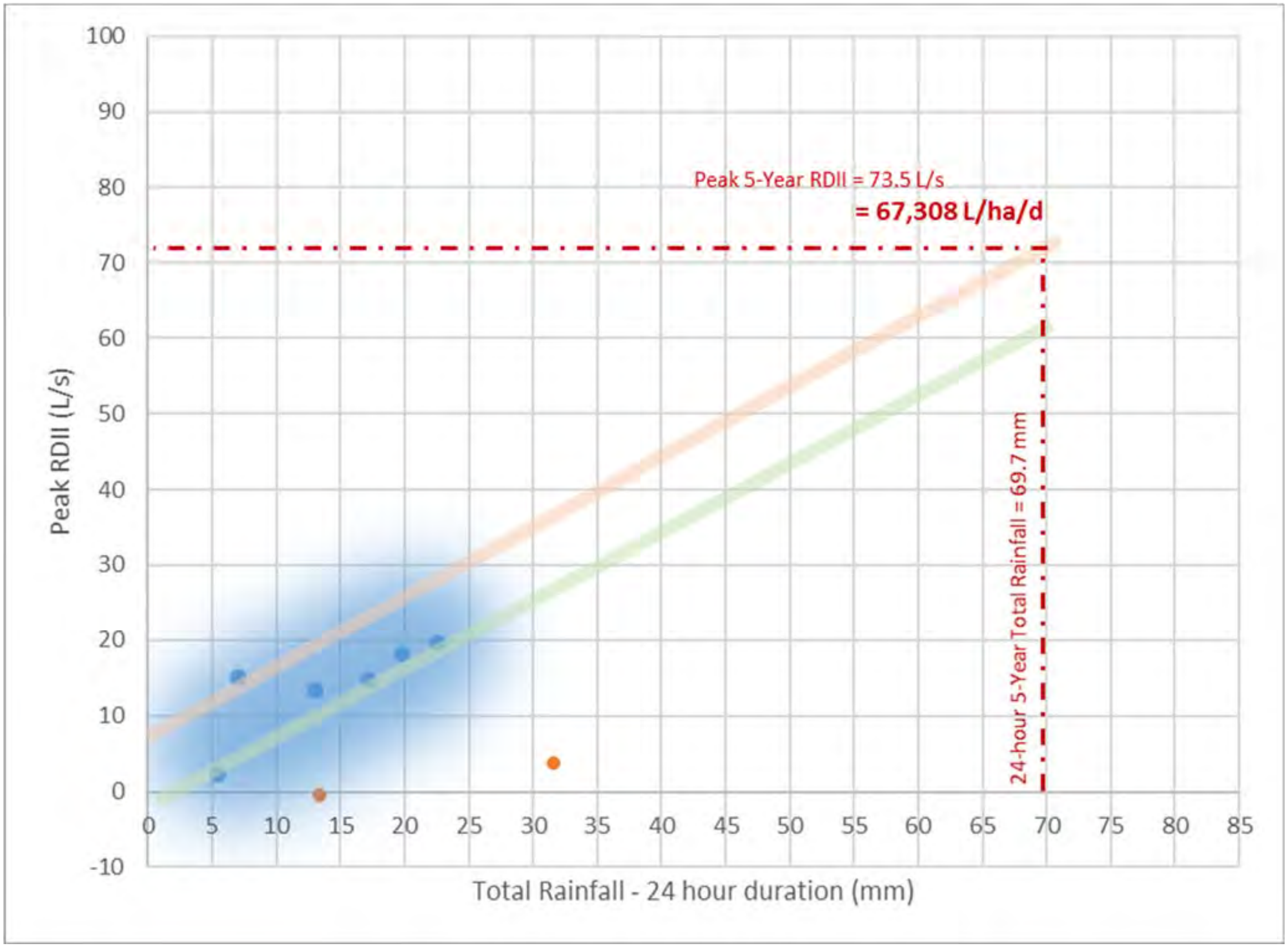


Figure 3-4: 24-hour Total Rainfall vs Peak RDII Plot for Catchment 2 – Esplanade

3.3.3 Catchment 3 – Transfer Beach

Catchment 3 (Transfer Beach) is approximately 34.9 ha in size and includes approximately 3.9 km of sanitary mains. A running 24-hour average of measured flows and calculated RDII for the catchment are shown in Figure 3-5.

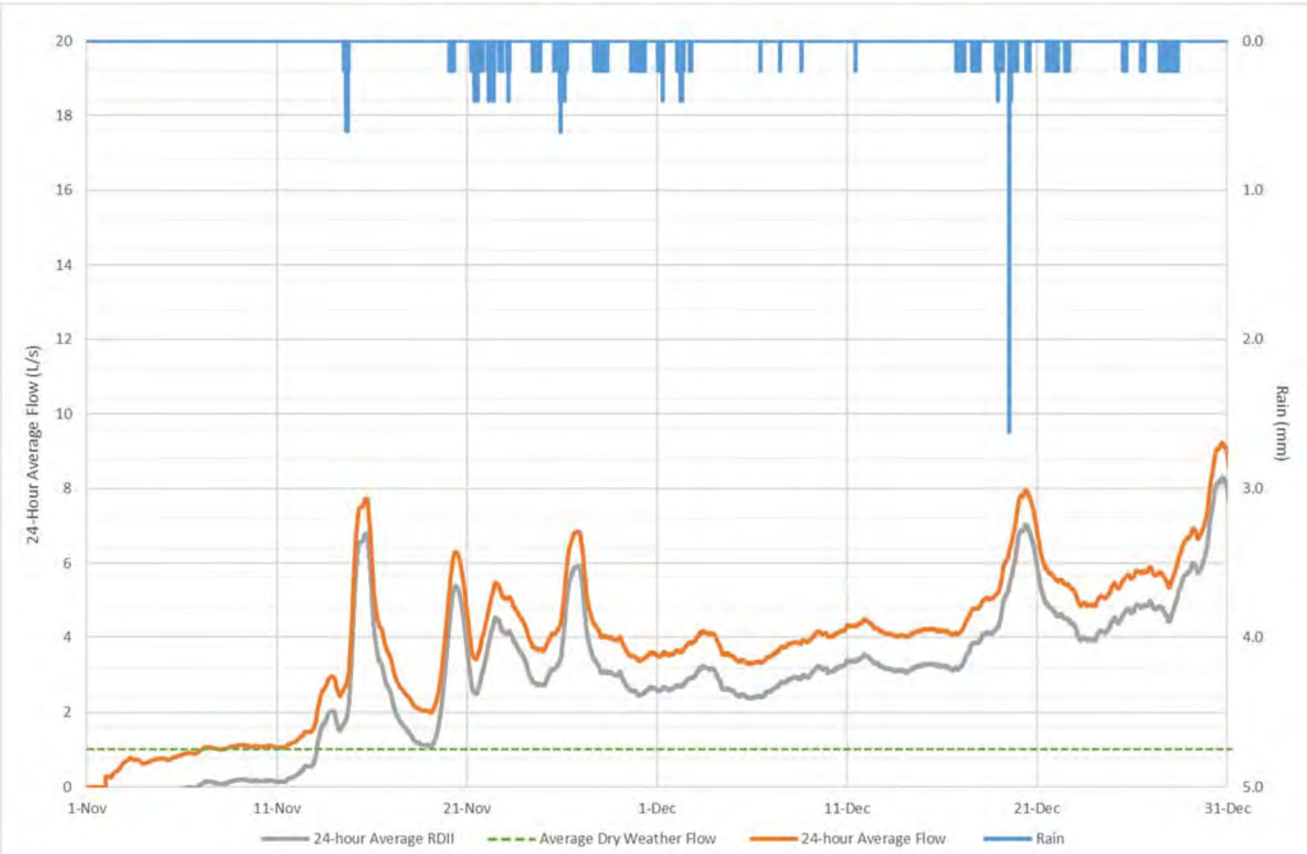


Figure 3-5: 24-Hour Average Flows for Catchment 3 – Transfer Beach

From the figure above, sewer flows in Catchment 3 appear to be responsive to all events during the flow monitoring period. In all, a good correlation between rainfall and system response has been found through the recorded data and most of the data has been used. However, it should be noted that average flows seem to be increasing over time, which could indicate an error in the recorded dataset. As such, most of the data from the initial part of the study period (up to Dec 2) has been used instead.

For Catchment 3, five of the eight rainfall events identified were used to derive the peak RDII Rate, as the others were determined to be outliers or not applicable for analysis and were excluded from the correlation. As shown in Figure 3-6, the derived 5-year 24-hour Peak RDII rate for Catchment 3 is 43,405 L/ha/d.

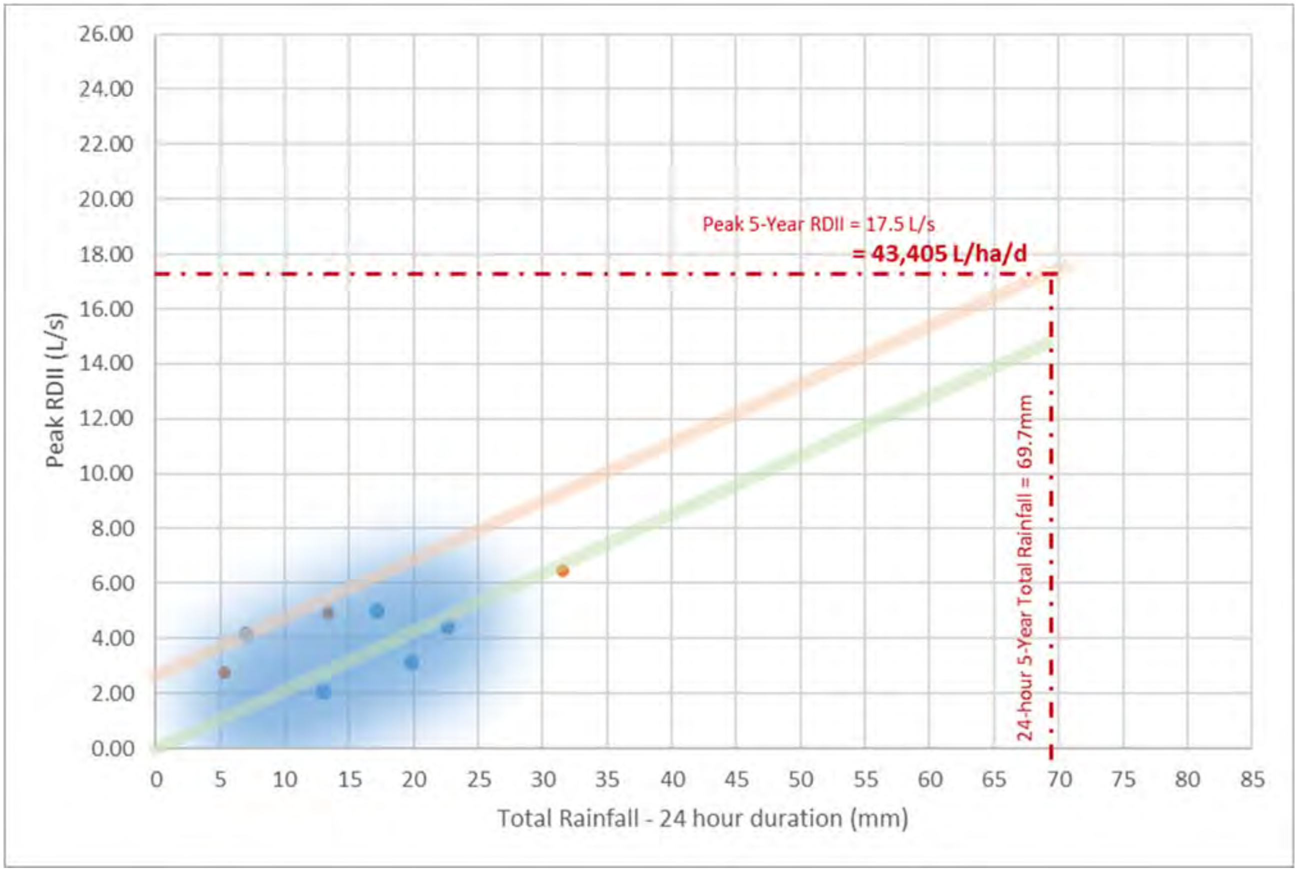


Figure 3-6: 24-hour Total Rainfall vs Peak RDII Plot for Catchment 3 – Transfer Beach

3.3.4 Catchment 4 – Methuane

Catchment 4 (Methuane) is approximately 25.1 ha in size and includes approximately 3.1 km of sanitary mains. A running 24-hour average of measured flows and calculated RDII for the catchment are shown in Figure 3-7.

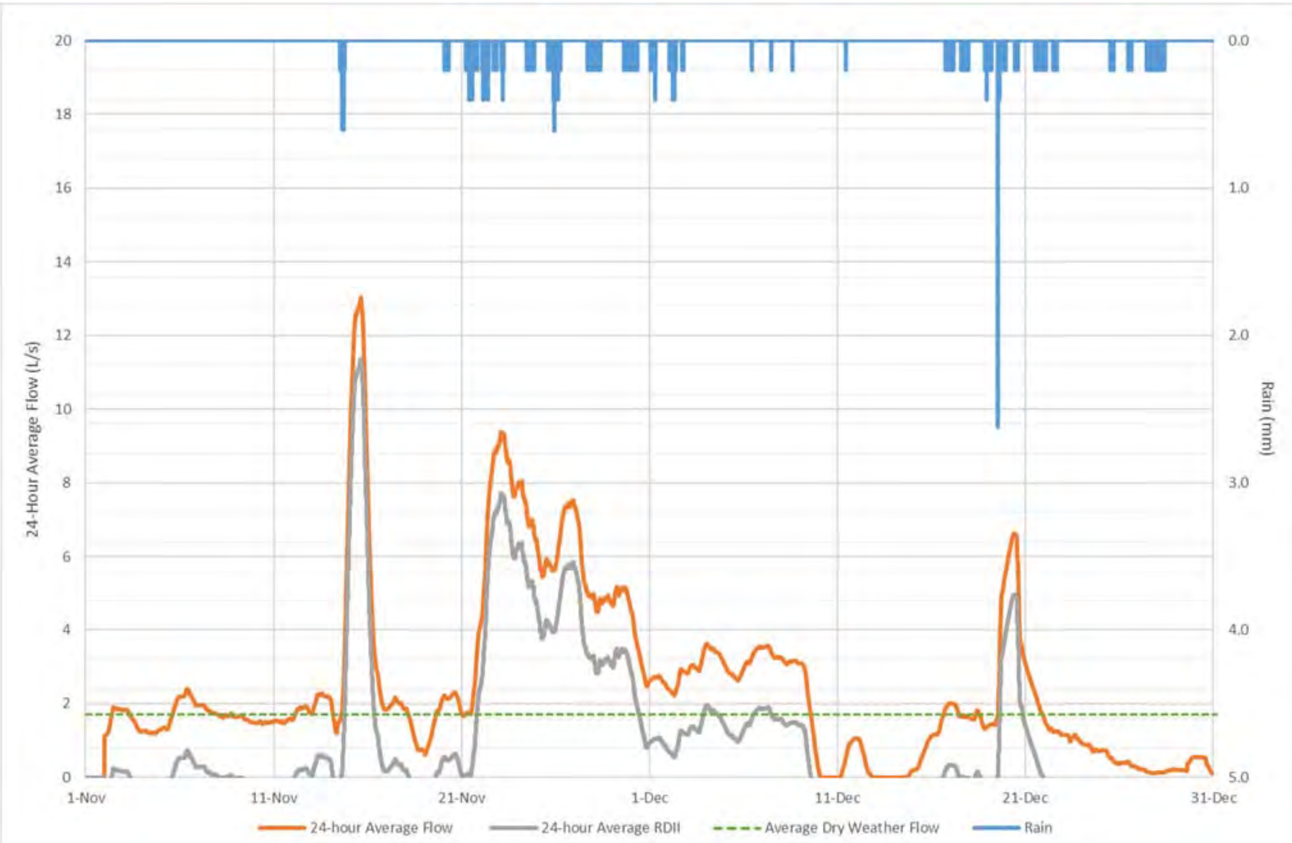


Figure 3-7: 24-Hour Average Flows for Catchment 4 – Methuane

From the figure above, sewer flows in Catchment 4 appear to be responsive to all events during the flow monitoring period. However, it is noted that there may have been erroneous data logged at Site 4 during the month of December, as it appears there were periods where no flows or low flows was recorded, even following periods of rain. Therefore, rainfall events during the month of December were omitted in the RDII derivation.

For Catchment 4, four of the eight rainfall events identified were used to derive the peak RDII Rate, as the others were determined to be outliers and were excluded from the correlation. As shown in Figure 3-8, the derived 5-year 24-hour Peak RDII rate for Catchment 4 is 53,146 L/ha/d.

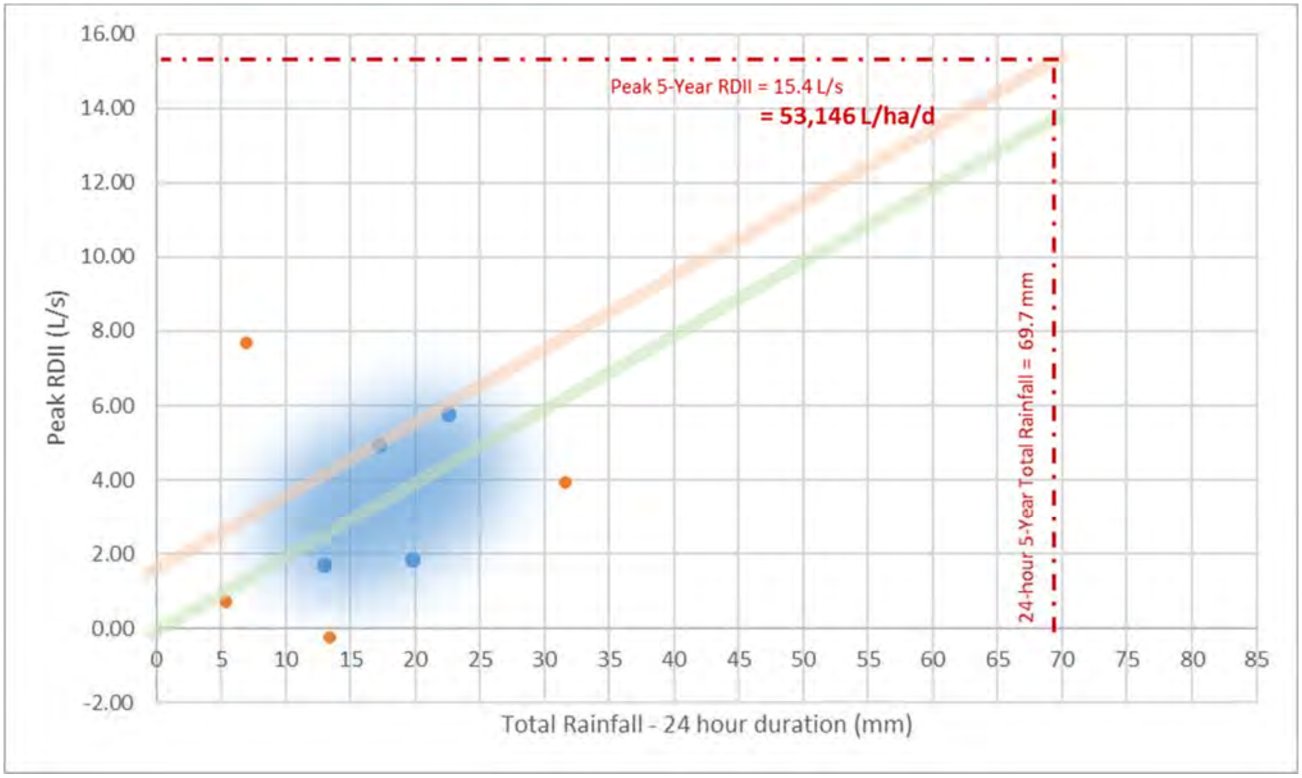


Figure 3-8: 24-hour Total Rainfall vs Peak RDII Plot for Catchment 4 – Methuane

3.3.5 Catchment 5 – Clarke

Catchment 5 (Clarke) is approximately 48.6 ha in size and includes approximately 6.5 km of sanitary mains. A running 24-hour average of measured flows and calculated RDII for the catchment are shown in Figure 3-9.

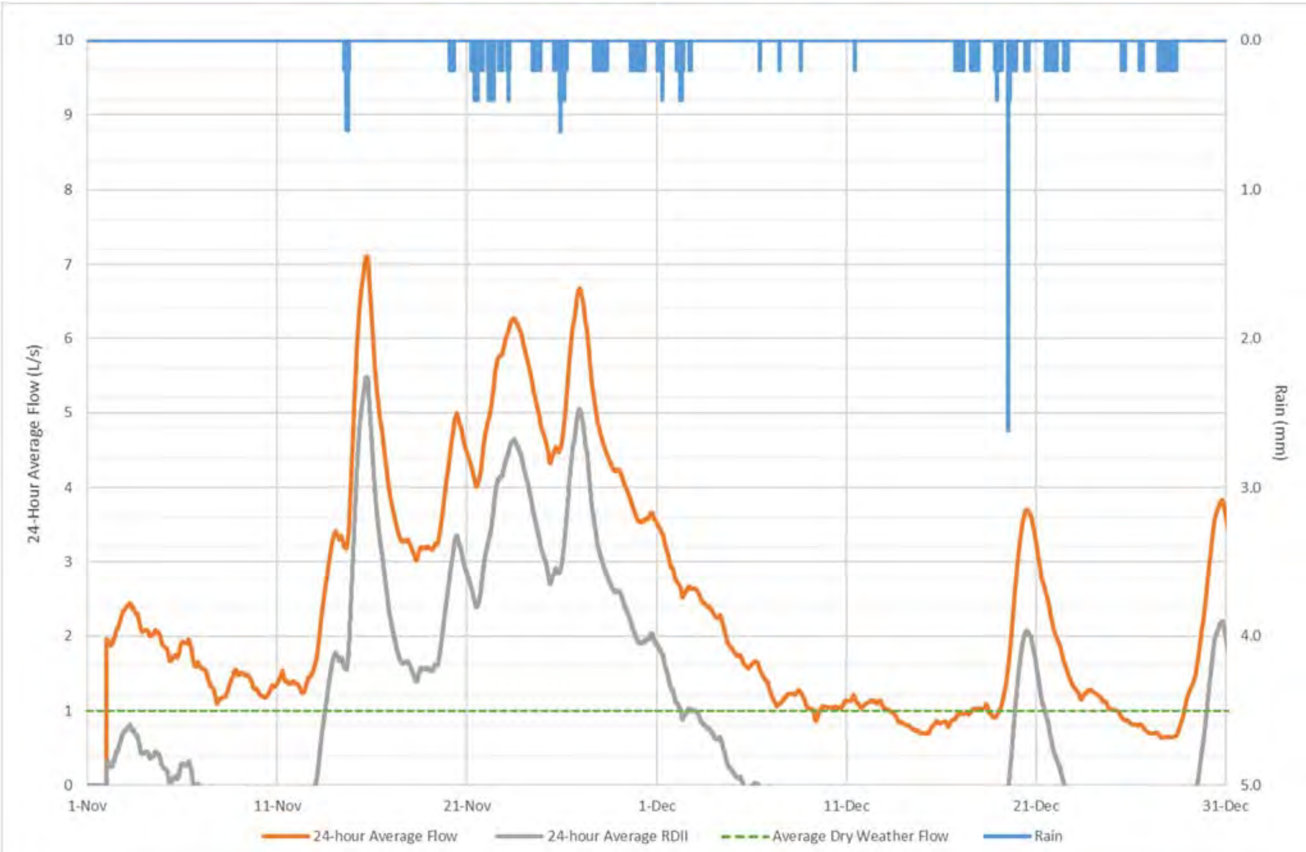


Figure 3-9: 24-Hour Average Flows for Catchment 5 – Clarke

From the figure above, sewer flows in Catchment 5 are responsive to many low intensity rainfall events during the November flow monitoring period, with a smaller response seen coincident to the high intensity rainfall event in mid-December. In all, a good correlation between rainfall and system response has been found through the recorded data and most of the data has been used.

For Catchment 5, six of the eight rainfall events identified were used to derive the peak RDII Rate, as the others were determined to be outliers and were excluded from the correlation. As shown in Figure 3-10, the derived 5-year 24-hour Peak RDII rate for Catchment 5 is 28,484 L/ha/d.

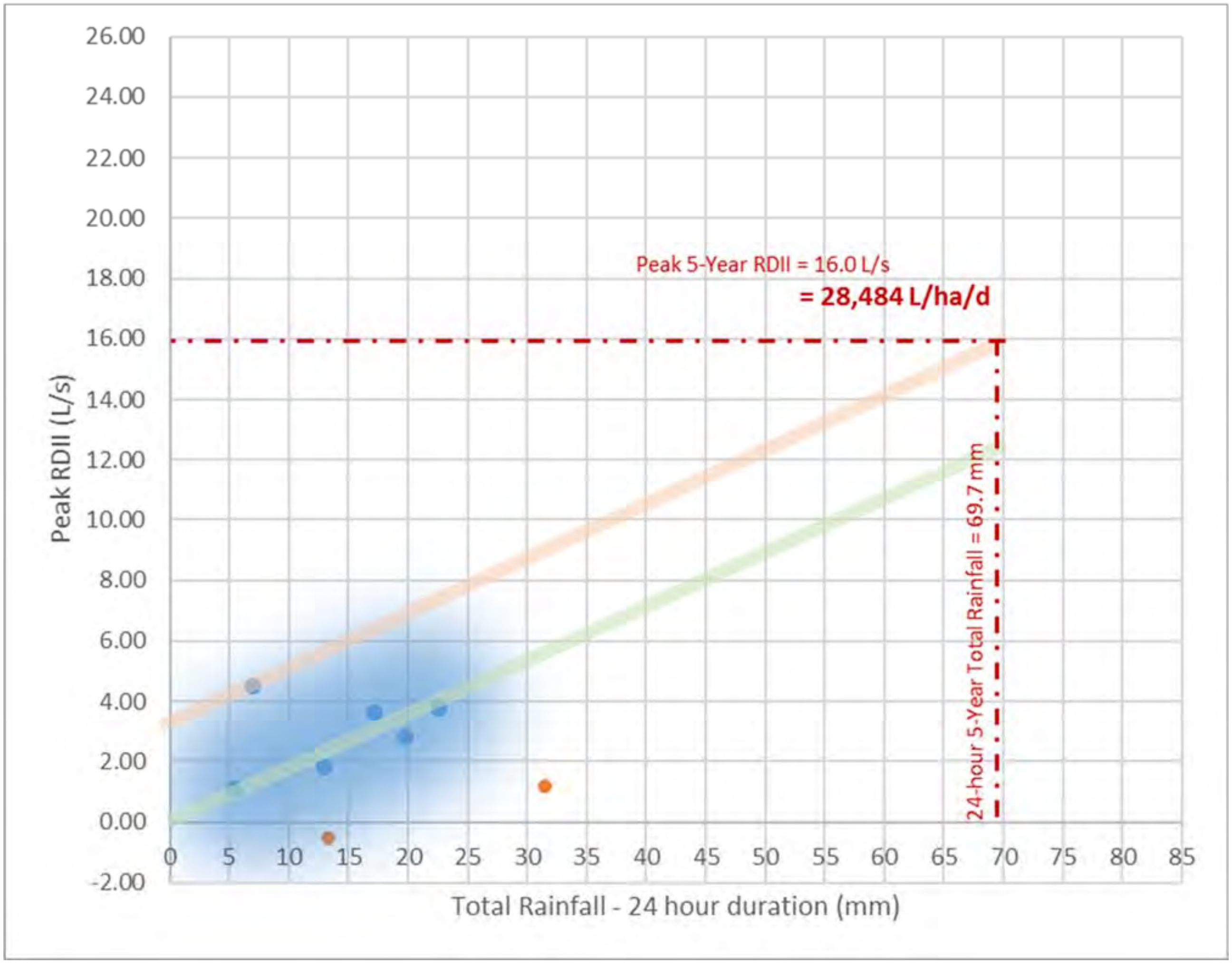


Figure 3-10: 24-hour Total Rainfall vs Peak RDII Plot for Catchment 5 – Clarke

3.3.6 Catchment 6 – David

Catchment 6 (David) is approximately 58.1 ha in size, and includes approximately 7.6 km of sanitary mains. A running 24-hour average of measured flows and calculated RDII for the catchment are shown in Figure 3-11.

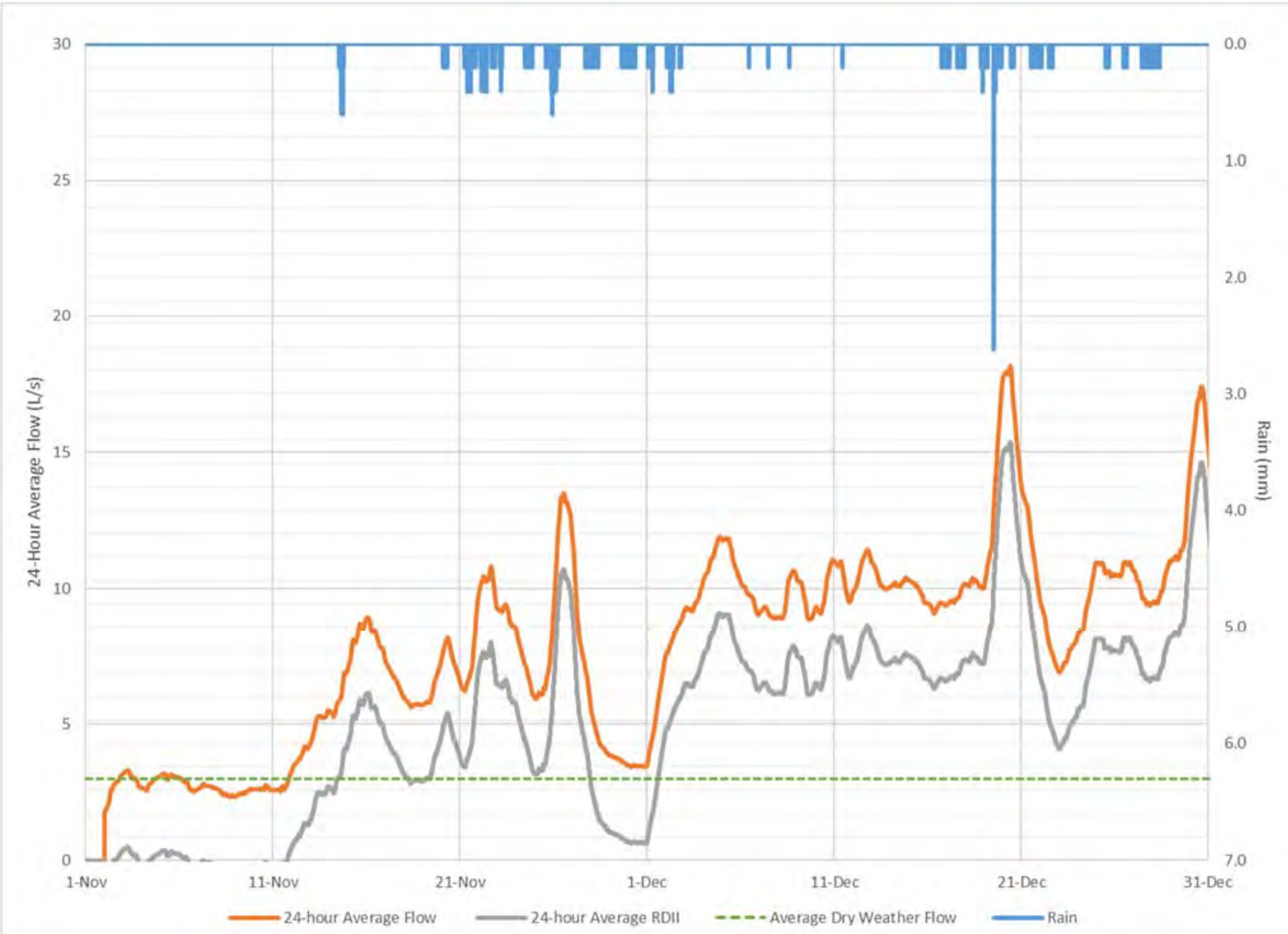


Figure 3-11: 24-Hour Average Flows for Catchment 6 – David

From the figure above, sewer flows in Catchment 6 appear to be responsive to all events during the flow monitoring period. In all, a good correlation between rainfall and system response has been found through the recorded data and most of the data has been used. However, it should be noted that average flows seem to be increasing over time, which could indicate an error in the recorded dataset. As such, most of the data from the initial part of the study period has been used instead.

For Catchment 6, four of the eight rainfall events identified were used to derive the peak RDII Rate, as the others were determined to be outliers or not applicable for analysis and were excluded from the correlation. As shown in Figure 3-12, the derived 5-year 24-hour Peak RDII rate for Catchment 6 is 41,527 L/ha/d.

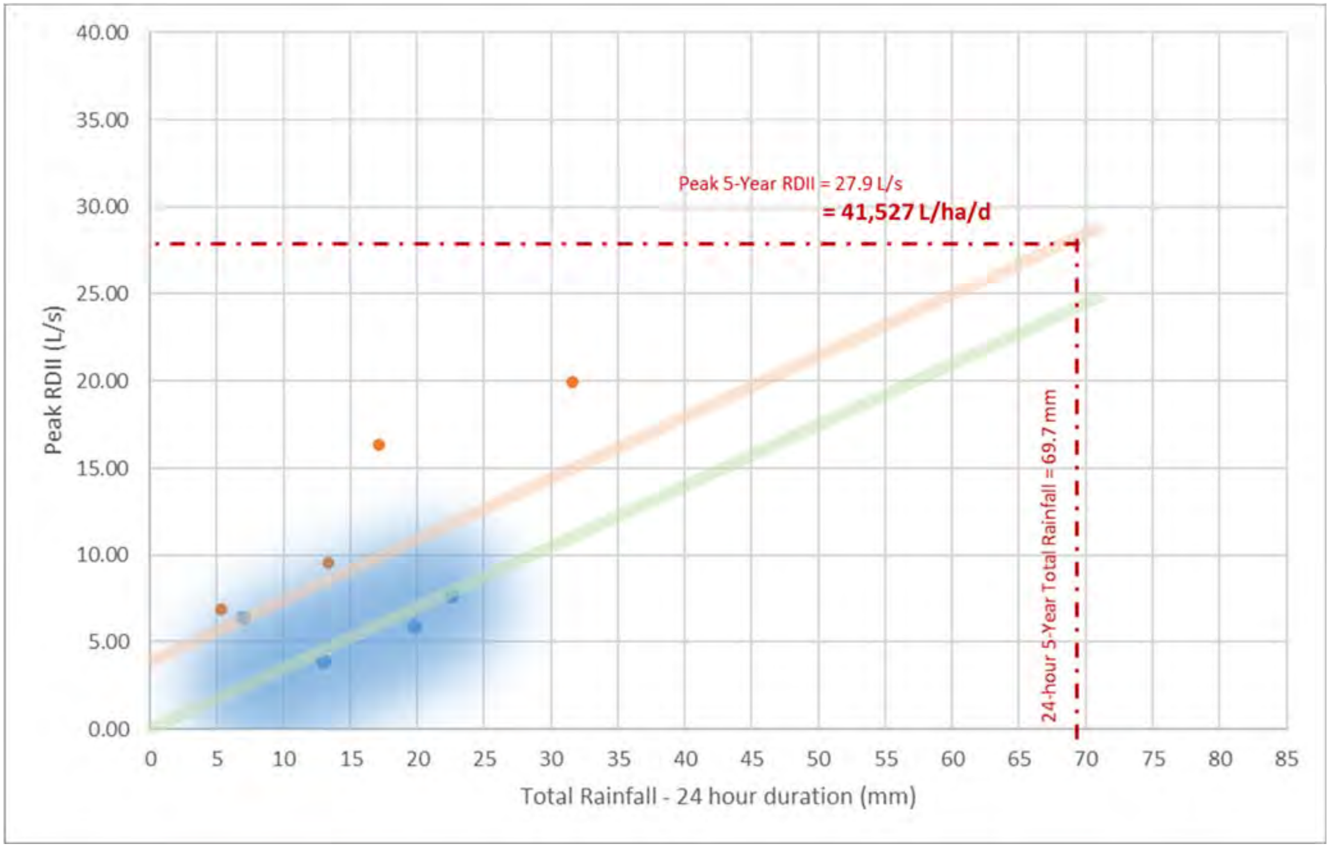


Figure 3-12: 24-hour Total Rainfall vs Peak RDII Plot for Catchment 6 – David

3.4 Overall RDII Ranking

Figure 3-13 and Table 3-1 summarize the derived RDII rates for all catchment areas.

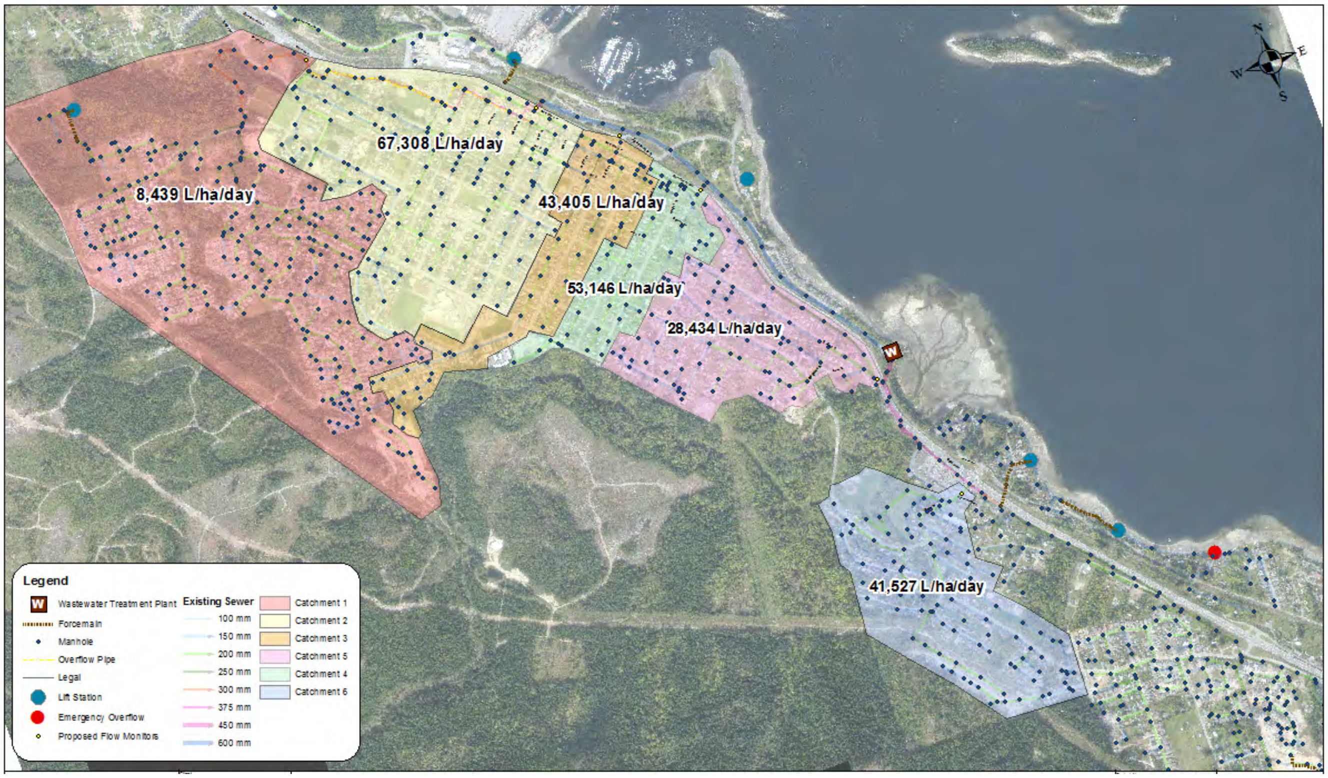


Figure 3-13: Catchment-Specific RDII Rates

Table 3-1: Catchment-Specific Peak RDII Rates

	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Peak 5-year RDII Flow (L/s)	16.4	73.5	17.5	15.4	16.0	27.9
Total Catchment Area (ha)	167.4	94.3	34.9	25.1	48.6	58.1
Peak 5-year RDII Rate (L/ha/day)	8,439	67,308	43,405	53,146	28,434	41,527

With the limited flow monitoring data available, it can be seen from Table 3-1 that the largest RDII rate of 67,141 L/ha/day was derived for Catchment 2, and the lowest RDII rate of 8,439 L/ha/d was derived for Catchment 1. The derived RDII of the catchments are ranked, with 1 being the highest derived RDII and 6 being the lowest derived RDII, as follows:

1. Catchment 2
2. Catchment 4
3. Catchment 3
4. Catchment 6
5. Catchment 5
6. Catchment 1

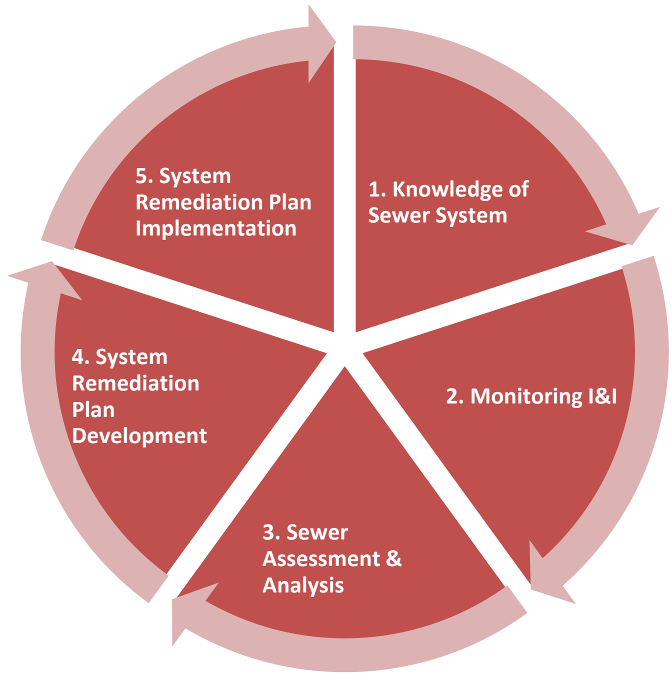
3.5 Conclusions from Flow Monitoring Results

These flow monitoring results provide the Town with its first glimpse into I&I rates within the Town and the critically high RDII catchments measured. The results confirm what has long been suspected as significant I&I in the Town's sanitary sewer system, most notably in catchments near the older part of the downtown core in the Town Centre. Catchments 2, 4, 3 and 6 all have RDII values significantly above (i.e. 4 to 6 times above) the suggested target of 11,200 L/ha/day. Overall, the estimated city-wide RDII rate is 33,358 L/ha/d, which is approximately 3 times above the recommended target rate.

Though it appears that these initial results are useful in determining next steps in sewer system assessment, analysis, and remediation works, a flow monitoring program budget is recommended for continued I&I assessment every three (3) years to obtain additional confidence in the estimated RDII rates.

4 Recommendations for Next Phase

The general I&I Reduction Program process is shown below.



Whereas this current Flow Monitoring Program has provided an initial glimpse into the current state of I&I in the Town's system, the Town has already expected these significant I&I values, due to the high peaking flows already noted and experienced at the Town's Wastewater Treatment Plant. While this confirms the Town's expectations, it additionally highlights the specific catchment areas where high I&I is experienced. This offers a valuable perspective where staff can focus its subsequent I&I reduction efforts for the most cost-effective reduction efforts.

A summary of recommendations for the next phase of works under each of the above categories is defined as follows:

4.1 Stage 1 – Knowledge of Sewer System

The Town and its staff have an extensive internal working knowledge of the sewer system and its development over the years, including the Town's sewer separation program in the 1990s. However, while most of the Downtown Core's sewers were separated in the past, it is noted that the drainage services into most homes and businesses were never separated and connected to the new storm sewer. This knowledge, and other known conditions by Town staff, should be all considered in further development of the Town's I&I Reduction Program

The Town has a good knowledge of the physical characteristics of its sewage system, currently having a CAD record and a sewer utility model developed. However, the sewer model has never been calibrated for accuracy, solely developed on population and per capita loading estimates assumed across the Town.

As a next step to gain a better understanding of the hydraulics of the sewer system and the availability of sewer flow monitoring data, we recommend the following tasks to gain a better knowledge of the Town's sewer system:

1. Establish of a deeper understanding and a thorough documentation of the development of the Town's sanitary sewer system. This includes the historical background of how the Town has addressed past and current challenges, as well as lessons learned about the utility.

2. Using the flow monitoring data received, carry out an RTK Calibration of the Town's sanitary sewer hydraulic model in 2018 to allow for better simulations of real system conditions. An added benefit of the RTK calibration process, which will aide in the I&I Reduction Program process, is as follows:

   a. Different catchments require different strategies as they "behave" and "react" differently to rainfall; some may be inflow-driven while others infiltration-driven. Where catchments are inflow-driven, it could be expected that manhole lid and joint offsets, and cross connections could be a high source of I&I, and manhole inspections and vapour testing should naturally be a first step for the next sewer assessment phase. Where catchments are infiltration driven, CCTV inspections are recommended, followed by lateral inspections if mainline investigations are inconclusive.

4.2 Stage 2 – Monitoring I&I

WSP | Opus has worked with the Town to select six flow monitoring catchments in this initial program, targeting flow monitoring for older parts of the Town's sanitary sewer system. It is estimated that an additional three sanitary sewer catchments could be included in a complete Town flow monitoring strategy.

As noted within this report, a flow monitoring budget should be established in three year increments in order to more accurately quantify the Town's estimated RDII rates. Reasons continued monitoring is threefold. Firstly, to gain more confidence in the estimated RDII to evaluate system impacts, second, to determine areas for sewer assessment and remediation, and thirdly, to evaluate the effectiveness of remediation and rehabilitation programs (see Stage 3 – 5 below).

From the initial results of this study, and with an estimated nine total sewer catchments for a complete Town flow monitoring strategy, we recommend the following:

1. From November to December in 2020, the Town shall set aside funds to repeat the 6-week flow monitoring program for the six catchments assessed under this program to establish additional data points to better quantify I&I and to ensure confidence in results. The results shall update RDII values and findings from this report, and include development of a detailed I&I reduction strategy budget and timeframes for catchment specific sewer investigations and rehabilitation strategies.

2. After 2020, the Town shall set out a budget to carry out flow monitoring at three year intervals to monitor 3 of 9 sanitary sewer catchments at a time. This will ensure that the Town reviews the RDII for its entire sewer utility within a 9-year running timeframe. As I&I rates are expected worsen over time, or improve as system rehabilitations are completed, this continued flow monitoring program is highly recommended.

4.3 Stage 3 – 5 – Sewer Assessment and Remediation

As the Town carries out its continued flow monitoring program, staff will start to identify critical parts of the sanitary sewer utility which require further assessment and remediation. The purpose of the remediation within the context of the Town's I&I Reduction Program is to significantly reduce RDII.

The following are our recommendations for the Town of Ladysmith:

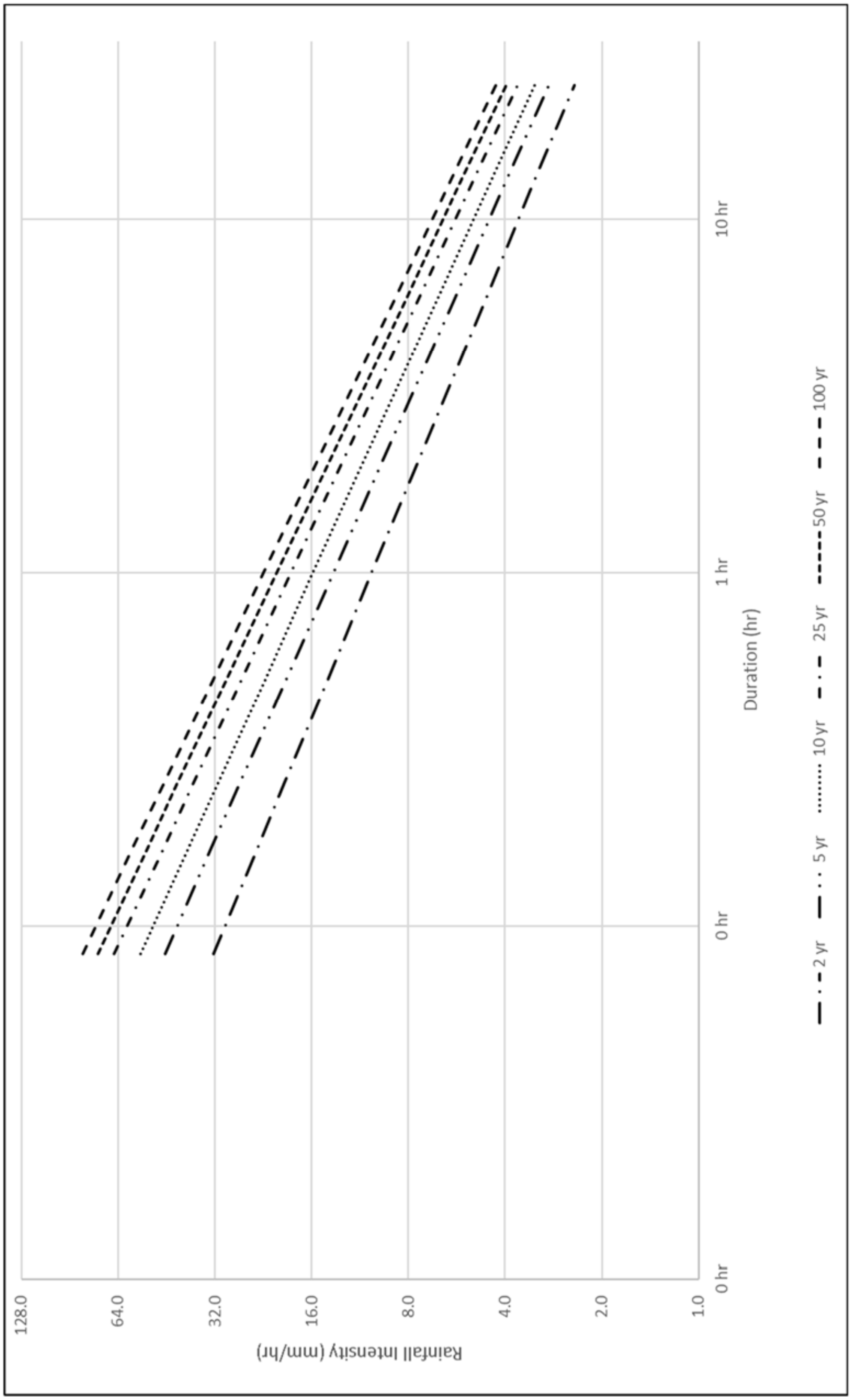
1. CCTV Inspections, Manhole Testing, and Vapour Testing are the most common tools for assessment of a sewer utility, and must be done first before any remediation works. If sufficient funding is currently available, Catchment 2 would be the prime candidate for CCTV Inspections and Vapour Testing in 2018. An estimated total length of 10,251 metres of sewers in length have been identified for investigation for Catchment 2.

   The Town is recommended to develop a 10-year rotation period for these sewer assessments, in line with industry standards for pipeline inspection from the WRc. These tests are recommended to be scheduled between January to October of each year, to avoid potential conflict / impact to the Town's flow monitoring programs.

2. After inspections, the selected remediation works such as manhole repairs, trenchless point repairs, external point repairs, and cross-connection rehabilitations shall be conducted by a certified MMCD contractor. Again, these inspections are recommended to be scheduled in conjunction with the above sewer assessments (preferably to be completed by the same contractor) between January to October of each year, to avoid conflict/impact to the flow monitoring programs.

Appendix A

Short Duration Rainfall Intensity-Duration-Frequency Data
Station: Nanaimo A, BC 1025370



MEMO

TO: Kim Fowler, Town of Ladysmith

FROM: Clive Leung, P.Eng., Negin Tousi, EIT

SUBJECT: **Waterfront Area Plan Sewer Servicing – Assessment**

DATE: **May 28, 2019**

WSP Canada Group Limited. ("WSP") has been retained by the Town of Ladysmith ("Town") to undertake a conceptual sewer servicing study for the Town's Waterfront Area development. The Waterfront Area Plan has been a crucial and strategic development for the Town over the years, with its goals of developing the Town's beautiful and scenic waterfront, while maximizing benefits to the community. The proposed development includes several residential, commercial, institutional, industrial, and park spaces which will be implemented in phases.

This memorandum provides our hydraulic capacity analysis of the Town of Ladysmith's sanitary sewer system to assess its capability in meeting existing and future servicing requirements.

DESIGN CRITERIA AND MODEL PARAMETERS

The Town is planning on a phased development of the Waterfront Area. This area will be serviced by the Town's existing sewage system. The existing 600 mm trunk sewer that runs through the middle of the site currently services connections adjacent to the Waterfront Area and runs parallel to the Trans-Canada Highway 1. This trunk sewer collects sewage flows from a large portion of the Town. In order to assess the servicing requirements for this study area, these additional contributing areas were considered: to this end, we have applied a preliminary growth estimate for the rest of the Town's population upstream of this trunk sewer.

The flow projections for the existing service area have been updated since the Design Parameters memo, dated March 20, 2019. The updates have been as a result of refined population and hectarage for the existing service area and the Waterfront Area development. Revised values for the existing service area are outlined in Table 1.

Table 1: Design Parameter Revisions since Design Parameter Memo

Parameter	Existing Service Area			
	Phase 1		Ultimate	
	Design Parameter Memo	Revised Values	Design Parameter Memo	Revised Values
Population, persons	10,007	10,118	12,511	12,650
ADWF, L/s [a]	22.7	22.95	28.4	28.7
Area, ha	258	284 [b]	258	244 [c]
I&I flows, L/s [d]	59.6	65.58	59.6	56.34

Notes:

a) Revised due to revised population.

b) Total existing service area is 287 ha (revised since the Design Parameter Memo). 3 ha will have been "re-developed" in the Waterfront Area in this phase.

c) Waterfront Area Development is estimated at 49 ha in total, with 6 hectares of I&I contributions which will be captured after developing the Waterfront Area which is assumed to run off to the coast at present. This will be captured by the new Lift Station. Therefore, total existing service area assessed under the ultimate scenario is 287 ha minus 43 ha (49 ha – 6 ha).

d) Revised due to revised total area.

The design parameter memo presented two methods of estimating the flow projections for the new Waterfront Area development: one using the Town's Design Criteria, and one using MMCD Design Guidelines. The values used in the model and sewer capacity assessment are derived as follows:

— I&I contributions are calculated based on the Town's Design Criteria for a more conservative estimate; and
— Population-based per capita flows are calculated based on the MMCD Design Guidelines as it is a more recent guideline and all assumptions and peaking factors are clearly laid out.

The flows for the existing service area and Waterfront Development area are shown in Table 2.

Table 2: Flow Projections

Parameter	Phase 1		Ultimate	
	Existing Service Area	Waterfront Development	Existing Service Area	Waterfront Development
Population, persons	10,118	525	12,650	1,235
ADWF, L/s	22.95	2.13	28.70	5.00
Peaking Factor	3.06	3.2	3.06	3.2
PDWF, L/s	70.2	6.8	87.8	16.0
Area, ha	284	3	244 [a]	49 [a]
I&I flows, L/s	65.58	0.39	56.34	6.36
PWWF, L/s	135.81	7.19	144.15	22.36

Notes:

a) Assuming an additional 6 hectares of I&I contributions will be captured after developing the Waterfront Area which is assumed to run off to the coast at present. This will be captured by the new Lift Station.

In the assessment of gravity sewer capacity, the maximum flow depth ratio (depth over diameter, d/D) is one of the most commonly used indicators as it identifies sewers that are, or are close to, surcharging. According to the MMCD Design Guidelines, gravity sewers should be designed with sewers flowing 80% full (d/D=0.8) unless an exception to this requirement is confirmed with the local authority. Gravity sewers that exceed a d/D of 0.8 require a closer assessment and potentially upsizing.

All the figures presented in this memo have the gravity sewers colour coded to indicate their performance under the various scenarios:

- Blue – Meets the d/D design criteria above
- Red – Exceeds the d/D design criteria above

PHASING APPROACH AND ASSUMPTIONS

As discussed in the Design Parameters memorandum, dated March 20, 2019, a phased approach is assumed for the Waterfront Area development. Phase 1 includes the development of the residential apartments on the Southeast Parcel (design horizon 2023), with the remainder of the developments occurring under the Ultimate phase (design horizon 2038).

Figure 1 shows the 600 mm trunk main and the respective existing manholes. These manholes will be used to directly connect flows from the Waterfront Area development and to capture the I&I associated with the surrounding area including the Waterfront Area development.

The sewer servicing approach for this development, shown on Figure 2, includes the following:

- Phase 1:
  - Connect the sewers from the residential apartments and approximately 3-ha equivalent of I&I on the Southeast Parcel directly to the existing 600 mm trunk main at MHTLN80. With a population equivalent of 525 persons, this is a large portion of the new Waterfront Area development and its proximity to the existing 600 mm trunk main will allow for a direct connection to minimize collection and pumping requirements for the Waterfront Area development.
- Ultimate Phase:
  - Connect the sewers from the residential apartments and approximately 3-ha equivalent of I&I on the Southeast Parcel directly to the existing 600 mm trunk main at MHTLN80 (constructed under Phase 1);
  - Connect the sewers from the residential apartments and townhouses and approximately 2-ha equivalent of I&I on the West Parcel directly to the existing 600 mm trunk main at manhole MHTLN110. With a population equivalent of 210 persons, this is a large portion of the new Waterfront Area development and its proximity to the existing 600 mm trunk main will allow for a direct connection to minimize collection and pumping requirements for the Waterfront Area development; and
  - Construct a lift station in the general vicinity of the Marina Landing, collecting sewage and approximately 6-ha equivalent of I&I from the remainder of the Waterfront Area development, and conveying it to the existing 600 mm trunk main through a new dedicated forcemain, discharging to the forcemain at MHTLN130.
  - The I&I for the remainder of the Waterfront Area is generally split between MHTLN80 – MHTLN160 proportional to their catchment.

Figure 1: Location of Trunk Sewer and Manholes of Interest

A total of seven manholes are the proposed manholes added to the model to capture the collector network upstream of the new Waterfront Area Lift Station. Flows from the Waterfront Area, excluding the two residential developments directly connecting to the existing trunk main, are assigned to the new junctions as per Table 3 and Figure 2.

Table 3: Pumped Area Model Loading Point

Development	**Live-Work-Learn Complex**	**Arts and Heritage Hub and Machine Shop**	**Hotel**	**Rest of Pumped Area**	
				NW Allocation (70%)	SE Allocation (30%)
Model Loading Point	J4	J5	J7	J2	J3

Table 4 summarizes the sewer loads added to the respective manholes as described above.

Table 4: Additional Flows as a Result of Waterfront Area Development

Manhole ID	Phase 1 PDWF (L/s)	Phase 1 I&I (L/s)	Development Element	Ultimate PDWF (L/s)	Ultimate I&I [a] (L/s)	Development Element
MHTLN160	-	-	-	-	0.49	-
MHTLN150	-	-	-	-	0.49	-
MHTLN140	-	-	-	-	0.99	-
MHTLN130	-	-	-	J2, J3, J4, J5, J7	0.49	-
MHTLN120	-	-	-	-	0.49	-
MHTLN110	-	-	-	-	0.49	-
MHTLN100	-	-	-	4.19	0.77	West Parcel
MHTLN90	-	-	-	-	0.49	-
MHTLN80	6.81	0.39	Southeast Parcel	6.82	0.88	Southeast Parcel
J2	N/A	N/A	N/A	2.28 [c]	0.39 [d]	Remainder of Dev
J3	N/A	N/A	N/A	0.98 [c]	0.39 [d]	Remainder of Dev
J4	N/A	N/A	N/A	1.47	-	Live-Work-Learn
J5	N/A	N/A	N/A	0.32	-	Arts and Heritage Hub and Machine Shop
J7	N/A	N/A	N/A	1.44	-	Hotel
TOTAL	**6.8**	**0.39**		**16.0**	**6.36**	

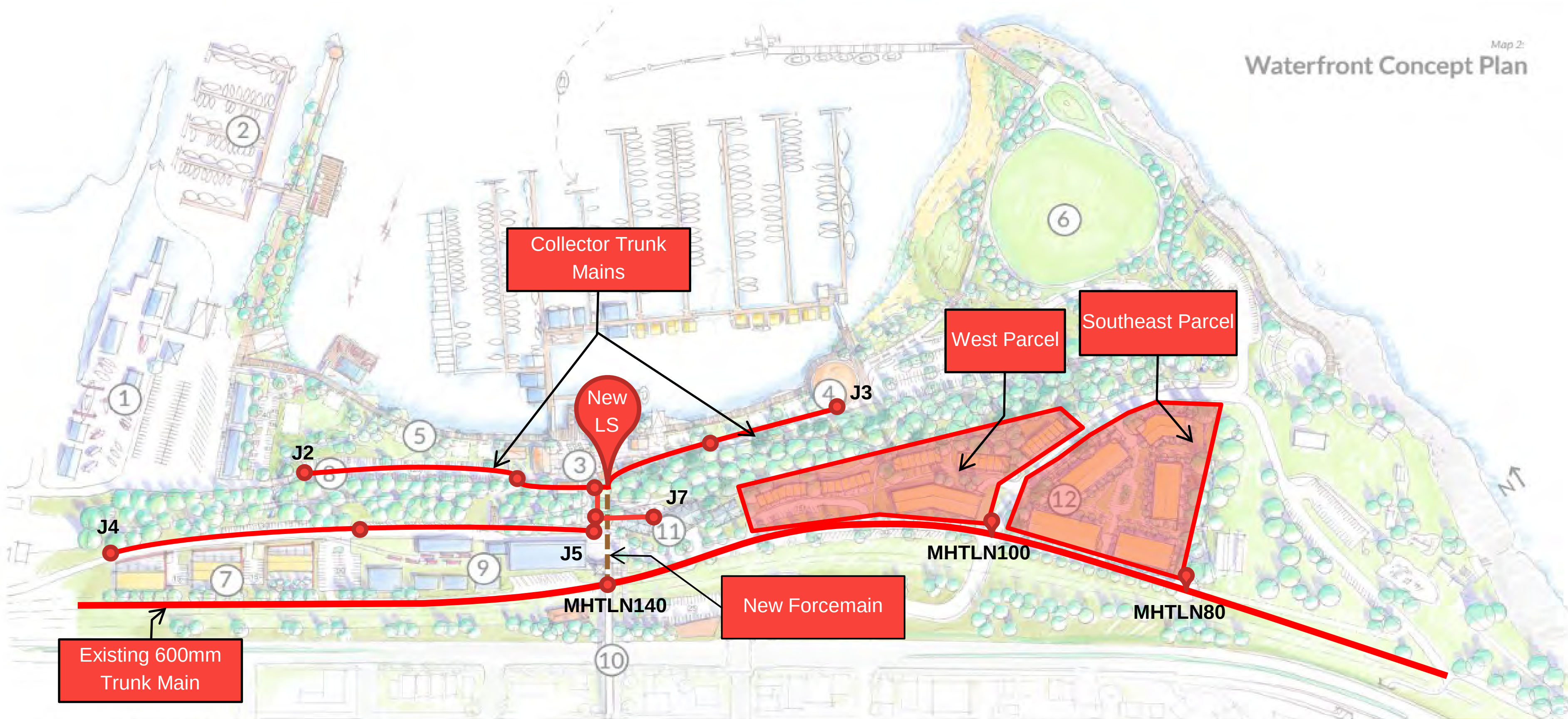
Notes:

a) Approximately 38 hectares of I&I contribution will be captured by the existing network (i.e. calculated from 49 ha total minus I&I accounted to elsewhere in the network). Additional I&I has been added onto the appropriate nodes from the remaining 11 ha: 3 ha for the Southeast Parcel, 2 ha for the West Parcel, and 6 ha for the pumped portion.

b) Contributions added to J2, J3, J4, J5, and J7 are directed to MHTLN130 through the proposed lift station and forcemain.

c) Contributions from the remainder of the Waterfront Area development (excluding the Southeast Parcel and West Parcel residents) are split approximately 70% to the West (J2) and 30% to the East (J3) of the proposed Lift Station.

d) I&I contributions from the remainder of the Waterfront Area development (excluding the Southeast Parcel and West Parcel residents) are assumed to split evenly between the West (J2) and East (J3) collector network.



1. MARINE SERVICES CENTRE
Existing facility with expanded and improved marine vessel repair and maintenance yard, with additional boat lift equipment, amenity buildings, associated site parking, and marine fuel services.

2. COMMERCIAL FISHING WHARF
Reconfigured boat docking with new access and vehicular turnaround on the breakwater, with potential expanded space for marine services. Note: Adjacent public boat launch, washrooms, and boat trailer parking is maintained.

3. MARINA LANDING
Improved vehicular access is enabled by the filling of foreshore to the north. The new additional space will provide water-oriented enterprises and programming, such as a paddling centre and expanded drop-off and turnaround area. Additional parking, access and services to the south will support the communities' expanded marina, where limited boat shelters and possible float homes may be established.

4. STZ'UMINUS FIRST NATION CULTURAL CENTRE
As an integral feature of the future waterfront, the SFN Cultural Centre is sited on the water's edge. It's future design will be led by SFN, and is expected to include spaces to showcase Stz'uminus culture, artist spaces, and retail spaces such as a cafe.

5. WATERFRONT WALKWAY
A continuous waterfront walkway establishes public access to the water, extending from the commercial fishing wharf to Slack Point, and further south to Transfer Beach Park.

6. SLACK POINT PARK
Substantial environmental improvements are achieved through the capping of the park area and surrounding foreshore and submarine floor. New plantings would improve ecological health, and a variety of park programming and events, such as concerts and festivals, could be accommodated in the reconfigured open area. The existing gravel parking would be retained and improved, with additional parking to support marina activities. Stz'uminus cultural references are incorporated into the park.

7. LIVE-WORK-LEARN
Mixed used live-work-learn buildings – with ground-level commercial, institutional, light industrial or entrepreneurial spaces for the tech industry or arts studios and residential uses above – are adjacent to the creative activities within the Machine Shop and surrounding structures.

8. FILLED FORESHORE & ACCESS ROAD
A retained and filled foreshore on either side of the community marina, combined with restorative ecological habitat plantings along the length of the new foreshore and submarine areas, creates room for improved vehicular access to the expanded marina. It also provides opportunity for additional marina parking and water-oriented amenities, as well as the possibility of future small-scale retail destinations, such as a pub.

9. ARTS AND HERITAGE HUB
Identity, character, and existing conditions are enhanced in this key central area to further define it as a creative, arts and culture, and heritage hub, building on current activities and structures. The Machine Shop is maintained.

10. GATACRE OVERPASS (PEDESTRIAN BRIDGE)
A pedestrian overpass/bridge safely and efficiently connects the downtown with the cultural hub and overall waterfront area.

11. WATERFRONT INN
A small boutique hotel or inn offers amenities to visitors by land or water, and includes publicly-accessible destinations for locals such as culinary and recreational opportunities. This Inn will be differentiated from and complementary to hotel development at Oyster Bay.

12. RESIDENTIAL DEVELOPMENT
A mix of housing types ranging from 2-3 storey townhomes to 5-6 storey apartments create housing choice and revenue for investment in public amenities such as the waterfront walkway. Many of the community's priorities for the future of the waterfront require capital investment, and the residential development will assist in covering costs.

The location of these homes is behind the existing forested ridge and does not cast shadow on the public waterfront walkway or impede views from upland areas. Public pedestrian linkages are included in the site plan.

STZ'UMINUS FIRST NATION

Figure 2: Waterfront Concept Plan

SYSTEM CAPACITY ANALYSIS

The main objective of the capacity analysis is to assess the impacts of the increased in flows due to each of the Waterfront Area development phases in conjunction with projected future population increase of the existing service area. The results are summarized in the following sections. Figures 3, 4, and 5 show the model results for existing 2014 conditions, Phase 1, and Ultimate phase, respectively.

EXISTING 2014 CONDITIONS

Figure 3 shows the North-West section of the sewer network, the area of interest for the purpose of this assessment. The model results on Figure 3 are for the existing network conditions in 2014 and shows that one segments of the sewer network near the intersection of Symonds St and 1st Avenue (Pipe ID P684) exceeds the MMCD maximum d/D criteria under 2014 conditions, at a d/D value of 0.82.

PHASE 1

Phase 1 of the Waterfront Area development includes the residential apartment development on the Southeast Parcel.

Under the Phase 1 scenario, shown on Figure 4, the vast majority of the of the gravity sewers meet the MMCD design criteria. The one exception is the 300 mm P684, which already exceeds the design criteria under 2014 conditions. Under Phase 1 scenario, the d/D for this pipe is incrementally increased from 0.82 to 0.83.

The addition of the flow contribution from the Southeast Parcel of the Waterfront Area development directly to manhole MHTLN80 results in no new deficiencies in the network.

ULTIMATE

The Ultimate Phase of the Waterfront Area development includes addition of residential apartments and townhouses, an expanded marina, a new cultural center, a Live-Work-Learn center, a new hotel, an artisan village, and some retail and commercial services.

Some sections of pipe network upstream of the Ludlow Lift Station also experience some exceedances under the Ultimate conditions, and the d/D will continue to increase with growing population upstream, causing further exceedances. This section of the network is not considered under this servicing review as it is upstream of an existing lift station and the only contributing flows are as a result of population growth upstream of the Waterfront Area development. However, in order to accurately assess the capacity of the downstream piping network, which will also be impacted by additional flows from the Waterfront Area development, the flow contributions from the Ludlow Lift Station are accounted for in the downstream pipes.

Similar to Phase 1, under the Ultimate Phase scenario, shown on Figure 5, with the exception of gravity sewer P684, all the gravity sewers in the northwest region satisfy the design criteria.

The addition of the sewage contribution from the West Parcel of the Waterfront Area development directly to manhole MHTLN100, and the contribution from the remainder of the development through a new Lift Station and dedicated forcemain, to manhole MHTLN130 result in no new deficiencies in the network.

North Vancouver Office
#210 - 889 Harbourside Drive
Tel (604) 990 4800
Fax (604) 990 4805

Legend

- Forcemain
- Manhole
- Lift Station

Results

- Meets MMCD Criteria
- Exceeds MMCD Criteria

Client: Town of Ladysmith

LADYSMITH

Figure No.:

Figure 3

Figure Title:

**Town of Ladysmith (North West) - Waterfront Area Development
Existing 2014 Conditions Peak Wet Weather Flow
Maximum Depth to Full Depth (d/D) Ratio**

N E S W

0 45 90
Meters

Project No.: **18P-00296-00**

Date: **April 2019**

Drawn By: **NT**

Path: G:\opus_dk\municipal\218 Ladysmith\gis\18P-00296-00 Waterfront Area Plan - Sewer Servicing Review\Figure 3 dD Results - PWWF Existing 2014.mxd

wsp
North Vancouver Office
#210 - 889 Harbourside Drive
Tel (604) 990 4800
Fax (604) 990 4805

Legend

- Forcemain
- Manhole
- Lift Station

Results

- Meets MMCD Criteria
- Exceeds MMCD Criteria

Client: Town of Ladysmith

LADYSMITH

Figure No.:

Figure 4

Figure Title:

Town of Ladysmith (North West) - Waterfront Area Development - Phase 1
Peak Wet Weather Flow
Maximum Depth to Full Depth (d/D) Ratio

N W E S

0 45 90
Meters

Project No.: **18P-00296-00**

Date: **April 2019**

Drawn By: **NT**

Path: G:\opus_dk\municipal\218 Ladysmith\gis\18P-00296-00 Waterfront Area Plan - Sewer Servicing Review\Figure 4 dD Results - PWWF Phase 1.mxd

North Vancouver Office
#210 - 889 Harbourside Drive
Tel (604) 990 4800
Fax (604) 990 4805

Legend

- Forcemain
- Manhole
- Lift Station
- New Infrastructure

Results

- Meets MMCD Criteria
- Exceeds MMCD Criteria

Client: Town of Ladysmith

LADYSMITH

Figure No.: **Figure 5**

Figure Title: **Town of Ladysmith (North West) - Waterfront Area Development - Ultimate Peak Wet Weather Flow Maximum Depth to Full Depth (d/D) Ratio**

N E S W

0 45 90
Meters

Project No.: **18P-00296-00**

Date: **May 2019**

Drawn By: **NT**

Path: G:\opus_dk\municipal\218 Ladysmith\gis\18P-00296-00 Waterfront Area Plan - Sewer Servicing Review\Figure 5 dD Results - PWWF Ultimate.mxd

WATERFRONT AREA LIFT STATION AND FORCEMAIN

This section details our recommendations on the additional infrastructure required to service the proposed Waterfront Area development.

As shown on the Figure 2 concept and the Figure 5 model snapshot, under the Ultimate Scenario, a new Lift Station will be required at a low elevation in the Waterfront Area development to enable collection of the flows by gravity. The exact location of the Lift Station depends on the final plan for the development, however it is anticipated that the location will be in the general vicinity of the Marina Landing, to allow for ease of collection of sewage from both ends of the developments.

Locating and routing constraints for the new lift station and waterfront collector network heavily rely on the final development plan for the area however a preliminary assessment based on the BC Online Cadastre shows that the general location of the new Lift Station will fall within a crown municipal parcel, as shown on Figure 6.

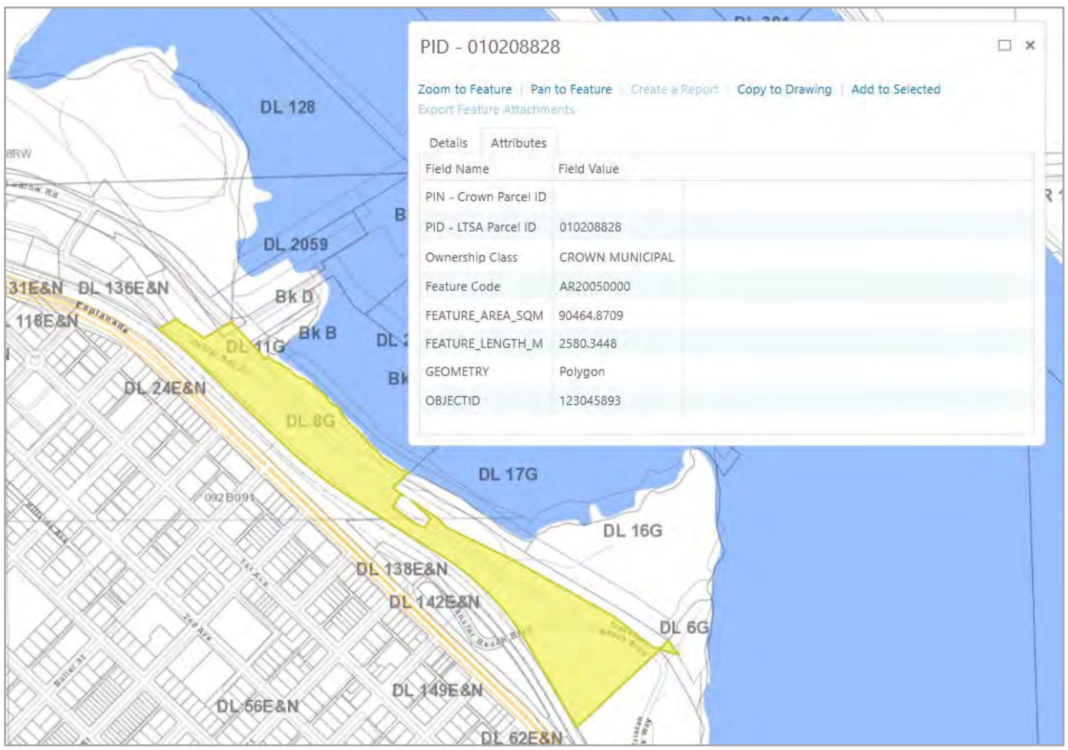


Figure 6: Property Ownership in the General Area

Two trunk sewers would convey the flows from the ends of the development to the new Lift Station: one gravity sewer collecting the flows from the Northwest sections, and one gravity sewer collecting the flows from the Southeast sections. A new trunk sewer would be constructed along oyster bay road to convey the flows from the live-work-learn development, the machine shop, the arts and heritage hub, and the hotel down to the new lift station. A dedicated forcemain will convey the pumped flows from the new lift station uphill to manhole MHTLN130, a linear distance of approximately 70 metres. At this time, all new proposed pipes are sized at 200 mm diameter. Based on the Ladysmith Design Criteria, “no sewer main shall be less than 200 mm in diameter unless otherwise approved by Engineer.”. However, the size of the pipes, particularly the forcemain must be reassessed and optimized during the preliminary and detail design phase in order to ensure an appropriate d/D ratio for the gravity sewers and sufficient design velocities for the forcemain.

Table 5 outlines the estimated costs for each of the new linear infrastructure identified in this assessment. The unit costs were obtained from our extensive database of historical sewer replacement works. These costs have accounted for 40% Engineering and Construction, including operations and maintenance, and administration costs, and 1% municipal overhead, and are listed in 2019 dollars. This class D cost estimate is based on the conceptual assessment provided in this report and not intended for budgeting purposes.

Upon confirmation of more details, and once the Town proceeds with the design of this infrastructure, a more detail cost estimating exercise should be undertaken.

Table 5: New Linear Infrastructure Cost

Infrastructure	Diameter (mm)	Approximate Length (m)	Unit Cost [1] ($/m)	Cost
West Gravity Sewer (P27)	200	240	1,014	$243,000
East Gravity Sewer (P28)	200	310	849	$263,000
Oyster Bay Gravity Sewer (var)	200	375	860	$323,000
Lift Station Forcemain (P26)	200	70	1,129	$79,000
Total				**$908,000**

Notes:

1) Unit costs vary primarily as a result of the number of service connections and the steepness of the construction area.

The unit costs presented in Table 5 are inclusive of service connections and consider the topography of the land and ease of construction.

In addition, an estimated 10 manholes will also be required to interconnect all the new gravity sewers to the new lift station. The cost of each manhole estimated at $10,000, with a 40% E&C included, finalizes this portion of the cost at $100,000. The cost of a new lift station at this location is approximated at **$700,000**, based on recent design and construction of other lift stations within the same flow ranges and in nearby communities, also with a 40% E&C.

CONCLUSION

The results presented in this memo are preliminary and are based on theoretical peak wet weather flows derived from the assumptions made during the development of the initial sewer model for as part of the Couverdon Lands Project in 2014. Further assumptions were made in estimating the Waterfront Area development impact that are discussed in the Design Parameters memorandum, dated March 20, 2019.

The addition of the Waterfront Area development flows to the sewer network does not result in any new deficiencies for the existing infrastructure in the Town. At the ultimate design horizon, the developer(s) will be required to design and construct new infrastructure including a gravity sewer collection network, a new lift station, and a new forcemain. A conceptual level cost estimate of approximately **$1,708,000** is recommended for the new infrastructure at this time.

CLOSURE

We trust you will find the forgoing letter report suitable. Please do not hesitate to contact the undersigned should you have any questions.

Yours sincerely,

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
C. W. LEUNG
41265
May 28, 2019

Clive Leung, P.Eng.
Project Manager, Infrastructure

Prepared by:

Negin Tousi, EIT.
Project Engineer, Infrastructure

NT/ML/ab
WSP Ref. 18P-00296-00

Appendix E - Preliminary Sanitary Sewer Capacity Report

TOWN OF LADYSMITH *Celebrate our Present. Embrance our Future. Honour our Past.*

For:
Jake Belobaba, Director of Development Services
Town of Ladysmith
132C Roberts Street
Ladysmith, BC

May 8, 2024

SMALL SCALE MULTI-UNIT HOUSING (Bill 44) PRELIMINARY SANITARY SEWER CAPACITY REVIEW

Permit to Practice No. 1001793

Ryan Bouma, P. Eng.
Director of Infrastructure Services

Reviewed by:
Michele Gill, AScT
Sr. Engineering Technologist

1.0 INTRODUCTION

In early 2024, the Town of Ladysmith's (Town) Engineering Department was asked by Mr. Jake Belobaba, Director of Development Services, to review the Town's utilities for capacity issues related to proposed changes to residential zones. The Engineering Department understands the zoning bylaw density increase changes are a directive from the Provincial government's legislation regarding Small Scale Multi-Unit Housing (SSMUH).

This report provides the findings of a preliminary review of the sanitary sewer collection system and the capacity of sanitary sewer mains to support additional density or highlight the need to request an extension to the SSMUH requirements. Water and storm water utilities were reviewed by others. The findings of this report are preliminary in nature as legislated deadlines for the density increase have not allowed for detailed review of the sanitary sewer system. The Engineering Department recommends a detailed review of the findings to provide detailed estimates and prioritization of projects.

2.0 BACKGROUND

While reviewing the sanitary system, the Engineering Department reviewed relevant sources of information, including:

- WSP 2017 Flow Monitoring Program report – This report provided the Engineering Department with measured flows and Rainfall Derived Inflow and Infiltration (I&I) rates. This report found that I&I is 4 to 6 times higher than the Town's standards and specifications in some areas. Having field measurement of I&I in specific catchments increases the confidence of the results herein.
- Town of Ladysmith record information – Pipe sizes, grades, and materials were obtained from the base mapping available to the Engineering Department. Field confirmation of piping was not completed at this stage of review.
- Town of Ladysmith Standards and Specifications – Town standards were used for population densities, peaking factors, and calculation methods.
- Virtual meeting with WSP – WSP/Opus constructed a model of the Town's sanitary sewer system in 2014. Although WSP was not able to run the model within the timelines required, a WSP representative met with the Engineering Department virtually on April 30, 2024. The WSP representative was able to provide a copy of the model to the Engineering Department and give brief comments about their knowledge of the sanitary sewer system.
- Opus Technical Memorandum No. 1 – Sanitary Sewer Model Development and Validation – This technical memorandum describes the construction of the sanitary system in 2014, including the extents of development and the inflow rates used.
- WSP Waterfront Area Plan Sewer Servicing Assessment – The Waterfront Area Plan was previously analyzed by WSP. The report was reviewed for downstream capacity findings.

- Opus Technical Memorandum No. 1 Phase 3 Advanced Secondary Wastewater Treatment Plant – This technical memorandum includes details of the wastewater treatment plant, including capacity and population growth.
- Ministry of Housing Policy Bulletin – Local Government Housing Initiatives SSMUH Extensions – This policy was reviewed to better understand the needs of this report and the ability to apply for an extension.

We understand that the SSMUH legislation requires the Town to increase density in "restricted zones" to allow for a minimum 4 units per lot on lots between 280 and 4050m^2 and 3 units on lots less than 280m^2. The sharp increase to available density has impacts to existing infrastructure that was designed for conventional one or two unit per lot density. The Province has acknowledged this concern and provided an opportunity to municipalities to apply for an extension until 2030 for several reasons. One reason is "the infrastructure that services the area where SSMUH would apply is such that compliance by June 30, 2024, is likely to increase a risk to health, public safety, or the environment in that area". An example is provided in the provincial bulletin as "upgrades that increase capacity required to meet demands of added development – including increasing pipe size".

The waste water treatment plant was not reviewed as part of this assignment, although some discussion is provided in Section 5.0 based on staff knowledge and review of design reports.

The Engineering Department further understands that the Town's Development Services Department is preparing zoning bylaws and an extension request for Council to review and that this report will be used to support their work.

3.0 METHODOLOGY

Given the relatively short deadline imposed on the Town, the Engineering Department carried out a high level preliminary review of the entire sanitary sewer system. Not all sanitary sewer utilities were checked as that is outside the scope of this report and should be done through detailed review and computer modelling.

3.1 DESKTOP REVIEW

A high level review of the entire sanitary sewer collection system was reviewed in an Engineering Department meeting to evaluate and discuss potential capacity issues within the system. Staff scanned the system for pipes that met one or more of the following criteria:

- Pipes that carry large catchment areas;
- Grades less than 2%;
- Small diameter pipe relative to the catchment area;
- Areas known to potentially have capacity concerns based on the Engineering Department's prior knowledge;

- Areas of recent growth on older pipes potentially sized for smaller catchments; and
- Areas of known high rates of Inflow and Infiltration (I&I).

Pipes that matched the above criteria were highlighted and determined whether to be included in capacity calculations. In all, the Engineering Department reviewed more than 20 pipes of concern with a total length more than 3000m.

3.2 CAPACITY CALCULATIONS

Following the desktop review Engineering staff developed a spreadsheet based on Section 5 of the Town's Standards and Specifications to calculate the flow rate and capacity of the identified pipes of concern. The calculations considered:

- Diameter;
- Grade;
- Material roughness;
- Peaking factor;
- Population density;
- Existing development plans (e.g.. Holland Creek Area);
- Catchment area; and
- I&I based on WSP metering in 2017.

Population density for single family residential is noted to be 36 persons per hectare (pph) in Section 5A.2.3 of the Town's Standards and Specifications. This was used to evaluate the system for existing conditions. "Pockets" of commercial development were treated the same, as the Standards and Specifications note 36 pph for Industrial and Commercial zones. The Downtown Area along 1st Avenue was similarly treated the same for simplicity. The relative size of the Downtown Area was not significant for this level of review.

Based on conversations with the Town's Development Services Department, predicting the uptake of SSMUH and a realistic population density prior to 2030 is difficult. The Engineering Department chose to evaluate four conditions to provide a range from Single Family development to High Density Multiple Family development. These were:

- 36 pph (SFD population)
- 48 pph (Low Density Multi-Family)
- 72 pph (inferred density potential)
- 120 pph (High Density Multi-Family)

The Town's Standards and Specifications note "peak stormwater infiltration shall be calculated on the basis of 11,200L per hectare"; however, the Standards are generally written for new construction where modern pipe materials and a separate storm water system are used. Results from the WSP 2017 Flow Monitoring Program were weighted based on the catchments being reviewed. In areas of Town that were not covered by the metering, I&I rates were used based on similar construction and age to areas that were covered.

Two calculations were carried out. The first was the rate of flow from the catchment area and the second was the capacity of the existing pipe. Rather than calculate the fullness of the pipe, the flow and capacity were merely checked as a percentage of pipe capacity to identify the pipes that are near or exceed capacity.

A final step in the spreadsheet calculations was to carry out a sensitivity analysis of pipes that were near or exceeded capacity. Because grade of pipe is generally fixed, the Engineering Department checked for improvements based on increasing pipe size, lining the pipe for decreased roughness, and decreasing I&I.

Sample calculations are provided in Appendix B.

3.3 COMPUTER MODELING

The computer model developed by WSP is based in PCSWMM using record information from 2014 and a census population of 7,842 people. Staff understands that little, if any, updates to the model have been completed and does not include a myriad of development that has occurred over the past 10 years, nor does it include updated I&I rates learned in 2017. The discrepancy of I&I between the model and known rates made comparison in some areas difficult. Through discussions with a WSP representative, updates to the model were not possible in the time required, although the model was provided to the Engineering Department for internal use.

Despite the lack of updating to the model, the Engineering Department used the model for verification of the spreadsheet calculations. The model is able to predict pipe fullness for the entire system, which would not be feasible with spreadsheet calculations; therefore, the model was also used to highlight pipes that may not have been captured during the desktop review.

We recommend the model be updated to reflect current extents of the sanitary sewer system and reflect the known I&I rates.

3.4 ANALYSIS

Upon completion of the above analysis, the Engineering Department reviewed the results, considered the impacted areas of the Town, and looked for potential improvements to the system. Results were generally broken into three categories as follows:

- Low – Pipes in this category do not have a capacity issue and would not prevent development. These pipes were not reviewed any further;

- Medium – Where capacity is nearly reached at existing conditions and exceeds capacity with some densification, pipes were reviewed in greater detail and included in Section 4; and
- High – There were several instances where pipes were at capacity under existing conditions and require detailed review. Further discussion is provided in Section 4.

The results of the analysis have allowed the Engineering Department to make recommendations for extension requests to the Province as well as for further detailed review prior to the 2030 extension expiry.

4.0 ANALYSIS RESULTS

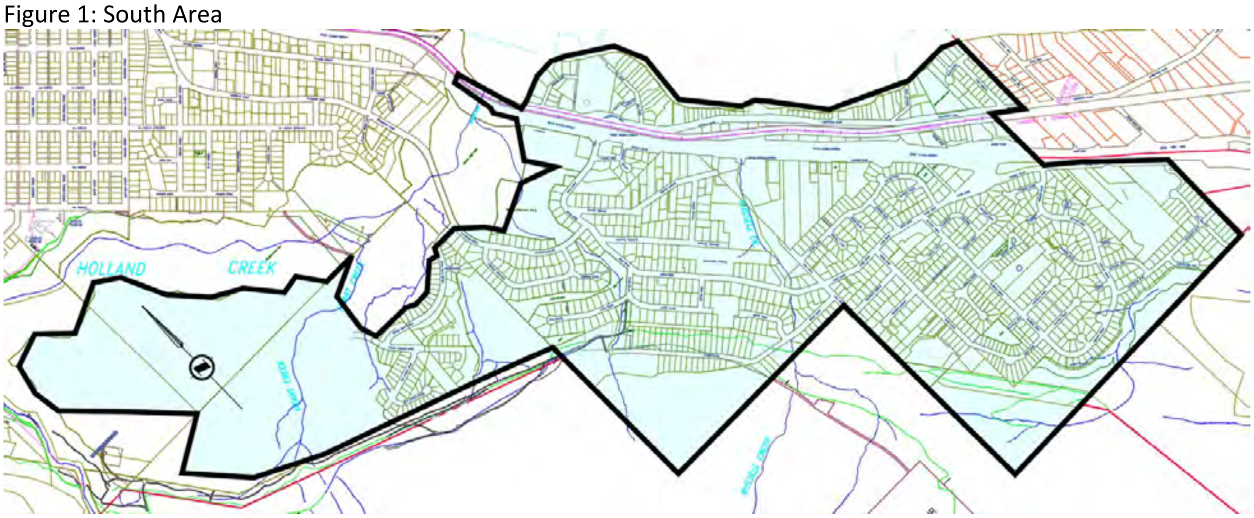
The Town generally consists of three large catchments that flow into trunk mains towards the Wastewater Treatment Plant. Due to the size of the catchments and findings of the analysis, the northern catchment was broken into two smaller areas for discussion.

Rocky Creek Road, Transfer Beach, and the Waterfront Area Plan are not discussed below. Preliminary review of these areas did not reveal concerns that were not already being addressed through development and nearly all of these areas do not fall within "Restricted Zones" under the SSMUH legislation.

4.1 SOUTH LADYSMITH

The South Area consists of all properties south of Holland Creek, except for the Westdowne Road Industrial Area which does not have sanitary sewer service and understood to be automatically exempt from SSMUH regulations. Generally, this includes the Chemainus Road, Holland Creek Area, Coronation Mall, Davis Road, Russel Road, and Stirling Drive areas as shown below.

Figure 1: South Area

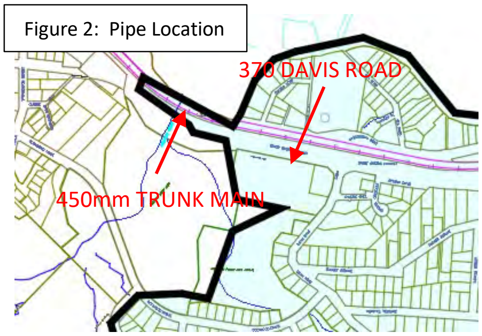


This area was initially reviewed as multiple catchment areas, but the analysis quickly revealed that the entire area is impacted by the same pipe capacity issue, which is the sanitary trunk main along Highway 1. Two other notable mains identified to have capacity concerns were the Chemainus Road foreshore main (150mm AC) and the low grade portions of the Holland Creek Ball Field main (200mm AC) which will be upgraded as part of the Holland Creek developments.

4.1.1 Highway 1

A 450mm diameter concrete main at a low 0.34% grade services the entire South Area. A portion of this trunk main runs under the Holland Creek highway crossing, attached to the bridge structure. Our preliminary review of this trunk main involved a more detailed look than all other pipes in Town due to the large area impacted and poor correlation with the computer model. Spreadsheet calculations determined this trunk main to be at capacity under existing conditions (proposed developments included), whereas the computer model output some available capacity. The Engineering Department concluded the discrepancy to be due to conservative spreadsheet calculations and the model's exclusion of development in the area from the last 10 years, which is significant in the South Area.

Figure 2: Pipe Location



The closest property to be impacted by a sewer backup on this main is Coronation Mall at 370 Davis Road. The Engineering Department checked with Infrastructure Services for a history of callouts related to this main and found nothing. Coronation Mall is estimated to be 2.5m above the trunk main based on an assumed slab elevation in Save On Foods of approximately 22m. Because of the elevation difference some surcharge may be occurring without reports to Infrastructure Services. An Engineering Department representative went to a manhole near Coronation Mall on Highway 1 and observed the Dry Weather Flow in the manhole to be less than half the pipe height.

Based on these findings and the critical nature of this trunk main, we recommend that an extension is requested from the Province for the entire South Area. Existing approved developments may continue as they have been included in the spreadsheet calculations. We further recommend that the computer model be updated to reflect current conditions and detailed review be completed. If a capacity issue is found to exist with detailed review, the Town should plan for upgrades to this trunk main. Alternatively, the extension could be lifted.

If required, upgrades are anticipated to consist of re-lining the existing concrete main to reduce roughness followed by twinning the main. Twinning the main would allow for flows during construction without a risky and costly bypass system, requiring bridge deck space that may not be available. This work would involve the Ministry of Transportation and Infrastructure as well as the need for Structural engineering of the bridge. Planning, design, budgeting, and construction of this project is likely to exceed 5 years and it is not possible to estimate costs at this time.

4.1.2 Chemainus Road

Both spreadsheet calculations and computer modelling highlighted a serious capacity issue under current conditions with the 150mm diameter Asbestos Cement (AC) main along the foreshore at Chemainus Road. Background knowledge of this main and associated pump stations indicate the main is in poor condition with high volumes of infiltrating salt water. We understand that the Town's Utility Department has had to replace corroded pumps in the Gill Road pump station as a result of salt water. The Engineering Department has reviewed the general area and note that the pipe appears to be buried in loose, saturated, sand and gravel. Seismic shaking is likely to cause liquefaction and excess settlement, resulting in service and joint separation as well as cracking of the brittle pipe material.

We recommend that the Town budget and design a replacement of the Chemainus foreshore main. There are geotechnical and environmental concerns with construction within the foreshore as well as excavation difficulty in saturated soil. Pipe bursting should be considered during detailed design to avoid open-cut excavation on the foreshore. Construction costs are anticipated to be much higher per metre than conventional open cut excavation in a roadway. Costs are not available at this time, although it is recommended that $100,000 be included in the 2025 budget to carry out detailed review and design of the upgrade.

4.2 MIDTOWN AREA

The Midtown Area consists of 4th Avenue Extension, north Dogwood Drive, and Bayview Avenue, shown in Figure 4 below. The area is relatively small with topography that provides a consistent slope down to the Wastewater Treatment Plant. The size and topography kept all but one pipe within available capacity.

Figure 3: Midtown Area

The pipe connecting 4th Avenue Extension to Dogwood Drive consists of a 130m long, 200mm diameter, AC pipe set at 0.4% grade. The capacity is exceeded under the current conditions. Infrastructure Services staff have one report of backup at a property serviced on this main from May 26, 2020.

We recommend that an extension be requested from the Province for this catchment. A detailed review of the capacity of this main should be completed; however, the sensitivity analysis revealed that replacing the main with a 250mm PVC pipe would sufficiently increase capacity for current conditions and anticipated development. The cost to replace this main is likely to range from $200,000 to $250,000.

Figure 4: 4th Avenue Extension Sub-Catchment

All other pipes in the Midtown Area were found to be suffiently sized.

4.3 OLD TOWN AREA

In general, the Old Town Area is steeply sloping and includes 1st to 6th Avenue. The area has very high I&I rates which was an important consideration in this area. The area is shown in Figure 2 below.

Figure 5: Old Town Area

A review of the 600mm diameter concrete trunk main crossing Highway 1 at Buller Street leading along the Highway and railroad track to the Wastewater Treatment Plant was found to be near capacity. The Engineering Department reviewed the WSP Waterfront Area Servicing Plan, which discussed the capacity of this main and found it to have capacity. We noted that the WSP report did not consider the higher than anticipated I&I rates in the Old Town Area. The model should be updated to reflect the current rates and rechecked.

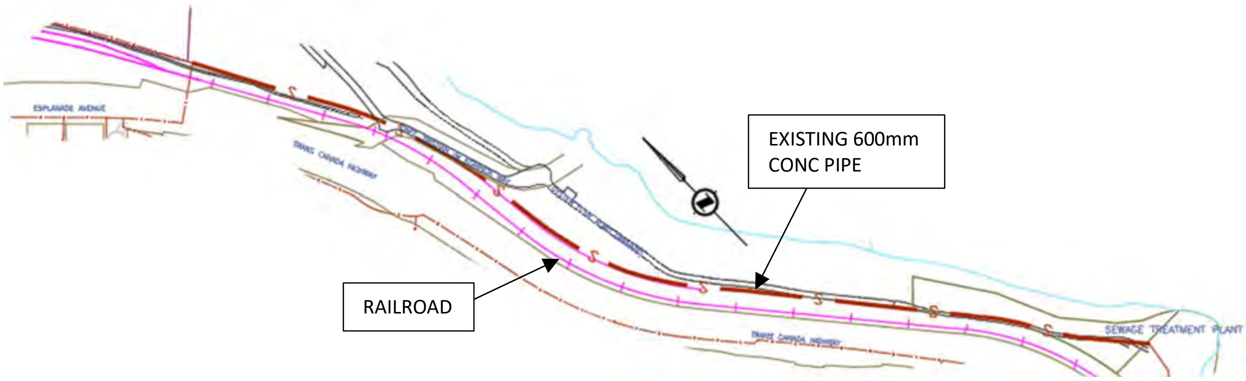
The sensitivity analysis revealed that I&I and pipe roughness were significant factors. I&I is reported to range from 43,405 to 67,308 L/Ha/day in this area, a 4 to 6 times higher rate relative to new construction. The high I&I rates are understood to be a result of old combined services and lack of storm service to some areas. The Town's Engineering Department is working with WSP to identify sources of I&I and come up with solutions to reduce the volume. WSP recently submitted a report on this subject, although it was not reviewed in time for this study.

One way to reduce I&I volume is to allow development and enforce the Town's Standards and Specifications for stormwater for new construction. Doing this will result in a net reduction in flow. As such, we recommend that development be allowed in this area with strict enforcement by the Development Services Department, with input from the Engineering Department, to remove combined services and construct new storm infrastructure where required. Detailed design will be required on a site by site basis between Town staff and developer consultants.

We recommend that the Town review the recently submitted WSP report regarding Inflow and Infiltration and consider implementing the recommendations in that report. There are likely costs associated with the recommendations so if the recommendations are accepted they should be budgeted and planned.

We further recommend detailed review of the capacity and consider lining the trunk main shown below. Reducing the roughness of the main will increase capacity sufficiently for more development and increase the life of the existing concrete main. This recommendation is relevant to the North Area described in Section 4.4, as it carries flows from both catchments.

Figure 6: Old Town Area Trunk Main



4.4 NORTH AREA

The North Area (Figure 6) consists of Malone Road, Colonia Drive, Jim Cram Drive, and the planned Lamont Lands development (south of Holland Creek, but planned to flow into this catchment). The area consists of relatively new construction materials with much lower I&I compared to the adjacent Old Town Area, but feeds into the trunk main within the Old Town Area. Our review of this area found multiple issues ranging from Low to High, that correlated with the computer model.

Figure 7: North Area

Based on the WSP report and the newer construction materials in the area, a relatively low I&I rate of 9000 L/Ha/day was used in our preliminary calculations. As such, there are few opportunities to improve I&I through development. Capacity concerns in the North Area require improvements to the infrastructure.

Several pipes were near to or at capacity. These include:

- 90m long, 150mm diameter at 801 Mackie Road;
- 60m long, 200mm diameter crossing Cloke Road at Taylor Crescent;
- 100m long, 300mm diameter on 2nd Avenue at Strathcona Road; and
- 550m long, 300mm diameter along Highway 1 from 1150 2nd Avenue to 1020 1st Avenue (round about).

4.4.1 Mackie Road

The Lamont Lands and Lot A developments are anticipated to inflow into this small sub-catchment on Mackie Road, which was likely not considered when the relatively small 150mm diameter main was constructed. Without the developments the pipe size is sufficient; however, with this additional development the pipe is nearing capacity under existing conditions. We have inferred builders in both developments are likely to build according to SSMUH which would result in a density around 72 pph and significantly exceed the pipe capacity. We recommend the Lamont Lands and Lot A developments be included in an extension request or require the developer(s) to make downstream improvements.

4.4.2 Cloke Road

This pipe is nearing capacity in current conditions and surcharges when population density reaches between 48 and 72 pph. An extension is not required due to this finding.

We recommend that this main be checked in the model as development proposals are presented to the Town and that replacement with a 250mm diameter pipe be considered in the next iteration of the Town's Development Cost Charge (DCC) bylaw.

4.4.3 2nd Avenue

Although a small sub-catchment of the Old Town Area flows into this main, the primary source of flow is the North Area. This pipe is twinned with an older 200mm diameter AC main in parallel. The Engineering Department is not aware of how the flows are shared between both pipes, but believe the newer 300mm main is at a slightly lower grade and will overflow into the older main when surcharged.

This main is near capacity under existing conditions without considering overflow; however, capacity is exceeded at 48 pph. The Engineering Department assumed an allowable 25% overflow and determined the overflow pipe and main reached capacity between 48 and 72 pph.

The Development Services Department should consider the likelihood this area will redevelop and push density beyond 48 pph. This main should also be monitored once the computer model has been updated. Consideration of replacing the overflow with a larger pipe, or complete replacement of both mains for the DCC bylaw is recommended.

4.4.4 Highway 1 to 1st Avenue (Round About)

This 300mm main with a twin 200mm overflow main is at capacity in existing conditions according to spreadsheet calculations and 85% according to the model. Similar to the description in 4.4.3, this pipe is shared with the Old Town Area and the Engineering Department does not know how the overflow is directed. Despite this, the North Area is the main contributor and is discussed in that context.

This is an existing capacity issue that should be reviewed in detail as a high priority to the Town. Consideration was given to recommending an extension request, but the need to upgrade the main shouldn't be delayed. An extension request should be made where new greenfield development may build in accordance with SSMUH, such as the new Malone Road development.

This main runs under the existing 1st Avenue round about, which is an extensive surface feature that would need to be removed for conventional open-cut excavation. The cost and disruption for this work is relatively high. A detailed review should be completed to determine the function of the bypass and how to increase capacity with minimal impacts to 1st Avenue. Conceptually, the Engineering Department suggests considering a pipe-burst replacement of one or both mains. It will be necessary to check pipe depths, nearby utilities, soil conditions, and dry weather flows with a specialized contractor in order to evaluate the feasibility. It is not possible to estimate costs at this time.

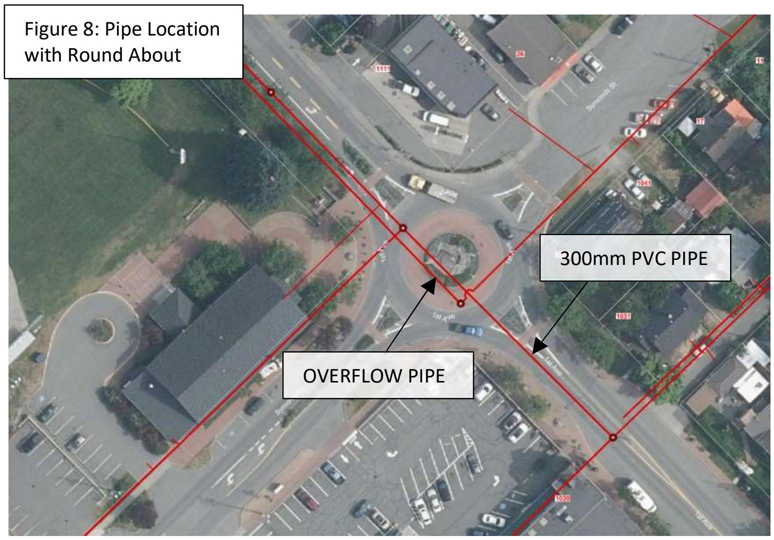


Figure 8: Pipe Location with Round About

5.0 WASTEWATER TREATMENT PLANT

According to the Province's bulletin, the Province may provide extensions for lack of treatment capacity; however, a preliminary review of the Town's Wastewater Treatment Plant was not part of this scope of work. The Engineering Department did a background review of available information to confirm whether an issue may exist and additional engineering may be required.

Background information indicates the Plant is designed for a population of 17,200 people and a maximum flow of 14,400m^3 per day. However, we understand the Wastewater Treatment Plant has gone into overflow on multiple occasions due to high inflows during heavy rainfall. Based on the measured flows and history of overflow, the Town's Wastewater Treatment Plant is nearing capacity due to I&I rather than population. Improving I&I throughout the system will reduce the inflow to the Treatment Plant and allow for increased population growth such as SSMUH.

6.0 SUMMARY AND CONCLUSION

The Engineering Department has reviewed background information and carried out an analysis, including limited verification with computer modeling, of the sanitary sewer collection system. The Town's sanitary sewer collection system seems to be limited by the trunk mains along Highway 1, which travel adjacent to large catchments at relatively low grades. These trunk mains were constructed prior to significant developments and may not be adequately sized for the proposed SSMUH density increases.

This review included recommendations for upgrades and application for an extension to the Province. The recommendations provided above are summarized as follows:

1. Update the sewer model with current conditions and I&I rates;
2. Request an extension for the entirety of the South Area;
3. Carry out detailed review of the Highway 1 main. Consider lining the existing 450mm diameter main in the near term and twinning longer term;
4. Budget for detailed design for replacement of the Chemainus Road foreshore;
5. Request an extension for the relatively small catchment leading to the main connecting 4th Avenue Extension to Dogwood Drive;
6. Include replacement of the 130m of main connecting 4th Avenue Extension to Dogwood Drive in the 2025 budget. Complete a more detailed assessment of the pipe and refine the cost estimate prior to budgeting;
7. Allow development within the Old Town Area with strict stormwater management requirements to reduce I&I;
8. Review and implement the recommendations in the recently submitted Inflow and Infiltration report from WSP;
9. Carry out detailed review of the trunk main leading from the Old Town Area to the Wastewater Treatment Plant. Consider lining the concrete pipe to reduce roughness;
10. Request an extension from the Province for the Lamont Lands and Lot A developments or require downstream improvements;
11. Monitor 200mm main on Cloke Road and consider replacement with 250mm main in the next DCC bylaw;
12. Monitor 300mm main and overflow main on 2nd Avenue and consider replacement in the next DCC bylaw;
13. Include detailed review and design for upgrades to the Highway 1 to 1st Avenue round about main in the 2025 Budget. Complete a detailed assessment and consider sub-surface replacement methods; and
14. Request an extension request for the Malone Road development.

Most of the recommendations require detailed analysis not performed in this review. Updates to the computer model will assist the Town's Engineering Department and consultants working for the Town. The Development Services Department should be aware of the recommendations and discuss them with the Engineering Department when a development proposal may impact one or more of the highlighted mains in this report.

A request should be made to the Province for the South Area of Town, 4th Avenue Extension, the Lamont Lands and Lot A developments, and the Malone Road development. These areas are shown in Appendix A. The Engineering Department is able to assist with these requests as required.

We trust this report meets your needs at this time. Please contact the undersigned with any questions. Thank you.

PROFESSIONAL ENGINEER R. F. BOUMA # 36317 BRITISH COLUMBIA

May 8, 2024

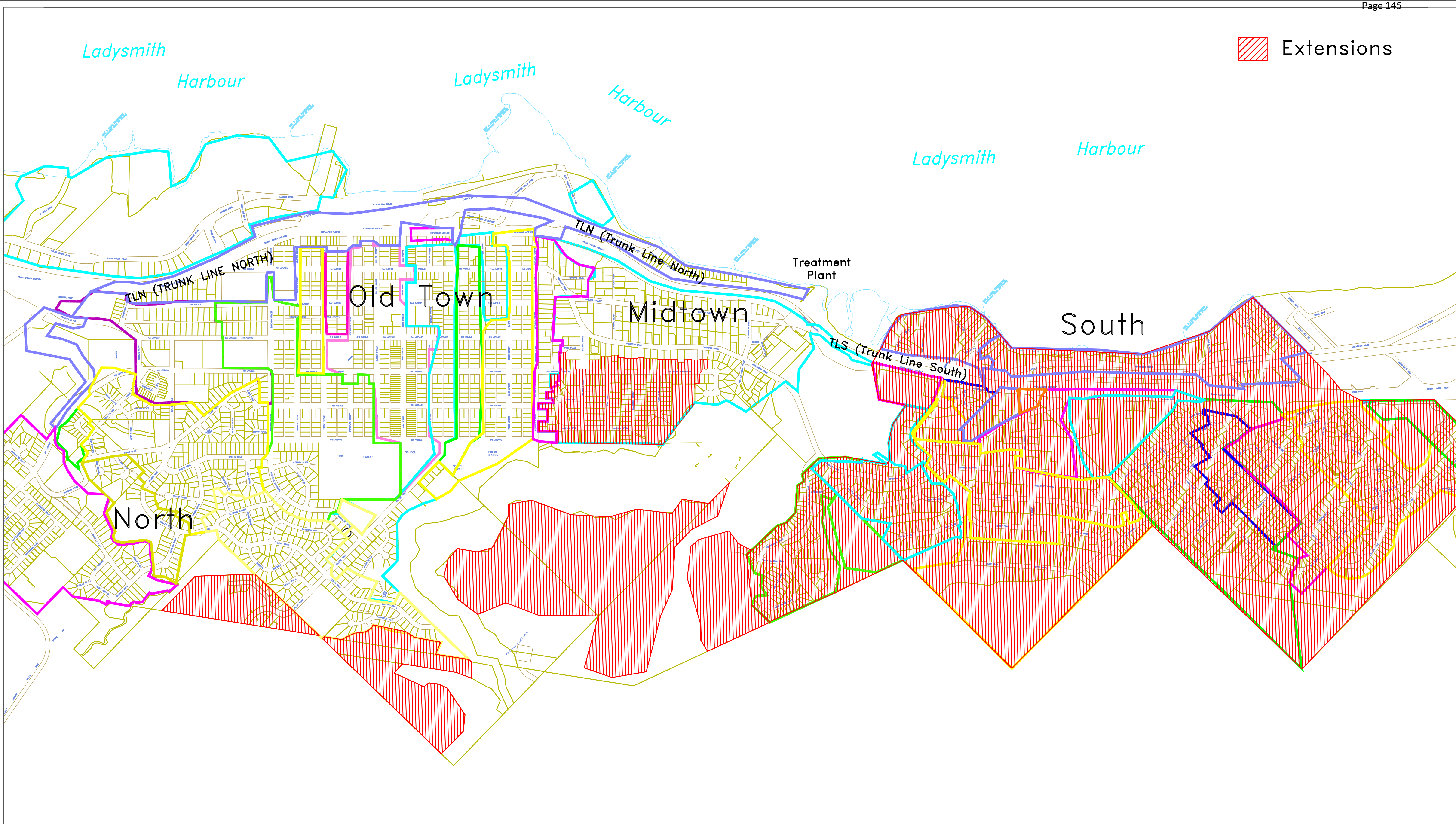
Per: Ryan Bouma, P. Eng.
Director of Infrastructure Services

Reviewed by: Michele Gill, AScT.
Sr. Engineering Technologist

Permit to Practice No. 1001793

APPENDICES
APPENDIX A – RECOMMENDED EXTENSION AREAS
APPENDIX B – SAMPLE CALCULATIONS

APPENDIX A
RECOMMENDED EXTENSION AREAS



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LADYSMITH

TOWN OF LADYSMITH

TITLE:
Recommended Extension Areas

SHEET No: 1
SCALE: N.T.S.
FILE:
DRAWN BY: M.R
DATE: 2024-05-09

APPENDIX B
SAMPLE CALCULATIONS

Catchment	Area (m2)	Area (Ha)	PPHa	Equiv. Pop	Peaking Factor	Peak Flow (L/D)	Infiltration Rate	Infiltration (L/D)	Total (L/D)	Dia (mm)	R (m)	Slope %	Slope m/m	Type	=((Rm^(2/3))*(Sm/m^(1/2)))/n	Q =V*PI()*(Rm^2)*1000	Flow (L/sec)	Density	Pipe Fullness (%)	n
K	523,870.89	52.3870893	36	1885.93521	3.60547834	1563930.67	28434	1489574.497	3053505.2	250	0.125	1.48	0.00148	PVC	1.06863	52.4563726	35.34	Low	67	0.009
K30 to K20		52.3870893	48	2514.58029	3.50638106	2027927.64	28434	1489574.497	3517502.1								40.71		78	
		52.3870893	72	3771.87043	3.35605736	2911481.1	28434	1489574.497	4401055.6								50.94	SSMUH	97	
		52.3870893	120	6286.45071	3.1514367	4556610.84	28434	1489574.497	6046185.3								69.98	High	133	

Catchment	Area (m2)	Area (Ha)	PPHa	Equiv. Pop	Peaking Factor	Peak Flow (L/D)	Infiltration Rate	Infiltration (L/D)	Total (L/D)	Dia (mm)	R (m)	Slope %	Slope m/m	Type	=((Rm^(2/3))*(Sm/m^(1/2)))/n	Q =V*PI()*(Rm^2)	Flow (L/sec)	Density	Pipe Fullness (%)	n
AB	58,143.29	5.81432864	36	209.315831	4.1407666	199347.44	11200	65120.48077	264467.9	250	0.125	0.51	0.00051	PVC	0.62731	30.7930343	3.06	Low	10	0.009
TLS 330 to TLS320		5.81432864	48	279.087775	4.09167643	262645.48	11200	65120.48077	327766.0								3.79		12	
		5.81432864	72	418.631662	4.01268501	386362.509	11200	65120.48077	451483.0								5.23	SSMUH	17	
		5.81432864	120	697.719437	3.89537599	625112.295	11200	65120.48077	690232.8								7.99	High	26	

Catchment	Area (m2)	Area (Ha)	PPHa	Equiv. Pop	Peaking Factor	Peak Flow (L/D)	Infiltration Rate	Infiltration (L/D)	Total (L/D)	Dia (mm)	R (m)	Slope %	Slope m/m	Type	=((Rm^(2/3))*(Sm/m^(1/2)))/n	Q =V*PI()*(Rm^2)	Flow (L/sec)	Density	Pipe Fullness (%)	n
South End south of Holland Creek	2,628,101.81	262.810181	36	9461.16652	2.97854664	6481520.92	14070	3697807.026	10179327.9	444	0.222	0.81	0.00081	Conc	1.15941	179.51103	117.82	Low	66	0.009
TLS40 to TLS30		262.810181	48	12614.8887	2.85387629	8280306.3	14070	3697807.026	11978113.3								138.64		77	
		262.810181	72	18922.333	2.67665056	11649148.9	14070	3697807.026	15346955.9								177.63	SSMUH	99	
		262.810181	120	31537.2217	2.45593694	17814288.4	14070	3697807.026	21512095.4								248.98	High	139	

Catchment	Area (m2)	Area (Ha)	PPHa	Equiv. Pop	Peaking Factor	Peak Flow (L/D)	Infiltration Rate	Infiltration (L/D)	Total (L/D)	Dia (mm)	R (m)	Slope %	Slope m/m	Type	=((Rm^(2/3))*(Sm/m^(1/2)))/n	Q =V*PI()*(Rm^2)	Flow (L/sec)	Density	Pipe Fullness (%)	n
South End south of Holland Creek	2,628,101.81	262.810181	36	9461.16652	2.97854664	6481520.92	14070	3697807.026	10179327.9	444	0.222	2.28	0.00228	Conc	1.94518	301.173012	117.82	Low	39	0.009
TLS50 to TLS40		262.810181	48	12614.8887	2.85387629	8280306.3	14070	3697807.026	11978113.3								138.64		46	
		262.810181	72	18922.333	2.67665056	11649148.9	14070	3697807.026	15346955.9								177.63	SSMUH	59	
		262.810181	120	31537.2217	2.45593694	17814288.4	14070	3697807.026	21512095.4								248.98	High	83	

Catchment	Area (m2)	Area (Ha)	PPHa	Equiv. Pop	Peaking Factor	Peak Flow (L/D)	Infiltration Rate	Infiltration (L/D)	Total (L/D)	Dia (mm)	R (m)	Slope %	Slope m/m	Type	=((Rm^(2/3))*(Sm/m^(1/2)))/n	Q =V*PI()*(Rm^2)	Flow (L/sec)	Density	Pipe Fullness (%)	n
South End south of Holland Creek	1,955,402.57	195.540257	36	7039.44925	3.10425184	5026011.35	19981	3907089.875	8933101.2	444	0.222	0.34	0.00034	Conc	0.67604	104.672018	103.39	Low	99	0.01
TLS70 to TLS60		195.540257	48	9385.93234	2.98197903	6437390.27	19981	3907089.875	10344480.1								119.73		114	
		195.540257	72	14078.8985	2.80594226	9086052.55	19981	3907089.875	12993142.4								150.38	SSMUH	144	
		195.540257	120	23464.8308	2.58298498	13940140.3	19981	3907089.875	17847230.2								206.57	High	197	

Manhole	Inflow Areas Considered	Area (m^2)	Area (Ha)	PPHa	Equiv. Pop	Peaking Fa	Peak Flow	Infiltration Rate	Infiltration (	Total (L/D)	Actual Flow (L/sec)	Pipe Dia	Radius	Slope (%)	Slope (m/r	Type	n	V	Q	Fullness	% Full
TLN 230		1804550	180.455	36	6496.38	3.137796	4688393	32445.4673	5854946.8	10543339.8	122.0293957	375	0.1875	1.4	0.0014	PVC	0.009	1.361933	150.4209	0.811253	81.12531
	No more Overflow. So	1804550	180.455	48	8661.84	3.01639	6009323	32445.4673	5854946.8	11864269.4	137.3179334	375	0.1875	1.4	0.0014		0.009	1.361933	150.4209	0.912891	91.28915
	all X, XW, W, V, U, T, S,	1804550	180.455	72	12992.76	2.841004	8489870	32445.4673	5854946.8	14344817.3	166.0279776	375	0.1875	1.4	0.0014		0.009	1.361933	150.4209	1.103756	110.3756
	and TLN contributions	1804550	180.455	120	21654.6	2.617852	13038363	32445.4673	5854946.8	18893309.4	218.6725627	375	0.1875	1.4	0.0014		0.009	1.361933	150.4209	1.453738	145.3738
TLN 170		499701	49.9701	36	85.9701	4.260966	84252.6	35408.5925	1769370.9	1853623.5	21.45397578	250	0.125	0.43	0.00043	PVC	0.009	0.576012	28.27494	0.758763	75.8763
		499701	49.9701	48	2398.565	3.5231	1943588	35408.5925	1769370.9	3712959.1	42.97406324	250	0.125	0.43	0.00043		0.009	0.576012	28.27494	1.519864	151.9864
	Z and a small amount of	499701	49.9701	72	3597.847	3.374169	2792142	35408.5925	1769370.9	4561512.4	52.79528286	250	0.125	0.43	0.00043		0.009	0.576012	28.27494	1.867211	186.7211
	TLN	499701	49.9701	120	5996.412	3.170961	4373309	35408.5925	1769370.9	6142680.2	71.09583547	250	0.125	0.43	0.00043		0.009	0.576012	28.27494	2.514447	251.4447
TLN 220		2024918	202.4918	36	7289.705	3.089569	5180071	31036.2887	6284594	11464665.0	132.6928821	375	0.1875	3.88	0.00388	CONC	0.013	1.569664	173.3641	0.7654	76.54001
		2024918	202.4918	48	9719.606	2.966947	6632639	31036.2887	6284594	12917232.8	149.5050093	375	0.1875	3.88	0.00388		0.013	1.569664	173.3641	0.862376	86.23759
	X, XW, W, V, U, T, S, R	2024918	202.4918	72	14579.41	2.790671	9357856	31036.2887	6284594	15642450.4	181.0468791	375	0.1875	3.88	0.00388		0.013	1.569664	173.3641	1.044316	104.4316
	and TLN Contributions	2024918	202.4918	120	24299.02	2.567854	14351155	31036.2887	6284594	20635748.5	238.8396814	375	0.1875	3.88	0.00388		0.013	1.569664	173.3641	1.377677	137.7677
TLN 180	X, XW, W, V, U, T, S, R	2036970	203.697	36	7333.092	3.08707	5206687	47311.6398	9637239.1	14843926.0	171.8046989	450	0.225	1.4	0.0014	Conc	0.013	1.064737	169.3391	1.01456	101.456
	and TLN Contributions	2036970	203.697	48	9777.456	2.964391	6666366	47311.6398	9637239.1	16303604.7	188.699128	450	0.225	1.4	0.0014		0.013	1.064737	169.3391	1.114327	111.4327
	(includes are to the right	2036970	203.697	72	14666.18	2.788076	9404800	47311.6398	9637239.1	19042038.8	220.393968	450	0.225	1.4	0.0014		0.013	1.064737	169.3391	1.301495	130.1495
	of MH)	2036970	203.697	120	24443.64	2.565286	14422135	47311.6398	9637239.1	24059373.8	278.4649747	450	0.225	1.4	0.0014		0.013	1.064737	169.3391	1.644422	164.4422
TLN 150		2551931	255.1931	36	9186.952	2.991182	6320365	42655.6158	10885419	17205783.8	199.1410157	600	0.3	0.53	0.00053		0.013	0.793613	224.3888	0.887482	88.74821
		2551931	255.1931	48	12249.27	2.866693	8076424	42655.6158	10885419	18961843.3	219.4657791	600	0.3	0.53	0.00053	ASTM	0.013	0.793613	224.3888	0.97806	97.80604
	X, XW, W, V, U, T, S, R, Z	2551931	255.1931	72	18373.9	2.689499	11365818	42655.6158	10885419	22251236.5	257.5374589	600	0.3	0.53	0.00053	reinforce	0.013	0.793613	224.3888	1.147729	114.7729
	and TLN Contributions	2551931	255.1931	120	30623.17	2.468456	17386152	42655.6158	10885419	28271570.7	327.2172535	600	0.3	0.53	0.00053	d Conc	0.013	0.793613	224.3888	1.45826	145.826
TLN 123	N, NP, P,O	299698	29.9698	36	1078.913	3.77849	937632.2	43405	1300839.2	2238471.4	25.90823334	250	0.125	2.04	0.00204	PVC	0.009	1.254621	61.58607	0.420683	42.06833
		299698	29.9698	48	1438.55	3.692621	1221765	43405	1300839.2	2522603.9	29.19680485	250	0.125	2.04	0.00204		0.009	1.254621	61.58607	0.474081	47.40813
		299698	29.9698	72	2157.826	3.559905	1766780	43405	1300839.2	3067619.4	35.50485414	250	0.125	2.04	0.00204		0.009	1.254621	61.58607	0.576508	57.65079
		299698	29.9698	120	3596.376	3.374326	2791129	43405	1300839.2	4091968.1	47.36074236	250	0.125	2.04	0.00204		0.009	1.254621	61.58607	0.769017	76.90171
TLN 120		2891543	289.1543	36	10409.55	2.937345	7032585	33281.3905	9623457.2	16656041.8	192.7782616	600	0.3	0.6	0.0006	Conc	0.013	0.844397	238.7475	0.807457	80.74567
	X, XW, W, V, U, T S, R , Z,	2891543	289.1543	48	13879.41	2.812179	8977215	33281.3905	9623457.2	18600672.4	215.2855607	600	0.3	0.6	0.0006		0.013	0.844397	238.7475	0.901729	90.17291
	N, NP, P, O, and TLN up	2891543	289.1543	72	20819.11	2.63498	12617325	33281.3905	9623457.2	22240782.5	257.4164635	600	0.3	0.6	0.0006		0.013	0.844397	238.7475	1.078195	107.8195
	to MH	2891543	289.1543	120	34698.52	2.415493	19277228	33281.3905	9623457.2	28900685.0	334.4986694	600	0.3	0.6	0.0006		0.013	0.844397	238.7475	1.401056	140.1056
TLN 83		241450	24.145	36	869.22	3.838421	767379.4	53146	1283210.2	2050589.6	23.73367602	250	0.125	2.65	0.00265		0.009	1.429949	70.19244	0.338123	33.8123
		241450	24.145	48	1158.96	3.757778	1001676	53146	1283210.2	2284886.6	26.44544657	250	0.125	2.65	0.00265		0.009	1.429949	70.19244	0.376756	37.67563
		241450	24.145	72	1738.44	3.632322	1452352	53146	1283210.2	2735562.0	31.66159703	250	0.125	2.65	0.00265		0.009	1.429949	70.19244	0.451068	45.10685
	L and M	241450	24.145	120	2897.4	3.455203	2302554	53146	1283210.2	3585764.7	41.50190588	250	0.125	2.65	0.00265		0.009	1.429949	70.19244	0.591259	59.12589

Appendix F- Form of Proposal

To facilitate fair evaluation, proposals should be organized as follows:

1. Project Understanding – Describe the site and project requirements and goals.
2. Approach – The consultant's scope of services and work task break down. Include deliverables and plans.
3. Project Team – Provide team member information, organization, and qualifications. Include reporting structure and project manager communication with the Town.
4. Experience – Firm experience on related projects.
5. References (Optional) – Proponents may provide references. The Town may request references if the proponent is shortlisted.
6. Schedule – Include key milestones and deliverables that match the scope. The schedule should be easy to follow. Include 2 weeks for Ladysmith staff to review documents at each review stage.
7. Fees – Tabulate costs and level of effort for all tasks and include subcontractors and subconsultants where applicable. Total the costs with all applicable taxes.

Proponents may expand on the above and provide any information that demonstrates their qualifications while maintaining a clear and concise proposal. The list is only for guidance so that each proposal can be examined without difficulty.

Appendix G - Evaluation

TECHNICAL EVALUATION

Proposals will be evaluated by a minimum of two Ladysmith staff. The scoring criteria shown below will be used to assist in the evaluation; however, the highest scoring proposal will not necessarily be selected. Other evaluation criteria may impact the selection, such as an interview, reference checks, or value-added services.

COSTS INCLUDED IN PROPOSAL EVALUATION

All personnel fees, salaries, wages and reimbursable expenses will be considered in the proposal evaluation. Points will be awarded based on a combination of rates, proposed budget relative to scope, suitable budget allocation to tasks, and value.

MINIMUM TECHNICAL SCORE

Each technical presentation will be evaluated on the basis of the firm's experience, competence of its personnel and acceptability of the method proposed. Technical portions of proposals must achieve a score of at least 70% to be considered "technically qualified".

SCORING

The table below describes the weighting that will be used to evaluate all proposals.

THE METHOD	**40**
General Approach	8
Proposed list of activities and reporting	10
Understanding of objectives	12
Proposed level of effort	10
FIRM PROFILE	**10**
Experience with similar projects	5
Location of the firm	2
Practices and/or policies within the organization governing its work with First Nations	3
THE PERSONNEL	**15**

Project Manager - How will they support the delivery of services by the firm? - What is their experience with similar projects on Vancouver Island and within BC? - Provide details on times when they challenged conventional wisdom and/or engineering standards in order to provide the best solution for the client.	5
Project Members - Provide a half-page bio of why each key staff member is suited for this role. Include project examples showcasing experience, qualifications, and local knowledge.	5
Team Organization	5
PRESENTATION	**10**
Quality - clear and concise	5
Content -relevant information provided without redundancies	5
PRICE PROPOSAL	**25**
Cost	15
Breakdown of costs	10
TOTAL	**100**

INTERVIEWS AND REFERENCES

The Town may request an interview and/or reference check with any or all shortlisted firms. An interview format has not been determined and would likely focus on areas of a proposal that are unclear to the evaluation team. The outcome of an interview would be used in the evaluation. If an interview is requested, an in-person or Microsoft Teams online meeting would be made available.