

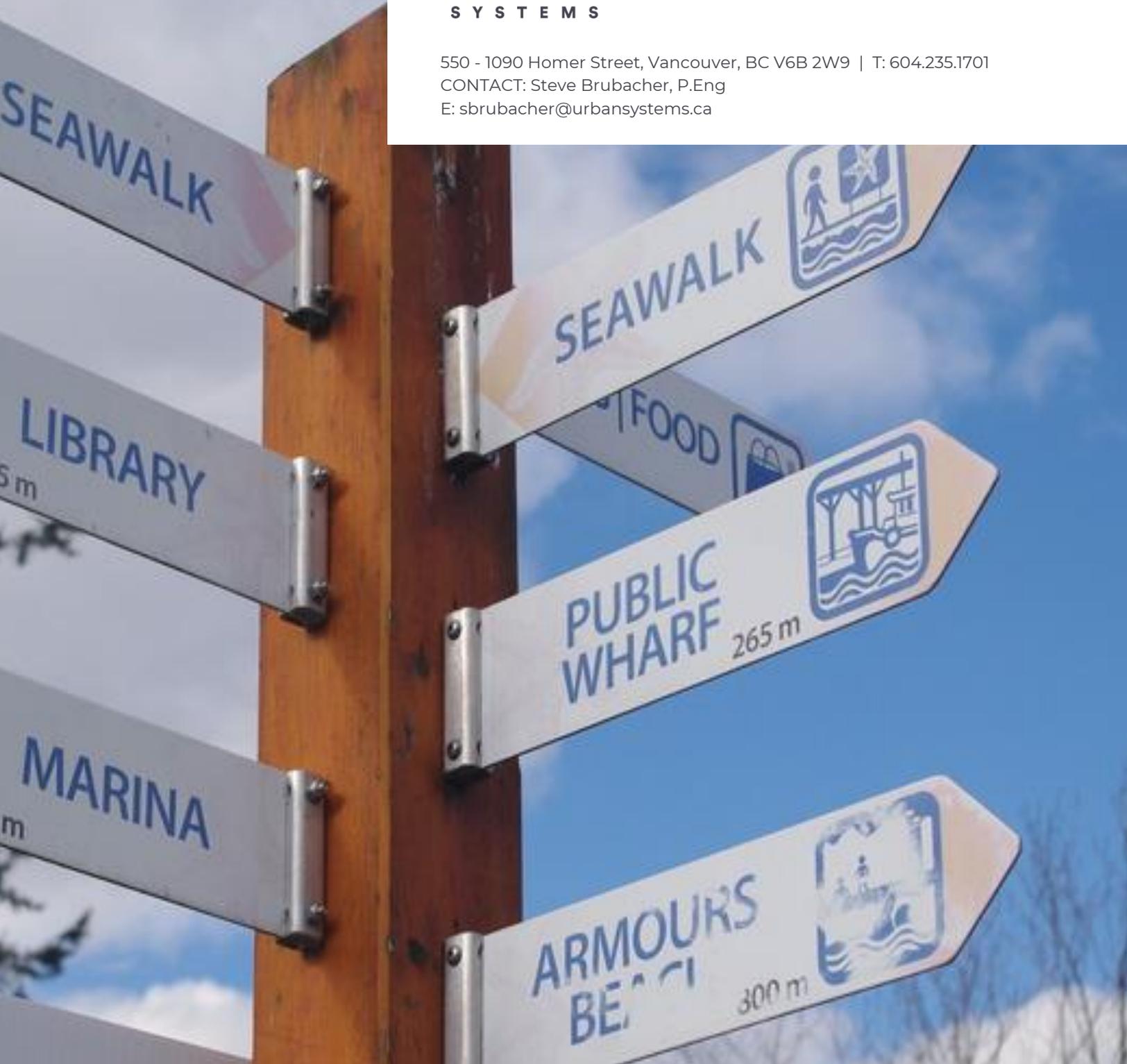
# TOWN OF GIBSONS

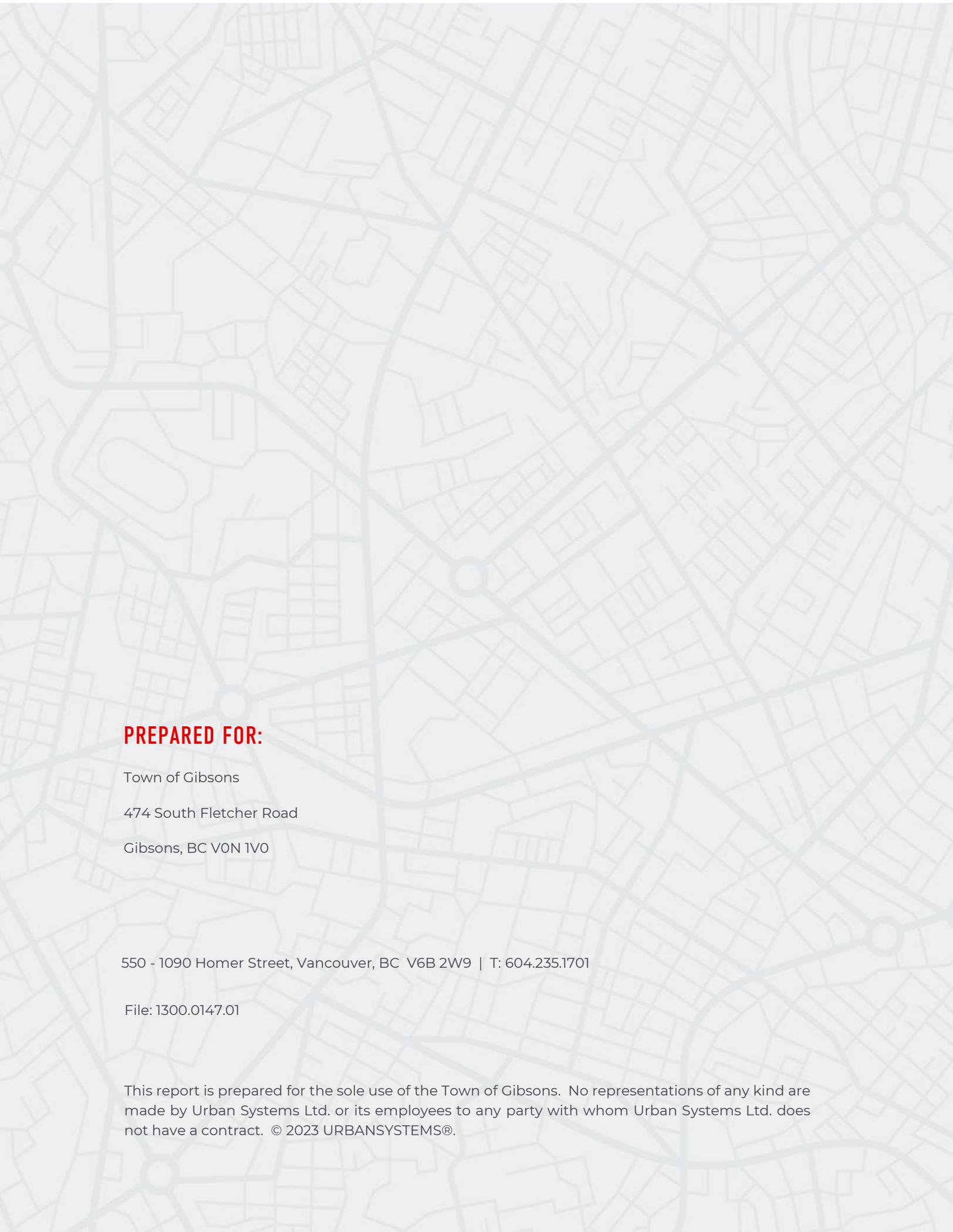
## SANITARY SEWER STRATEGIC PLAN

January 5, 2024



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**PREPARED FOR:**

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# **CONTENTS**

<b>EXECUTIVE SUMMARY</b>	<b>V</b>
<b>1.0 INTRODUCTION</b>	<b>1</b>
<b>1.1 BACKGROUND</b>	<b>1</b>
<b>1.2 POLICY CONTEXT</b>	<b>1</b>
<b>1.3 REGULATORY CONTEXT</b>	<b>2</b>
<b>1.4 INTEGRATION</b>	<b>2</b>
<b>1.5 METHODOLOGY</b>	<b>3</b>
<b>2.0 GROWTH FORECAST</b>	<b>4</b>
<b>3.0 COLLECTION SYSTEM</b>	<b>4</b>
<b>3.1 CAPACITY ASSESSMENT</b>	<b>4</b>
3.1.1 PERFORMANCE SERVICE LEVELS	5
3.1.2 MODEL UPDATE AND CALIBRATION	7
3.1.3 RISK ASSESSMENT	9
<b>3.2 CONDITION ASSESSMENT</b>	<b>13</b>
<b>3.3 INTEGRATED COLLECTION SYSTEM CAPITAL PRIORITIES</b>	<b>20</b>
<b>3.4 NON-CAPITAL PRIORITIES</b>	<b>21</b>
<b>4.0 TREATMENT SYSTEM</b>	<b>25</b>
<b>4.1 CAPACITY ASSESSMENT</b>	<b>25</b>
4.1.1 LIKELIHOOD OF FAILURE (LOF):	25
4.1.2 CONSEQUENCE OF FAILURE (COF):	26
<b>4.2 CONDITION ASSESSMENT</b>	<b>28</b>
4.2.1 LIKELIHOOD OF FAILURE (LOF):	28
4.2.2 CONSEQUENCE OF FAILURE (COF):	28
<b>4.3 RISK ASSESSMENT</b>	<b>29</b>
<b>4.4 CAPITAL PRIORITIES</b>	<b>33</b>
<b>4.5 NON-CAPITAL PRIORITIES</b>	<b>34</b>
<b>5.0 FINANCIAL PLAN</b>	<b>35</b>
<b>6.0 CONCLUSIONS AND RECOMMENDATIONS</b>	<b>37</b>

# **APPENDICES**

**APPENDIX A – GROWTH MEMO**

**APPENDIX B – COLLECTION SYSTEM CAPACITY ASSESSMENT**

**APPENDIX C – COLLECTION SYSTEM CONDITION ASSESSMENT**

**APPENDIX D – COLLECTION SYSTEM RISK ASSESSMENT SUMMARY**

**APPENDIX E – TREATMENT PLANT CAPACITY AND CONDITION ASSESSMENT**

**APPENDIX F – CAPITAL PLAN**

# **TABLES**

Table 1-1: Municipal Wastewater Regulation Registration.....	2
Table 3-1: Hydraulic Levels of Service.....	6
Table 3-2: Gravity Main Hydraulic Level of Service Ratings.....	6
Table 3-3: Ground Water Infiltration and Rainfall Derived Inflow and Infiltration Rates for the WWTP .....	7
Table 3-4: Modelling Scenario Summary.....	8
Table 3-5: Collection System Capacity Results.....	9
Table 3-6: Consequence of Failure by Flows.....	9
Table 3-7: Capacity Risk Matrix—Scoring from likelihood and consequence factors.....	10
Table 3-8: Capacity Risk Scores (Number of Gravity or Pressure Mains).....	10
Table 3-9: Condition Statistic for Sanitary Assets.....	14
Table 3-10: Condition Ranking for Likelihood of Failure.....	14
Table 3-11: Consequence of Failure by Road Classification.....	15
Table 3-12: Condition risk matrix—Scoring from likelihood and consequence factors.....	16
Table 3-13: Condition Risk Scores (Number of Gravity or Pressure Mains).....	16
Table 3-14: Integrated Collection System Capital Priorities.....	20
Table 3-15: Integrated Collection System Capital Priorities (Pipes/\$2023).....	20

Table 4-1: Capacity LoF Scoring.....	25
Table 4-2: CoF Scoring.....	26
Table 4-3: Capacity Risk Summary.....	26
Table 4-4: Mechanical /Electrical Assets – LoF score and Expected Asset Life Remaining .....	28
Table 4-5: Civil/Structural Assets - LoF score and Expected Asset Life Remaining .....	28
Table 4-6: Condition Risk Summary .....	28
Table 4-7: Priority Scores for Upgrade Projects .....	30
Table 4-8: Upgrade Project Timelines and Cost Estimates.....	33

## **FIGURES**

Figure 3-1: .....	11
Figure 3-2: .....	12
Figure 3-3.....	17
Figure 3-4.....	18
Figure 3-5.....	19
Figure 3-6.....	22
Figure 3-7.....	23
Figure 3-8.....	24

January 5, 2024

File: 1300.0147.01

**Attention: Trevor Rutley, Director of Infrastructure Services**

**RE: Sanitary Sewer Strategic Plan Final Report**

Enclosed please find a copy of the Sanitary Sewer Strategic Plan Final Report. This report outlines an integrated and comprehensive plan to help ensure the Town is able to deliver sustainable sanitary sewer services to its residents and customers for many years to come. We appreciate all the input received from the Town staff during this process.

Sincerely,

**URBAN SYSTEMS LTD.**



Steve Brubacher, P.Eng. Project Lead  
Integrated Risk Assessment



Matt Smith, P.Eng., Treatment

PERMIT TO PRACTICE URBAN SYSTEMS LTD.
Signature <u>Steve Brubacher</u>
Date <u>2024-01-08</u>
PERMIT NUMBER: 1000527
Engineers and Geoscientists BC (EGBC)

## **EXECUTIVE SUMMARY**

The Town of Gibsons current Wastewater Collection Strategic Plan was adopted in June 2008. Since adoption the Town has adopted an Eco-Asset Strategy and Asset Management Policy. Specific significant accomplishments since 2008 include:

- Upgrading of the Prowse Road Sanitary Pump Station
- CCTV Inspection of the majority of the Town's sanitary sewer collection system
- Addition of equalization storage at the WWTP
- Upgrading of the SCADA system
- Upgrades within the sanitary sewer collection system

The primary objectives of this strategy are to take a fresh look at the current wastewater collection and treatment system and align future planning with the current OCP, Eco-Asset Strategy and Asset Management Policy.

The following conclusions have been reached in this report:

- the Town of Gibsons collection system has good capacity in order to accommodate the forecasted growth.
- The condition of the collection system will need greater attention as the system ages in order to ensure that inflow and infiltration doesn't become a major issue going in the future.
- The treatment plant and outfall however will require considerable attention in order to both accommodate the increased capacity and deal with condition related needs. Prioritizing the completion of preliminary design and Municipal Wastewater Registration updating are of highest priority.
- A risk based prioritized capital plan totaling \$37 Million (\$2023) is outlined in order to help ensure that the Town can provide the desired levels of service both for existing and also future customers.

The following recommendations are provided:

- Complete an update and recalibration of the sewer model at least once every 5 years
- Update the strategic plan every 10 years
- Prioritize inspection of the shoreline service connection to ensure that any failures are addressed before they impact the system performance.
- Ensure source control provisions are enforced (ie. Grease traps and pretreatment for high strength discharges).
- Ensure that emergency response plans are kept upto date and that lift station designs incorporate best practices.
- Ongoing CCTV inspections and monitoring of wet weather flows at the Prowse Road pump station be a consistent priority for the Town.
- Update the Subdivision and Development Bylaw to explicitly require the 22,500 L/ha/day design inflow and infiltration rate be used for all sanitary sewer system upgrades.
- Video inspect the entire system at least once every 10 year and engage a qualified professional to provide quality assurance to the work by the inspection contractor and complete the pipe scoring and remediation recommendations instead of just relying on the contractor to provide this information.
- Continue to prioritize the ongoing monitoring and optimization of the plant performance and maintain compliance with federal and provincial regulations for reporting.

- Regular condition assessments are completed in order to address deterioration before it becomes an issue.
- Prior to spending efforts rehabilitating the foreshore sewer complete a feasibility study to evaluate the opportunity to relocate this sewer further inland and divert flows from Upper Gibsons. Also consider requiring all redevelopment to install individual pump systems in order to discharge flows to the sewer on the upland side.
- Review this capital plan with the overall financial plan as well as with the DCC bylaw update in order to confirm the affordability and rate impacts. The sequencing of projects may need to be adjusted in order to better balance the cash flow and reserve fund and borrowing impacts. It is recommended that these budgets be reviewed and updated annually in order to ensure that appropriate inflationary adjustments are made.



# 1.0 INTRODUCTION

## 1.1 BACKGROUND

The Town of Gibsons current Wastewater Collection Strategic Plan was adopted in June 2008. Since adoption the Town has adopted an Eco-Asset Strategy and Asset Management Policy. Specific significant accomplishments since 2008 include:

- Upgrading of the Prowse Road Sanitary Pump Station
- CCTV Inspection of the majority of the Town's sanitary sewer collection system
- Addition of equalization storage at the WWTP
- Upgrading of the SCADA system
- Upgrades within the sanitary sewer collection system

The primary objectives of this strategy are to take a fresh look at the current wastewater collection and treatment system and align future planning with the current OCP, Eco-Asset Strategy and Asset Management Policy.

## 1.2 POLICY CONTEXT

The Official Community Plan outlines the overall vision:

*"Gibsons will continue to be a welcoming, sustainable community that offers residents and visitors an outstanding quality of life in a spectacular natural environment. We will ensure this beautiful town retains its seaside village character for the enjoyment of all and we will nurture our unique cultural heritage and natural assets while supporting opportunities for our local economy."*

This vision is built on the pillars of environmental, social and economic sustainability. Given the size and relatively slow growth rate of the Town these commitments are critical for the Town to thrive for generations to come.

Within the OCP there are a number of specific areas of relevance to the Sewer Strategic Plan. Specifically there is an overarching statement that "Nature is our most valuable infrastructure asset". The associated objectives are stated as:

- Recognize and value the contribution of natural assets to provide valuable services to the community.
- Provide for the replacement of infrastructure assets preferably by the use of reserve funds set aside annually from operating revenues during the life-cycle of the asset.
- Construct, upgrade or replace public works assets – roads, sidewalks, water, sewer and drainage – to meet recognized engineering, environmental and safety standards.
- Maintain public works to satisfy public health and safety concerns.
- Establish explicit Levels of Service for municipal infrastructure, in consultation with the community.
- Operate and maintain effective and reliable municipal infrastructure supported by healthy natural assets based on a long term approach aimed at minimizing operational cost now and in the future.



The accompanying policies are stated as:

- **13.3.1** Pursue a program of sewage collection system upgrades and expansions
- **13.3.2** Upgrade the treated effluent sewage outfall and the outfall facilities to meet ultimate design capacity.
- **13.3.3** Require existing development to connect to the Town’s sanitary sewer system when the sewer services are extended adjacent to the existing development.
- **13.3.4** Consider exempting a single-detached dwelling from the requirement to connect to the Town’s sanitary sewer system where the parcel size is 1.6 ha (4 acres) in size or greater.
- **13.3.5** Minimize the quantity of infiltration and inflow to the sanitary collection system in order to decrease the volume of clean water conveyed to the wastewater treatment plant.
- **13.3.6** Construct the North Road sanitary diversion to direct flows directly to the Wastewater Treatment Plant and away from the Prowse Road Lift Station.
- **13.3.7** Pursue grant funding and other sources of funding to upgrade the Prowse Road Lift Station.

## 1.3 REGULATORY CONTEXT

The Town of Gibsons Wastewater Treatment Plant (WWTP) is regulated under a Municipal Wastewater Regulation Registration.

The registration is old and the information for the registration is basic so it is only expected that there are a few regulatory gaps. The information from the registration is summarized in the table below.

**Table 1-1: Municipal Wastewater Regulation Registration**

Parameter	Regulatory Requirement
<b>Flow</b>	6,750 m <sup>3</sup> /d maximum
<b>Carbonaceous BOD5 (CBOD5)</b>	45 mg/L maximum
<b>Total Suspended Solids (TSS)</b>	45 mg/L maximum
<b>LC50 96 hour Rainbow Trout Test</b>	Pass
<b>pH</b>	6.0 to 9.0
<b>Faecal coliforms</b>	200/100 mL assumed to be as a geometric mean of 5 consecutive samples immediately after UV disinfection until receiving environment data indicate otherwise

## 1.4 INTEGRATION

The Sewer Strategic Plan is primarily focused on the engineering assets of the sanitary sewer collection and treatment system.

In addition it is important to recognize that assets are best managed in an integrated fashion. Synergies between the roads program and other deep utilities should be explored wherever possible so as to minimize capital costs, the carbon footprint and also social impacts of proposed projects



## 1.5 METHODOLOGY

The development of the Sanitary Sewer Strategic Plan has taken the following approach:

### Step 1. Taking Stock of Today

- Sewer Flows – Confirmed assumptions for future growth requirements
- Service Levels – Confirmed levels of service for capacity and condition
- Unit Costs – Confirm unit costs for upgrades

### Step 2. Update and Calibrate Sewer Model

- Update sewer model to reflect GIS dataset
- Allocate demands based on water meter records
- Complete calibration based on field test results

### Step 3. Complete Capacity and Condition Assessment

- Confirm methodology for condition assessment
- Analyze existing and future conditions for capacity
- Analyze existing and future conditions for condition

### Step 4. Triple Bottom Line Prioritization

- Assign triple bottom line risk scores based on likelihood and consequence of failure
- Prepare prioritized project list
- Assign capital costs



## 2.0 GROWTH FORECAST

Previous strategic plans have been prepared in alignment with the growth forecast contemplated in the current Official Community Plan (OCP) with a build out population of 10,000 people. Given the the increased densities being developed lately in Gibsons it was decided to reassess what the build out capacity of the Town was based on the current vacant land, and OCP designations. There is a total of just over 82 hectares of vacant residential or mixed use land and 11.7 hectares of institutional, commercial, and industrial land. These vacant lands could yield an estimated approximately 3,222 new residential units and 305,000 m<sup>2</sup> of ICI building area. For sanitary sewer servicing we need to convert both the ICI building area to equivalent population in order to forecast the impact on the system. The development potential forecast is estimated to increase the residential population by approximately 6,852 people and ICI equivalent population of 2,347 people for a total increase of 9,199 population equivalent. Note that this includes 3,301 people in the Gospel Rock Neighbourhood Plan area. With a current residential population estimated at just under 5,000 people this growth will push the residential population beyond 10,000 people.

This assessment is outlined in greater detail in **Appendix A**.

## 3.0 COLLECTION SYSTEM

The Town of Gibsons Sanitary Sewer Collection system is illustrated in Figure 3-1. Flow is conveyed either by gravity directly to the sanitary sewer treatment plant or it is conveyed by gravity to the Prowse Road Sanitary Pump Station where it is pumped to the treatment plant. There is a small area of the Town on Shoal Lookout and Georgia Drive where the homes have individual pump stations in order to convey flow into the system given their elevation. In the future with the development of Gospel Rock two additional pump stations will be constructed that will also pump flows to the treatment plant.

Flows from the plant are treated and conveyed through an outfall to the ocean.

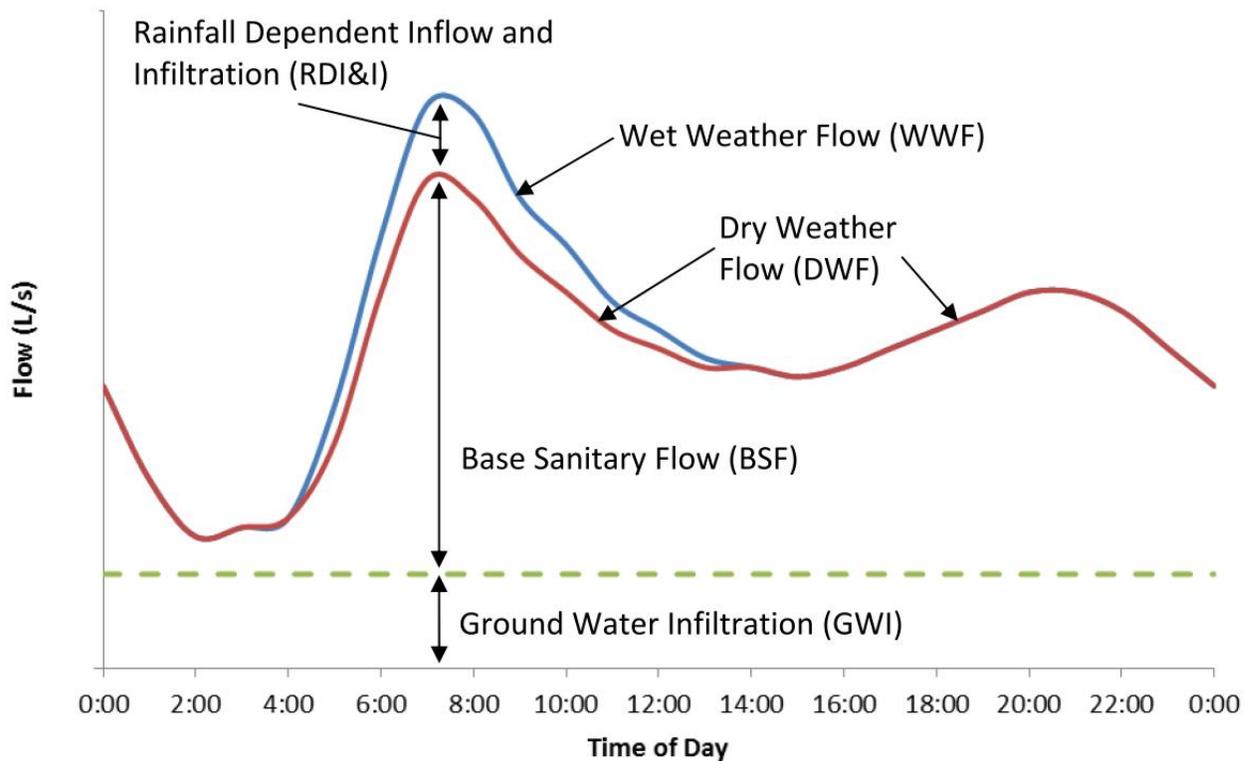
### 3.1 CAPACITY ASSESSMENT

Daily flow conveyed in a sanitary system can be generally divided into five components:

- Groundwater infiltration (GWI) – groundwater entering the sanitary sewer system via defect in the collection system, which is a function of pipe condition and location with respect to the saturated zone
- Base sanitary flow (BSF) – all of the wastewater from customers that originate within the buildings being serviced, which is a function of per-capita water consumption
- Dry weather flow (DWF) – a combination of GWI + BSF
- Rainfall-dependent inflow and infiltration (RDI&I) – rainwater entering the sanitary sewer system through direct connections as well as through infiltration
- Wet weather flow (WWF) – the combination of all flow contributions GWI+BSF+RDI&I



The relationship between these components is illustrated in the diagram below.



### 3.1.1 PERFORMANCE SERVICE LEVELS

Levels of service for sanitary systems communicate to customers what they can expect in terms of overall system performance. To have these expectations spelled out is perhaps the most important ingredient for sanitary sewer strategic planning and service delivery as it defines the standard to achieve and most critically, allows for technical assessments to determine how to mitigate any present-day gaps. While levels of service often encompass various categories, such as risk, customer satisfaction, finance, engagement, system capacity, reliability and governance, this strategy focuses primarily on the technical needs related to risk: system capacity and reliability. As communities continue to evolve the needs and outcomes of strategic plans, levels of service expand beyond servicing capacities towards a more holistic and integrated risk-based approach that considers condition, economic, social, and environmental factors.

Levels of service help to prioritize upgrades by identifying which assets perform the worst against defined standards, and what is at stake (e.g. consequences) if no upgrades occurred. Together, these factors inform risk ratings and the overall prioritization of capital upgrades using a similar approach that guided the Water Supply Strategic Plan.

Overall, the approach for this strategic plan and its prioritized capital recommendations stem from four important process milestones: network hydraulic modeling, network condition assessment, treatment plant capacity and condition assessment, and an overall risk assessment. These analyses are summarized in the following sections including the definitions and applications for the risk methodology.



For the collection system assessment, the following hydraulic levels of service have been used:

Table 3-1: Hydraulic Levels of Service

Criteria	Score
<b>Hydraulic Capacity (q/Q*)</b>	
<b>q/Q &lt; 0.97**</b>	A
<b>0.97 ≤ q/Q &lt; 1.00</b>	B
<b>q/Q ≥ 1.00</b>	C
<b>Hydraulic Grade Line (HGL)</b>	
<b>HGL ≤ 0.8D***</b>	A
<b>0.8D &lt; HGL ≤ 0.30m Above Crown</b>	B
<b>0.3m Above Crown &lt; HGL ≤ 0.60m Above Crown</b>	C
<b>HGL &gt; 0.60m Above Crown</b>	D
<b>Velocity (v)</b>	
<b>v &lt; 0.75 m/s</b>	Fail
<b>v ≥ 0.75 m/s</b>	Pass

\*q/Q = peak flow / full pipe flow.

\*\*q/Q = 0.97 is the equivalent of d/D = 0.80

\*\*\* D = diameter

Table 3-2: Gravity Main Hydraulic Level of Service Ratings

LOF Rating	Capacity	HGL	Velocity	Description
<b>1</b>	A	A	Pass	Gravity main performing as designed
<b>2</b>	A	A	Fail	Adequate capacity, low velocity indicates potential sediment
	A or B	B, C or D	Pass or Fail*	Adequate capacity, backwater caused by downstream conditions**
<b>3</b>	C	B	Pass or Fail*	Capacity exceeded with limited or no surcharging
<b>4</b>	C	C	Pass or Fail*	Capacity exceeded and surcharging likely
<b>5</b>	C	D	Pass or Fail*	Capacity exceeded and flooding likely

\*LoF ratings from 3.5 are Independent of velocity criteria

\*\*Increased HGL caused by downstream lack of capacity and not a deficiency in the pipe being evaluated.

Pipes that score a 3 or higher are evaluated for upgrading.



### 3.1.2 MODEL UPDATE AND CALIBRATION

The sanitary sewer collection system model was reconstructed from the current geographic information system (GIS) and record drawings. Once this model was constructed base sanitary sewer flows were allocated using the water meter records and an assumed conversion rate from water demand to sanitary sewer flow and calibrated with the flow meters at the treatment plant. The current base sanitary flow is 172 L/capita/day which is within normal sanitary sewer flow generation rates for municipalities in BC. A detailed summary of the model update and calibration is contained in **Appendix B**.

The treatment plant flow meter was also used to calibrate the wet weather performance of the system. Data from November 2-7 2020 was selected to calibrate the system performance as this was a peak rain event. It is worth noting that the Town has sewers that can be impacted by ocean levels with can impact both inflow and infiltration. These are most pronounced during King Tide events. There is limited allowance for the influence of tidal influences as it is assumed that the Town will continue to proactively ensure that the system is protected from these events. At the time of this sanitary sewer strategy development the Prowse Road lift station flow meter was not providing reliable data. The Town has since worked to rectify this situation and will provide useful information moving forward.

In assessing the wet weather performance of the system, we also considered what impact climate variability could have on the system. Rainfall scaling factors were applied consistent with the Subdivision and Development Servicing and Stormwater Management Bylaw in order to determine both the 1 in 5 and 1 in 25 year return period events. Many sanitary sewer systems are designed historically based on the 1 in 5 year event however more communities are moving to the 1 in 25 year return period for sizing of upgrades given the greater resiliency. The MMCD is silent on the return period.

The following table outlines the calibrated Ground Water Infiltration and Rainfall Derived Inflow and Infiltration Rates for the WWTP. These are compared to the MMCD 2022 Design Guideline values which are referenced in the Subdivision Development Bylaw.

**Table 3-3: Ground Water Infiltration and Rainfall Derived Inflow and Infiltration Rates for the WWTP**

	Existing Climate 1:5 Year	Future Climate 1:25 Year
<b>Ground Water Infiltration</b>	1,400 L/ha/day	1,400 L/ha/day
<b>Rainfall Derived Inflow and Infiltration</b>	7,100 L/ha/day (WWTP Gravity) 14,700 L/ha/day (Prowse) 10,700 L/ha/day (Total)	10,000 L/ha/day (WWTP Gravity) 21,300 L/ha/day (Prowse) 15,400 L/ha/day (Total)
<b>Total Inflow and Infiltration</b>	8,500 L/ha/day (WWTP Gravity) 16,100 L/ha/day (Prowse) 12,100 L/ha/day (Total)	11,400 L/ha/day (WWTP Gravity) 22,700 L/ha/day (Prowse) 16,800 L/ha/day (Total)
<b>MMCD 2022 Design Guidelines</b>		
<b>New System Above Groundwater Table</b>	11,200 L/ha/day	
<b>Old System (25+ years) or Pipes Below Water Table</b>	22,500 L/ha/day	



As illustrated above the Prowse Road catchment is more susceptible to the influences of inflow and infiltration which is not surprising given the proximity to the ocean and the older nature of this portion of the system. It is also clear that the MMCD design guideline values for older systems align with the forecasted performance of the Gibsons lower system providing that the system is adequately maintained and not allowed to deteriorate further without repairs.

***It is recommended that ongoing CCTV inspections and monitoring of wet weather flows at the Prowse Road pump station be a consistent priority for the Town.***

***It is further recommended that the Town update the Subdivision and Development Bylaw to explicitly require the 22,500 L/ha/day design inflow and infiltration rate be used for all sanitary sewer system upgrades.***

The following table summarizes the three scenarios that have been modeled. Extended period simulations have been used to assess the deficiencies in the existing system since they are more realistic and less conservative. Steady state simulation has been used for the sizing of upgrades since it is more conservative.

Table 3-4: Modelling Scenario Summary

Scenario	2021-PWWF-5	OCP-PWWF-5	OCP-PWWF-25
<b>I&amp;I Design</b>	5yr, 24hr	5yr, 24hr	25yr, 24hr
<b>Per Capita Water Use</b>	Meter Data	Meter Data + 172 L/cap/day for growth	Meter Data + 172 L/cap/day for growth
<b>Climate Change Considered?</b>	No	Yes	Yes
<b>Scenario Use</b>	Identify existing system deficiencies	Identify future system deficiencies and timing of upgrades	Size system improvements
<b>Simulation Type</b>	Extended Period Simulation	Extended Period Simulation	Steady State
<b>Serviced Area</b>	208 ha	295 ha	295 ha
<b>Population*</b>	6,318	15,512	15,512
<b>BSF</b>	13L/s	31L/s	31L/s
<b>I&amp;I**</b>	26L/s	39L/s	48L/s
<b>PWWF***</b>	94L/2	134L/s	161L/s

\*includes residential population and ICI equivalent population.

\*\*I&I composed of monitored I&I and future I&I areas.

\*\*\*Sum of the peak flows at the two model outfalls.



Below is a summary of how the system performed against the hydraulic levels of service.

**Table 3-5: Collection System Capacity Results**

LOF	2021-PWWF-5		OCP-PWWF-5	
Rating	# of Pipes	Length (m)	# of Pipes	Length (m)
<b>1</b>	178	10,530	205	12,215
<b>2</b>	415	25,956	378	23,508
<b>3</b>	1	78	2	176
<b>4</b>	0	0	0	0
<b>5</b>	0	0	0	0
<b>Total</b>	594	36,573	585	35,899

The results indicate that there is only one gravity main that has a deficiency under the existing scenario and two pipes with deficiencies under the future scenario. The existing deficiency is a pipe on Gibsons Way which due to pipe slopes is marginally surcharging. This deficiency is not critical and as such is not a capacity only upgrade priority but will be considered in conjunction with condition priorities. The sanitary sewer upgrades that are being completed as part of the White Tower Pond project have been included in the future scenario and resolves a future capacity bottleneck at Davis Road and increasing the number of pipes that are rated 1. The only remaining deficiency is located along the Shoreline Trunk Sewer between School Road and Prowse Road.

### 3.1.3 RISK ASSESSMENT

Risk is the combination of likelihood and consequence. In consequence, risk analysis considers the impact of failure as a way to determine the need for prioritized attention to a particular asset. Table 3.6 summarizes the relationship between the amount of flow and consequence that comes when high flows (and seemingly high customer base) are impacted by a localized failure. Since upgrades are not recommended for consequence of failure scores of '1' or '2', these scores are not defined in the table below.

**Table 3-6: Consequence of Failure by Flows**

PEAK DRY WEATHER FLOW	CONSEQUENCE OF FAILURE	POPULATION IMPACTED
<b>q&lt;=0.246 l/s</b>	3	≤ 75 people
<b>0.246 L/s&lt;q&lt;=0.720/s</b>	4	75 < people ≤ 220
<b>q&gt;0.720/s</b>	5	> 220 people

A consequence of failure score of 3, represents approximately 50% of the existing system, or, in other words, 50% of the system has peak dry weather flows less than or equal to 0.246 l/s, whereas each of the failure scores 4 and 5 represent approximately 25% of the system.

In select circumstances, the level of impact (i.e., consequence) may increase should the pipe fail. For example, deep mains and those close to structures present elevated repair conditions, while environmental risks can vary depending on a pipe's proximity to a sensitive area. These factors, along with seismic considerations are used to increase the consequence of failure scoring by 1 or more, depending on the combination of applicable factors.



illustrates the relationship between capacity-driven likelihood and consequence of failure. The complete capacity-risk methodology is outlined in **Appendix B**.

**Table 3-7: Capacity Risk Matrix—Scoring from likelihood and consequence factors**

<b>Consequence</b>	<b>5</b>	2	3	4	5	5
	<b>4</b>	2	3	4	5	5
	<b>3</b>	2	2	3	4	4
	<b>2</b>	1*	2*	2*	3*	3*
	<b>1</b>	1*	1*	2*	2*	3*
		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>

**Likelihood of Failure**

\*Not applicable in this analysis since there are no Consequence of Failure scores of 1 or 2.

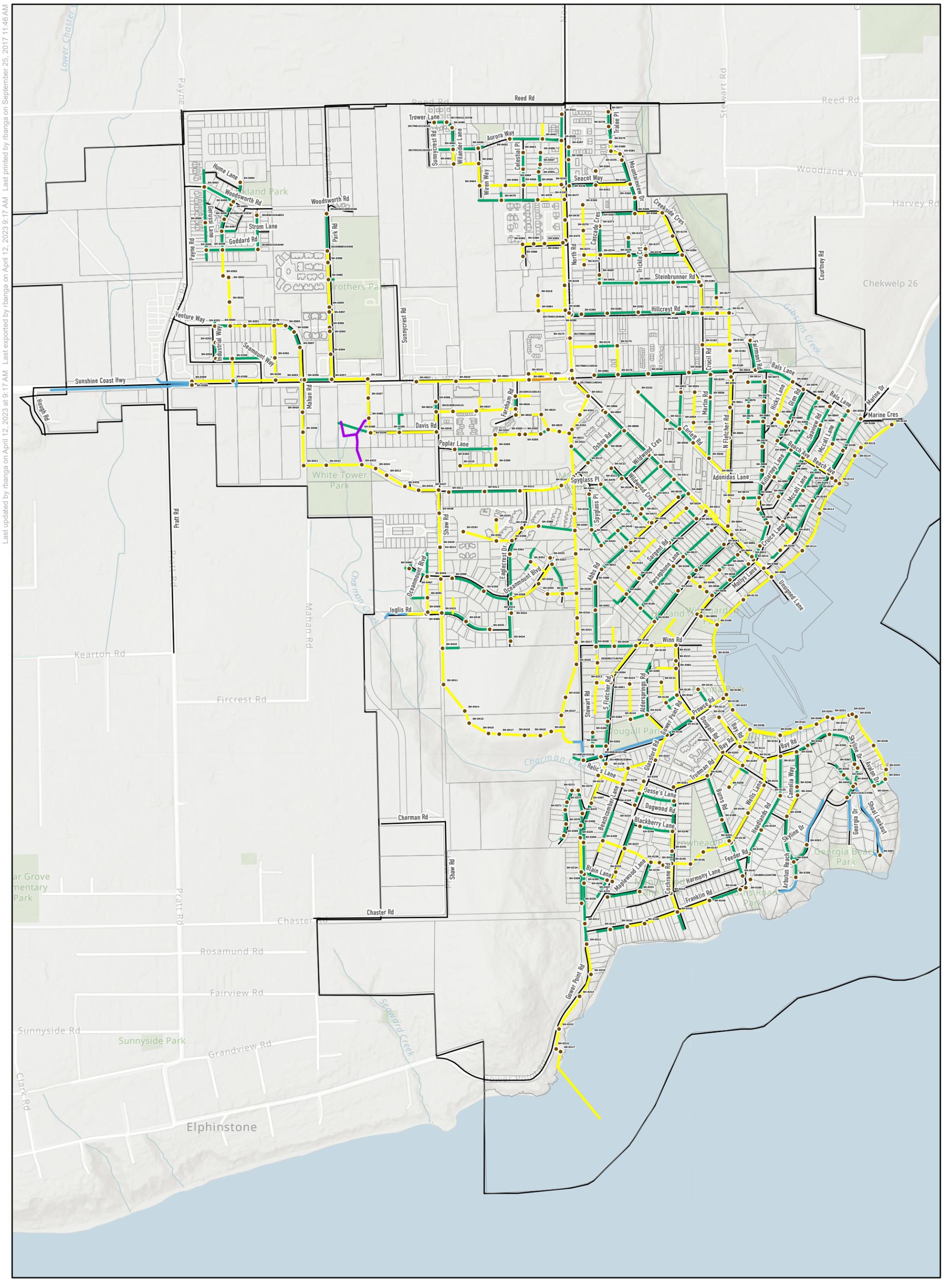
The following table summarizes the system capacity risk scores under existing and future scenarios.

**Table 3-8: Capacity Risk Scores (Number of Gravity or Pressure Mains)**

	Existing	Future
<b>1</b>	22	22
<b>2</b>	285	261
<b>3</b>	302	302
<b>4</b>	1	2
<b>5</b>	0	14

These results are graphically illustrated on Figure 3-1 and Figure 3-2. The Prowse Road lift station has a firm capacity of 75 L/s and projected peak wet weather flows are only forecast to reach 39 L/s providing that inflow and infiltration is kept to levels consistent with today.

Figure 3-1:



Last updated by rbanga on April 12, 2023 at 9:17 AM. Last exported by rbanga on April 12, 2023 9:17 AM. Last printed by rbanga on September 25, 2017 11:46 AM.

**URBAN**  
systems

Project #: 1300.0147.01  
 Author: RB  
 Checked: SB  
 Status:  
 Revision: A  
 Date: 2023 / 4 / 12

0 100 200 300  
Meters

Coordinate System:  
Name: NAD 1983 UTM Zone 10N  
Scale: 1:10,500  
(When plotted at 11"x17")

Data Sources:  
- Town of Gibson  
- Data BC

The accuracy & completeness of information shown on this drawing is not guaranteed. It will be the responsibility of the user of the information shown on this drawing to locate & establish the precise location of all existing information whether shown or not.

**Legend**

- Manhole
- Existing Capacity Risk
  - 1
  - 2
  - 3
  - 4
- Future Pipes
- Town of Gibsons Boundary

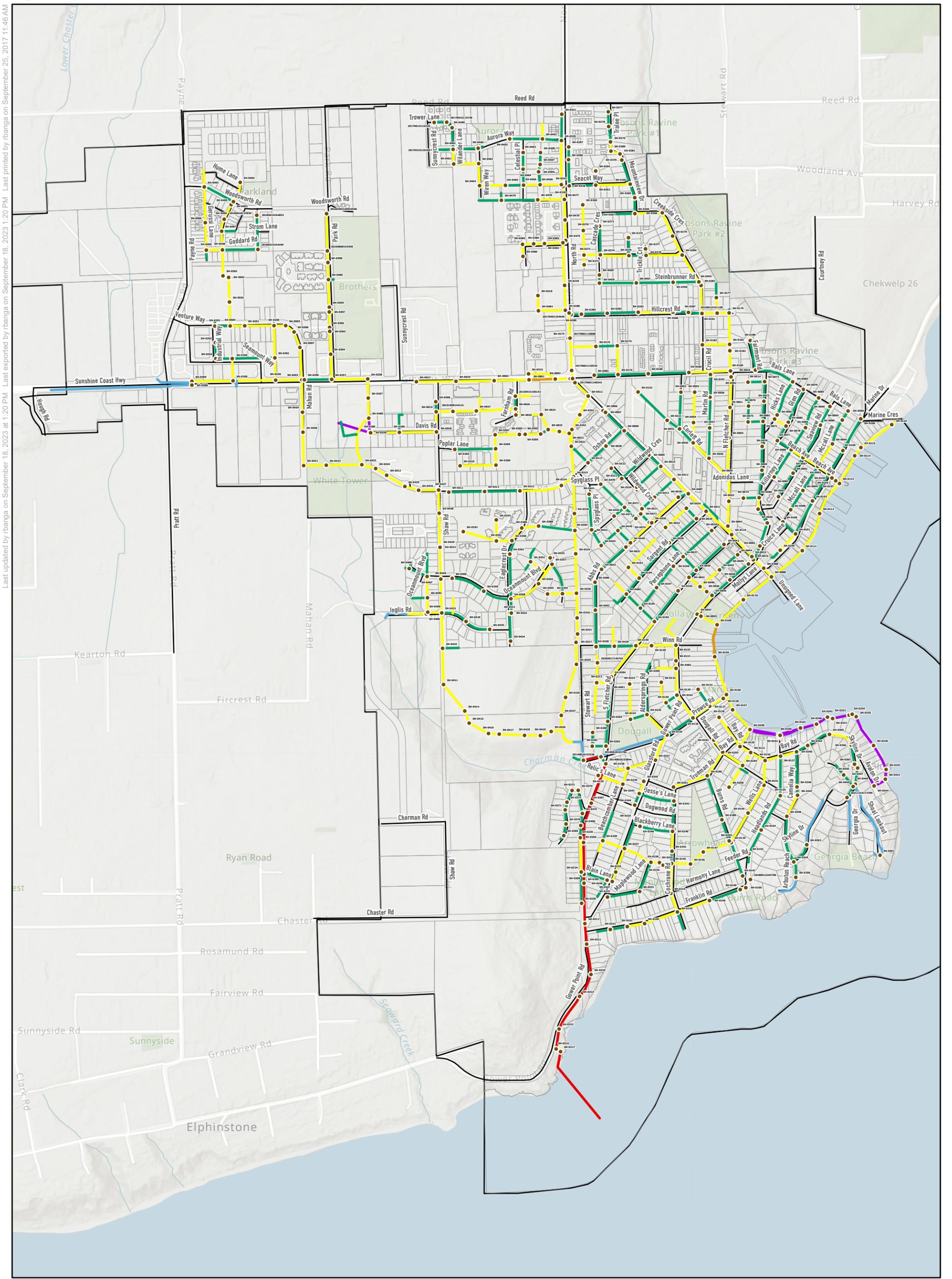


**TOWN OF GIBSONS**

**Town of Gibsons**

**Existing Sewer Network Capacity Risk of Failure**

Figure 3-2:



Last updated by rbanga on September 18, 2023 at 1:20 PM. Last exported by rbanga on September 18, 2023 at 1:20 PM. Last printed by rbanga on September 25, 2017 11:46 AM.

**URBAN**  
systems

Project #: 1300.0147.01  
 Author: RB  
 Checked: SB  
 Status:  
 Revision: A  
 Date: 2023 / 9 / 18

0 100 200 300  
Meters

Coordinate System:  
Name: NAD 1983 UTM Zone 10N  
Scale: 1:10,500  
(When plotted at 11"x17")

Data Sources:  
- Town of Gibson  
- Data BC

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**Legend**

- Manhole
- Town of Gibsons Boundary

**Future Capacity Risk**

- Pipes To Be Abandoned
- 1
- 2
- 3
- 4
- 5



**Town of Gibsons**  
 Future Sewer Network  
 Capacity Risk of Failure



## 3.2 CONDITION ASSESSMENT

We have considered not only capacity risks but also risks associated with condition failures. To assess the likelihood of failure due to condition risks, the methodology incorporates age and the results of condition inspections, called Internal Condition Grades (ICGs) or Structural Condition Grades (SCGs). Given that age is merely an indicator for condition, where there are ICGs, those ratings are applied to give a more accurate depiction of the status of the asset. The Town has completed comprehensive video inspections for the sanitary sewer collection system and from these inspections ICGs have been provided by the contractors. The Town also engaged MJP & Associates to review the video reports and rescore the pipes from 2019 that had scores of 4 or 5 as well as all of the asbestos cement mains that were scored in 2022 and provide updated recommendations. The results of MJP's work is contained in Appendix C. As illustrated there can be a fair bit of variability between contractor's scoring and scoring completed by a professional who has extensive experience in condition assessment.

Key conclusions from the work by MJP include:

For the 2019 pipes that were flagged as ICG's of 4 or 5 only one pipe was confirmed to be a 4 and is recommended to have the holes grouted and resurveyed. The remainder were rescored at 2 or 3s and recommended to be reinspected in 10 years.

For the 2022 pipes 92% were confirmed to be ICG 1 or 2. Eleven mains were identified as having structural defects that require rehabilitation. Fifteen mains require attention by the Town for manhole locating and servicing connection cleaning, seven require records investigations and 40 mains need to be cleaned and resurveyed. The total estimated cost for the recommended activities is approximately \$320,000. The structural repair recommendations have been incorporated into the risk-based capital project prioritization.

It is recommended for future video inspection work that that Town engage a qualified professional to provide quality assurance to the work by the inspection contractor and complete the pipe scoring and remediation recommendations instead of just relying on the contractor to provide this information.

It is recommended that the Town video inspect the entire system at least once every 10 years.

Table 3-9 summarizes the types of pipes (by material), their age in relation to projected service life, as well as percentage of pipes that exceed an ICG score of 3. Table 3-10 outlines the criteria for system performance in regard to condition analysis. The condition scores are indicative of a system that is beginning to reach the average life expectancy and as such condition scores are good. However, without proactive maintenance they will also begin to deteriorate over time.



Table 3-9: Condition Statistic for Sanitary Assets

PIPE MATERIAL	# OF PIPES	SERVICE LIFE (YEARS)	TOWN OF GIBSONS AVG. AGE OF PIPE	ICG SCORE > 3
AC	328	50	50	16
CONC	2	50	52	1
DI	4	50	48	0
HDPE	6	50	10	0
POLY	7	80	28	0
PVC	280	80	26	4

Table 3-10: Condition Ranking for Likelihood of Failure

LIKELIHOOD OF FAILURE	CRITERIA	
	ICG Score	Asset Age
5	5	Only applicable where actual, field-level condition data is available
4	4	Asset age is $\geq 133\%$ of useful life
3	3	Asset age is $\geq 100\%$ to $< 133\%$ of useful life
2	2	Asset age is $\geq 80\%$ to $< 100\%$ of useful life
1	1	Asset age is $< 80\%$ of useful life

Any pipe which performs to a likelihood of failure of 3 or greater and demonstrates elevated consequence scores can be triggered for the capital plan, as discussed below.

While likelihood of failure denotes the probability that a loss of service may occur, the consequence of failure tells what’s at stake if the loss does occur. Whereas capacity driven projects consider the significance of the flow within the pipe, the condition risk methodology considers the liabilities of loss of service to surrounding areas due to a failed pipe. For example, a failure within an arterial road presents greater traffic control and road reconstruction requirements than a failure within a local road. The Town’s GIS data set is used to analyze if a pipe is physically located in a road and if so, what the road classification is. Table 3.11 summarizes the risk consequence criteria associated with each road class.



Table 3-11: Consequence of Failure by Road Classification

ROAD CLASSIFICATION	CONSEQUENCE OF FAILURE
<b>Arterial/Highway</b>	5
<b>Coast Line</b>	5
<b>Collector</b>	4
<b>Local</b>	2
<b>Lane</b>	2
<b>Statutory Right of Way</b>	3

By applying road classifications as a proxy for *cost to restore service*, the risk methodology harnesses readily available GIS-data for local governments in an automated manner. Like capacity, the level of impact (consequence) may increase in select circumstances. For example, larger mains and those in close proximity to structures or watercourses present greater consequences from failure, as do those in high-seismic areas. These factors are used to increase consequence of failure scoring by 1 or more, depending on the combination of applicable factors. Table 3-12 illustrates the relationship between condition-driven likelihood and consequence of failure. The complete condition risk methodology is outlined in Appendix A.

The risk scores derived from the table below are combined with the capacity-based risk scores from Table 3-8 to arrive at an overall prioritization raking. This process is described in Section 3.3.





Table 3-12: Condition risk matrix—Scoring from likelihood and consequence factors

Consequence	5	2	3	4	5	5
	4	2	3	4	5	5
	3	2	2	3	4	4
	2	1	2	2	3	3
	1	1	1	2	2	3
		1	2	3	4	5
		<b>Likelihood of Failure</b>				

The following table summarizes the system capacity risk scores under existing and future scenarios. It is important to restate the existing risk scores for gravity mains are based on video inspections while the future scores are based on the asset age.

Table 3-13: Condition Risk Scores (Number of Gravity or Pressure Mains)

	Existing	Future
<b>1</b>	275	139
<b>2</b>	256	215
<b>3</b>	38	103
<b>4</b>	39	65
<b>5</b>	9	95

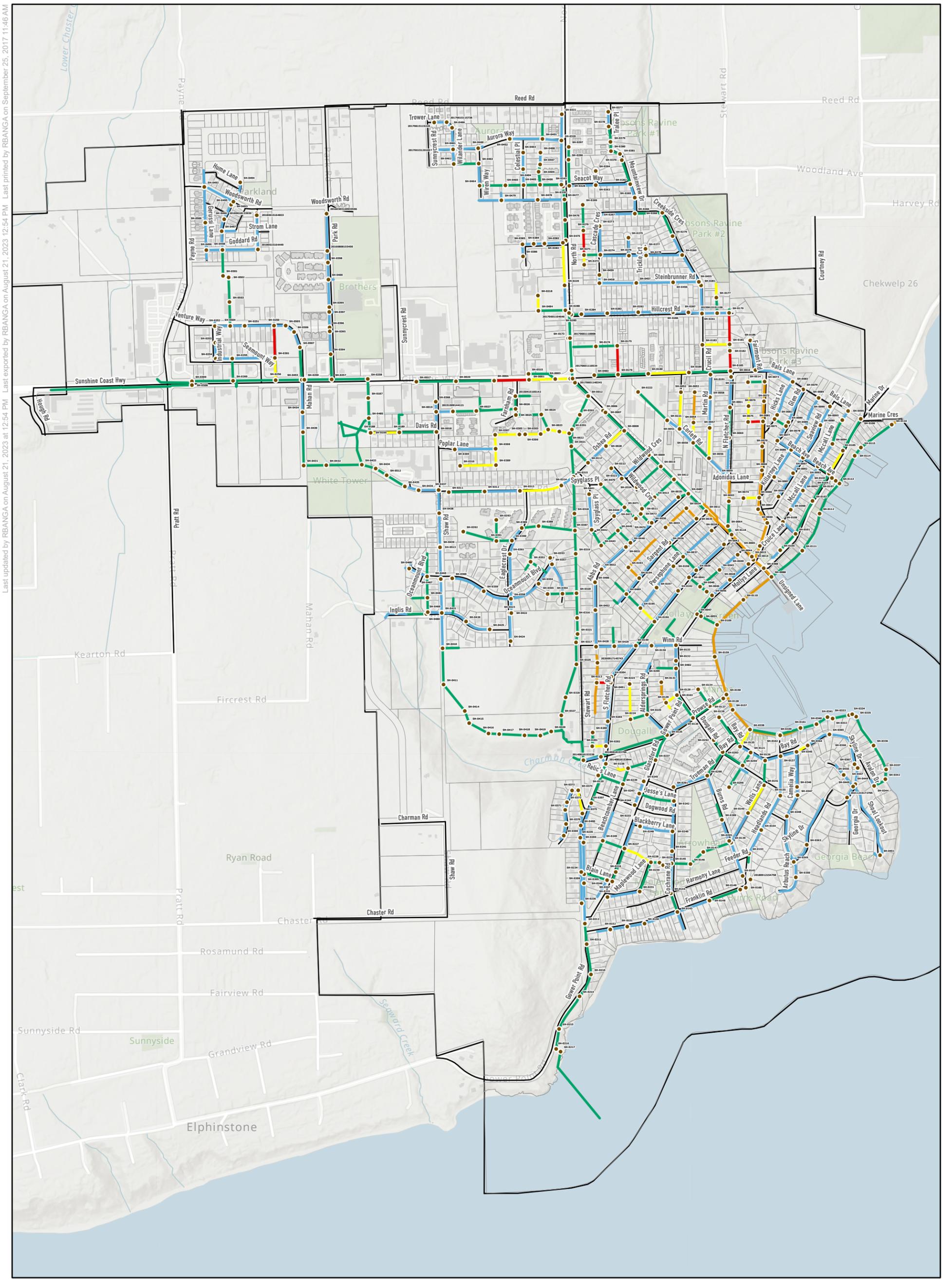
These results are graphically illustrated on Figure 3-3 and Figure 3-4.

It is important to note that in the future the condition of the foreshore sewer will reach a point where renewal and rehabilitation efforts will be required.

***Prior to expending considerable effort in rehabilitation of the foreshore sewer it is recommended that the Town complete a feasibility study to evaluate the opportunity to retreat from the foreshore and relocate this main and the Prowse Road Pump Station further inland to provide for greater resiliency. At the same time evaluation can be completed to see if any flows from upper Gibsons can be diverted directly to the gravity connection to the WWTP and thereby reduce the flows being conveyed by this sewer. At time of redevelopment it is recommended that waterfront lots are required to pump to the upland sewer to facilitate this potential change in the future. Figure 3-5 illustrates a potential servicing concept to guide future feasibility work.***

Doing so will require that foreshore properties will likely need to individually pump to the sewer.

Figure 3-3



**URBAN**  
systems

Project #: 1300.0147.01  
 Author: RB  
 Checked: SB  
 Status:  
 Revision: A  
 Date: 2023 / 8 / 21

0 100 200 300  
Meters

Coordinate System:  
Name: NAD 1983 UTM Zone 10N  
Scale: 1:10,500  
(When plotted at 11"x17")

Data Sources:  
- Town of Gibson  
- Data BC

The accuracy & completeness of information shown on this drawing is not guaranteed. It will be the responsibility of the user of the information shown on this drawing to locate & establish the precise location of all existing information whether shown or not.

**Legend**

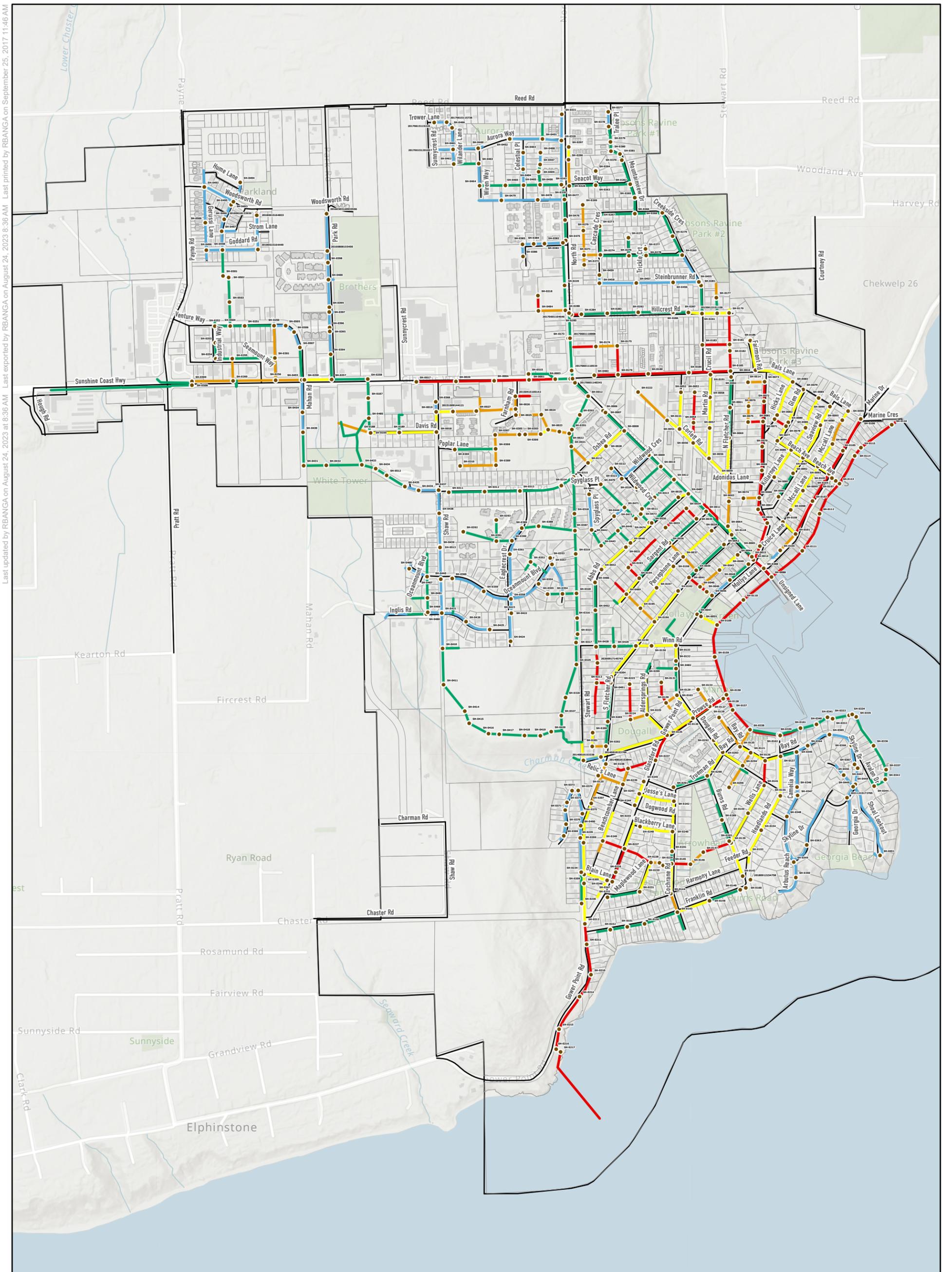
- Manhole
- Existing Condition Risk
  - 1
  - 2
  - 3
  - 4
  - 5
- Town of Gibsons Boundary



**Town of Gibsons**

**Future Sewer Network  
Condition Risk of Failure**

Figure 3-4



Last updated by RBANGA on August 24, 2023 at 8:36 AM. Last exported by RBANGA on August 24, 2023 at 8:36 AM. Last printed by RBANGA on September 25, 2017 11:46 AM.

**URBAN**  
systems

Project #: 1300.0147.01  
 Author: RB  
 Checked: SB  
 Status:  
 Revision: A  
 Date: 2023 / 8 / 24

0 100 200 300  
Meters

Coordinate System:  
Name: NAD 1983 UTM Zone 10N  
Scale: 1:10,500  
(When plotted at 11"x17")

Data Sources:  
- Town of Gibson  
- Data BC

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**Legend**

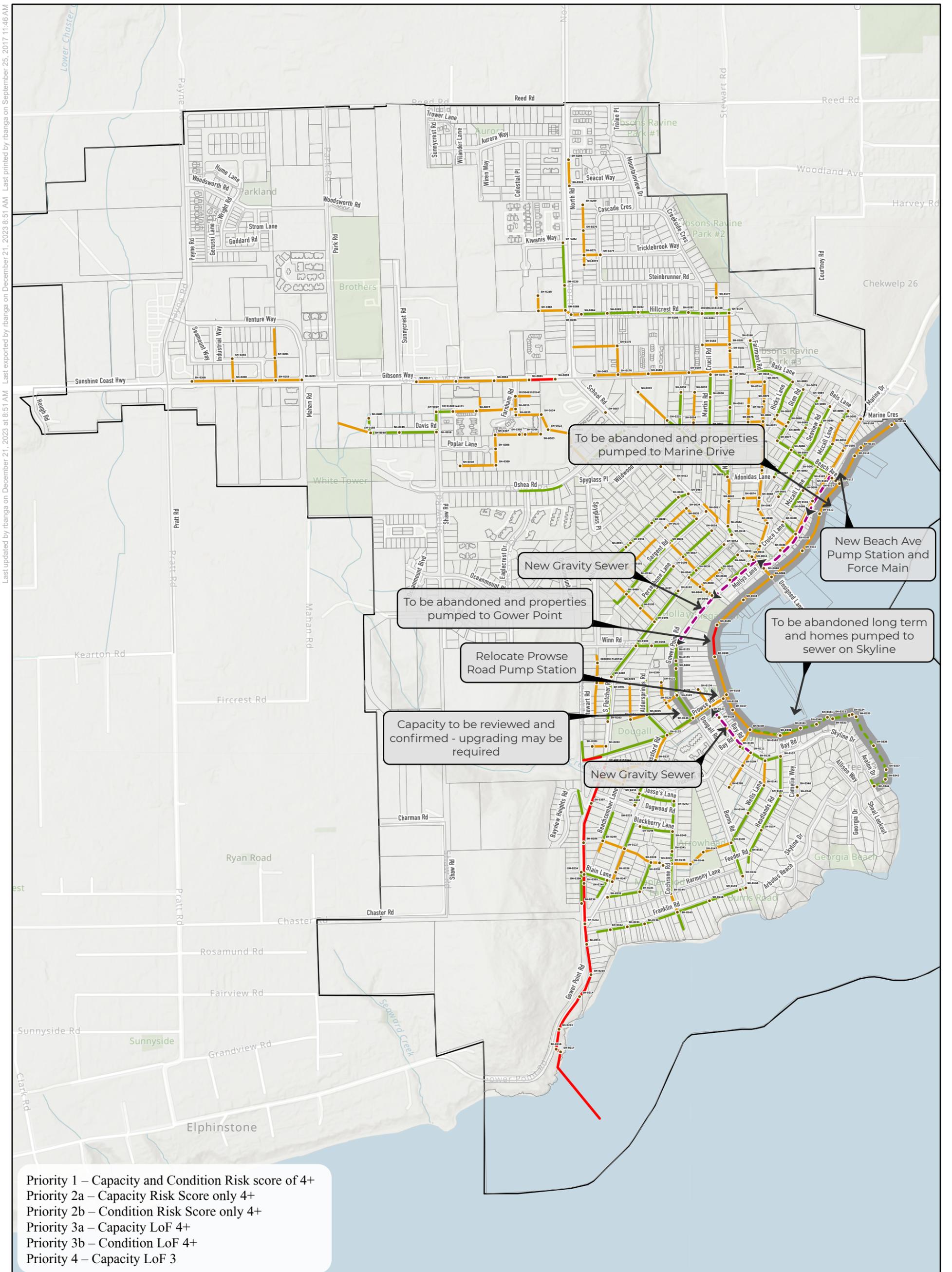
- Manhole
- Future Condition Risk
  - 1
  - 2
  - 3
  - 4
  - 5
- ▭ Town of Gibsons Boundary



**Town of Gibsons**

**Future Sewer Network Condition Risk of Failure**

Figure 3-5



Priority 1 – Capacity and Condition Risk score of 4+  
 Priority 2a – Capacity Risk Score only 4+  
 Priority 2b – Condition Risk Score only 4+  
 Priority 3a – Capacity LoF 4+  
 Priority 3b – Condition LoF 4+  
 Priority 4 – Capacity LoF 3

**URBAN**  
systems

Project #: 1300.0147.01  
 Author: RB  
 Checked: SB  
 Status:  
 Revision: A  
 Date: 2023 / 12 / 21

0 100 200 300  
Meters

Coordinate System:  
Name: NAD 1983 UTM Zone 10N  
Scale: 1:10,500  
(When plotted at 11"x17")

Data Sources:  
- Town of Gibson  
- Data BC

The accuracy & completeness of information shown on this drawing is not guaranteed. It will be the responsibility of the user of the information shown on this drawing to locate & establish the precise location of all existing information whether shown or not.

**Legend**

- Manhole
- Future Priority
- Priority 1 Capacity and Condition
- Priority 2b Condition
- Priority 3a Capacity
- Priority 3b Condition
- Town of Gibsons Boundary
- Roads
- Town\_of\_Gibsons\_Parcels



**TOWN OF GIBSONS**

**Town of Gibsons**

**Future Potential Shoreline Sewer Abandonment**

Last updated by rbanga on December 21, 2023 at 8:51 AM. Last exported by rbanga on December 21, 2023 at 8:51 AM. Last printed by rbanga on September 25, 2017 11:46 AM.



### 3.3 INTEGRATED COLLECTION SYSTEM CAPITAL PRIORITIES

In order to create an integrated collection system risk-based capital plan we have taken the information outlined in the previous sections and developed priorities in the following groups:

**Table 3-14: Integrated Collection System Capital Priorities**

Priority	Condition Risk	Capacity Risk
<b>1</b>	4 or 5	4 or 5
<b>2a</b>		4 or 5
<b>2b</b>	4 or 5	
<b>3a</b>		Likelihood of Failure = 4 or 5
<b>3b</b>	Likelihood of Failure = 4 or 5	
<b>4</b>		Likelihood of Failure = 3

This overall process is outlined in Figure 3-6.

In creating these groups it allows Gibsons to focus priorities in order of impact and based on available funding. The following table outlines the system characteristics under both the existing and future scenario. The projects are shown graphically in Figure 3.7 and 3.8. The future scenario is cumulative and so includes the existing system risks. We have included an allowance to re-video inspect the entire system every 10 years and also an allowance for rehabilitation and repair for deficiencies identified.

The three largest capital projects in the list are for the upgrading of the wastewater treatment plant outfall pipe, the pipe along the shoreline feeding into the Prowse Road Lift Station and also the main on Gibsons Way. All of these projects have a growth component to them as well as a benefit to existing customers. The outfall pipe shows up as Priority 1 in the future scenario while the other two projects show up as Priority 2a and 2b in the existing scenario and Priority 1 in the future scenario.

**Table 3-15: Integrated Collection System Capital Priorities (Pipes/\$2023)**

Priority	Existing Cost	Future (20 years)* Cost	Growth Driven
<b>1 Capacity and Condition</b>	0	\$8,048k	Yes
<b>2a Capacity</b>	\$2,292k	0 / \$0	Yes
<b>2b Condition</b>	\$2,513k	\$1,676k	No
<b>3a Capacity</b>	\$0**	\$0**	Yes
<b>3b Condition</b>	\$165k	\$195k	No
<b>4</b>	0 / \$0	\$0	No
<b>Additional Maintenance Recommendations</b>	\$54k	\$54k + \$300k (every 10 years to re-video) and score entire system + \$2,000k ( every 10 years for condition based repairs)	No
<b>Total</b>	<b>\$5,024k</b>	<b>\$14,573k</b>	

\* Includes Existing Pipes



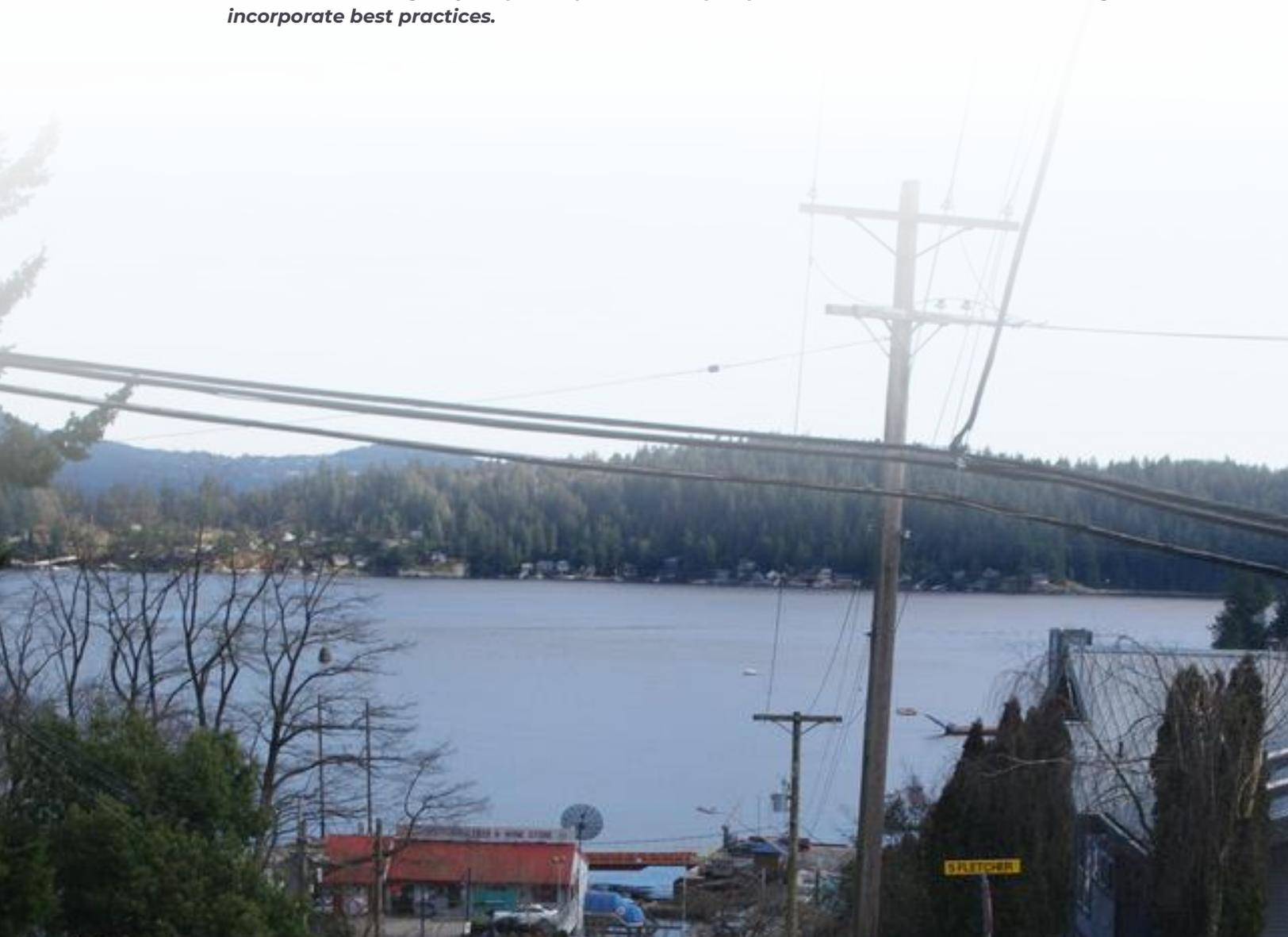
\*\* No 3a projects are outlined as the deficiencies are marginal.

It is recommended that the Town prioritize the maintenance and repair recommendations from the video inspection assessment and consider planning for the two major upgrade projects to align with other corresponding works over the next 20 years.

## 3.4 NON-CAPITAL PRIORITIES

The following non-capital priorities are provided in addition to the capital recommendations in the previous section.

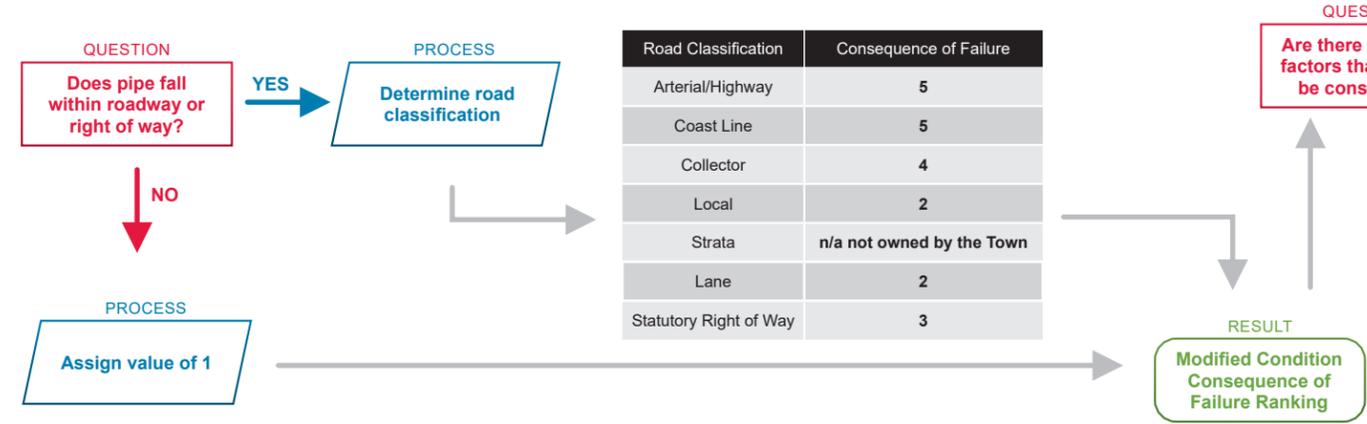
- ***Complete an update and recalibration of the sewer model at least once every 5 years (\$50k each time).***
- ***Update the strategic plan every 10 years (\$200k each time)***
- ***Prioritize inspection of the shoreline service connection to ensure that any failures are addressed before they impact the system performance.***
- ***Update the Subdivision and Development Bylaw to increase the inflow and infiltration rate (by staff)***
- ***Update the Development Cost Charges Bylaw (underway)***
- ***Ensure source control provisions are enforced (ie. Grease traps and pretreatment for high strength discharges).***
- ***Ensure that emergency response plans are kept upto date and that lift station designs incorporate best practices.***





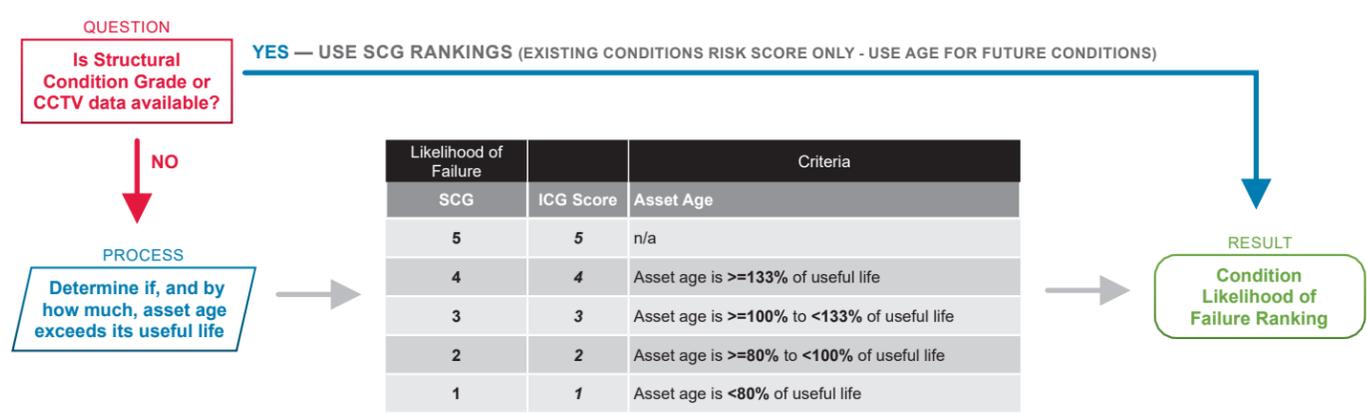
ASSET CONDITION

Condition — Consequence of Failure



Original Score	Based on Road Classification	1	2	3	4	5
Modified Score	<ul style="list-style-type: none"> <li>Crossing or adjacent to a sensitive watercourse or ocean (30m Buffer)</li> <li>Within 2m proximity to a structure</li> <li>Located in a high-risk seismic zone (where identified by the Town)</li> <li>At depth &gt;5m</li> </ul>	1	3	4	5	5

Condition — Likelihood of Failure



**Condition Risk Score Matrix**

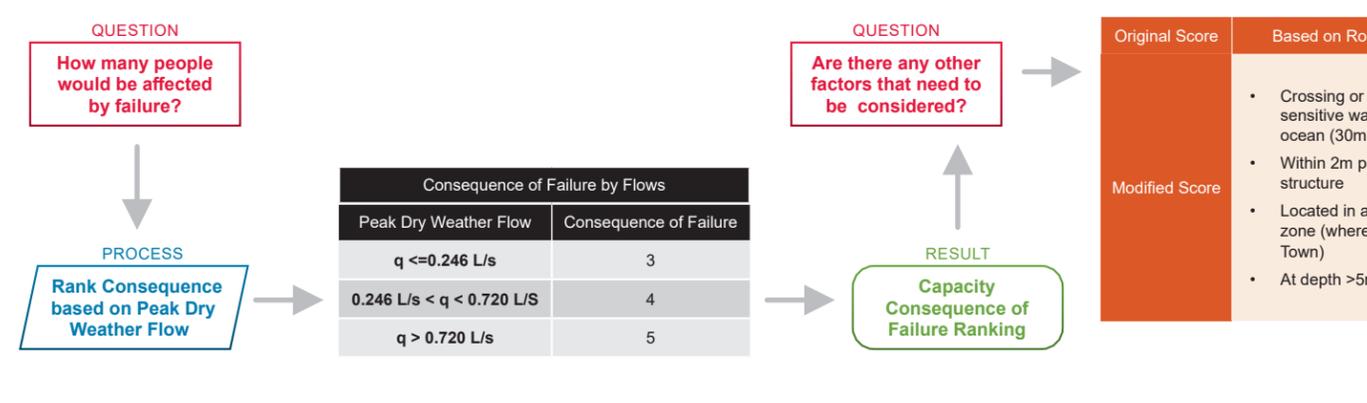
Consequence	1	2	3	4	5
5	2	3	4	5	5
4	2	3	4	5	5
3	2	2	3	4	4
2	1	2	2	3	3
1	1	1	2	2	3

Likelihood of Failure

Priority	Project Trigger
1	Capacity <b>and</b> condition risk of 4+
2a	Capacity risk score only 4+
2b	Condition risk score only 4+
3a	Capacity LoF 4+
3b	Condition LoF 4+
4	Capacity LoF 3

ASSET CAPACITY

Capacity — Consequence of Failure



Original Score	Based on Road Classification	1	2	3	4	5
Modified Score	<ul style="list-style-type: none"> <li>Crossing or adjacent to a sensitive watercourse or ocean (30m Buffer)</li> <li>Within 2m proximity to a structure</li> <li>Located in a high-risk seismic zone (where identified by the Town)</li> <li>At depth &gt;5m</li> </ul>	1	3	4	5	5

**Capacity Risk Score Matrix**

Consequence	1	2	3	4	5
5	2	3	4	5	5
4	2	3	4	5	5
3	2	2	3	4	4
2	1*	2*	2*	3*	3*
1	1*	1*	2*	2*	3*

Likelihood of Failure

*\*Not applicable to this methodology*

Capacity — Likelihood of Failure

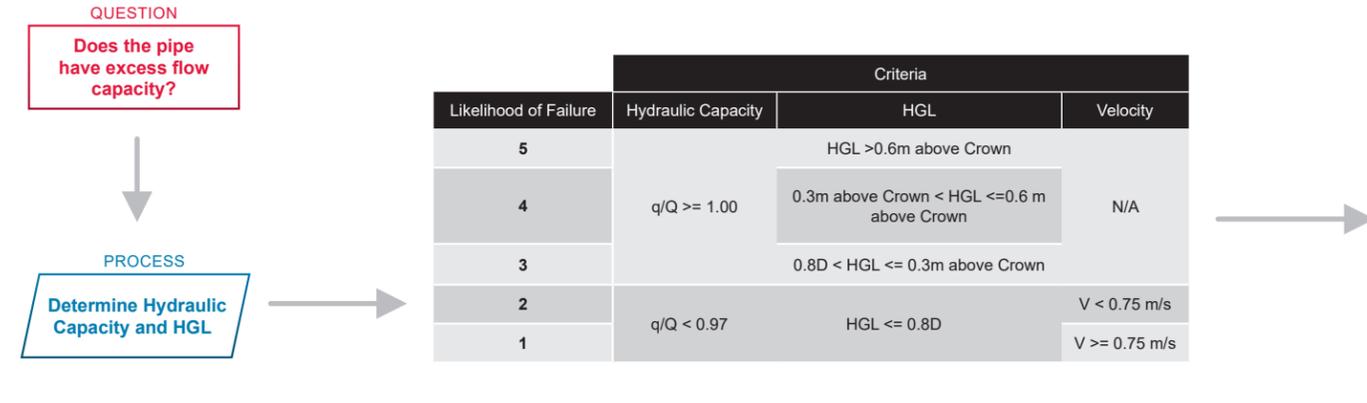
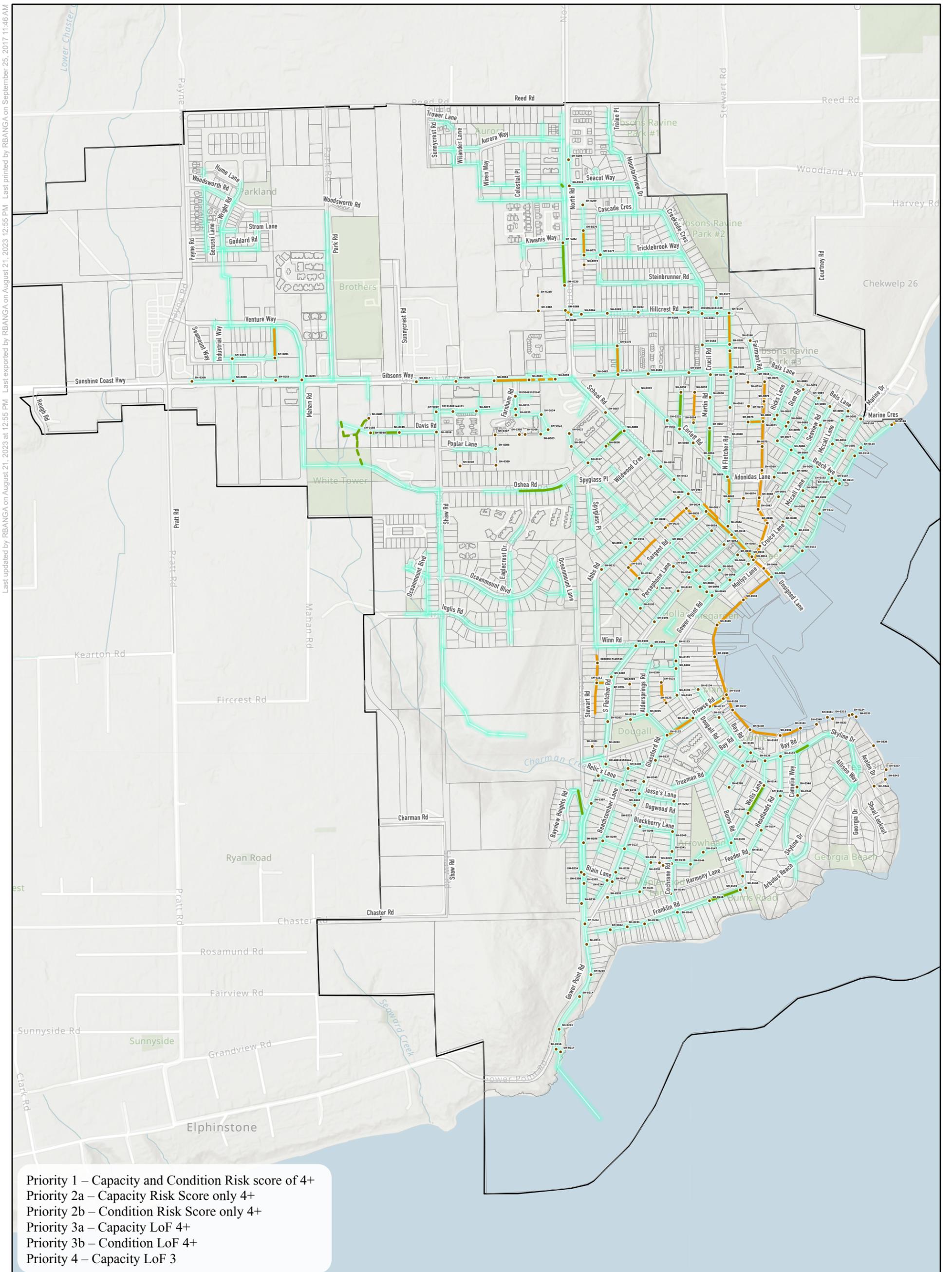


Figure 3-6

Figure 3-7



Priority 1 – Capacity and Condition Risk score of 4+  
 Priority 2a – Capacity Risk Score only 4+  
 Priority 2b – Condition Risk Score only 4+  
 Priority 3a – Capacity LoF 4+  
 Priority 3b – Condition LoF 4+  
 Priority 4 – Capacity LoF 3

**URBAN**  
systems

Project #: 1300.0147.01  
 Author: RB  
 Checked: SB  
 Status:  
 Revision: A  
 Date: 2023 / 8 / 21

0 100 200 300  
Meters

Coordinate System:  
Name: NAD 1983 UTM Zone 10N  
Scale: 1:10,500  
(When plotted at 11"x17")

Data Sources:  
- Town of Gibson  
- Data BC

The accuracy & completeness of information shown on this drawing is not guaranteed. It will be the responsibility of the user of the information shown on this drawing to locate & establish the precise location of all existing information whether shown or not.

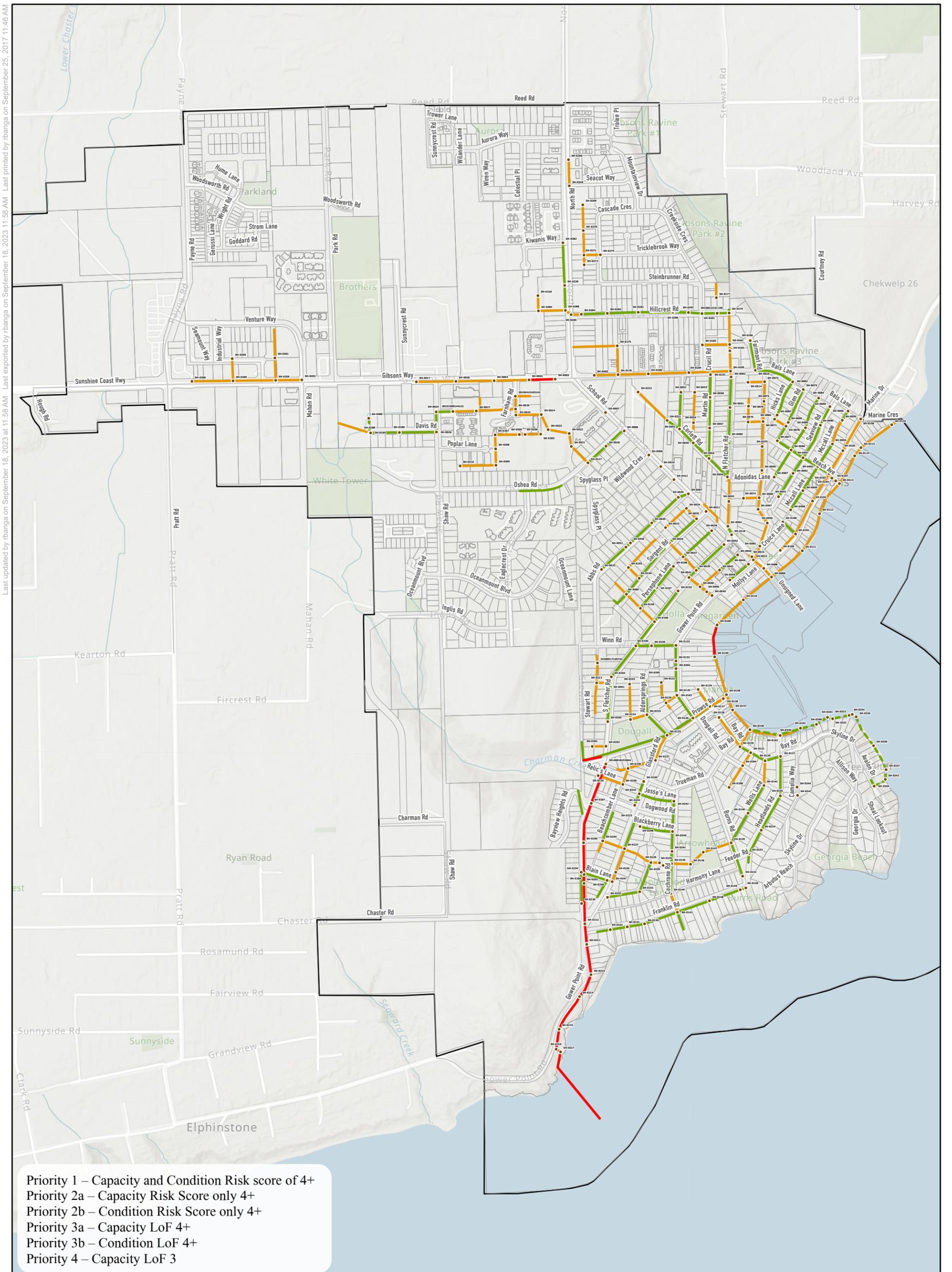
**Legend**

- Manhole
- Existing Priority
  - Priority 2a Capacity
  - Priority 2b Condition
  - Priority 3a Capacity
  - Priority 3b Condition
  - Pipes with SGC Scores
- Town of Gibsons Boundary



**Town of Gibsons**  
Existing Sewer Network Upgrade Priority

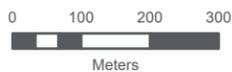
Figure 3-8



Priority 1 – Capacity and Condition Risk score of 4+  
 Priority 2a – Capacity Risk Score only 4+  
 Priority 2b – Condition Risk Score only 4+  
 Priority 3a – Capacity LoF 4+  
 Priority 3b – Condition LoF 4+  
 Priority 4 – Capacity LoF 3



**Project #:** 1300.0147.01  
**Author:** RB  
**Checked:** SB  
**Status:**  
**Revision:** A  
**Date:** 2023 / 9 / 18



**Coordinate System:**  
 Name: NAD 1983 UTM Zone 10N  
**Data Sources:**  
 - Town of Gibson  
 - Data BC

**Scale:** 1:10,500  
 (When plotted at 11"x17")

The accuracy & completeness of information shown on this drawing is not guaranteed. It will be the responsibility of the user of the information shown on this drawing to locate & establish the precise location of all existing information whether shown or not.

**Legend**

- Manhole
- Future Priority**
- Priority 1 Capacity and Condition
- Priority 2b Condition
- - - Priority 3a Capacity
- Priority 3b Condition
- Town of Gibsons Boundary



**Town of Gibsons**  
**Future Sewer Network Upgrade Priority**



## 4.0 TREATMENT SYSTEM

A review has been completed of both the condition and capacity of the sanitary sewer treatment plant. The condition assessment was limited to a visual inspection and did not include a detailed electrical or structural review. The assessment is outlined in Appendix E.

It is worth noting that the current plant is authorized under the Municipal Wastewater Regulation. Any significant changes to the plant or the outfall will likely trigger a major amendment that could take 2-5 years to complete. During the previous registration, very limited environmental impact assessment work on the receiving environment was completed and as such this next registration will require a full environmental impact study in order to support the application.

### 4.1 CAPACITY ASSESSMENT

The flows to the treatment plant are forecasted to increase from the current maximum daily flow of 3.4 MLD to an ultimate maximum daily flow of 8.2 MLD. Peak wet weather flows are forecast to increase from the current 6.4 MLD to a future flow of 13.9 MLD.

From a biological loading perspective loads and corresponding solids production are also forecast to increase by an amount similar to the flows.

In a consistent fashion with the collection system the following capacity assessment scores were used to evaluate the existing system:

#### 4.1.1 LIKELIHOOD OF FAILURE (LOF):

The LoF score is derived from level of service (LoS) scores (A, B, C → where A is the best case and C is worst case)

LoF is a value from 1-5, where 1 is the best case (operating as designed) and 5 is the worst case (capacity exceeded). This is outlined in Table 4-1.

Table 4-1: Capacity LoF Scoring

LoF score	Hydraulic LoS	Load LoS	MWR Redundancy
1	A	A	Pass or NA
2	A	A	Fail
3	C	B	Pass or fail or NA
3	B	C	Pass or fail or NA
4	C	C	Pass or NA
5	C	C	Fail

**Notes:**

If one of hydraulic or load LoS was not applicable, left that LoS score out.

A (best): flow/capacity < 0.95

B: 0.95 < flow/capacity < 1

C (worst): flow/capacity > 1



### 4.1.2 CONSEQUENCE OF FAILURE (COF):

CoF is a value between 1 and 5, where 1 is the best case and 5 is the worst case. This is outlined in Table 4-2.

Table 4-2: CoF Scoring

CoF score	Criteria (\$)
1	1 = no impact
2	2 = moderate operational challenges. Costs <\$50,000 to mitigate issue.
3	3 = significant operational challenges, but no exceedances. Costs >\$50,000 to mitigate issue
4	4 = plant capacity exceeded –non-life threatening injury, or short-term environmental impact. Includes impact >\$50,000 for solids stream (thickener, aerobic digester, centrifuge) due to high operational costs related to system failure or being undercapacity.
5	5 = plant capacity exceeded – serious public health issue (life threatening injury), permanent or unacceptable environmental damage, operator safety is compromised.

**Notes:**

Plant capacity exceeded refers to a permit exceedance OR plant overflow.

Mitigation does not include replacement cost. Only the cost to mitigate the one time exceedance.

In order to accommodate the future flows and loads the following upgrades are needed at the treatment plant:

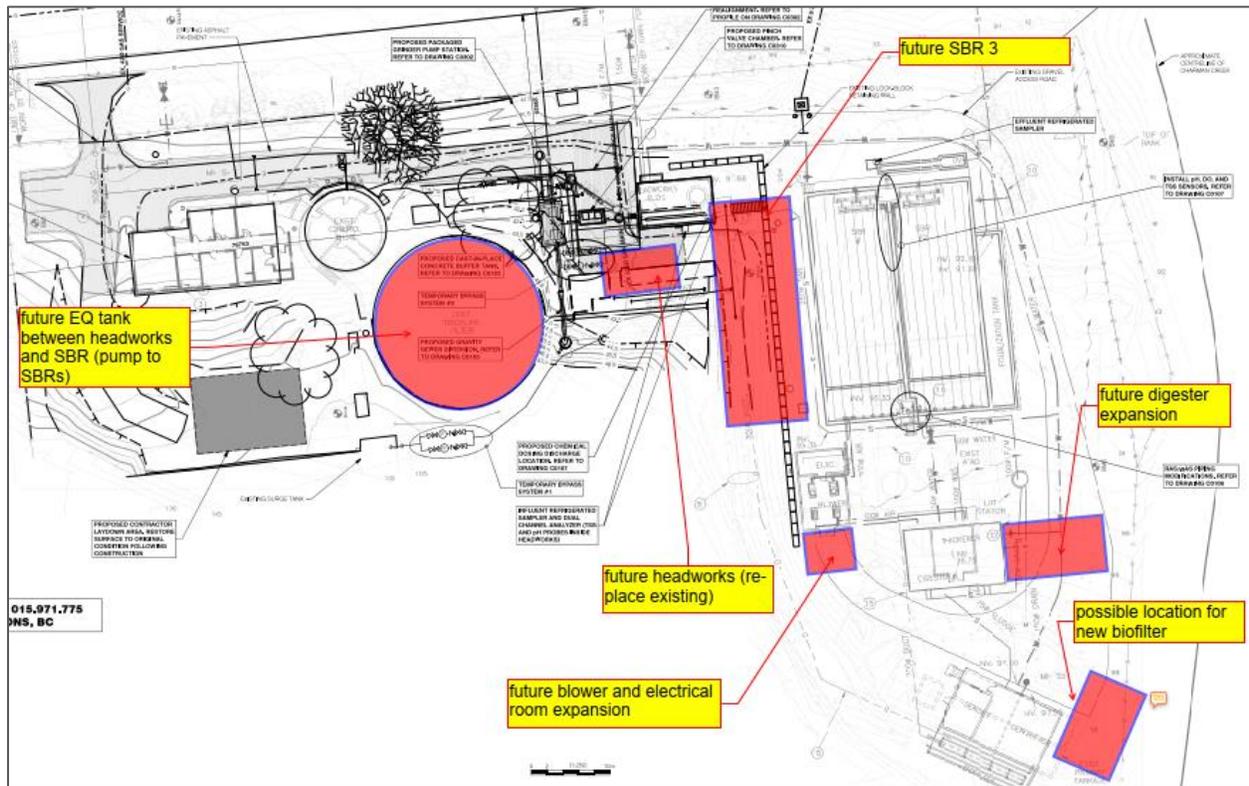
Table 4-3: Capacity Risk Summary

Plant Process	Existing Capacity Risk	Future Capacity Risk
Headworks	2	5
SBR EQ Tank	NA	5
SBR	2	5
Thickener	2	5
Digester	2	5
Centrifuge	2	5
Odour Control	2	3
Outfall	5	5

All upgrades for capacity are driven by future growth.



The following figure outlines the proposed plant expansion.



Due to the location of the WWTP, geohazards will need to be considered during design and construction of all future plant upgrades. The WWTP is located on a level area at the mouth of a ravine and is surrounded to the west and north-west by slopes. Thurber Engineering (Thurber) recently completed a desktop study and site reconnaissance to review the geohazard potential at the WWTP site (Thurber Engineering, 2023).

The study identified that large static landslides are not likely, but that there is a risk of smaller, more localized landslides occurring. The report notes that this risk is most concentrated near the base of the slopes, and that a landslide barrier is a potential mitigation measure for this hazard. The site currently incorporates offsets from the slope and debris walls (lock block wall with fence behind) to help mitigate the impacts of any small landslides. However, during construction of the third SBR tank and blower/electrical room expansions, these protective measures may need to be moved back to create space for the new infrastructure.

The geohazard study also notes that landslides due to seismic activity may be a hazard at the WWTP. It is noted that damage to buildings closer to the base of slopes is more likely, compared to the tanks which are offset further. This potential hazard should be taken into consideration during design and construction of future infrastructure near the base of the slopes.

The report notes that debris floods and flows are not considered likely for the plant, however, that flood walls could be implemented if other studies identify concerns.

There is a small two lock block high wall adjacent to SBR #1 which will need to be removed to construct the third SBR. A new wall, closer to the slope may need to be constructed to protect the new tank structure from geohazards.



## 4.2 CONDITION ASSESSMENT

A visual condition assessment was completed with Town staff with a focus on the equipment that could be seen. This did not include a structural or electrical inspection.

### 4.2.1 LIKELIHOOD OF FAILURE (LOF):

The likelihood of failure (LoF) is based on the condition assessment scores (1-5) assigned through discussion with the Town operations staff. This relates to the existing condition of equipment – the assessment separated assets into mechanical/electrical and civil/structural assets (Table 4-4 and Table 4-5)

Table 4-4: Mechanical /Electrical Assets – LoF score and Expected Asset Life Remaining

Expected Asset Life Remaining (yrs)	LoF Score
>10	1
5-10	2
2-5	3
0-2	4
0	5

Table 4-5: Civil/Structural Assets - LoF score and Expected Asset Life Remaining

Expected Asset Life Remaining (yrs)	LoF Score
>25	1
10-25	2
2-10	3
0-2	4
0	5

### 4.2.2 CONSEQUENCE OF FAILURE (COF):

The same consequence of failure criteria and scores used for the capacity analysis were used in the condition assessment.

The following tables summarize the components with the highest condition risk scores.

Table 4-6: Condition Risk Summary

Plant Process	Existing Condition Risk
Headworks	5
SBR	3
UV	3
Centrifuge	3
Outfall	4



### **4.3 RISK ASSESSMENT**

A risk analysis was conducted for each unit process based on an evaluation of condition and capacity. The outputs were used to assign upgrade priority scores for project prioritization consistent with the collection system process. Unit processes without upgrades scores are deemed lower risk at this time and upgrades for these should be planned according to the upgrade trigger and timing results section of the condition and capacity analysis. The risk scoring matrix followed the same one as the collection system.



Table 4-7: Priority Scores for Upgrade Projects

Process	Component	Upgrade Priority Score	Comments
<b>MWR Registration</b>	-	2a (existing)	*timing to align with outfall upgrading and upstream EQ tank addition and/or flow increase
<b>Buffer Tank</b>	Tank	Na	*add future SBR EQ tank instead
	Pinch Valve	Na	*add future SBR EQ tank instead
<b>Headworks</b>	Existing headworks channel	2b (existing)	
	Fine Screen (6mm)	2b (existing)	
	Screen conveyor/motor	2b (existing)	
	Bypass Manual Bar Screen (25mm and 12mm)	2b (existing)	
	Grit Removal + motor	2b (existing)	
	Grit classification + motor		
<b>SBR</b>	Splitter Box	1 (future)	
	Tanks(1535m <sup>3</sup> /tank: 29x9.625x5.5m)	1 (future)	
	SBR Blowers	2b (existing)	
	WAS Pumps	1 (future)	
	Decanters + motor	1 (future)	



Process	Component	Upgrade Priority Score	Comments
	Fine bubble air diffusers	1 (future)	
	WAS Flowmeter	2b (existing)	
	Instrumentation (DO Probe, pH, TSS in each SBR, effluent pH and TSS)	1 (future)	*means that new SBR will be required with new instruments.
<b>FUTURE Upstream EQ tank (between headworks and SBRs)</b>	-	2a (future)	* to be upgraded before SBR upgrade is required to ensure MDF is being conveyed to the SBRs instead of PWWF
<b>UV System</b>	Banks A and B	2b (future)	*capacity risk score 4+ in future due to flow being equal to capacity, instead of being <95% of capacity.
<b>Equalization Tank</b>	Motorized plug valve	2b (future)	
	Tank	2b (future)	
	Flowmeter	2b (future)	
<b>Outfall</b>	Pipeline	2a (Existing) 1 (future)	
	Outfall Diffusers	2b (existing)	
<b>Thickener</b>	Rotary Drum Thickener	2b (existing)	Score adjusted based on operator concerns with condition failure
	Flowmeter		
	Instrumentation		



Process	Component	Upgrade Priority Score	Comments
	Polymer System		
<b>Aerobic Digester</b>	Aerobic Digester Tanks	1 (future)	
	Aerobic Digester Blowers	2b (existing)	Score adjusted based on operator concerns with condition failure
	Bubble aeration system	1 (future)	
<b>Centrifuge</b>	Sludge pump (progressive cavity)	1 (future)	
	Centrifuge	2b (existing)	
	Polymer System	2b (existing)	
	Flowmeter	3b (existing)	
	Dewatered Sludge Conveyor	3a (future)	*may have to be upgraded when centrifuge is upgraded
	Sludge Storage (rental)	Na	*rental
<b>Odour Control</b>	Biofilter	4 (existing)	*upgrade or reconfiguration may be required soon after centrifuge upgrade to ensure adequate air exchange.
<b>Backup Power</b>	Generator	2b (existing)	



## 4.4 CAPITAL PRIORITIES

A timeline and cost for each upgrade project, including anticipated time to initiate a study/design is outlined in Table 4-8. The timeline over which it was assumed that the buildout population will be reached is 20 years (2043). Furthermore, 10,000 people is expected to occur around year 10 (2033). We have grouped the projects into works that can be completed together for efficiency. These groupings can be reconsidered as this plan moves forward.

Table 4-8: Upgrade Project Timelines and Cost Estimates

Upgrade Project	Project Group	Design Trigger Year	Engineering (20% of capital with contingency) (rounded)	Upgrade Trigger Year	Capital Replacement Cost, including 35% contingency (\$) (rounded)	Upgrade Trigger Year Population *	Growth Driven
Centrifuge 1	1	2023	\$205,000	2024	\$1,021,000	6,608	No
MWR Registration	1	2024	\$200,000	2024	N/A	6,608	Yes
Aerobic Digester Blowers (x2)	1	-	\$0	2024	\$78,000	6,608	No
Outfall - Diffusers (replacement)	-	2024	\$216,000	2027	\$1,080,000	7,561	Yes
Outfall - Pipeline (Phase 1)	-	2024	from collection system costs	2026	from collection system costs	6,318	No
Outfall - Diffuser Interim Repair	-	2024	\$16,200	2024	\$81,000	6,318	No
Plant Upgrading Preliminary Design and Expanded Condition Assessment	2	2024	\$400,000	N/A	N/A	NA	Yes
Outfall - Pipeline (Phase 2)		2024	from collection system costs	2031	from collection system costs	9,049	-
Odour Control	3	2025	\$227,000	2026	\$1,134,000	7,229	Yes
Thickener	4	2025	\$160,000	2026	\$800,000	7,229	Yes
Headworks	5	2025	\$479,000	2026	\$2,395,000	7,229	Yes
SBR Blowers (x2)	6	-	\$0	2027	\$143,000	7,561	No
UV System	7	2029	\$218,000	2031	\$1,087,000	9,049	No
FUTURE SBR EQ tank (between headworks and SBRs)	8	2031	\$352,000	2033	\$1,757,000	9,900	Yes
Generator (Backup Power)	8	2031	\$79,000	2033	\$395,000	9,900	Yes
SBR	8	2031	\$888,000	2033	\$4,438,000	9,900	Yes
Aerobic Digester	8	2031	\$684,000	2033	\$3,417,000	9,900	Yes
Centrifuge 2	8	2031	\$213,000	2033	\$1,061,000	9,900	Yes

\*Includes equivalent population from industrial, commercial and institutional.

The costs are in \$2023 and include a contingency allowance of 20%. Borrowing costs and Gibsons' administration costs are not included.



## 4.5 NON-CAPITAL PRIORITIES

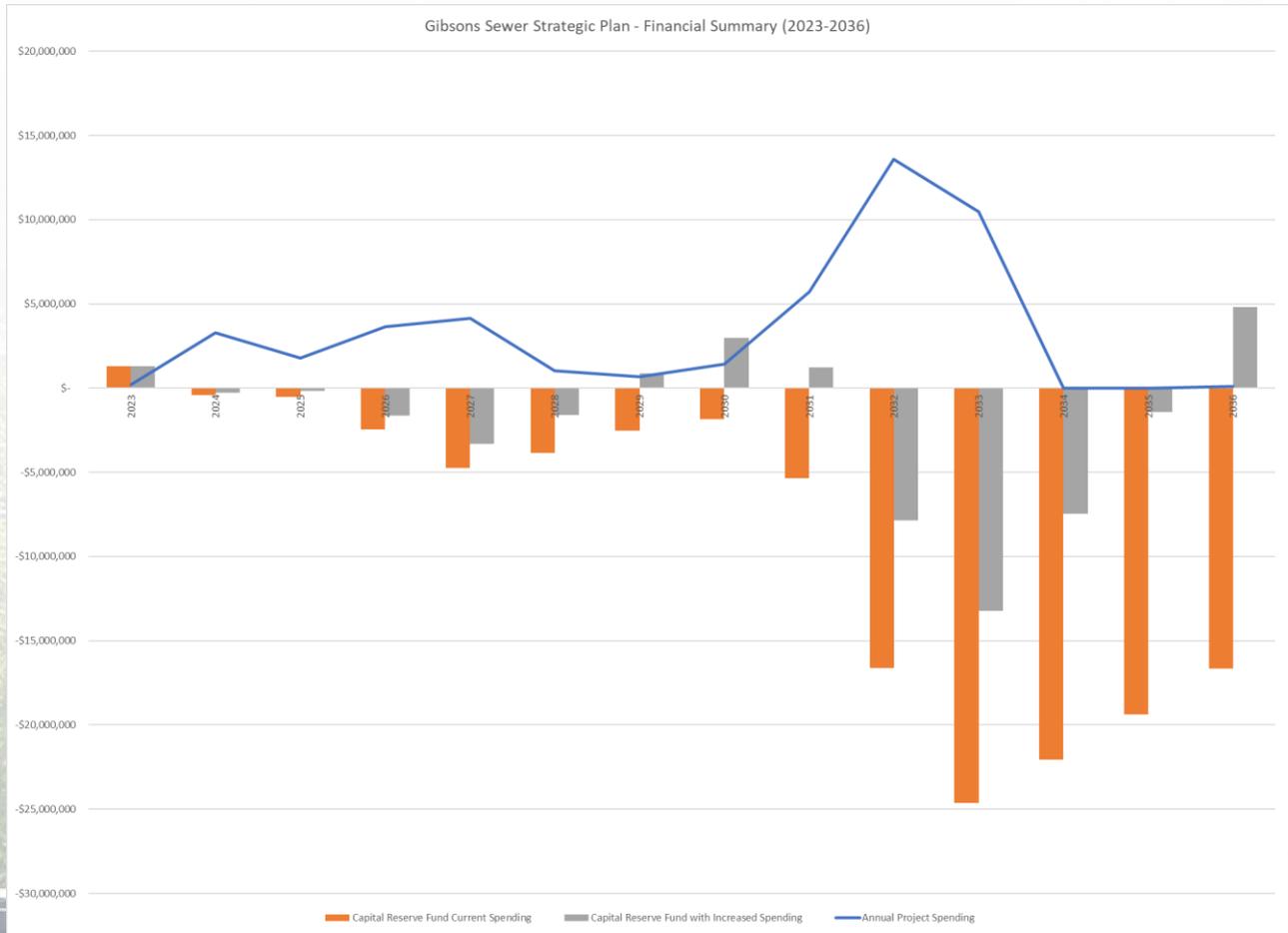
*From a non-capital process, it is recommended that the Town continue to prioritize the ongoing monitoring and optimization of the plant performance and maintain compliance with federal and provincial regulations for reporting.*

*Further it is recommended that regular condition assessments are completed in order to address deterioration before it becomes an issue.*



## 5.0 FINANCIAL PLAN

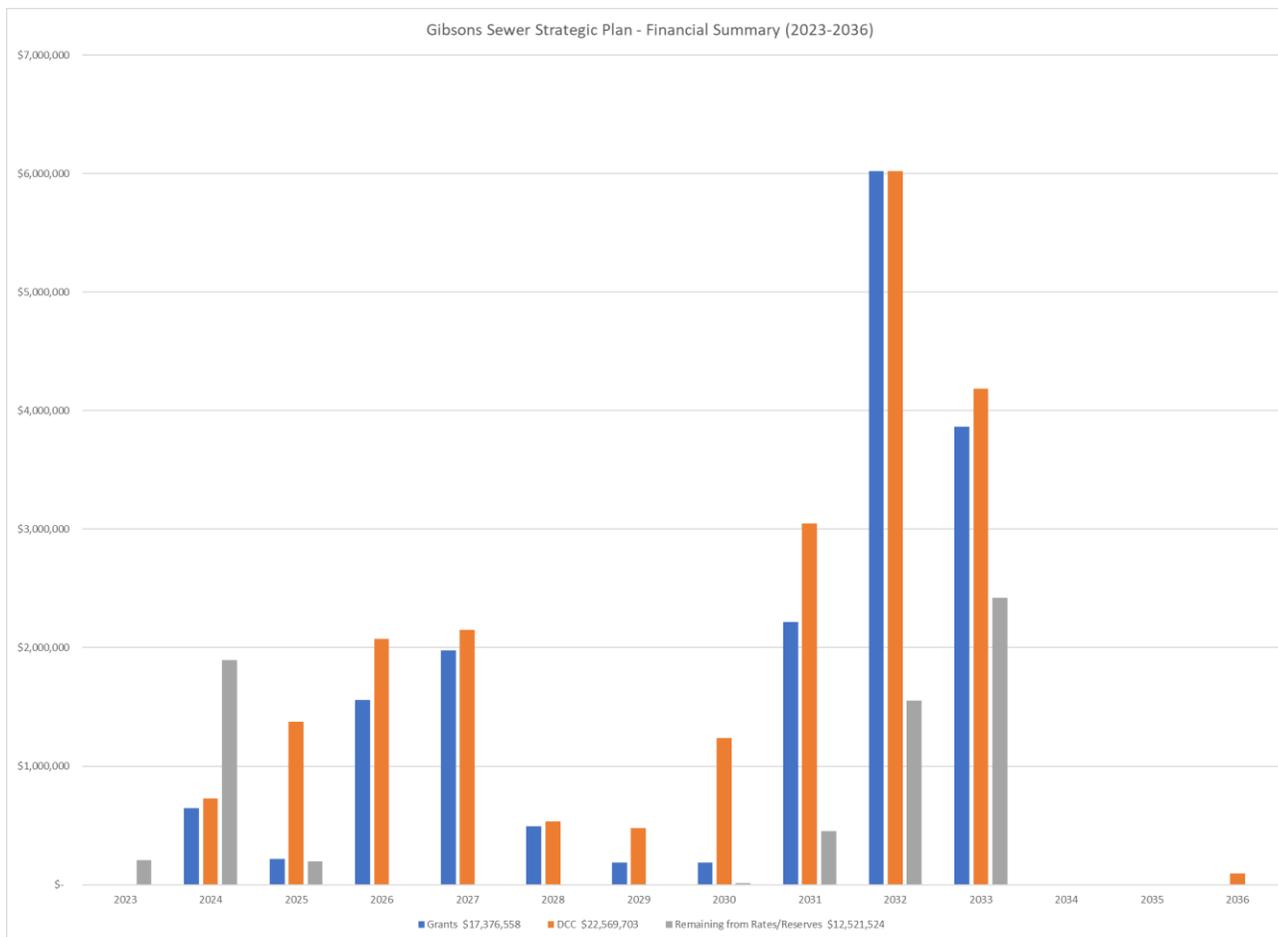
We have mapped out the financial plan for both the collection system and also for the treatment plant projects. They are outlined in the graph below and in detail in **Appendix F**. We have included an assumed annual inflation rate of 5% but have not included any Gibsons administration costs or any borrowing costs or assumed any grants.





In terms of funding levels we have shown what the impact will be to the capital reserve fund balance if the current funding level of \$1.5 million/year is only grown at the assumed 5% rate of inflation and if that funding level is further increased by 8% a year (13% total per year). At the current funding level assuming no grants are received the reserve fund doesn't balance until 2042. However, with the increased funding level the fund balances by 2036. Through borrowing these impacts can be reduced however interest costs will need to be added.

If we further consider the potential for both grants at 50% of what are considered to be eligible projects and also DCC revenues at 99% of growth based projects (after any grants) the following graph illustrates the funding breakdown.



***It is recommended that the Town review this capital plan with their overall financial plan as well as with the DCC bylaw update in order to confirm the affordability and rate impacts. The sequencing of projects may need to be adjusted in order to better balance the cash flow and reserve fund and borrowing impacts. It is recommended that these budgets be reviewed and updated annually in order to ensure that appropriate inflationary adjustments are made.***



## 6.0 CONCLUSIONS AND RECOMMENDATIONS

The following conclusions have been reached in this report:

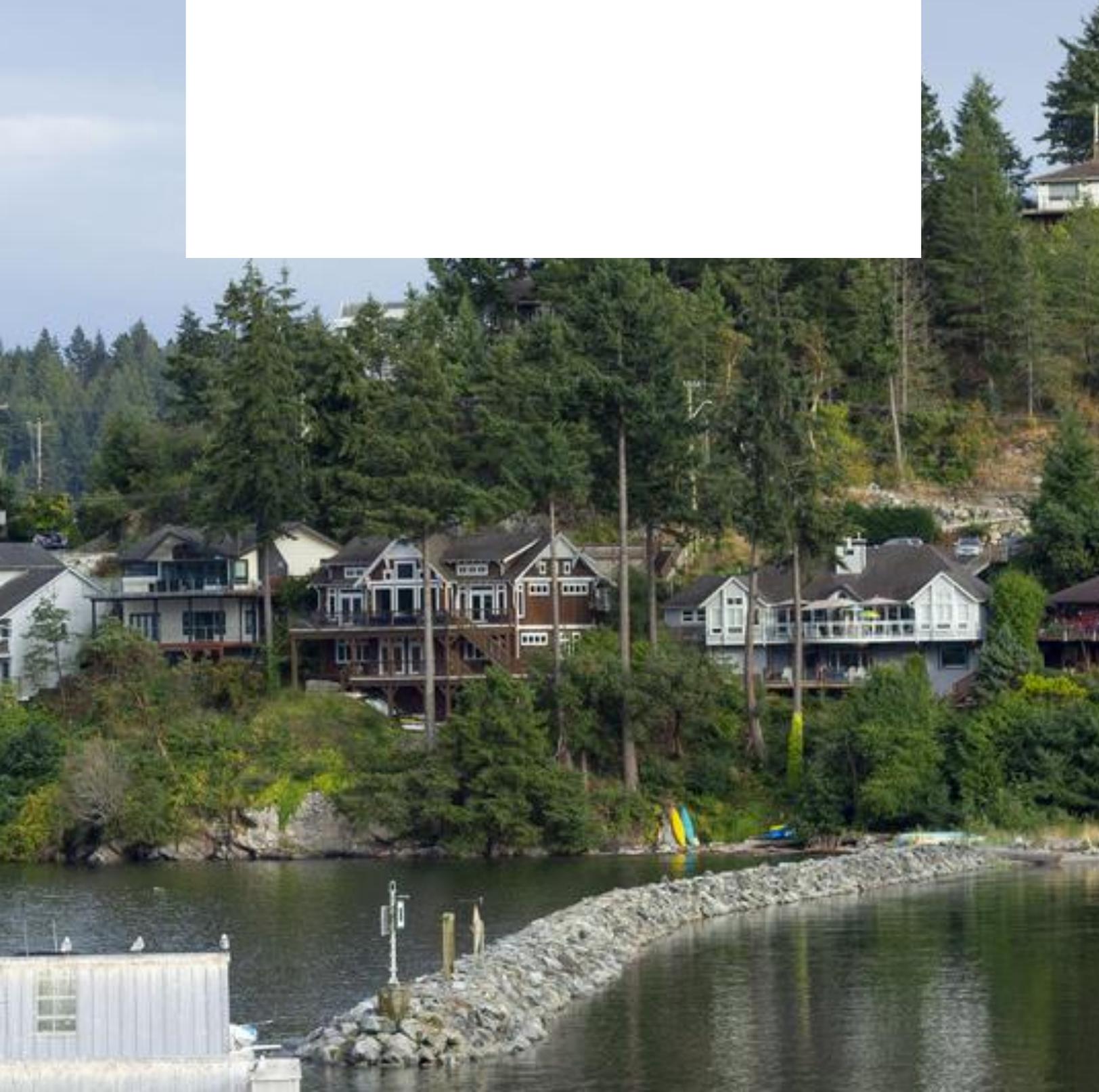
- the Town of Gibsons collection system has good capacity in order to accommodate the forecasted growth.
- The condition of the collection system will need greater attention as the system ages in order to ensure that inflow and infiltration doesn't become a major issue going in the future.
- The treatment plant and outfall however will require considerable attention in order to both accommodate the increased capacity and deal with condition related needs. Prioritizing the completion of preliminary design and Municipal Wastewater Registration updating are of highest priority.
- A risk based prioritized capital plan totaling \$37 Million (\$2023) is outlined in order to help ensure that the Town can provide the desired levels of service both for existing and also future customers.

The following recommendations are provided:

- Complete an update and recalibration of the sewer model at least once every 5 years
- Update the strategic plan every 10 years
- Prioritize inspection of the shoreline service connection to ensure that any failures are addressed before they impact the system performance.
- Ensure source control provisions are enforced (ie. Grease traps and pretreatment for high strength discharges).
- Ensure that emergency response plans are kept up to date and that lift station designs incorporate best practices.
- Ongoing CCTV inspections and monitoring of wet weather flows at the Prowse Road pump station be a consistent priority for the Town.
- Update the Subdivision and Development Bylaw to explicitly require the 22,500 L/ha/day design inflow and infiltration rate be used for all sanitary sewer system upgrades.
- Video inspect the entire system at least once every 10 year and engage a qualified professional to provide quality assurance to the work by the inspection contractor and complete the pipe scoring and remediation recommendations instead of just relying on the contractor to provide this information.
- Continue to prioritize the ongoing monitoring and optimization of the plant performance and maintain compliance with federal and provincial regulations for reporting.
- Regular condition assessments are completed in order to address deterioration before it becomes an issue.
- Prior to spending efforts rehabilitating the foreshore sewer complete a feasibility study to evaluate the opportunity to relocate this sewer further inland and divert flows from Upper Gibsons. Also consider requiring all redevelopment to install individual pump systems in order to discharge flows to the sewer on the upland side.
- Review this capital plan with their overall financial plan as well as with the DCC bylaw update in order to confirm the affordability and rate impacts. The sequencing of projects may need to be adjusted in order to better balance the cash flow and reserve fund and borrowing impacts. It is recommended that these budgets be reviewed and updated annually in order to ensure that appropriate inflationary adjustments are made.



# APPENDIX A: GROWTH MEMO



# MEMORANDUM



DATE January 20, 2023 FROM Samantha Lahey  
TO Lesley-Anne Staats, Director of Planning FILE 1300.0146.01  
CC Steve Brubacher; Jessica Wang; Kendrick Carnes SUBJECT Town of Gibsons – Build Out Estimates

## 1.1 OVERVIEW

Urban Systems helped to estimate a 'build-out' scenario for the Town of Gibsons in support of Gibsons' Sanitary Sewer Strategic Plan and the Town's Development Cost Charge Bylaw Update. The build out scenario will help estimate the Town's population and housing forecasts, as well as anticipated Industrial, Commercial and Institutional (ICI) development.

## 1.2 METHOD

Using GIS and data provided by the Town, each Official Community Plan (OCP) designation was assigned a total vacant land area (in hectares). It was assumed that any development of vacant parcels would maximize the allowable density of the respective OCP designation. Only designations that permit residential, commercial, industrial and institutional uses were assessed.

### Residential

For residential designations, the allowable density (units per hectare or uph) was multiplied by the total area of vacant parcels in that designation. This calculation yielded a high and low unit count for all residential and mixed-use OCP designations. Residential land located in the Gospel Rock and Upper Gibsons Neighbourhood Plan Areas were netted out of these calculations, and respective unit and population estimates were directly translated to the Town's total unit count. Additionally, vacant parcels that are subject to instream development applications were discounted; the proposed units on each of those parcels have been manually factored in.

Table 1 below summarizes the result of the new residential unit estimates.

Table 1: Estimated New Units on Residentially Designated Vacant Parcels

OCP Designation	Vacant Land (ha)	Density		Estimated New Units	
		UPH Low	UPH High	UPH Low	UPH High
Detached Residential	2.88	15.0	20.0	43	58
High Density Residential	0.30	60.0	110.0	18	34
Live / Work <sup>1</sup>	0.00	40.0	75.0	-	-
Low Density Residential 1	0.16	20.0	25.0	3	4
Low Density Residential 2	1.18	25.0	40.0	29	47

<sup>1</sup> The Live / Work designation did not include maximum allowable density standards. For the purposes of this calculation, the density allowed in the Medium Density Residential designation was used based off similar permitted uses.

OCP Designation	Vacant Land (ha)	Density		Estimated New Units	
		UPH Low	UPH High	UPH Low	UPH High
Medium Density Residential	2.24	40.0	75.0	90	168
Mixed-Use Commercial	4.55	120.0	120.0	546	546
Mixed-Use Gateway	0.00	100.0	100.0	-	-
Multi-Unit Residential Special Character <sup>2</sup>	0.09	20.0	40.0	2	4
Residential / Tourist Accommodation	0.59	120.0	120.0	71	71
Gospel Rock Neighbourhood Plan	47.13	-	-	1,130	1,130
Upper Gibsons Neighbourhood Plan	21.23	-	-	915	915
<b>Grand Total</b>	<b>80.36</b>			<b>2,848</b>	<b>2,976</b>

There is a total of **80.36 hectares of vacant residential or mixed-use** land in the Town not currently subject to an active development application. If all vacant parcels were to redevelopment at maximum allowable density under current OCP designations, this would yield a total of **2,976 new residential units**.

#### Industrial, Commercial, and Institutional (ICI)

The OCP does not prescribe density standards for ICI designations. To estimate the amount of ICI development potential on existing vacant lands, performance standards in associated zones were used as a proxy. Using the maximum lot coverage and maximum building height permitted in respective zones, the estimated buildable area (m<sup>2</sup>) was calculated. **It is important to note that these calculations do not factor in allowable commercial space permitted in mixed-use designations.**<sup>3</sup>

Table 2 below summarizes the result of estimated new ICI development.

<sup>2</sup> The Multi-Unit Residential Special Character designation allocates different densities for Single Family and Multi-Family uses. For the purpose of this calculation, the low density scenario uses the lower allowable density for single family and the high density scenario uses the higher allowable density for multi-family.

<sup>3</sup> Potential commercial floor space would need to be calculated at the individual parcel level and netted out from potential residential floor space. As such, Allowable commercial space permitted in mixed-used designations was allocated as residential units for the purposes of this calculation.

Table 2: Estimated New Development on ICI Designated Vacant Parcels

OCP Designation	Total Vacant Land	ICI Assumptions			ICI Estimates	
		Zone	Max Lot Coverage	Storeys	Estimated Buildable Area (ha)	Estimated Buildable Area (m <sup>2</sup> )
Commercial Harbour	0.15	M-1	80%	2	0.24	2,403
Public / Community Uses	9.25	PA	80%	3	22.20	222,037
Service Commercial	2.33	IL	80%	3	5.60	55,988
<b>Grand Total</b>	<b>11.7</b>				<b>28</b>	<b>280,429</b>

There is a total of **11.7 hectares of vacant commercial, industrial and institutional** land in the Town. If all vacant land were to develop at a maximum allowable lot coverage and building height permitted in respective zones, this would yield a total of **280,429 m<sup>2</sup> of new ICI development**.

#### In Stream Development Applications (On Vacant Land)

The Town provided a map highlighting parcels that are subject to active development applications. A total of 27.5 hectares of land is subject an in stream development application, 20.1 hectares of which is located on vacant land (7.4 ha is assumed to be redevelopment of non-vacant sites<sup>4</sup>). The development of an 18.4 ha parcel located in Gospel Rock comprises most of the active development lands and has not been included in this assessment. This results in **1.8 ha of vacant land that is subject to an in stream development application**. The in stream development applications on vacant lands account for an additional 132 residential units, four commercial units and 11 hotel units, as illustrated in Table 3 below.

Table 3: Vacant Parcels with Active Development Applications - Unit Count

Proposed Land Use	Unit Counts <sup>5</sup>
Townhouse	20
Apartment	115 <sup>6</sup>
Commercial	25,000m <sup>2</sup> buildable <sup>7</sup>
Hotel	111
<b>TOTAL:</b>	<b>246</b>

### 1.3 ESTIMATING REDEVELOPMENT

It is expected that a portion of new growth will derive from redevelopment of currently occupied lots. An attempt to estimate growth from redevelopment was made using five-year historic building permit trends. However, this approach fell short as it was not possible to determine if /

<sup>4</sup> Assumes redevelopment of non-vacant sites will yield a net zero replacement rate (i.e., one for one).

<sup>5</sup> Does not account for active development application in Gospel Rock

<sup>6</sup> Includes three commercial units on vacant land that are part of mixed-use development

where redevelopment was replacing like for like (e.g., new single family home replacing existing single family home) versus redevelopment that contributes to growth (e.g., duplex replacing single family home or commercial redevelopment with increased floor space). Redevelopment estimates were not determined due to data limitations.

## 1.4 TRANSLATING TO POPULATION ESTIMATES

To translate residential development to population estimates, an occupancy rate is applied to each residential unit. For non-residential uses, an equivalency factor is used, based on a population per gross area. In 2016, Urban Systems supported the Town in updating their DCC rates. As part of this exercise equivalent population per square metre of non-residential space was established. The same non-residential equivalency factors were used to estimate population in the exercise. For residential development, occupancy rates for single family and two family units were increase by 1.0 to account for accessory dwelling units (i.e., secondary suites and / or coach houses). The higher density scenario was used for residential development.

Table 4 below summarizes the result of translating estimated new development on vacant lands to population estimates.

*Table 4: Population Estimates for Development of Vacant Land*

OCP Designations	Estimated New Units	ICI Estimates	Population Estimates	
	UPH High	Buildable Area (m <sup>2</sup> )	Equivalent Factors	Population
Commercial Harbour		2,403	0.005	12
Detached Residential	58		3.3	190
Gospel Rock Neighbourhood Plan <sup>8</sup>	1,130			3,301
High Density Residential	34		2	67
Live / Work	-		1.5	-
Low Density Residential 1	4		3.3	13
Low Density Residential 2	47		3.3	156
Medium Density Residential	168		3.3	555
Mixed-Use Commercial	546		1.5	820
Mixed-Use Gateway	-		1.5	-
Multi-Unit Residential Special Character	4		2	7
Public / Community Uses		221,407	0.005	1,110
Residential / Tourist Accommodation	71		1.5	106
Service Commercial		55,988	0.005	280
Upper Gibsons Neighbourhood Plan <sup>9</sup>	915	-		1,995

<sup>8</sup> Population estimates for the Gospel Rock Neighbourhood Plan Area were calculated separately based on residential unit type allocations outlined in the Neighbourhood Plan.

<sup>9</sup> Population estimates were already calculated in the Upper Gibsons Neighbourhood Plan. Total population for this Neighbourhood Plan area was added to the total in Table 3.

	Estimated New Units	ICI Estimates	Population Estimates	
OCP Designations	UPH High	Buildable Area (m <sup>2</sup> )	Equivalent Factors	Population
<b>Grand Total</b>	<b>2,976</b>	<b>280,429</b>		<b>8,611</b>

It is estimated that the 2,976 residential units and 280,429 m<sup>2</sup> of buildable ICI development would yield a **total population increase of 8,611** in the Town.

**In Stream Development Applications (On Vacant Land)**

Urban Systems applied the same equivalent factor, by land use, to the in stream development applications to estimate additional population. Table 5 below summarizes the additional estimated population resulting from in stream development applications on vacant land.

Proposed Land Use	Unit Counts / Buildable m <sup>2</sup>	Equivalent Factor	Population Estimate
Townhouse	20	3.3	66
Apartment	115	2.0	230
Hotel	111	1.5	167
Commercial	25,000m <sup>2</sup>	0.005	125
<b>TOTAL:</b>	<b>246</b>		<b>588</b>

It is estimated that the in stream development applications would yield an **additional population of increase of 588 residents.**

**1.5 SUMMARY**

It is estimated that a total of 3,222 anticipated units and 280,429m<sup>2</sup> of building ICI development would **yield a total population increase of 9,199 in the Town.**

Sincerely,

**URBAN SYSTEMS LTD.**

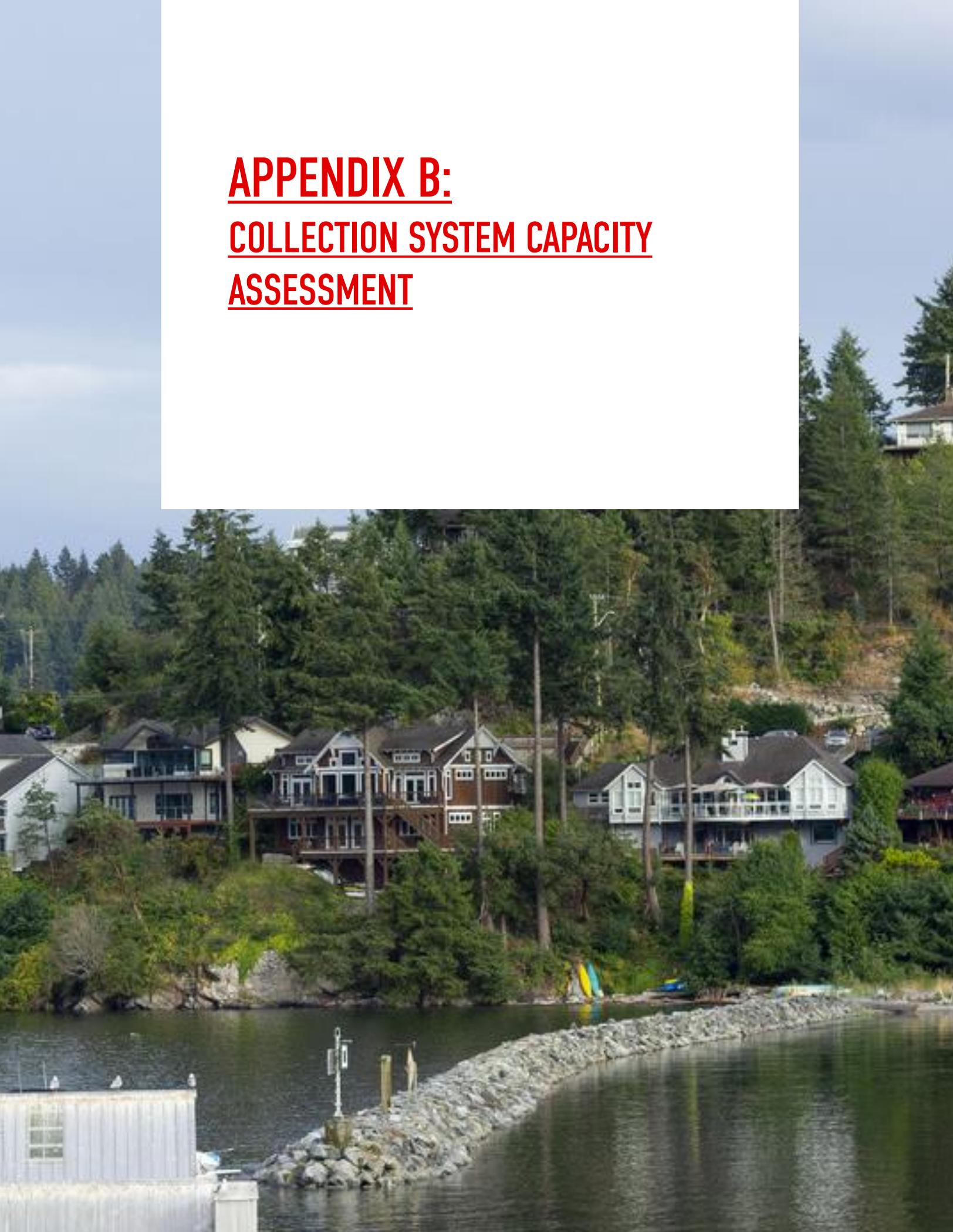


Samantha Lahey, RPP, MCIP  
 Community Planner

cc: Steve Brubacher, P.Eng, Urban Systems

<file://usl.urban-systems.com/projects/Projects.VAN/1300/0146/01/D-Design/GIS/Projects/Tables>

**APPENDIX B:**  
**COLLECTION SYSTEM CAPACITY**  
**ASSESSMENT**



# CAPACITY RISK METHODOLOGY

This memo outlines the proposed methodology for assessing and rating capacity risks for sewer pipes in the Gibsons Sewer Strategic Plan. The methodology is broken down into three parts: an assessment of the likelihood of failure, an assessment of the consequence of failure (including an environmental impact analysis), and a risk score. These capacity risk scores will be used in conjunction with condition risk scores (methodology outlined under separate cover) for developing the prioritized capital plan for the Town.

## Part 1 – Likelihood of Failure

The likelihood of failure will be assessed using the hydraulic capacity, hydraulic grade line (HGL) and flow velocity of the pipe under the scenario being reviewed. Table 1 defines how the criteria correlate to the likelihood of failure; Figure 1 illustrates the relationship between failure and HGL.

**Table 1 – Normal Operating Conditions Criteria**

Criteria	Score
<b>Hydraulic Capacity (q/Q*)</b>	
$q/Q < 0.97^{**}$	A
$0.97 \leq q/Q < 1.00$	B
$q/Q \geq 1.00$	C
<b>Hydraulic Grade Line (HGL)</b>	
$HGL \leq 0.8D^{***}$	A
$0.8D < HGL \leq 0.30$ m Above Crown	B
$0.30$ m Above Crown $< HGL \leq 0.60$ m Above Crown	C
$HGL > 0.60$ m Above Crown	D
<b>Velocity (v)</b>	
$v < 0.75$ m/s	Fail
$v \geq 0.75$ m/s	Pass

\*q/Q = peak flow / full pipe flow.

\*\*q/Q = 0.97 is the equivalent of d/D = 0.80

\*\*\*D = diameter

**Table 2 – Normal Operating Conditions Likelihood of Failure Scores**

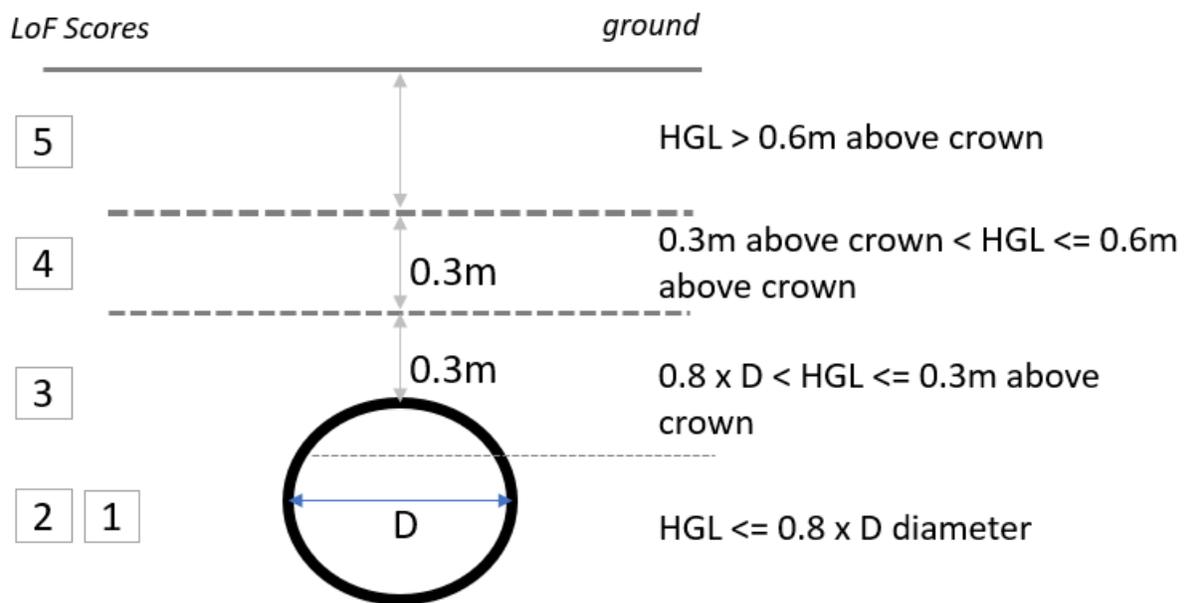
LoF Rating	Capacity	HGL	Velocity	Description
1	A	A	Pass	Gravity main performing as designed
2	A	A	Fail	Adequate capacity, low velocity indicates potential sedimentation
	A or B	B, C, or D	Pass or Fail*	Adequate capacity, backwater caused by downstream conditions**
3	C	B	Pass or Fail*	Capacity exceeded with limited or no surcharging
4	C	C	Pass or Fail*	Capacity exceeded and surcharging likely
5	C	D	Pass or Fail*	Capacity exceeded and flooding likely

\*LoF ratings from 3-5 are independent of velocity criteria.

\*\* Increased HGL caused by downstream lack of capacity and not a deficiency in the pipe being evaluated.

In general, ratings of '1', and '2' will not trigger an upgrade as there is capacity available in the gravity main to convey flows.

Only gravity mains receiving an LoF rating of '3', '4' and '5' are considered deficient and should be investigated for upgrade recommendations.



**Figure 1: Relationship for Capacity Risk & HGL**  
 (for pipes with no backwater caused by downstream pipes)

## Part 2 – Consequence of Failure

The consequence of failure for capacity-based risks is a function of the peak dry weather flow in the segment of pipe. Peak dry weather flows are used for the consequence of failure as they occur much more frequently than wet weather flows. Tables 3 correlates the consequence of failure to the peak dry weather flow. A distribution has been chosen to divide the system into categories to inform the prioritization process. The categories have been chosen such that under existing flows in the 2021 model scenario demonstrated the following distribution:

Consequence of Failure of 3 = 50% of the system

Consequence of Failure of 4 = 25% of the system

Consequence of Failure of 5 = 25% of the system

Figures 1-3 illustrate the pipes that fall into the following categories at the end of the Technical Memo.

**Table 3 – Consequence of Failure by Flows**

Peak Dry Weather Flow	Consequence Of Failure
$q \leq 0.246 \text{ L/s}$	3
$0.246 \text{ L/s} < q \leq 0.720 \text{ L/s}$	4
$q > 0.720 \text{ L/s}$	5

### Modified Consequence Score

Due to the environment or the nearby surroundings, some sewer mains present an increased level of consequence should they fail. For this study, we assume that pipes greater than 5m deep (presents elevated repair conditions), mains that are located within 2m of a structure, or pipes within a high-risk seismic zone present elevated consequence from failure. Environmental risks apply too, and can vary depending on proximity to the sensitive area. Adjacent to a sensitive watercourse is defined as *within the 30m of the ocean waterfront or riparian assessment area*.

Overall, in instances where sewer mains meet the criteria listed, the original score (consequence score from Part 2) for these pipes will be modified as presented in Table 4.

**Table 4 – Modified Consequence Score**

Original Score	Based on PDWF	1	2	3	4	5
Modified Score	<ul style="list-style-type: none"> <li>one or more of:                             <ul style="list-style-type: none"> <li>Crossing or adjacent to a sensitive watercourse or ocean (30m Buffer)</li> <li>within 2m proximity to a structure</li> <li>located in a high-risk seismic zone (where identified by the Town)</li> <li>at depth &gt;5m</li> </ul> </li> </ul>			4	5	5

\*Not applicable in this analysis since there are no Consequence of Failure scores of 1 or 2.

Many sewer trunk mains (large diameter with significant catchment areas) are located close to stream environments, given that sewer systems predominantly rely on gravity-based flows.

### Part 3 - Risk Score

The risk score combines the likelihood of asset failure and the consequence of failure into a single 1 to 5 rating. A risk score of 5 represents the highest risk and a score of 1 the least risk. Table 6 correlates the consequence and the likelihood of failure to the risk score using the input values that arise from all the tables outlined above.

**Table 6 – Risk Score**

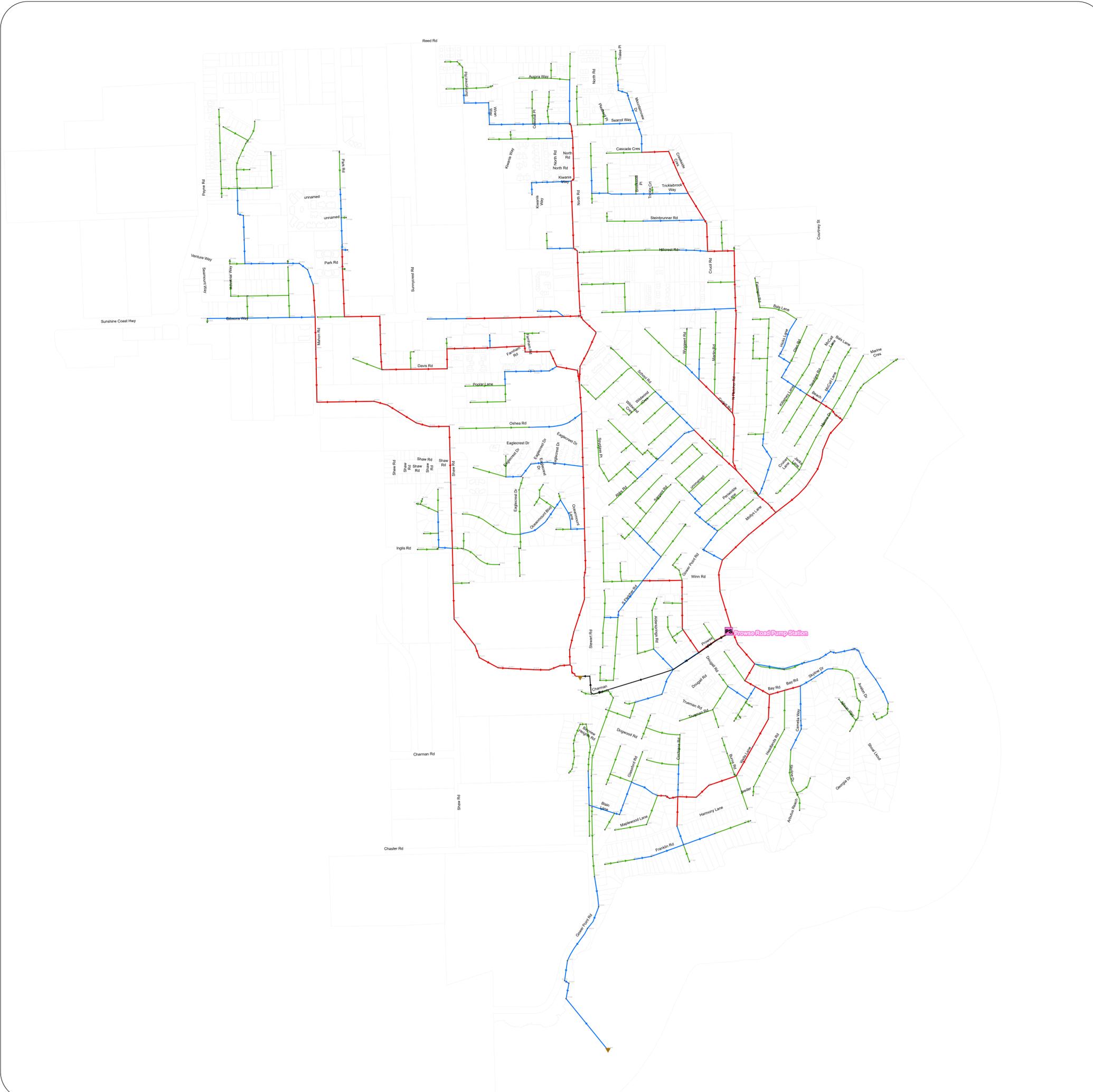
Consequence	5	2	3	4	5	5
	4	2	3	4	5	5
	3	2	2	3	4	4
	2	1*	2*	2*	3*	3*
	1	1*	1*	2*	2*	3*
		1	2	3	4	5
		Likelihood of Failure				

\*Not applicable in this analysis since there are no Consequence of Failure scores of 1 or 2.

It is important to recognize that an asset assessed as *moderate* or *low risk* may transition to having a higher risk over time simply due to the influx of development and new flows. Further, as more detailed flow data becomes available, the risk assessment could change. With this in mind, there must be emphasis on keeping the risk assessment current.

### Legend

- Parcel
  - Outfall
  - Forcemain
  - Pump Station
  - Manholes
- Gravity Main CoF Rating**
- CoF of 3 = 50% of system pipe length     \*q <= 0.246 L/s
  - CoF of 4 = 25% of system pipe length     \*0.246 L/s < q <= 0.720 L/s
  - CoF of 5 = 25% of system pipe length     \*q > 0.720 L/s

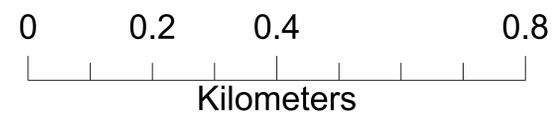


**2021 Scenario  
Consequence of Failure  
Gravity Main Results**



Project: **Town of Gibsons Wastewater Strategic Plan**  
 Project ID: **2022-046-GIB**  
 Client: **Town of Gibsons**  
 Date: **March 2023**  
 Created by: **SZ**  
 Reviewed by: **WdS**

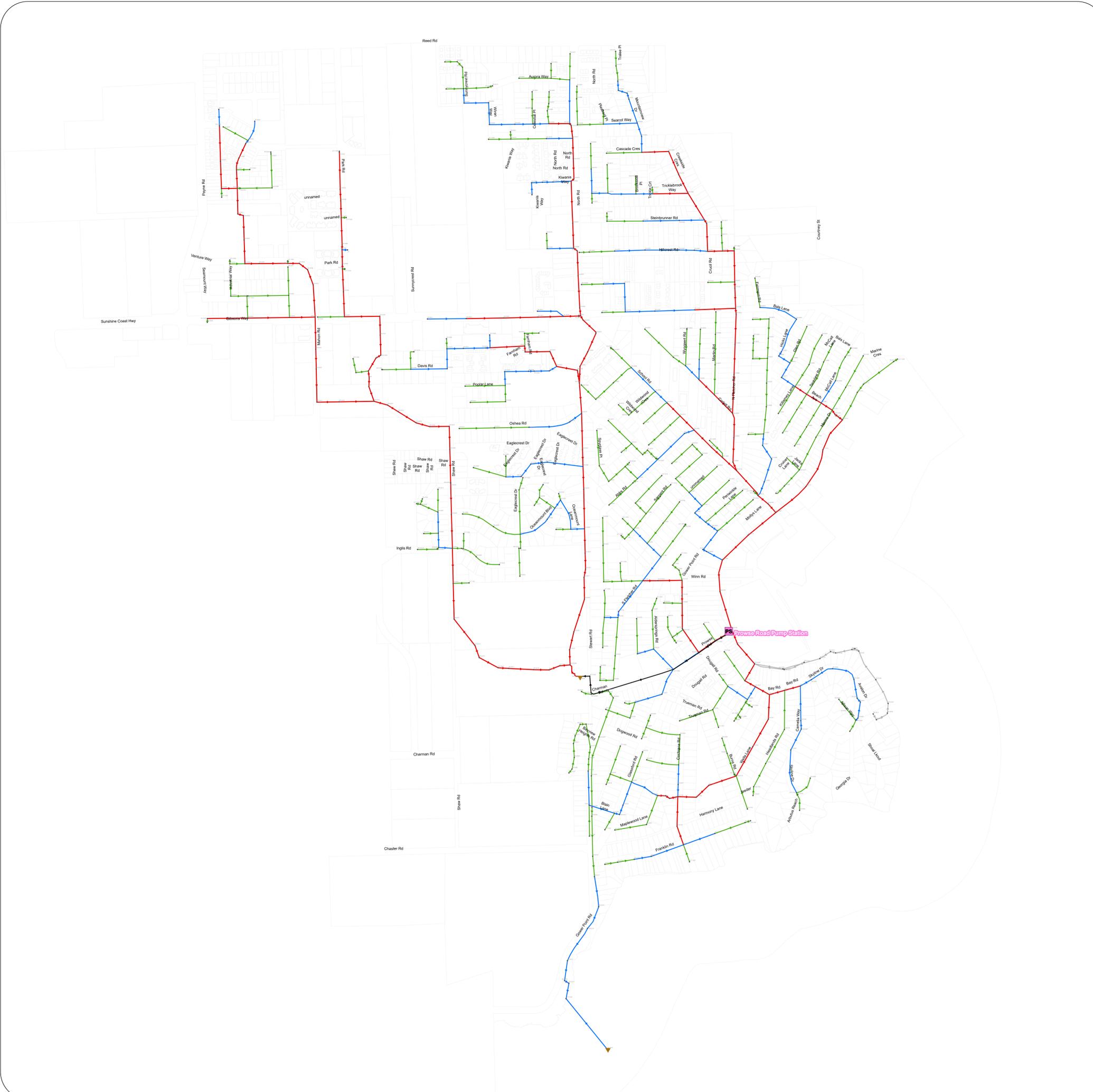
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**Figure B.1**

### Legend

- Parcel
  - Outfall
  - Forcemain
  - Pump Station
  - Manholes
- Gravity Main CoF Rating**
- CoF of 3 = 50% of system pipe length \*q <= 0.246 L/s
  - CoF of 4 = 25% of system pipe length \*0.246 L/s < q <= 0.720 L/s
  - CoF of 5 = 25% of system pipe length \*q > 0.720 L/s

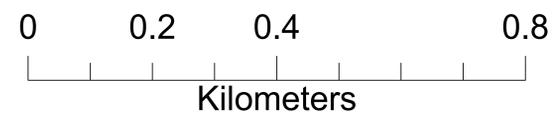


**OCP Scenario  
Consequence of Failure  
Gravity Main Results**



Project: **Town of Gibsons Wastewater Strategic Plan**  
 Project ID: **2022-046-GIB**  
 Client: **Town of Gibsons**  
 Date: **March 2023**  
 Created by: **SZ**  
 Reviewed by: **WdS**

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**Figure B.2**



# Sewer Model Update and Calibration Town of Gibsons, BC

## Technical Memorandum #1

**FINAL**

**Prepared for:**

Town of Gibsons, BC  
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**Submission Date: March 9, 2023**

**Contact:** Dr. Werner de Schaetzen, Ph.D., P.Eng.

**Project ID:** 2022-046-GIB

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## Document History and Version Control

Revision No.	Date	Document Description	Revised By	Reviewed By
R0	February 3, 2023	First Draft	Sean Zoschke	Werner de Schaetzen
R1	February 23, 2023	Updated Draft	Sean Zoschke	Werner de Schaetzen
R2	March 9, 2023	Final	Sean Zoschke	Werner de Schaetzen

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Project ID: 2022-046-GIB  
Permit to Practice #: 1000623

Page | 2





## 1 Introduction

GeoAdvice Engineering Inc. (GeoAdvice) and Urban Systems Ltd. (USL) were retained by the Town of Gibsons, BC (Town) to update the Town's sewer model and strategic plan. This technical memorandum summarizes the sewer model update, including the methodology and assumptions used to update and calibrate the Town's hydraulic sewer model.

In the preparation of this tech memo, GeoAdvice would like to acknowledge the support of the following Town Staff:

- Gracelyn Shannon
- Jackson Wright
- Paul Sheridan
- Rob Knowles
- Silvana Williams

The Town sewer system is shown in **Figure 1** on the following page.

### Legend

- Parcel
- Outfall
- Pump Station
- Forcemain
- Low Pressure Main
- Gravity Main**
  - 100 mm
  - 150 mm
  - 200 mm
  - 250 mm
  - 300 mm
  - 350 mm
  - 375 mm
  - 450 mm
  - 600 mm

Shaded parcels are currently being developed. There are no loads in the existing model scenario for these parcels (no water meter records), but there are growth loads in the future scenario that are allocated to the existing sewer network to the south.



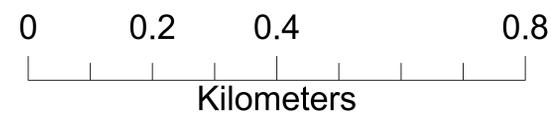
Shaded parcels are serviced by low pressure sewer pipes which are not modeled.

**Sanitary Sewer System**



Project: **Town of Gibsons Wastewater Strategic Plan**  
 Project ID: **2022-046-GIB**  
 Client: **Town of Gibsons**  
 Date: **February 2023**  
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**Figure 1**



## 2 Model Update

The hydraulic model update was divided into multiple tasks as follows:

- Task 1: Data Collection and Review
- Task 2: GIS Model Update
- Task 3: Data Gaps and Connectivity Analysis
- Task 4: Node Elevation Extraction
- Task 5: Primary System Components
- Task 6: Existing Base Sanitary Flow (BSF) Calculation and Allocation
- Task 7: Future Base Sanitary Flow (BSF) Calculation and Allocation
- Task 8: Field data review and analysis
- Task 9: Inflow & infiltration

### 2.1 Data Collection and Review

Prior to updating the model, information on the Town sewer system was compiled, collected and reviewed. This included reviewing the following pertinent information:

- Previous InfoSewer hydraulic model
- GIS database
- As-built drawings
- Pump station operations
- Land-use and zoning maps
- Record drawings
- Background reports
- Planning parcel data
- Growth projection data

### 2.2 GIS Model Build

The Town's previous InfoSewer model was not spatially consistent with the Town's GIS data and did not have matching ID's; as such, the pipe and node network topology were rebuilt. The Town's GIS data, as-built drawings, and previous InfoSewer model were the key sources of information on the Town system to update the pipe and node network topology model. Attributes of the sewer mains, such as nominal diameter, inlet and outlet invert elevations, material, age, were extracted from both the GIS database, as-built drawings and previous InfoSewer model. The coordinate system used in the model is UTM NAD 83 Zone 10.

### 2.3 Data Gaps and Connectivity Analysis

The next task involved reviewing the GIS sewer data, identifying data gaps (e.g. missing diameter) and checking system connectivity (e.g. orphan pipe). Refer to **Appendix A** for typical connectivity and data gap issues and solutions. As much as possible, a one-to-one relationship between the model and GIS data was maintained to facilitate future model updates.



## 2.4 Node Elevation Extraction

The provided contours shapefile was used to validate ground elevations in the model and to determine missing ground elevations.

## 2.5 Primary System Components

The Town operates and maintains one (1) pump station throughout the sanitary network.

The hydraulic modeling data for all the primary system components are summarized in a series of tables provided in **Appendix B**.

## 2.6 Existing Base Sanitary Flow Calculation and Allocation

The existing sewer base sanitary flow (BSF) was calculated based on water demands and water-sewer conversion rates determined during calibration. Several parcels are serviced by the water distribution system and are not serviced by the sanitary sewer system and were therefore excluded from the sewer load allocation.

**Table 2.1** summarizes the existing BSF loading.

**Table 2.1: Calibrated Existing BSF Load Summary**

Land Use	Average Water Consumption (L/s)	Conversion Rate (%)	Base Sanitary Flow (L/s)
Single-Family Residential	8.08	90%	7.27
Multi-Family Residential	3.26	80%	2.61
Industrial	3.66	50%	1.83
Institutional	0.46	50%	0.23
Commercial	1.25	50%	0.62
<b>Total</b>	<b>16.71</b>		<b>12.57</b>

Based on an estimated residential population of 4,968 (census 2021) and calibrated residential water-sewer conversion rates, the calibrated residential BSF rate is approximately 172 L/cap/day. This is within the normal range of BSF rates for municipalities in BC.



## 2.7 Future Growth Base Sanitary Flow Calculation and Allocation

Future growth was provided by USL in *Town of Gibsons – Build Out Estimates* (January 20, 2023). In addition, a shapefile showing the spatial distribution of the anticipated growth was provided. It is estimated that the actual and equivalent population will increase by 9,199 between now and full build-out. The growth area BSF was calculated based on the population increase of 9,199 and the calibrated residential BSF rate of 172 L/cap/day and allocated to the model.

The Town's existing and future growth sewer load allocation is shown on **Figure 2** on the following page.

Note that all flows from the future Gospel Rock Neighbourhood areas will be pumped from two future pump stations through the future Gospel Rock Forcemain, which will tie into the existing gravity system at Shaw Rd and Inglis Rd. Model loads from the Gospel Rock Neighbourhood areas are allocated to the gravity system at the forcemain tie-in location, as shown on the following page.

### Legend

- Parcel
- Growth Areas
- Existing Sewer Load Allocation Line
- Growth Sewer Load Allocation Line
- Outfall
- Pump Station
- Forcemain
- Gravity Main
- Low Pressure Main

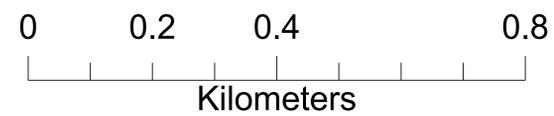
All flows from the future Gospel Rock Neighbourhood areas are allocated to the location that the future Gospel Rock Forcemain will tie-in to the existing gravity system at Shaw Rd and Inglis Rd.

**Town of Gibsons  
Sewer Load Allocation**



Project: **Town of Gibsons Wastewater Strategic Plan**  
 Project ID: **2022-046-GIB**  
 Client: **Town of Gibsons**  
 Date: **February 2023**  
 Created by: **SZ**  
 Reviewed by: **WdS**

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**Figure 2**



## 2.8 Field Data Review and Analysis

Data from all of the Town’s sewer data loggers was provided by the Town. The data was in 10-second intervals for the period between January 1, 2020 and July 1, 2022. The data was reviewed and it was determined that two (2) of the data logger sites were suitable for model calibration, which were the wastewater treatment plant gravity inflow (which is inflow from the gravity system on the west side of the Town) and the wastewater treatment plant total inflow (which includes gravity inflow from the west and pumped inflow from the Prowse Road Pump Station Forcemain from the east).

Note that the Town also provided daily 2021 flow data for the Prowse Road Pump Station, but this data was questionable so it was not used for model calibration. The Prowse Road average dry weather flow (ADWF) in the provided 2021 data is 4.4 L/s. This is 28% of the wastewater treatment plant (WWTP) total inflow ADWF of 15.7 L/s, but meter records show that 54% of water demands at sewer-serviced parcels in the WWTP catchment are in the Prowse Road catchment. In addition, the previous model calibration in 2008 summarized in *Wastewater Collection Strategic Plan Development* (KWL, 2008) used temporary flow monitor data at Prowse Road which had an ADWF of 7.8 L/s which is significantly higher than 4.4 L/s and is comparable to the Prowse Road ADWF of 8.9 L/s in the updated model. The increase in Prowse Road ADWF from 7.8 L/s to 8.9 L/s between the 2008 field data and the updated model aligns with the increase in WWTP ADWF from 14 L/s to 15.7 L/s, likely due to population growth. It is recommended that the Town re-calibrates the Prowse Road Pump Station flow monitor as it appears to be reading low.

July 13, 2021 was selected as the dry weather calibration day, and November 2-7, 2020 was selected as the wet weather calibration period. **Table 2.2** summarizes the average dry weather flow (ADWF) and peak wet weather flow (PWWF) of the flow monitors at the wastewater treatment plant (WWTP).

**Table 2.2: Flow Monitor Locations and Flow Summary**

Flow Monitor	Average Dry Weather Flow	Peak Wet Weather Flow
WWTP Total Inflow	15.7 L/s	44.6 L/s
WWTP Gravity Inflow	6.8 L/s	19.8 L/s

The Town noted that during the King Tides in the fall of 2022 a broken service was discovered and the manholes along the foreshore were submerged resulting in significant additional inflow being observed. The Town has since repaired the service connection and the manholes have been sealed and bolted.



## 2.9 Inflow & Infiltration Allocation

Inflow and Infiltration (I&I) represent additional loading on the sanitary sewer system during dry and wet weather. They are categorized into the following:

- Ground Water Infiltration (GWI)
- Rainfall Dependent Inflow and Infiltration (RDI&I)

It is worth noting that the Town has sewers that can be impacted by ocean levels which can impact both inflow and infiltration. These are more pronounced during King Tide events. At this time no specific allowance has been made for this as it assumed that the Town will work to ensure the sewers are isolated from these impacts through sealing of manholes and service connections that are at risk.

### 2.9.1 Ground Water Infiltration

Ground water infiltration loads were estimated for each flow monitoring catchment using the Stevens – Schultzbach Method. The Stevens – Schultzbach method uses a curve fitting technique to estimate ground water infiltration for a wide range of catchment sizes. This method is based on average dry weather flow (ADWF) and minimum nightly flow (MNF) experienced in typical residential flow patterns. The Stevens – Schultzbach equation is included below:

$$GWI = \frac{0.4 MNF}{1 - 0.6 \left( \frac{MNF}{ADWF} \right)^{ADWF^{0.7}}}$$

**Table 2.3** summarizes the GWI allocated to each sanitary catchment. Total GWI loads and GWI rates were calculated at the catchment level. GWI loads were then spatially distributed to each serviced parcel based on the respective area.

**Table 2.3: GWI Allocation per Flow Monitoring Catchment**

Flow Monitor	MNF (L/s)	ADWF (L/s)	GWI (L/s)	Catchment Area (ha)	GWI (L/ha/day)
WWTP Total Inflow	5.3	15.7	3.2	206	<b>1,400</b>
WWTP Gravity Inflow	2.1	6.8	1.5	104	<b>1,200</b>
Prowse Road Pump Station Inflow*	3.2	8.9	1.7	102	<b>1,500</b>

\*Based on the Prowse Road Pump Station inflow in the calibrated model and not based on field data. Daily field flow data was provided for the Prowse Road Pump Station but this data was questionable so it was not used.

The WWTP total inflow GWI rate of 1,400 L/ha/day was applied to the unmonitored areas.



## 2.9.2 Rainfall Dependent Inflow & Infiltration

The RTK method was used to quantify the rainfall dependent inflow & infiltration for the wet weather flow calibration. Refer to **Section 3.2** for further details regarding the RTK method.

Design storms derived from the *Town of Gibsons Subdivision and Development Servicing and Stormwater Management Bylaw* (February 5, 2013) and the calibrated RTK parameters were used to quantify the RDI&I in the Town’s network without climate change. Rainfall scaling factors of 1.17 for the 5-year rainfall and 1.24 for the 25-year rainfall provided by USL in 2017 based on climate models from 2006 were applied to the bylaw design storms to generate climate change design storms. The climate change design storms and the calibrated RTK parameters were used to quantify the RDI&I in the Town’s network with climate change. It is important to note that climate change predictions are a relatively new area of focus and it is recommended that the Town revisit these projections at the time of detailed design of upgrades as well as when the next master plan update is completed.

I&I rates under a 5-year and a 25-year design storm with and without climate change are summarized in **Table 2.4**. As with GWI, I&I rates were calculated at the catchment level and I&I loads were then spatially distributed to each serviced parcel based on the respective area.

**Table 2.4: I&I Allocation per Flow Monitoring Catchment (GWI + RDI&I)**

Flow Monitor	Catchment Area (ha)	Without Climate Change		With Climate Change	
		5-Year Peak I&I (L/ha/day)	25-Year Peak I&I (L/ha/day)	5-Year Peak I&I (L/ha/day)	25-Year Peak I&I (L/ha/day)
WWTP Total Inflow	206	10,700	12,700	12,300	15,400
WWTP Gravity Inflow	104	7,100	8,300	8,100	10,000
Prowse Road Pump Station Inflow*	102	14,700	17,400	16,900	21,300

\*Based on the Prowse Road Pump Station inflow in calibrated model and not based on field data. Daily field flow data was provided for the Prowse Road Pump Station but this data was questionable so it was not used.

The WWTP total inflow I&I rates were applied to the unmonitored areas.



### 3 Model Calibration

Before describing how the model was calibrated, it is useful to examine why a hydraulic model may not match the field data. Most of the sources of errors or mismatches are:

- Input data errors
- System loading errors
- Operational control errors
- Poorly calibrated measuring equipment
- Outdated data

The cumulative effect of these areas of uncertainty or “approximation” is that, without verification and validation of the model’s ability to recreate known conditions, it is likely that the modeling results would be grossly misleading.

The main reasons for and benefits of a well calibrated model are listed below:

- Confidence: Demonstrate the model’s ability to reproduce existing conditions.
- Understanding: Confirm the understanding of the performance of the system.
- Troubleshooting: Uncover missing information and misinformation or anomalies about the system.

#### 3.1 Dry Weather Flow Calibration Results

Modeling results were first reviewed, and then key model parameters were adjusted until the model results closely matched the dry weather flow field data. A summary of the calibration changes is shown in **Table 3.1**.

**Table 3.1: Calibration Adjustments**

Parameter	Description
BSF	Adjusted sanitary sewer loading rates (see <b>Table 2.1</b> )
GWl	Calculated GWl rates (see <b>Table 2.3</b> )
Pattern	Calibrated diurnal patterns from the previous InfoSewer model

**Table 3.2** summarizes the dry weather flow (DWF) calibration results.

**Table 3.2: Dry Weather Flow Calibration Results (July 13, 2021)**

Flow Monitor	Average Flow (L/s)			Peak Flow (L/s)		
	Field	Model	Difference	Field	Model	Difference
WWTP Total Inflow	15.7	15.5	- 0.3	37.7	36.1	- 1.6
WWTP Gravity Inflow	6.8	6.7	- 0.1	11.2	11.3	+ 0.1

The dry weather flow calibration hydrographs are shown in **Appendix C**.



Overall, the model predicts a good agreement with the dry weather field data. Modeled average dry weather flows are within 0.6 L/s and peak dry weather flows are within 1.6 L/s of the field data.

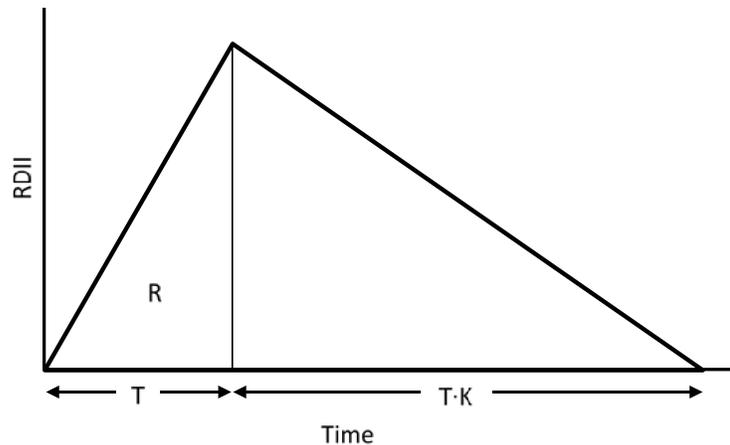
### 3.2 RTK Wet Weather Flow Calibration Results

The RTK method was used to quantify the rainfall dependent inflow & infiltration (RDI&I) for the wet weather flow calibration. With the RTK method, RDI&I is simulated using three triangular unit hydrographs representing fast, medium, and slow responses to rainfall. The shape of each triangle is quantified by three parameters:

- R: the fraction of effective rainfall volume over the watershed that enters the sewer system.
- T: the time to peak in hours.
- K: the ratio of the time to recession to the time to peak.

The relationship between the R, T, and K parameters is shown in **Figure 3.1**.

**Figure 3.1: RTK Method Parameters**



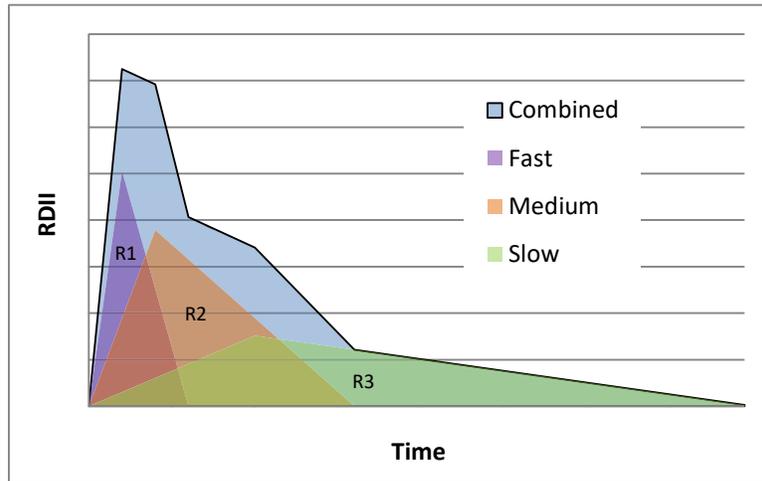
The sum of the three R-values (R1, R2, and R3) equals to the total fraction of rainfall volume over the watershed that enters the sewer system:

$$R = R1 \text{ (fast)} + R2 \text{ (medium)} + R3 \text{ (slow)}$$

The total RDI&I represents the sum of the three components, as shown in **Figure 3.2**.



**Figure 3.2: RTK Method for Representing RDI&I**



The wet weather flow calibration results are summarized in **Table 3.3**. Wet weather flow hydrographs comparing the model and field results can be found in **Appendix D**. The calibrated RTK parameters for each of the flow monitoring catchments can be found in **Appendix E**.

**Table 3.3: RTK Wet Weather Flow Calibration Results Summary (November 2-7, 2020)**

Flow Monitor	Average Flow (L/s)			Peak Flow (L/s)		
	Field	Model	Difference	Field	Model	Difference
WWTP Total Inflow	23.3	23.4	+ 0.1	44.6	46.3	+ 1.7
WWTP Gravity Inflow	8.1	8.4	+ 0.3	19.8	18.7	- 1.1

Overall, the model predicts a good agreement with the wet weather field data.



## 4 Conclusions

GeoAdvice Engineering Inc. and Urban Systems Ltd. (USL) were retained by the Town of Gibsons, BC (Town) to update the Town's sewer model and strategic plan. The first step to updating the sewer master plan was to update the Town's sewer model.

The following is a list of key conclusions drawn while performing the sewer model update:

- GIS data, as-built drawings and the previous InfoSewer model were the key sources of information on the sewer system to update the model.
- The sewer model includes the following elements:
  - 604 junctions
  - 603 pipes
  - 2 outfalls
  - 1 wet well
  - 1 pump station
- Existing sewer load was determined based on water meter records and sewer flow monitoring data. The Town's calibrated 2021 BSF load is 12.6 L/s, and the estimated residential BSF rate is 172 L/cap/day.
- The model was calibrated against two (2) flow monitoring locations.
- Overall the model predicts a good correlation with the observed dry weather and wet weather field data.

Overall, the model is up-to-date and good agreements were achieved between the model results and observed field data. As such, the model can be used as a reliable planning tool for sanitary sewer system modeling studies moving forward, including development of the Town's Sanitary Sewer Strategic Plan.

Lastly, it is recommended that the Town re-calibrates the Prowse Road Pump Station flow monitor as it appears to be reading low based on the provided daily 2021 data.



## Submission

Prepared by:

A handwritten signature in black ink, reading "Sean Zoschke". The signature is fluid and cursive, with the first letters of the first and last names being capitalized and prominent.

---

Sean Zoschke, E.I.T.  
Hydraulic Modeler

**Reviewed and Approved by:** Original Signed, Sealed and Certified  
by W. de Schaetzen

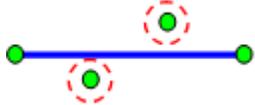
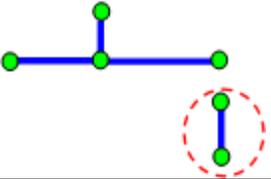
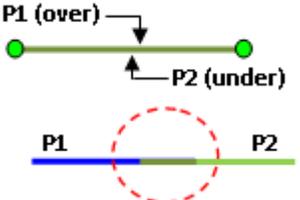
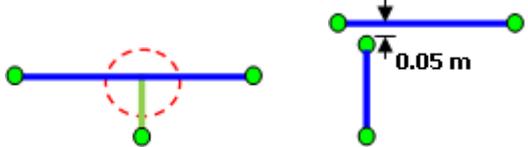
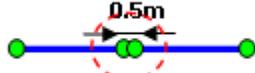
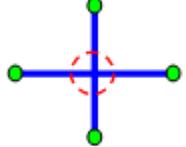
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Werner de Schaetzen, Ph.D., P.Eng.  
Project Manager

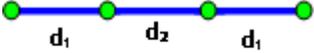


## Appendix A Data Gaps and Connectivity Fixes

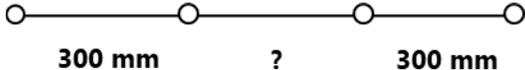
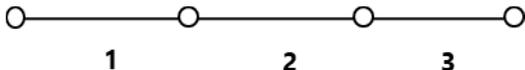
Table A.1: Connectivity Issue Fixes

Connectivity Issue Type	Solution
<p>Disconnected (Orphan) Nodes</p> 	<p>Checked for proper connectivity in GIS. No orphan nodes in GIS. Deleted orphan nodes.</p>
<p>Disconnected (Orphan) Links</p> 	<p>Checked for proper connectivity in GIS. No orphan links in GIS. Deleted orphan links.</p>
<p>Overlapping Links</p> 	<p>Checked for proper connectivity in GIS. No overlapping links in GIS. Deleted links in model not in GIS.</p>
<p>Parallel Links</p> 	<p>Checked GIS for proper connectivity. Deleted links in model not in GIS.</p>
<p>Link Split Candidates</p> 	<p>Fixed connectivity based on GIS.</p>
<p>Nodes in Close Proximity</p> 	<p>Fixed connectivity based on GIS.</p>
<p>Crossing Links, Not Connected</p> 	<p>Fixed connectivity based on GIS.</p>
<p>Self-Overlap Links</p> 	<p>Checked GIS for proper connectivity. Redrew links.</p>
<p>Self-Intersect Links</p> 	<p>Checked GIS for proper connectivity.</p>



Connectivity Issue Type	Solution
	Redrew links.
<p data-bbox="203 403 571 432">Link Diameter Discrepancies</p>  <p data-bbox="412 506 618 535"><math> d_2 - d_1  \geq 150 \text{ mm}</math></p>	Checked GIS for correct diameter.

**Table A.2: Data Gap Issue Fixes**

Data Gap Issue Type	Solution
<p data-bbox="203 686 651 716">Missing Pipe Diameter or Material</p>	<p data-bbox="824 686 1398 758"><b>Rule 1:</b> Identical upstream and downstream pipe diameter then use same diameter;</p>  <p data-bbox="842 890 1398 919">Diameter: 1 = 3, 2 unknown, then 1 = 2 = 3</p>  <p data-bbox="824 1058 1398 1129">The missing pipe diameter would be inferred as 300 mm.</p> <p data-bbox="824 1178 1398 1325"><b>Rule 2:</b> Different diameter but same upstream and/or downstream material then use the same diameter as the pipe matching material;</p>  <p data-bbox="967 1457 1273 1486">Material: 2 = 1, or 2 = 3</p> <p data-bbox="867 1499 1370 1528">Diameter: 2 = 1, or 2 = 3 (Respectively)</p>  <p data-bbox="911 1667 1354 1696">The missing pipe diameter would be inferred as 450 mm.</p>



# Hydraulic Modeling Capacity Analysis Town of Gibsons, BC

## Technical Memorandum #2

**FINAL**

**Prepared for:**

Town of Gibsons, BC  
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And

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**Submission Date: March 9, 2023**

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**Project ID:** 2022-046-GIB

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Project ID: 2022-046-GIB  
EGBC Permit to Practice: 1000623

Page | 1





## Document History and Version Control

Revision No.	Date	Document Description	Revised By	Reviewed By
R0	February 2, 2023	First Draft	Sean Zoschke	Werner de Schaetzen
R1	February 23, 2023	Updated Draft	Sean Zoschke	Werner de Schaetzen
R2	March 9, 2023	Final	Sean Zoschke	Werner de Schaetzen

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Project ID: 2022-046-GIB  
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Page | 2



## 1 Introduction

GeoAdvice Engineering Inc. (GeoAdvice) and Urban Systems Ltd. (USL) were retained by the Town of Gibsons, BC (Town) to assess the hydraulic performance of the Town's sanitary sewer collection system. This technical memorandum describes the assumptions and results of the hydraulic modeling and capacity analysis using InfoSewer software program (Innovyze Software). InfoSewer is a sewer collection system modeling and management software application of Innovyze Inc.

**Table 1.1** summarizes the main components of the Gibsons sanitary sewer system. Most of the flows in the sewer system are conveyed to the Gibsons Wastewater Treatment Plant at Stewart Rd and Charman Rd. A small portion of the system flows are conveyed to an outfall at the ocean beside Grower Point Rd. Therefore, there are two (2) modeled outfalls.

**Table 1.1: Model Statistics**

Component	Total
Manholes	604
Wet wells and pump stations	1
Total force main length	0.6 km
Total gravity main length	36.6 km
Outfalls	2
Existing sewer service area	208 ha

In the preparation of this memo, GeoAdvice would like to acknowledge the support of the following Town Staff:

- Gracelyn Shannon
- Jackson Wright
- Paul Sheridan
- Rob Knowles
- Silvana Williams



## 2 Sanitary Sewer Capacity Assessment

The objectives of the system capacity assessment were to review the existing system performance under existing and future OCP flows, and to make recommendations on system upgrades sized for the future OCP flows. The scenarios analyzed are summarized in the table below.

**Table 2.1: Modeling Scenario Summary**

Scenario	2021-PWWF-5	OCP-PWWF-5	OCP-PWWF-25
<b>I&amp;I Design Storm</b>	5yr, 24 Hour	5yr, 24 Hour	25yr, 24 Hour
<b>Per-Capita Water Use</b>	Meter Data	Meter Data + 172 L/cap/day for growth	Meter Data + 172 L/cap/day for growth
<b>Climate Change Considered?</b>	No	Yes	Yes
<b>Scenario Use</b>	Identify existing system deficiencies	Identify future system deficiencies and timing of upgrades	Size system improvements
<b>Simulation Type</b>	Extended Period Simulation	Extended Period Simulation	Steady State
<b>Serviced Area</b>	208 ha	295 ha	295 ha
<b>Population*</b>	6,318	15,512	15,512
<b>BSF</b>	13 L/s	31 L/s	31 L/s
<b>I&amp;I**</b>	26 L/s	39 L/s	48 L/s
<b>PWWF***</b>	94 L/s	134 L/s	161 L/s

\*Includes residential population and ICI equivalent population.

\*\*I&I composed of monitored I&I and future I&I areas.

\*\*\*Sum of the peak flows at the two model outfalls.



## 2.1 Gravity Main Capacity Analysis

### 2.1.1 Gravity Main Likelihood of Failure Criteria

Based on the Urban System Ltd. (USL) memo *Capacity Risk Methodology* (July 2022), the following performance criteria were used for assigning likelihood of failure (LoF) scores to each gravity main.

**Table 2.2: Gravity Main Hydraulic Level of Service Criteria Scoring**

Criteria	Score
<b>Hydraulic Capacity (q/Q*)</b>	
$q/Q < 0.97^{**}$	A
$0.97 \leq q/Q < 1.00$	B
$q/Q \geq 1.00$	C
<b>Hydraulic Grade Line (HGL)</b>	
$HGL \leq 0.8D^{***}$	A
$0.8D < HGL \leq 0.30 \text{ m Above Crown}$	B
$0.30 \text{ m Above Crown} < HGL \leq 0.60 \text{ m Above Crown}$	C
$HGL > 0.60 \text{ m Above Crown}$	D
<b>Velocity (v)</b>	
$v < 0.75 \text{ m/s}$	Fail
$v \geq 0.75 \text{ m/s}$	Pass

\*q/Q = peak flow / full pipe flow.

\*\*q/Q = 0.97 is the equivalent of d/D = 0.80

\*\*\*D = diameter

**Table 2.3: Gravity Main Hydraulic Level of Service Ratings**

LoF Rating	Capacity	HGL	Velocity	Description
1	A	A	Pass	Gravity main performing as designed
2	A	A	Fail	Adequate capacity, low velocity indicates potential sedimentation
	A or B	B, C, or D	Pass or Fail*	Adequate capacity, backwater caused by downstream conditions**
3	C	B	Pass or Fail*	Capacity exceeded with limited or no surcharging
4	C	C	Pass or Fail*	Capacity exceeded and surcharging likely
5	C	D	Pass or Fail*	Capacity exceeded and flooding likely

\*LoF ratings from 3-5 are independent of velocity criteria.

\*\*Increased HGL caused by downstream lack of capacity and not a deficiency in the pipe being evaluated.



In general, LoF ratings of ‘1’, and ‘2’ will not trigger an upgrade as there is capacity available in the gravity main to convey flows.

Only gravity mains receiving an LoF rating of ‘3’, ‘4’ and ‘5’ are considered deficient and proposed gravity main upgrades were identified to eliminate these deficiencies. Prioritization of these upgrades will be considered as part of the master plan.

### 2.1.2 Gravity Main Likelihood of Failure Results

**Table 2.4** summarizes the existing and future gravity main LoF results under each scenario.

**Table 2.4: Gravity Main LoF Results (Number of Pipes)**

LoF Rating	2021-PWWF-5		OCP-PWWF-5	
	# of Pipes	Length (m)	# of Pipes	Length (m)
1	178	10,530	205	12,215
2	415	25,956	378	23,508
<b>3</b>	<b>1</b>	<b>78</b>	<b>2</b>	<b>176</b>
<b>4</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>5</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>

The capacity analysis results show that there is one (1) gravity main deficiency (LoF = ‘3’, ‘4’ or ‘5’) in the existing 2021 scenario, and there are two (2) gravity main deficiencies under the future OCP scenario.

The existing deficiency is a pipe on Gibsons Way that is marginally deficient under the existing and future scenarios. It is a flat pipe with steep pipes directly upstream and downstream, and the pipe HGL under existing and future conditions is at the pipe crown which is 1.5 m below grade. This deficiency is non-critical, and therefore upgrades are not recommended to address it. The one (1) remaining future deficiency is located on the Shoreline Trunk Sewer along the waterfront between School Road and Prowse Road and is addressed by Project 2 (discussed in **Section 3**).

Note that Project 1 is a planned upgrade that was included in the future analysis scenario that alleviates future deficiencies on Davis Road. The model was initially run without this upgrade included, and there were future deficiencies on Davis Road.

Lastly, the Town is considering abandoning the Foreshore Sewer that is located along the waterfront between Avalon Drive and Labonte Park, and connecting all properties it services to the gravity main on Skyline Drive. The properties that would be re-connected would require pumped service connections. This change was included in the future analysis scenario and the model shows that the Skyline Drive gravity main will have capacity for the additional loads.



The gravity main LoF capacity results are shown on **Figure 2.1** and **Figure 2.2**. Detailed gravity main results can be found in **Appendix A**. Gravity main consequence of failure maps corresponding to the USL memo *Capacity Risk Methodology* (July 2022) can be found in **Appendix B**.

## 2.2 Pump Station Capacity Analysis

A pump station's capacity is considered deficient when the peak inflow exceeds the station's firm capacity. The Prowse Road Pump Station firm capacity was determined with one of the two identical pumps out of service. In addition, it is recommended that the forcemain velocity is between 1.0 m/s and 3.5 m/s. **Table 2.5** summarizes the pump station capacity analysis results under the 2021-PWWF-5 and OCP-PWWF-5 scenarios.

**Table 2.5: Prowse Road Pump Station Capacity Results**

Pump Station	Scenario	Firm Capacity (L/s)	PWWF (L/s)	Reserve Capacity (L/s)	Forcemain Diameter (mm)	Forcemain Velocity (m/s)*
Prowse Road	2021-PWWF-5	75.0	31.3	+ 43.7	250	1.5
Prowse Road	OCP-PWWF-5	75.0	38.5	+ 36.5	250	1.5

\*Forcemain velocity calculated based on firm capacity and forcemain diameter.

As shown in the table above, the Prowse Road Pump Station has sufficient capacity under the existing and future OCP scenarios. In addition, the forcemain velocity is within the recommended range.

### Legend

- Parcel
- Outfall
- Forcemain
- Pump Station
- Manholes
- 0.7D < HGL ≤ 0.30 m Above Crown
- 0.30 m Above Crown < HGL ≤ 0.60 m Above Crown
- HGL ≥ 0.60 m Above Crown (No Flooding)
- HGL = Rim Elevation (Flooding)

#### Gravity Main LoF Rating

- 1 Gravity main performing as designed
- 2 Adequate capacity, low velocity indicates potential sedimentation OR Adequate capacity, backwater caused by downstream conditions
- 3 Capacity exceeded with limited or no surcharging
- 4 Capacity exceeded and surcharging likely
- 5 Capacity exceeded and overflow likely

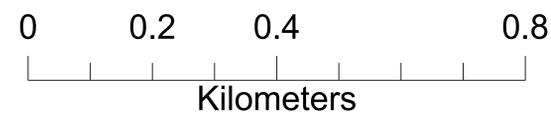


**2021 Peak Weather Flow  
5-yr 24-hr I&I  
Likelihood of Failure  
Gravity Main Results**



Project: **Town of Gibsons Wastewater Strategic Plan**  
 Project ID: **2022-046-GIB**  
 Client: **Town of Gibsons**  
 Date: **March 2023**  
 Created by: **SZ**  
 Reviewed by: **WdS**

DISCLAIMER: GeoAdvice does not warrant in any way the accuracy and completeness of the information shown on this map. Field verification of the accuracy and completeness of the information shown on this map is the sole responsibility of the user.



**Figure 2.1**

### Legend

- Parcel
- Outfall
- Forcemain
- Pump Station
- Manhole
- 0.7D < HGL ≤ 0.30 m Above Crown
- 0.30 m Above Crown < HGL ≤ 0.60 m Above Crown
- HGL ≥ 0.60 m Above Crown (No Flooding)
- HGL = Rim Elevation (Flooding)

- Gravity Main LoF Rating**
- 1 Gravity main performing as designed
  - 2 Adequate capacity, low velocity indicates potential sedimentation OR Adequate capacity, backwater caused by downstream conditions
  - 3 Capacity exceeded with limited or no surcharging
  - 4 Capacity exceeded and surcharging likely
  - 5 Capacity exceeded and overflow likely

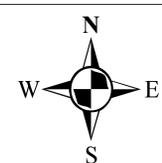
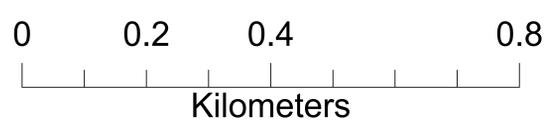


**OCP Peak Weather Flow  
5-yr 24-hr I&I  
Likelihood of Failure  
Gravity Main Results**



Project: **Town of Gibsons Wastewater Strategic Plan**  
 Project ID: **2022-046-GIB**  
 Client: **Town of Gibsons**  
 Date: **March 2023**  
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**Figure 2.2**



### 3 System Improvement Recommendations

This section summarizes the required infrastructure improvements to alleviate the identified hydraulic capacity deficiencies. Gravity mains with a LoF rating of either '3', '4', or '5' were considered "deficient" and proposed upgrades were considered to eliminate these deficiencies.

The following design criteria were used for sizing new gravity mains.

**Table 3.1: Design Criteria**

Facility	Criterion	Parameter Value
Gravity Main*	Design Flow/Sizing Scenario	OCP-PWWF-25
	Max. depth/Diameter ratio	$d/D < 0.7$
	Min. Velocity	$v \geq 0.75$ m/s
	Min. Diameter	D = 200 mm
	Manning Roughness Coefficient	n = 0.013

d= flow depth, D = Diameter, n = Manning coefficient, v = velocity

\*Same slope as existing pipe was assumed.

The recommended upgrades are as follows:

- Project 1: Install 158 m of 200 mm pipe and 82 m of 150 mm pipe in White Tower Park to divert flows away from Davis Road to alleviate future deficiencies on Davis Road. This upgrade is triggered by large portions of the future Upper Gibsons Neighbourhood Plan Area that will likely be serviced by the pipes on Park Road. This is a planned upgrade that was added to the future model scenario based on provided drawings. It should be completed before the developments that will be serviced by the pipes on Park Road are built.
- Project 2: Upgrade two existing 350 mm gravity mains directly north of the Prowse Road Pump Station to 450 mm (length = 216 m). This upgrade is triggered by anticipated developments in the north portion of the Prowse Road Pump Station catchment and should be completed as these developments begin to be built.

The system improvements are summarized in **Table 3.2** and shown in **Figure 3.1**. Detailed gravity main upgrades are provided in **Appendix C**.

**Table 3.2: Proposed Gravity Main Improvements Summary**

Project	Diameter	Capacity Deficiency Quantity	Diameter Continuity Quantity
1	150 mm	81 m	0 m
1	200 mm	158 m	0 m
2	450 mm	97 m	119 m

### Legend

- Parcel
  - Gravity Main
  - Forcemain
  - Manhole
  - Pump Station
  - Outfall
  - Diameter Continuity Upgrade
- Gravity Main Upgrade Diameter**
- 150
  - 200
  - 450

Project 1: Install 158 m of 200 mm pipe and 82 m of 150 mm pipe to divert flows away from Davis Road and to alleviate anticipated future Davis Road deficiencies. This is a planned upgrade and was included in the OCP model scenario based on provided drawings.

Project 2: Upsize 216 m of 350 mm to 450 mm.

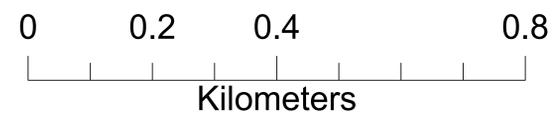
The Town is considering abandoning the Foreshore Sewer and connecting all properties it services to the gravity main on Skyline Drive. This change was included in the OCP model scenario and the model shows that the Skyline Drive gravity main has capacity for the additional loads.

### System Improvement Recommendations



Project: **Town of Gibsons Wastewater Strategic Plan**  
 Project ID: **2022-046-GIB**  
 Client: **Town of Gibsons**  
 Date: **March 2023**  
 Created by: **SZ**  
 Reviewed by: **WdS**

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**Figure 3.1**



## 4 Summary

Key conclusions drawn while performing the Town of Gibsons sanitary sewer capacity analysis and system improvement recommendations:

- The 2021-PWWF-5 and OCP-PWWF-5 scenarios were used to determine existing and future infrastructure deficiencies. The OCP-PWWF-25 scenario was used to determine sizes and capacities for system improvement recommendations.
- The capacity analysis results show that there is one (1) gravity main deficiency (LoF = '3', '4' or '5') in the existing 2021 scenario, and there are two (2) gravity main deficiencies under the future OCP scenario. The existing deficiency is non-critical, and the remaining one (1) future deficiency is addressed by Project 2. Project 1 is a planned upgrade that will alleviate anticipated future deficiencies on Davis Road.
- The following table summarizes the recommended gravity main upgrades; however, upgrades to be included as part of the capital plan are to be assessed as part of the risk prioritization:

**Table 4.1: Proposed Gravity Main Upgrades**

Project	Diameter	Capacity Deficiency Quantity	Diameter Continuity Quantity
1	150 mm	81 m	0 m
1	200 mm	158 m	0 m
2	450 mm	97 m	119 m

- The Prowse Road Pump Station has sufficient capacity under the existing and future OCP scenarios.

## 5 Recommendations

It is recommended that the Town verify the input data for the infrastructure recommended for upgrade (i.e. gravity main diameters and inverts). The Town should confirm the Prowse Road Pump Station firm capacity presented in this memo by completing drawn down tests.



## Submission

Prepared by:

---

Sean Zoschke, E.I.T.  
Hydraulic Modeler

Reviewed and Approved by:

Original signed, sealed and certified  
by W. de Schaetzen.

---

Werner de Schaetzen, Ph.D., P.Eng.  
Project Manager



## **Appendix A      Detailed Gravity Main and Manhole Results**

Pipe Modeling Results

Pipe ID	Install Year	Length (m)	Diameter (mm)	Material	Slope (/)	Full Flow Capacity (L/s)	2021 PWWF 5-Year 24-Hour I&I					OCP PWWF 5-Year 24-Hour I&I w/ Climate Change				
							Flow (L/s)	d/D	q/Q	Flow Remaining to d/D = 1 (L/s)	LoF	Flow (L/s)	d/D	q/Q	Flow Remaining to d/D = 1 (L/s)	LoF
SP-0001	Unknown	44.9	150	Unknown	0.110	50.6	2.4	0.15	0.05	48.2	1	2.6	0.15	0.05	48.0	1
SP-0005	Unknown	104.3	150	CONC	0.043	31.7	2.0	0.17	0.06	29.6	2	2.2	0.18	0.07	29.5	2
<b>SP-0006</b>	<b>Unknown</b>	<b>78.3</b>	<b>150</b>	<b>CONC</b>	<b>0.000</b>	<b>1.7</b>	<b>2.0</b>	<b>1.00</b>	<b>1.17</b>	<b>-0.3</b>	<b>3</b>	<b>2.2</b>	<b>1.00</b>	<b>1.26</b>	<b>-0.5</b>	<b>3</b>
SP-0007	Unknown	57.3	300	PVC	0.086	283.3	5.4	0.10	0.02	277.9	1	6.1	0.10	0.02	277.2	1
SP-0008	Unknown	78.5	200	PVC	0.055	76.8	0.1	0.03	0.00	76.7	2	0.1	0.03	0.00	76.6	2
SP-0009	Unknown	103.1	200	PVC	0.079	92.5	0.5	0.05	0.01	92.0	1	0.9	0.07	0.01	91.6	1
SP-0011	Unknown	49.6	200	PVC	0.109	108.2	0.7	0.06	0.01	107.5	1	1.1	0.07	0.01	107.1	1
SP-0012	Unknown	55.5	200	PVC	0.142	123.4	0.9	0.06	0.01	122.5	1	1.3	0.07	0.01	122.1	1
SP-0013	Unknown	60.5	200	PVC	0.134	119.9	1.2	0.07	0.01	118.7	1	1.7	0.08	0.01	118.2	1
SP-0014	Unknown	74.8	200	PVC	0.172	136.0	2.0	0.09	0.02	133.9	1	2.6	0.10	0.02	133.4	1
SP-0015	Unknown	67.7	150	AC	0.137	56.4	0.1	0.03	0.00	56.3	2	0.2	0.05	0.00	56.2	1
SP-0016	Unknown	45.0	200	PVC	0.239	160.4	2.0	0.08	0.01	158.4	1	2.6	0.09	0.02	157.8	1
SP-0017	Unknown	89.4	200	PVC	0.174	136.8	11.8	0.20	0.09	125.0	1	14.3	0.22	0.10	122.5	1
SP-0018	Unknown	10.4	200	AC	0.139	122.3	11.8	0.21	0.10	110.5	1	14.3	0.23	0.12	108.0	1
SP-0019	Unknown	40.1	200	AC	0.133	119.6	12.7	0.22	0.11	106.9	1	16.0	0.25	0.13	103.7	1
SP-0020	Unknown	34.8	200	AC	0.313	183.4	12.7	0.18	0.07	170.7	1	16.0	0.20	0.09	167.5	1
SP-0021	Unknown	18.6	150	AC	0.133	55.6	0.0	0.01	0.00	55.5	2	0.0	0.01	0.00	55.5	2
SP-0022	Unknown	8.8	150	Unknown	0.090	45.8	0.0	0.00	0.00	45.8	2	0.0	0.00	0.00	45.8	2
SP-0023	1971	60.4	150	AC	0.013	17.1	3.1	0.29	0.18	13.9	2	0.7	0.14	0.04	16.4	2
SP-0024	1971	118.3	200	AC	0.006	25.9	1.0	0.13	0.04	24.9	2	1.1	0.14	0.04	24.9	2
SP-0025	1971	114.2	200	AC	0.011	34.7	1.7	0.15	0.05	33.0	2	1.9	0.16	0.05	32.9	2
SP-0027	1971	11.6	200	AC	0.005	23.4	3.5	0.26	0.15	19.9	2	1.1	0.15	0.05	22.4	2
SP-0027_2	Unknown	105.9	200	AC	0.005	23.4	4.3	0.29	0.19	19.1	2	2.3	0.21	0.10	21.2	2
SP-0028	1971	18.0	200	AC	0.004	20.5	4.4	0.32	0.22	16.0	2	2.3	0.23	0.11	18.1	2
SP-0029	1971	75.8	200	AC	0.022	48.3	4.8	0.21	0.10	43.4	1	2.8	0.16	0.06	45.4	1
SP-0030	1971	49.6	200	AC	0.129	117.7	4.8	0.14	0.04	112.9	1	2.8	0.11	0.02	114.9	1
SP-0031	1971	64.0	200	AC	0.033	59.4	5.7	0.21	0.10	53.7	1	3.7	0.17	0.06	55.7	1
SP-0032	1971	39.3	200	AC	0.082	94.0	5.7	0.17	0.06	88.4	1	3.7	0.14	0.04	90.4	1
SP-0033	1971	38.7	100	AC	0.008	4.5	0.9	0.29	0.19	3.7	2	1.2	0.34	0.25	3.4	2
SP-0034	1971	38.3	150	AC	0.010	15.2	0.1	0.04	0.00	15.2	2	0.1	0.05	0.01	15.1	2
SP-0035	1971	43.7	150	AC	0.010	15.2	0.0	0.04	0.00	15.2	2	0.1	0.04	0.00	15.2	2
SP-0037	1971	61.9	200	AC	0.068	85.6	0.0	0.01	0.00	85.6	2	0.0	0.01	0.00	85.6	2
SP-0038	1971	73.4	200	AC	0.020	45.9	0.2	0.04	0.00	45.8	2	0.2	0.05	0.01	45.7	2
SP-0039	1971	71.8	200	AC	0.017	42.8	0.3	0.06	0.01	42.5	2	0.3	0.06	0.01	42.4	2
SP-0040	1971	98.9	200	AC	0.011	34.3	0.1	0.04	0.00	34.2	2	0.1	0.05	0.00	34.1	2
SP-0041	1971	18.5	200	AC	0.005	24.1	0.1	0.05	0.01	24.0	2	0.1	0.05	0.01	23.9	2
SP-0042	1971	87.2	200	AC	0.007	28.1	0.6	0.10	0.02	27.5	2	0.6	0.10	0.02	27.5	2
SP-0043	1971	110.4	200	AC	0.018	44.6	0.9	0.10	0.02	43.7	2	0.9	0.10	0.02	43.7	2
SP-0044	1971	31.7	200	AC	0.067	85.0	0.9	0.07	0.01	84.2	1	0.9	0.07	0.01	84.1	1
SP-0045	1971	110.1	200	AC	0.041	66.3	0.1	0.03	0.00	66.2	2	0.1	0.04	0.00	66.2	2
SP-0046	1971	58.3	200	AC	0.114	111.0	0.8	0.06	0.01	110.2	1	0.9	0.06	0.01	110.1	1

Pipe ID	Install Year	Length (m)	Diameter (mm)	Material	Slope (/)	Full Flow Capacity (L/s)	2021 PWWF 5-Year 24-Hour I&I					OCP PWWF 5-Year 24-Hour I&I w/ Climate Change				
							Flow (L/s)	d/D	q/Q	Flow Remaining to d/D = 1 (L/s)	LoF	Flow (L/s)	d/D	q/Q	Flow Remaining to d/D = 1 (L/s)	LoF
SP-0047	1971	91.1	150	AC	0.044	31.9	0.2	0.06	0.01	31.7	2	0.2	0.06	0.01	31.6	2
SP-0048	1971	60.7	150	AC	0.062	38.0	0.5	0.08	0.01	37.5	1	0.6	0.09	0.02	37.4	1
SP-0049	1971	66.1	200	AC	0.108	108.0	1.5	0.08	0.01	106.5	1	1.6	0.09	0.02	106.3	1
SP-0050	1971	67.9	200	AC	0.051	74.2	0.0	0.02	0.00	74.2	2	0.0	0.02	0.00	74.2	2
SP-0051	1971	91.9	200	AC	0.040	65.6	0.0	0.02	0.00	65.6	2	0.0	0.02	0.00	65.6	2
SP-0052	1971	90.9	200	AC	0.055	77.2	0.0	0.02	0.00	77.2	2	0.0	0.02	0.00	77.2	2
SP-0053	1971	78.0	200	AC	0.158	130.5	1.7	0.08	0.01	128.7	1	1.9	0.08	0.01	128.6	1
SP-0054	1971	91.4	200	AC	0.056	77.3	7.4	0.21	0.10	69.9	1	9.0	0.23	0.12	68.3	1
SP-0055	1971	91.0	200	AC	0.061	81.1	7.6	0.21	0.09	73.5	1	9.2	0.23	0.11	71.9	1
SP-0056	1971	116.9	200	AC	0.076	90.3	7.8	0.20	0.09	82.6	1	9.4	0.22	0.10	80.9	1
SP-0057	1971	74.5	200	AC	0.096	101.7	9.6	0.21	0.09	92.1	1	11.4	0.23	0.11	90.3	1
SP-0058	1971	74.3	200	AC	0.100	104.0	9.6	0.21	0.09	94.4	1	11.4	0.22	0.11	92.6	1
SP-0059	1971	27.9	200	AC	0.235	158.9	9.6	0.17	0.06	149.3	1	11.4	0.18	0.07	147.5	1
SP-0060	1971	58.7	200	AC	0.078	91.5	0.1	0.02	0.00	91.4	2	0.1	0.02	0.00	91.4	2
SP-0061	1971	60.5	200	AC	0.087	96.9	0.1	0.02	0.00	96.8	2	0.1	0.02	0.00	96.8	2
SP-0062	1971	47.5	150	AC	0.080	43.2	0.2	0.05	0.01	43.0	2	0.3	0.06	0.01	42.9	2
SP-0063	1971	44.6	150	AC	0.168	62.4	0.2	0.05	0.00	62.2	1	0.3	0.05	0.00	62.2	1
SP-0064	1971	74.9	200	AC	0.096	101.4	0.4	0.05	0.00	101.0	1	0.5	0.05	0.01	100.9	1
SP-0065	1971	71.4	200	AC	0.085	95.8	0.5	0.05	0.01	95.4	1	0.5	0.05	0.01	95.3	1
SP-0066	1971	82.4	200	AC	0.069	86.2	0.5	0.06	0.01	85.7	1	0.6	0.06	0.01	85.6	1
SP-0067	1971	47.1	200	AC	0.237	159.6	0.2	0.03	0.00	159.4	1	0.2	0.03	0.00	159.4	1
SP-0068	1971	34.8	200	AC	0.039	64.9	0.7	0.07	0.01	64.1	2	0.8	0.08	0.01	64.1	2
SP-0069	1971	49.5	200	AC	0.094	100.4	0.7	0.06	0.01	99.7	1	0.8	0.06	0.01	99.7	1
SP-0070	1971	72.5	200	AC	0.115	111.3	0.9	0.06	0.01	110.5	1	1.1	0.07	0.01	110.2	1
SP-0071	1971	46.2	200	AC	0.053	75.4	0.9	0.08	0.01	74.5	1	1.2	0.09	0.02	74.2	1
SP-0072	1971	119.4	150	AC	0.129	54.7	0.4	0.06	0.01	54.3	1	0.7	0.08	0.01	54.1	1
SP-0073	1971	110.3	150	AC	0.040	30.3	0.7	0.11	0.02	29.6	2	1.0	0.12	0.03	29.3	1
SP-0074	1971	14.4	150	AC	0.039	30.3	0.7	0.11	0.02	29.5	2	1.0	0.12	0.03	29.3	1
SP-0075	1971	40.2	150	AC	0.227	72.5	0.8	0.07	0.01	71.8	1	1.0	0.08	0.01	71.5	1
SP-0076	1971	108.1	150	AC	0.058	36.5	0.0	0.02	0.00	36.5	2	0.0	0.02	0.00	36.5	2
SP-0077	1971	13.3	150	AC	0.058	36.5	0.0	0.01	0.00	36.5	2	0.0	0.01	0.00	36.5	2
SP-0078	1971	50.7	200	AC	0.101	104.0	0.8	0.06	0.01	103.2	1	1.1	0.07	0.01	102.9	1
SP-0079	1971	49.7	250	AC	0.102	190.2	0.8	0.05	0.00	189.3	1	1.1	0.06	0.01	189.0	1
SP-0080	1971	98.0	200	AC	0.064	83.2	0.2	0.04	0.00	83.0	2	0.3	0.04	0.00	83.0	2
SP-0081	1971	79.0	200	AC	0.052	75.1	0.4	0.05	0.01	74.7	2	0.4	0.05	0.01	74.6	2
SP-0082	1971	95.9	150	AC	0.007	12.6	0.2	0.08	0.01	12.5	2	0.2	0.08	0.01	12.5	2
SP-0083	1971	42.2	250	AC	0.131	215.3	1.4	0.06	0.01	213.9	1	1.7	0.06	0.01	213.5	1
SP-0084	1971	82.6	150	AC	0.018	20.5	0.1	0.06	0.01	20.3	2	0.1	0.06	0.01	20.3	2
SP-0085	1971	55.1	150	AC	0.010	14.9	0.1	0.06	0.01	14.8	2	0.1	0.07	0.01	14.8	2
SP-0086	1971	51.6	250	AC	0.154	233.5	1.6	0.06	0.01	232.0	1	1.9	0.06	0.01	231.6	1
SP-0087	1971	32.2	200	AC	0.054	76.5	0.1	0.03	0.00	76.4	2	0.1	0.03	0.00	76.4	2
SP-0088	1971	39.7	250	AC	0.170	244.9	2.4	0.07	0.01	242.5	1	2.8	0.08	0.01	242.1	1

Pipe ID	Install Year	Length (m)	Diameter (mm)	Material	Slope (/)	Full Flow Capacity (L/s)	2021 PWWF 5-Year 24-Hour I&I					OCP PWWF 5-Year 24-Hour I&I w/ Climate Change				
							Flow (L/s)	d/D	q/Q	Flow Remaining to d/D = 1 (L/s)	LoF	Flow (L/s)	d/D	q/Q	Flow Remaining to d/D = 1 (L/s)	LoF
SP-0089	1971	109.0	200	AC	0.035	61.3	0.0	0.00	0.00	61.3	2	0.0	0.00	0.00	61.3	2
SP-0090	1971	80.5	200	AC	0.018	43.9	0.0	0.00	0.00	43.9	2	0.0	0.00	0.00	43.9	2
SP-0091	1971	67.0	150	AC	0.007	13.2	0.1	0.05	0.01	13.1	2	0.1	0.05	0.01	13.1	2
SP-0092	1971	110.8	200	AC	0.023	50.0	0.3	0.05	0.01	49.8	2	0.3	0.05	0.01	49.8	2
SP-0093	1971	95.6	200	AC	0.011	34.7	0.3	0.06	0.01	34.4	2	0.3	0.06	0.01	34.4	2
SP-0094	1971	15.8	250	AC	0.101	189.2	2.7	0.08	0.01	186.5	1	3.1	0.09	0.02	186.1	1
SP-0095	1971	14.0	250	AC	0.420	385.5	2.7	0.06	0.01	382.8	1	3.1	0.06	0.01	382.4	1
SP-0096	1971	14.0	250	AC	0.010	59.5	2.7	0.15	0.05	56.8	2	3.1	0.16	0.05	56.4	2
SP-0097	1971	114.9	200	AC	0.002	13.3	0.1	0.07	0.01	13.2	2	0.2	0.08	0.01	13.2	2
SP-0098	1971	13.7	200	AC	0.010	32.8	0.0	0.02	0.00	32.8	2	0.0	0.02	0.00	32.8	2
SP-0099	1971	30.9	200	AC	0.004	20.4	0.1	0.06	0.01	20.3	2	0.2	0.06	0.01	20.3	2
SP-0100	1971	94.8	200	AC	0.005	23.1	0.2	0.06	0.01	22.9	2	0.2	0.07	0.01	22.9	2
SP-0101	1971	109.4	250	AC	0.003	31.7	2.9	0.21	0.09	28.7	2	3.4	0.22	0.11	28.2	2
SP-0102	1971	124.4	250	AC	0.005	39.9	3.0	0.19	0.08	36.9	2	3.6	0.20	0.09	36.3	2
SP-0103	1971	121.2	250	AC	0.001	21.6	3.2	0.26	0.15	18.4	2	3.8	0.28	0.18	17.8	2
SP-0104	1971	108.4	300	AC	0.003	52.5	16.1	0.38	0.31	36.5	2	20.0	0.43	0.38	32.6	2
SP-0105	1971	108.7	300	AC	0.003	50.8	16.1	0.39	0.32	34.7	2	20.0	0.44	0.39	30.8	2
<b>SP-0106</b>	<b>1971</b>	<b>97.2</b>	<b>350</b>	<b>AC</b>	<b>0.000</b>	<b>20.9</b>	<b>17.4</b>	<b>0.70</b>	<b>0.83</b>	<b>3.5</b>	<b>2</b>	<b>22.2</b>	<b>1.00</b>	<b>1.06</b>	<b>-1.3</b>	<b>3</b>
SP-0107	1971	43.4	150	AC	0.211	69.9	0.3	0.05	0.00	69.7	1	0.3	0.05	0.00	69.7	1
SP-0108	1971	108.5	200	AC	0.006	24.8	0.3	0.07	0.01	24.5	2	0.3	0.08	0.01	24.5	2
SP-0109	1971	115.7	150	AC	0.017	19.9	0.3	0.09	0.02	19.6	2	0.4	0.09	0.02	19.6	2
SP-0110	1971	56.3	200	AC	0.237	159.6	0.7	0.05	0.00	159.0	1	0.7	0.05	0.01	158.9	1
SP-0111	1971	113.4	150	AC	0.037	29.4	0.0	0.00	0.00	29.4	2	0.0	0.00	0.00	29.4	2
SP-0113	1971	43.2	200	AC	0.165	133.1	0.7	0.05	0.01	132.5	1	0.7	0.05	0.01	132.4	1
SP-0114	1971	70.6	150	AC	0.024	23.4	0.2	0.07	0.01	23.2	2	0.3	0.07	0.01	23.2	2
SP-0115	1971	77.0	150	AC	0.014	18.2	0.4	0.10	0.02	17.8	2	0.5	0.11	0.03	17.7	2
SP-0116	1971	24.9	200	AC	0.329	188.1	1.1	0.06	0.01	187.0	1	1.2	0.06	0.01	186.9	1
SP-0117	1971	19.3	200	AC	0.055	77.1	1.1	0.08	0.01	76.0	1	1.2	0.09	0.02	75.9	1
SP-0118	1971	73.0	150	AC	0.015	18.4	0.1	0.05	0.00	18.4	2	0.1	0.05	0.00	18.4	2
SP-0119	1971	12.9	200	PVC	0.297	178.7	1.3	0.06	0.01	177.4	1	1.4	0.06	0.01	177.3	1
SP-0120	1971	54.5	200	PVC	0.116	111.7	1.3	0.08	0.01	110.4	2	1.4	0.08	0.01	110.3	2
SP-0121	1971	62.6	200	AC	0.073	88.4	0.0	0.00	0.00	88.4	2	0.0	0.00	0.00	88.4	2
SP-0122	1971	111.0	200	AC	0.022	48.9	0.0	0.02	0.00	48.9	2	0.0	0.02	0.00	48.9	2
SP-0123	1971	77.6	150	AC	0.104	49.1	0.3	0.06	0.01	48.8	1	0.3	0.06	0.01	48.7	1
SP-0124	1971	80.4	200	AC	0.006	25.1	0.5	0.10	0.02	24.6	2	0.5	0.10	0.02	24.6	2
SP-0125	1971	68.2	150	AC	0.083	44.0	0.2	0.05	0.01	43.8	2	0.2	0.05	0.01	43.8	2
SP-0126	1971	52.3	200	AC	0.119	113.1	0.1	0.03	0.00	113.0	2	0.1	0.03	0.00	113.0	2
SP-0127	1971	84.7	150	AC	0.020	21.4	0.4	0.09	0.02	21.1	2	0.4	0.09	0.02	21.0	2
SP-0128	1971	84.8	150	AC	0.012	16.9	0.2	0.07	0.01	16.7	2	0.2	0.08	0.01	16.7	2
SP-0129	1971	30.5	200	AC	0.063	82.1	0.7	0.06	0.01	81.4	1	0.7	0.07	0.01	81.4	1
SP-0130	1971	58.7	200	AC	0.151	127.2	0.3	0.04	0.00	126.9	1	0.3	0.04	0.00	126.9	1
SP-0132	1971	47.0	200	AC	0.088	97.0	2.4	0.11	0.03	94.6	1	2.7	0.11	0.03	94.4	1

Pipe ID	Install Year	Length (m)	Diameter (mm)	Material	Slope (/)	Full Flow Capacity (L/s)	2021 PWWF 5-Year 24-Hour I&I					OCP PWWF 5-Year 24-Hour I&I w/ Climate Change				
							Flow (L/s)	d/D	q/Q	Flow Remaining to d/D = 1 (L/s)	LoF	Flow (L/s)	d/D	q/Q	Flow Remaining to d/D = 1 (L/s)	LoF
SP-0133	1971	73.0	200	AC	0.083	94.6	2.4	0.11	0.03	92.2	1	2.7	0.12	0.03	91.9	1
SP-0134	1971	46.5	200	AC	0.107	107.1	2.6	0.11	0.02	104.5	1	2.9	0.11	0.03	104.2	1
SP-0135	1971	22.9	200	AC	0.005	22.5	2.6	0.23	0.12	19.9	2	2.9	0.24	0.13	19.6	2
SP-0136	1971	76.8	200	AC	0.005	22.5	2.8	0.24	0.12	19.7	2	3.1	0.25	0.14	19.4	2
SP-0137	1971	3.7	200	AC	0.014	38.2	2.8	0.18	0.07	35.4	2	3.1	0.19	0.08	35.1	2
SP-0138	1971	64.6	150	AC	0.013	17.4	0.1	0.06	0.01	17.2	2	0.1	0.07	0.01	17.2	2
SP-0139	1971	20.6	150	AC	0.000	3.4	0.0	0.07	0.01	3.3	2	0.0	0.07	0.01	3.3	2
SP-0140	1971	39.6	150	AC	0.051	34.3	0.2	0.06	0.01	34.1	2	0.2	0.06	0.01	34.1	2
SP-0141	1971	83.4	200	AC	0.006	25.9	3.1	0.23	0.12	22.8	2	3.5	0.25	0.13	22.4	2
SP-0142	1971	92.8	200	AC	0.064	82.7	1.3	0.09	0.02	81.4	1	1.4	0.09	0.02	81.3	1
SP-0143	1971	61.1	200	AC	0.039	64.7	4.5	0.18	0.07	60.3	1	5.0	0.19	0.08	59.8	1
SP-0144	1971	61.2	150	AC	0.005	10.7	0.1	0.08	0.01	10.5	2	0.3	0.12	0.03	10.4	2
SP-0145	1971	46.7	200	AC	0.023	49.4	4.6	0.21	0.09	44.9	1	5.3	0.22	0.11	44.1	1
SP-0146	1971	15.1	200	AC	0.073	88.9	4.6	0.15	0.05	84.3	2	5.3	0.17	0.06	83.6	2
SP-0147	1971	118.8	350	AC	0.005	107.1	17.5	0.27	0.16	89.5	2	22.5	0.31	0.21	84.6	2
SP-0148	1971	78.6	250	AC	0.005	42.4	9.2	0.32	0.22	33.2	2	10.7	0.34	0.25	31.7	2
SP-0149	1971	49.2	250	AC	0.014	69.4	9.2	0.25	0.13	60.2	2	10.7	0.27	0.15	58.6	2
SP-0150	1971	107.6	150	AC	0.008	13.5	0.1	0.05	0.01	13.5	2	0.1	0.05	0.01	13.5	2
SP-0151	1971	51.4	150	AC	0.067	39.3	0.3	0.07	0.01	39.0	2	0.4	0.07	0.01	39.0	2
SP-0152	1971	52.5	150	AC	0.005	11.1	0.5	0.14	0.04	10.7	2	0.5	0.14	0.04	10.6	2
SP-0153	1971	104.1	200	AC	0.015	39.6	0.7	0.09	0.02	39.0	2	0.7	0.09	0.02	38.9	2
SP-0154	1971	54.6	150	AC	0.005	10.7	0.1	0.06	0.01	10.6	2	0.1	0.06	0.01	10.6	2
SP-0155	1971	17.5	200	AC	0.065	83.3	0.3	0.04	0.00	83.1	2	0.3	0.04	0.00	83.0	2
SP-0156	1971	97.6	200	AC	0.006	25.3	0.5	0.09	0.02	24.8	2	0.5	0.10	0.02	24.8	2
SP-0157	1971	101.8	200	AC	0.018	44.3	0.7	0.09	0.02	43.6	2	0.9	0.10	0.02	43.5	2
SP-0158	1971	59.2	200	AC	0.005	23.0	1.5	0.17	0.07	21.5	2	1.7	0.18	0.07	21.3	2
SP-0159	1971	89.6	200	AC	0.005	23.0	1.6	0.18	0.07	21.4	2	1.8	0.19	0.08	21.2	2
SP-0160	1971	56.5	200	AC	0.005	22.2	4.3	0.30	0.20	17.9	2	4.9	0.32	0.22	17.4	2
SP-0161	1971	52.5	200	AC	0.006	24.4	4.4	0.29	0.18	20.0	2	4.9	0.30	0.20	19.5	2
SP-0162	1971	88.0	200	AC	0.003	17.5	4.4	0.34	0.25	13.1	2	4.9	0.36	0.28	12.5	2
SP-0163	1971	105.5	200	AC	0.050	73.3	0.1	0.03	0.00	73.2	2	0.1	0.03	0.00	73.2	2
SP-0164	1971	102.0	200	AC	0.018	43.8	4.8	0.22	0.11	39.0	1	5.4	0.24	0.12	38.4	1
SP-0165	1971	95.7	200	AC	0.018	43.7	4.9	0.23	0.11	38.8	1	5.5	0.24	0.13	38.2	1
SP-0166	1971	74.0	200	AC	0.016	41.1	5.0	0.24	0.12	36.0	1	5.6	0.25	0.14	35.4	1
SP-0167	1971	79.1	200	AC	0.006	25.8	0.1	0.05	0.01	25.7	2	0.1	0.05	0.01	25.7	2
SP-0168	1971	117.7	200	AC	0.019	45.7	0.2	0.04	0.00	45.5	2	0.2	0.05	0.00	45.5	2
SP-0169	1971	118.2	200	AC	0.053	75.4	0.2	0.04	0.00	75.2	2	0.2	0.04	0.00	75.2	2
SP-0170	1971	48.1	200	AC	0.021	47.8	2.0	0.14	0.04	45.8	1	3.5	0.18	0.07	44.2	1
SP-0171	1971	49.4	200	AC	0.008	29.1	7.1	0.34	0.24	22.1	1	9.3	0.39	0.32	19.8	1
SP-0172	1971	36.6	200	AC	0.012	36.0	8.0	0.32	0.22	28.0	1	10.6	0.37	0.29	25.4	1
SP-0173	1971	59.2	200	AC	0.011	35.2	8.1	0.33	0.23	27.1	1	10.7	0.38	0.30	24.5	1
SP-0174	1971	65.0	200	AC	0.003	16.8	0.1	0.04	0.00	16.7	2	0.0	0.00	0.00	16.8	1

Pipe ID	Install Year	Length (m)	Diameter (mm)	Material	Slope (/)	Full Flow Capacity (L/s)	2021 PWWF 5-Year 24-Hour I&I					OCP PWWF 5-Year 24-Hour I&I w/ Climate Change				
							Flow (L/s)	d/D	q/Q	Flow Remaining to d/D = 1 (L/s)	LoF	Flow (L/s)	d/D	q/Q	Flow Remaining to d/D = 1 (L/s)	LoF
SP-0175	1971	92.5	200	AC	0.006	24.8	0.1	0.05	0.01	24.7	2	0.0	0.00	0.00	24.8	1
SP-0176	1971	10.5	350	AC	0.010	147.0	31.3	0.31	0.21	115.7	2	38.5	0.35	0.26	108.5	2
SP-0179	1971	26.7	200	AC	0.006	25.8	0.0	0.02	0.00	25.8	2	0.0	0.02	0.00	25.8	2
SP-0180	1972	39.2	150	AC	0.010	15.2	0.2	0.07	0.01	15.1	2	0.2	0.07	0.01	15.1	2
SP-0184	1972	45.4	200	AC	0.082	94.2	5.2	0.16	0.06	89.0	1	6.2	0.17	0.07	88.0	1
SP-0185	1972	41.3	200	AC	0.092	99.4	0.1	0.03	0.00	99.3	2	0.1	0.03	0.00	99.3	2
SP-0187	1972	10.1	200	AC	0.076	90.3	0.1	0.02	0.00	90.3	2	0.1	0.02	0.00	90.2	2
SP-0188	1972	94.2	200	AC	0.076	90.3	5.7	0.17	0.06	84.6	1	6.8	0.19	0.08	83.6	1
SP-0189	1972	81.5	200	AC	0.081	93.5	0.1	0.03	0.00	93.4	2	0.1	0.03	0.00	93.4	2
SP-0190	1972	19.1	200	AC	0.048	71.7	6.1	0.20	0.09	65.6	1	7.2	0.21	0.10	64.6	1
SP-0191	1972	60.6	200	AC	0.048	71.7	6.1	0.20	0.09	65.6	1	7.3	0.22	0.10	64.4	1
SP-0196B	1972	66.8	150	AC	0.068	39.7	0.1	0.03	0.00	39.6	2	0.1	0.03	0.00	39.6	2
SP-0197	1972	64.0	200	AC	0.068	85.4	0.3	0.05	0.00	85.1	2	0.5	0.06	0.01	84.9	1
SP-0198	1972	86.3	200	AC	0.058	79.1	0.4	0.05	0.01	78.7	2	0.6	0.06	0.01	78.5	2
SP-0199	1972	71.0	200	AC	0.076	90.4	0.1	0.03	0.00	90.3	2	0.2	0.03	0.00	90.3	2
SP-0200	1972	90.4	200	AC	0.067	85.0	0.8	0.07	0.01	84.2	1	1.0	0.08	0.01	84.0	1
SP-0201	1972	121.4	200	AC	0.088	97.1	1.2	0.08	0.01	95.9	1	1.4	0.09	0.02	95.7	1
SP-0202	1972	124.5	200	AC	0.080	92.7	1.2	0.08	0.01	91.5	1	1.6	0.09	0.02	91.1	1
SP-0203	1972	89.8	150	AC	0.010	15.2	0.4	0.11	0.03	14.8	2	0.6	0.13	0.04	14.7	2
SP-0206	1972	57.2	150	AC	0.013	17.6	2.3	0.24	0.13	15.3	2	10.5	0.56	0.60	7.1	1
SP-0207	1972	60.3	150	AC	0.037	29.4	2.3	0.19	0.08	27.2	1	10.8	0.42	0.37	18.6	1
SP-0208	1972	43.6	150	AC	0.049	33.6	2.3	0.18	0.07	31.3	1	0.0	0.00	0.00	33.6	1
SP-0209	1972	2.6	150	AC	0.004	9.5	2.7	0.36	0.28	6.8	2	0.2	0.11	0.03	9.3	2
SP-0210	1972	85.8	150	AC	0.003	8.7	2.8	0.39	0.32	5.9	2	0.3	0.13	0.04	8.4	2
SP-0211	1972	63.5	150	PVC	0.010	15.2	0.1	0.07	0.01	15.1	2	0.1	0.07	0.01	15.1	2
SP-0212	1972	110.8	150	AC	0.005	11.0	3.1	0.36	0.28	8.0	2	0.6	0.16	0.06	10.4	2
SP-0213	1972	17.8	200	AC	0.057	78.5	7.3	0.21	0.09	71.2	1	8.9	0.23	0.11	69.6	1
SP-0214	1972	115.4	150	Unknown	0.010	15.2	0.2	0.08	0.01	15.0	2	0.2	0.09	0.02	15.0	2
SP-0215	1972	45.6	150	Unknown	0.010	15.2	0.3	0.10	0.02	14.9	2	0.3	0.10	0.02	14.9	2
SP-0216	1972	115.9	150	AC	0.010	15.2	0.0	0.00	0.00	15.2	2	0.0	0.00	0.00	15.2	2
SP-0217	1972	81.4	150	AC	0.010	15.2	0.2	0.08	0.02	15.0	2	0.3	0.10	0.02	14.9	2
SP-0218	1972	78.1	150	AC	0.010	15.2	0.4	0.11	0.02	14.9	2	0.4	0.12	0.03	14.8	2
SP-0219	1972	58.1	200	AC	0.223	155.0	1.0	0.06	0.01	154.0	1	1.1	0.06	0.01	153.9	1
SP-0220	1972	116.3	200	Unknown	0.034	60.1	0.0	0.00	0.00	60.1	2	0.0	0.00	0.00	60.1	2
SP-0221	1972	91.1	150	AC	0.022	22.5	1.1	0.15	0.05	21.4	2	1.2	0.16	0.05	21.3	2
SP-0222	1972	61.1	150	AC	0.010	15.2	0.3	0.10	0.02	14.9	2	0.4	0.11	0.02	14.9	2
SP-0223	1972	59.5	150	AC	0.214	70.5	0.6	0.06	0.01	69.9	1	0.6	0.07	0.01	69.8	1
SP-0224	1972	46.4	150	Unknown	0.010	15.2	0.1	0.05	0.01	15.2	2	0.1	0.05	0.01	15.2	2
SP-0225	1972	22.4	150	Unknown	0.010	15.2	0.1	0.06	0.01	15.2	2	0.1	0.06	0.01	15.1	2
SP-0226	1972	35.0	100	PVC	0.010	5.2	0.0	0.06	0.01	5.1	2	0.0	0.07	0.01	5.1	2
SP-0227	1980	41.1	150	AC	0.010	15.2	0.1	0.05	0.01	15.1	2	0.1	0.06	0.01	15.1	2
SP-0228	1980	40.8	150	AC	0.229	72.8	0.2	0.04	0.00	72.6	1	0.2	0.04	0.00	72.6	1

Pipe ID	Install Year	Length (m)	Diameter (mm)	Material	Slope (/)	Full Flow Capacity (L/s)	2021 PWWF 5-Year 24-Hour I&I					OCP PWWF 5-Year 24-Hour I&I w/ Climate Change				
							Flow (L/s)	d/D	q/Q	Flow Remaining to d/D = 1 (L/s)	LoF	Flow (L/s)	d/D	q/Q	Flow Remaining to d/D = 1 (L/s)	LoF
SP-0229	1980	74.0	150	AC	0.005	10.8	0.2	0.09	0.02	10.6	2	0.2	0.10	0.02	10.6	2
SP-0230	1972	116.2	150	AC	0.009	14.3	0.2	0.08	0.01	14.2	2	0.2	0.09	0.02	14.1	2
SP-0231	1972	41.8	150	AC	0.010	15.5	0.5	0.12	0.03	15.0	2	0.5	0.13	0.04	14.9	2
SP-0232	1972	18.0	200	Unknown	0.003	19.0	0.7	0.13	0.04	18.3	2	0.8	0.14	0.04	18.2	2
SP-0233	1972	118.3	200	AC	0.011	34.6	0.8	0.10	0.02	33.9	2	0.8	0.11	0.02	33.8	2
SP-0235	1972	125.7	300	AC	0.006	74.7	0.0	0.01	0.00	74.7	2	0.0	0.01	0.00	74.7	2
SP-0236	1972	121.4	300	AC	0.004	62.7	0.1	0.04	0.00	62.5	2	0.2	0.04	0.00	62.5	2
SP-0237	1972	95.0	300	AC	0.007	79.4	0.2	0.03	0.00	79.2	2	0.2	0.04	0.00	79.2	2
SP-0238	1972	26.8	300	AC	0.009	93.4	0.2	0.03	0.00	93.3	2	0.2	0.03	0.00	93.2	2
SP-0239	1972	121.1	300	AC	0.011	101.7	0.2	0.03	0.00	101.5	2	0.2	0.03	0.00	101.5	2
SP-0240	1972	61.6	300	AC	0.094	296.1	0.3	0.02	0.00	295.8	2	0.3	0.02	0.00	295.8	2
SP-0241	1972	91.8	300	AC	0.000	10.1	0.4	0.14	0.04	9.7	2	0.4	0.14	0.04	9.7	2
SP-0242	1972	74.8	300	AC	0.020	135.1	0.4	0.04	0.00	134.7	2	0.4	0.04	0.00	134.7	2
SP-0243	1972	91.5	150	Unknown	0.011	16.2	0.2	0.08	0.01	16.0	2	0.2	0.08	0.01	16.0	2
SP-0244	1972	81.8	150	Unknown	0.010	15.3	0.2	0.09	0.02	15.0	2	0.3	0.09	0.02	15.0	2
SP-0245	1972	115.7	300	AC	0.009	93.0	0.4	0.05	0.00	92.6	2	0.4	0.05	0.01	92.6	2
SP-0246	1972	60.5	300	AC	0.010	97.1	0.4	0.05	0.00	96.7	2	1.1	0.07	0.01	96.0	2
SP-0247	1972	15.6	250	DI	0.378	365.8	0.4	0.03	0.00	365.4	1	1.1	0.04	0.00	364.7	1
SP-0248	1972	47.2	250	DI	0.111	198.5	0.4	0.03	0.00	198.1	1	1.1	0.05	0.01	197.4	1
SP-0249	1972	197.7	250	DI	0.111	198.5	0.4	0.03	0.00	198.1	2	1.1	0.05	0.01	197.4	2
SP-0250	1973	127.8	200	PVC	0.033	59.7	2.4	0.14	0.04	57.4	1	2.8	0.15	0.05	56.9	1
SP-0251	1973	74.7	200	AC	0.067	85.0	2.4	0.11	0.03	82.7	1	2.9	0.13	0.03	82.2	1
SP-0252	1973	45.7	150	AC	0.010	15.2	0.0	0.00	0.00	15.2	2	0.0	0.00	0.00	15.2	2
SP-0253	1973	80.6	150	AC	0.040	30.6	0.4	0.08	0.01	30.2	2	0.4	0.08	0.01	30.2	2
SP-0255	1973	13.8	200	AC	0.124	115.4	2.7	0.11	0.02	112.6	1	3.3	0.12	0.03	112.1	1
SP-0256	1973	30.6	200	AC	0.049	72.6	0.0	0.00	0.00	72.6	2	0.0	0.00	0.00	72.6	2
SP-0257	1973	77.5	200	AC	0.030	57.2	0.1	0.03	0.00	57.1	2	0.1	0.04	0.00	57.1	2
SP-0258	1973	92.5	200	AC	0.083	94.4	0.3	0.04	0.00	94.0	2	0.7	0.06	0.01	93.7	1
SP-0259	1973	103.9	200	AC	0.029	55.7	0.5	0.07	0.01	55.3	2	0.9	0.09	0.02	54.9	2
SP-0260	1973	46.1	200	AC	0.138	122.0	0.6	0.05	0.01	121.4	1	1.0	0.07	0.01	121.0	1
SP-0261	1973	40.7	200	AC	0.093	100.1	0.7	0.06	0.01	99.4	1	1.1	0.07	0.01	98.9	1
SP-0262	1973	121.6	150	AC	0.088	45.1	0.5	0.07	0.01	44.6	1	0.6	0.08	0.01	44.5	1
SP-0263	1973	45.1	150	AC	0.081	43.3	0.6	0.08	0.02	42.6	1	0.7	0.09	0.02	42.6	1
SP-0264	1975	106.0	150	AC	0.010	15.2	0.3	0.10	0.02	14.9	2	0.4	0.11	0.02	14.9	2
SP-0265	1975	51.2	150	AC	0.078	42.6	0.5	0.08	0.01	42.0	1	0.6	0.09	0.02	41.9	1
SP-0266	1975	116.9	150	AC	0.016	19.4	0.1	0.06	0.01	19.3	2	0.1	0.06	0.01	19.3	2
SP-0267	1975	85.9	200	AC	0.013	37.0	0.7	0.09	0.02	36.3	2	0.8	0.10	0.02	36.2	2
SP-0268	1975	78.1	200	AC	0.063	82.4	0.2	0.04	0.00	82.2	2	0.2	0.04	0.00	82.2	2
SP-0269	1975	50.2	200	AC	0.054	76.2	0.3	0.04	0.00	76.0	2	0.3	0.05	0.00	75.9	2
SP-0270	1975	85.5	200	AC	0.054	76.2	0.5	0.06	0.01	75.8	2	0.5	0.06	0.01	75.7	2
SP-0271	1975	83.4	200	AC	0.052	74.5	0.5	0.06	0.01	73.9	2	0.6	0.06	0.01	73.9	2
SP-0272	1975	96.5	200	AC	0.031	57.4	0.1	0.02	0.00	57.4	2	0.1	0.02	0.00	57.4	2

							2021 PWWF 5-Year 24-Hour I&I					OCP PWWF 5-Year 24-Hour I&I w/ Climate Change				
Pipe ID	Install Year	Length (m)	Diameter (mm)	Material	Slope (/)	Full Flow Capacity (L/s)	Flow (L/s)	d/D	q/Q	Flow Remaining to d/D = 1 (L/s)	LoF	Flow (L/s)	d/D	q/Q	Flow Remaining to d/D = 1 (L/s)	LoF
SP-0273	1975	75.1	200	AC	0.017	42.3	0.8	0.10	0.02	41.5	2	0.9	0.10	0.02	41.4	2
SP-0274	1975	89.7	200	AC	0.024	50.5	1.3	0.11	0.03	49.2	2	1.5	0.12	0.03	49.1	2
SP-0275	1975	97.6	200	AC	0.038	64.1	0.2	0.04	0.00	63.9	2	0.2	0.04	0.00	63.9	2
SP-0276	1975	93.8	200	AC	0.020	46.2	0.3	0.06	0.01	45.8	2	0.4	0.06	0.01	45.8	2
SP-0277	1975	25.6	200	AC	0.014	39.4	1.7	0.14	0.04	37.7	2	1.9	0.15	0.05	37.5	2
SP-0278	1975	13.6	200	AC	0.018	43.6	1.7	0.13	0.04	42.0	2	1.9	0.14	0.04	41.7	2
SP-0279	1975	25.7	200	AC	0.104	105.9	1.7	0.09	0.02	104.2	1	1.9	0.09	0.02	104.0	1
SP-0280	1975	36.7	200	AC	0.056	77.9	0.7	0.07	0.01	77.2	1	0.7	0.07	0.01	77.1	1
SP-0281	1989	36.3	200	PVC	0.019	44.9	0.3	0.06	0.01	44.6	2	0.3	0.06	0.01	44.6	2
SP-0282	1989	36.5	200	PVC	0.042	66.9	0.3	0.05	0.01	66.6	2	0.4	0.05	0.01	66.6	2
SP-0283	1976	102.9	200	PVC	0.012	35.3	0.5	0.08	0.01	34.8	2	0.5	0.08	0.01	34.8	2
SP-0284	1976	93.7	200	Unknown	0.004	20.0	0.1	0.05	0.01	19.9	2	0.2	0.07	0.01	19.8	2
SP-0285	1976	81.0	200	AC	0.109	108.2	0.6	0.05	0.01	107.6	1	0.7	0.06	0.01	107.5	1
SP-0286	1976	15.9	200	AC	0.080	92.9	0.7	0.06	0.01	92.2	1	0.8	0.07	0.01	92.1	1
SP-0287	1976	30.2	200	AC	0.036	62.0	0.7	0.08	0.01	61.3	2	0.9	0.08	0.01	61.2	2
SP-0288	1976	39.1	150	AC	0.010	15.2	0.0	0.00	0.00	15.2	2	0.0	0.00	0.00	15.2	2
SP-0289	1976	37.0	200	AC	0.015	39.6	0.0	0.02	0.00	39.6	2	0.0	0.02	0.00	39.6	2
SP-0290	1976	106.6	200	AC	0.043	68.4	0.2	0.04	0.00	68.1	2	0.2	0.04	0.00	68.1	2
SP-0291	1976	91.0	200	AC	0.014	38.6	0.4	0.07	0.01	38.2	2	0.4	0.07	0.01	38.2	2
SP-0292	1976	98.6	150	AC	0.040	30.3	0.2	0.06	0.01	30.1	2	0.2	0.06	0.01	30.1	2
SP-0293	1976	59.5	200	AC	0.027	53.5	0.7	0.08	0.01	52.8	2	0.7	0.08	0.01	52.7	2
SP-0294	1976	39.4	150	AC	0.067	39.3	0.1	0.04	0.00	39.2	2	0.1	0.04	0.00	39.2	2
SP-0295	1976	69.1	150	AC	0.024	23.5	0.4	0.09	0.02	23.1	2	0.4	0.09	0.02	23.1	2
SP-0296	1976	33.7	150	AC	0.024	23.5	0.1	0.05	0.01	23.3	2	0.1	0.05	0.01	23.3	2
SP-0297	1976	89.8	150	AC	0.024	23.5	0.2	0.06	0.01	23.3	2	0.2	0.07	0.01	23.3	2
SP-0298	1976	57.9	200	Unknown	0.080	92.9	0.1	0.02	0.00	92.9	2	0.1	0.02	0.00	92.9	2
SP-0299	1976	32.9	150	AC	0.054	35.4	0.0	0.03	0.00	35.3	2	0.0	0.03	0.00	35.3	2
SP-0300	1977	43.4	200	PVC	0.007	28.2	1.0	0.13	0.04	27.1	2	3.1	0.23	0.11	25.0	2
SP-0301	1977	87.6	200	PVC	0.008	29.9	1.2	0.13	0.04	28.8	2	3.2	0.22	0.11	26.7	2
SP-0302	1977	85.5	200	AC	0.058	79.1	0.0	0.00	0.00	79.1	2	0.0	0.00	0.00	79.1	2
SP-0303	1977	66.8	200	AC	0.051	74.1	0.1	0.03	0.00	74.0	2	0.2	0.04	0.00	73.9	2
SP-0304	1977	47.8	200	AC	0.019	45.3	0.0	0.02	0.00	45.2	2	0.0	0.02	0.00	45.2	2
SP-0305	1977	49.1	200	AC	0.037	63.3	0.1	0.02	0.00	63.3	2	0.1	0.02	0.00	63.3	2
SP-0306	1977	66.6	200	AC	0.073	88.5	0.2	0.04	0.00	88.3	2	0.3	0.04	0.00	88.3	2
SP-0307	1977	127.3	200	AC	0.018	44.2	0.9	0.10	0.02	43.3	2	5.1	0.23	0.12	39.0	1
SP-0309	1977	78.2	200	AC	0.008	29.0	1.1	0.13	0.04	27.8	2	5.4	0.29	0.19	23.5	2
SP-0310	1977	81.6	200	PVC	0.021	47.7	0.1	0.03	0.00	47.6	2	0.1	0.03	0.00	47.6	2
SP-0311	1977	107.8	200	AC	0.022	48.6	2.2	0.14	0.04	46.5	1	10.4	0.31	0.21	38.2	1
SP-0312	1977	42.6	200	AC	0.061	80.7	1.4	0.09	0.02	79.3	1	1.5	0.10	0.02	79.2	1
SP-0313	1977	47.9	200	AC	0.071	87.6	1.4	0.09	0.02	86.1	1	1.6	0.09	0.02	86.0	1
SP-0314	1977	107.2	200	AC	0.028	55.0	0.2	0.05	0.00	54.7	2	0.2	0.05	0.00	54.7	2
SP-0315	1977	82.1	200	AC	0.034	60.6	1.9	0.12	0.03	58.6	1	2.1	0.13	0.04	58.5	1

Pipe ID	Install Year	Length (m)	Diameter (mm)	Material	Slope (/)	Full Flow Capacity (L/s)	2021 PWWF 5-Year 24-Hour I&I					OCP PWWF 5-Year 24-Hour I&I w/ Climate Change				
							Flow (L/s)	d/D	q/Q	Flow Remaining to d/D = 1 (L/s)	LoF	Flow (L/s)	d/D	q/Q	Flow Remaining to d/D = 1 (L/s)	LoF
SP-0316	1977	76.4	200	AC	0.078	91.4	2.1	0.11	0.02	89.3	1	2.3	0.11	0.03	89.1	1
SP-0317	1977	63.5	200	AC	0.061	80.9	2.2	0.11	0.03	78.7	1	2.4	0.12	0.03	78.5	1
SP-0318	1977	77.0	200	AC	0.032	58.4	0.3	0.05	0.01	58.1	2	0.4	0.06	0.01	58.0	2
SP-0319	1977	73.4	200	AC	0.108	107.6	0.5	0.05	0.00	107.2	1	0.6	0.05	0.01	107.0	1
SP-0320	1977	29.1	150	Unknown	0.005	11.3	0.1	0.05	0.01	11.2	2	0.1	0.07	0.01	11.2	2
SP-0321	1977	48.9	200	AC	0.003	16.9	0.5	0.12	0.03	16.4	2	0.7	0.14	0.04	16.2	2
SP-0322	1977	85.8	200	AC	0.038	63.9	0.8	0.08	0.01	63.2	2	1.0	0.09	0.02	62.9	2
SP-0323	1977	53.8	150	AC	0.051	34.5	0.2	0.05	0.01	34.3	2	0.2	0.05	0.01	34.3	2
SP-0324	1977	51.3	200	AC	0.073	88.4	1.0	0.07	0.01	87.4	1	1.2	0.08	0.01	87.1	1
SP-0325	1977	19.8	150	AC	0.014	18.1	0.1	0.04	0.00	18.1	2	0.1	0.04	0.00	18.1	2
SP-0326	1977	107.9	200	AC	0.037	63.1	1.2	0.10	0.02	61.9	1	1.5	0.11	0.02	61.6	1
SP-0327	2006	94.6	150	PVC	0.096	47.2	3.6	0.19	0.08	43.6	1	4.0	0.20	0.09	43.1	1
SP-0328	1977	84.0	200	PVC	0.104	105.5	4.4	0.14	0.04	101.1	1	5.0	0.15	0.05	100.5	1
SP-0329	1977	85.7	200	AC	0.047	70.8	0.1	0.03	0.00	70.6	2	0.1	0.03	0.00	70.6	2
SP-0330	1977	12.7	200	AC	0.077	90.7	4.4	0.15	0.05	86.3	1	5.0	0.16	0.06	85.8	1
SP-0331	1977	106.4	200	AC	0.046	70.4	0.1	0.03	0.00	70.3	2	0.1	0.03	0.00	70.3	2
SP-0332	1977	84.4	200	AC	0.035	61.3	0.3	0.05	0.01	61.0	2	0.3	0.05	0.01	61.0	2
SP-0333	1977	44.5	150	Unknown	0.022	22.8	0.4	0.09	0.02	22.4	2	0.4	0.10	0.02	22.4	2
SP-0334	1977	45.5	200	AC	0.018	43.5	0.9	0.10	0.02	42.6	2	1.2	0.12	0.03	42.2	2
SP-0335	1977	71.9	200	AC	0.028	55.1	0.7	0.08	0.01	54.4	2	0.8	0.09	0.02	54.3	2
SP-0336	1977	48.2	200	AC	0.003	19.2	0.0	0.04	0.00	19.1	2	0.1	0.04	0.00	19.1	2
SP-0337	1977	67.0	200	AC	0.003	19.2	0.1	0.06	0.01	19.1	2	0.2	0.07	0.01	19.0	2
SP-0338	1977	56.4	100	PVC	0.010	5.2	0.1	0.09	0.02	5.1	2	0.1	0.09	0.02	5.1	2
SP-0339	1978	12.3	100	AC	0.028	8.7	0.0	0.05	0.01	8.6	2	0.0	0.05	0.01	8.6	2
SP-0340	1977	7.7	200	AC	0.047	70.7	0.1	0.03	0.00	70.6	2	0.2	0.04	0.00	70.6	2
SP-0341	1978	38.2	200	PVC	0.033	59.9	0.1	0.03	0.00	59.8	2	0.1	0.03	0.00	59.8	2
SP-0342	1978	78.4	200	AC	0.033	59.9	0.1	0.04	0.00	59.8	2	0.2	0.04	0.00	59.8	2
SP-0343	1978	79.0	200	AC	0.025	51.5	0.3	0.05	0.01	51.2	2	0.3	0.05	0.01	51.2	2
SP-0344	1978	42.3	150	Unknown	0.057	36.4	0.1	0.04	0.00	36.3	2	0.1	0.05	0.00	36.3	2
SP-0345	1978	103.1	200	AC	0.022	48.8	0.5	0.07	0.01	48.2	2	0.6	0.08	0.01	48.2	2
SP-0346	1978	76.3	200	AC	0.065	83.8	0.8	0.07	0.01	83.0	1	0.9	0.07	0.01	82.9	1
SP-0347	1978	22.5	200	AC	0.028	55.1	0.0	0.00	0.00	55.1	2	0.3	0.05	0.01	54.8	2
SP-0348	1978	23.8	100	Unknown	0.028	8.7	0.0	0.05	0.01	8.6	2	0.0	0.05	0.01	8.6	2
SP-0349	1979	38.9	150	AC	0.010	15.2	0.1	0.05	0.00	15.2	2	0.1	0.05	0.00	15.2	2
SP-0350	1980	123.9	200	AC	0.030	57.1	0.0	0.02	0.00	57.0	2	0.1	0.03	0.00	57.0	2
SP-0351	1980	122.9	200	AC	0.021	47.1	0.7	0.08	0.01	46.4	2	3.3	0.18	0.07	43.8	1
SP-0352	1980	122.1	150	AC	0.028	25.4	0.2	0.06	0.01	25.2	2	0.2	0.06	0.01	25.2	2
SP-0353	1980	107.2	150	AC	0.010	15.2	0.1	0.07	0.01	15.1	2	0.2	0.07	0.01	15.1	2
SP-0354	1980	49.0	150	AC	0.010	15.2	0.2	0.07	0.01	15.1	2	0.2	0.07	0.01	15.1	2
SP-0355	1980	42.0	150	AC	0.010	15.2	0.4	0.11	0.02	14.9	2	0.4	0.11	0.03	14.9	2
SP-0356	1980	72.5	200	AC	0.010	32.8	0.5	0.08	0.01	32.3	2	0.5	0.09	0.02	32.3	2
SP-0357	1980	17.2	200	AC	0.010	32.8	0.5	0.08	0.02	32.3	2	0.5	0.09	0.02	32.3	2

Pipe ID	Install Year	Length (m)	Diameter (mm)	Material	Slope (/)	Full Flow Capacity (L/s)	2021 PWWF 5-Year 24-Hour I&I					OCP PWWF 5-Year 24-Hour I&I w/ Climate Change				
							Flow (L/s)	d/D	q/Q	Flow Remaining to d/D = 1 (L/s)	LoF	Flow (L/s)	d/D	q/Q	Flow Remaining to d/D = 1 (L/s)	LoF
SP-0358	1980	46.4	200	AC	0.010	32.8	0.8	0.11	0.03	32.0	2	0.9	0.11	0.03	31.9	2
SP-0359	1980	26.0	200	AC	0.086	96.3	0.8	0.07	0.01	95.4	1	0.9	0.07	0.01	95.4	1
SP-0360	1980	107.0	200	AC	0.007	28.4	0.2	0.05	0.01	28.2	2	0.2	0.06	0.01	28.2	2
SP-0361	1980	105.6	200	AC	0.021	47.4	0.3	0.06	0.01	47.0	2	0.3	0.06	0.01	47.0	2
SP-0362	1980	126.1	200	AC	0.054	75.9	0.5	0.06	0.01	75.5	2	0.5	0.06	0.01	75.4	2
SP-0363	1980	44.7	200	AC	0.039	64.7	0.5	0.06	0.01	64.2	2	0.5	0.07	0.01	64.2	2
SP-0364	1980	56.8	375	PVC	0.129	629.1	18.3	0.12	0.03	610.8	1	57.3	0.20	0.09	571.8	1
SP-0365	1981	110.0	250	PVC	0.004	38.5	12.0	0.38	0.31	26.5	2	10.8	0.36	0.28	27.7	2
SP-0366	1981	50.9	250	PVC	0.061	146.5	12.0	0.19	0.08	134.4	1	10.9	0.18	0.07	135.6	1
SP-0367	1981	69.7	250	PVC	0.098	186.1	12.8	0.18	0.07	173.3	1	11.7	0.17	0.06	174.4	1
SP-0368	1981	118.3	250	PVC	0.121	206.7	12.9	0.17	0.06	193.8	1	11.8	0.16	0.06	194.9	1
SP-0369	1981	74.0	250	PVC	0.121	206.5	13.9	0.18	0.07	192.5	1	13.0	0.17	0.06	193.5	1
SP-0370	1981	48.0	250	PVC	0.085	173.8	13.9	0.19	0.08	159.8	1	13.0	0.19	0.07	160.8	1
SP-0371	1981	25.5	250	PVC	0.308	329.9	13.9	0.14	0.04	316.0	1	13.0	0.14	0.04	316.9	1
SP-0372	1981	43.9	150	Unknown	0.114	51.4	0.1	0.03	0.00	51.3	2	0.1	0.04	0.00	51.3	2
SP-0373	1981	108.0	200	PVC	0.034	60.7	0.2	0.05	0.00	60.5	2	0.3	0.05	0.00	60.5	2
SP-0374	1981	95.7	200	PVC	0.029	56.1	0.2	0.04	0.00	55.9	2	0.2	0.04	0.00	55.9	2
SP-0375	1981	65.8	250	PVC	0.091	179.3	14.1	0.19	0.08	165.2	1	13.2	0.18	0.07	166.2	1
SP-0376	1981	104.2	300	PVC	0.002	44.4	14.1	0.39	0.32	30.3	2	13.2	0.37	0.30	31.3	2
SP-0377	1981	55.5	300	PVC	0.002	46.8	14.1	0.38	0.30	32.7	2	13.2	0.36	0.28	33.6	2
SP-0378	1981	45.4	300	PVC	0.002	47.6	14.1	0.37	0.30	33.5	2	13.2	0.36	0.28	34.4	2
SP-0379	1982	132.2	200	PVC	0.035	61.1	0.5	0.06	0.01	60.6	2	0.5	0.06	0.01	60.6	2
SP-0380	1982	7.2	200	PVC	0.025	52.0	1.3	0.11	0.03	50.6	2	1.6	0.12	0.03	50.4	2
SP-0382	1983	78.6	200	PVC	0.049	72.8	0.1	0.03	0.00	72.6	2	0.2	0.03	0.00	72.6	2
SP-0383	1983	29.1	250	PVC	0.001	15.6	0.6	0.13	0.04	15.0	2	0.0	0.00	0.00	15.6	1
SP-0384	1983	81.2	250	PVC	0.002	28.0	0.7	0.11	0.02	27.3	2	0.0	0.00	0.00	28.0	1
SP-0385	1983	13.8	250	PVC	0.001	22.6	0.7	0.12	0.03	21.9	2	0.0	0.00	0.00	22.6	1
SP-0386	1983	9.4	250	PVC	0.002	27.4	0.8	0.11	0.03	26.6	2	0.0	0.00	0.00	27.4	1
SP-0387	1983	50.4	250	PVC	0.003	33.5	0.8	0.11	0.02	32.7	2	0.0	0.00	0.00	33.5	1
SP-0388	1983	15.9	250	PVC	0.002	25.8	0.8	0.12	0.03	25.0	2	0.0	0.00	0.00	25.8	1
SP-0389	1983	39.1	250	PVC	0.002	26.9	0.9	0.12	0.03	26.0	2	0.0	0.00	0.00	26.9	1
SP-0390	1983	116.7	250	PVC	0.001	21.3	0.9	0.14	0.04	20.4	2	0.0	0.00	0.00	21.3	1
SP-0391	1983	87.6	250	PVC	0.002	28.4	0.9	0.12	0.03	27.5	2	0.0	0.00	0.00	28.4	1
SP-0392	1983	101.8	250	PVC	0.002	28.3	0.7	0.11	0.03	27.5	2	0.0	0.00	0.00	28.3	1
SP-0393	1984	20.1	200	DI	0.002	14.6	0.0	0.04	0.00	14.6	2	0.0	0.00	0.00	14.6	1
SP-0394	1984	40.3	150	POLY	0.425	99.2	0.6	0.05	0.01	98.7	1	0.0	0.00	0.00	99.2	1
SP-0396	1986	47.7	150	PVC	0.013	17.5	0.4	0.10	0.02	17.1	2	0.4	0.10	0.02	17.1	2
SP-0397	1986	7.8	150	PVC	0.147	58.4	0.4	0.06	0.01	58.0	1	0.4	0.06	0.01	58.0	1
SP-0398	1986	133.6	150	PVC	0.147	58.4	0.7	0.07	0.01	57.7	1	0.8	0.08	0.01	57.5	1
SP-0399	1986	70.9	150	PVC	0.010	14.9	0.9	0.17	0.06	14.0	2	1.1	0.19	0.08	13.8	2
SP-0400	1986	25.0	150	PVC	0.046	32.7	1.0	0.12	0.03	31.7	1	1.2	0.13	0.04	31.5	1
SP-0401	1986	105.1	150	PVC	0.067	39.5	1.2	0.12	0.03	38.3	1	1.4	0.13	0.04	38.1	1

Pipe ID	Install Year	Length (m)	Diameter (mm)	Material	Slope (/)	Full Flow Capacity (L/s)	2021 PWWF 5-Year 24-Hour I&I					OCP PWWF 5-Year 24-Hour I&I w/ Climate Change				
							Flow (L/s)	d/D	q/Q	Flow Remaining to d/D = 1 (L/s)	LoF	Flow (L/s)	d/D	q/Q	Flow Remaining to d/D = 1 (L/s)	LoF
SP-0402	1986	38.4	150	PVC	0.151	59.1	0.6	0.07	0.01	58.5	1	1.9	0.12	0.03	57.3	1
SP-0403	1986	49.5	200	AC	0.141	123.3	1.8	0.08	0.02	121.5	1	3.3	0.11	0.03	120.0	1
SP-0404	1988	50.5	200	PVC	0.042	67.2	5.7	0.20	0.09	61.5	1	6.4	0.21	0.10	60.8	1
SP-0405	1988	91.5	250	PVC	0.017	78.1	11.4	0.26	0.15	66.7	1	10.2	0.24	0.13	68.0	1
SP-0406	1988	104.1	200	PVC	0.024	51.0	0.2	0.05	0.01	50.8	2	0.2	0.05	0.01	50.8	2
SP-0407	1988	86.4	200	PVC	0.026	52.9	0.3	0.06	0.01	52.6	2	0.4	0.06	0.01	52.6	2
SP-0408	1988	38.6	200	PVC	0.031	57.9	0.0	0.00	0.00	57.9	2	0.0	0.00	0.00	57.9	2
SP-0409	1988	134.0	200	PVC	0.021	47.8	0.1	0.03	0.00	47.7	2	0.1	0.04	0.00	47.7	2
SP-0410	1988	42.8	200	PVC	0.032	59.1	0.1	0.03	0.00	59.0	2	0.1	0.03	0.00	59.0	2
SP-0411	1988	97.0	200	PVC	0.042	66.9	0.6	0.07	0.01	66.3	2	0.7	0.07	0.01	66.2	2
SP-0412	1988	40.8	200	PVC	0.015	39.6	0.6	0.09	0.02	38.9	2	0.7	0.09	0.02	38.9	2
SP-0413	1988	20.0	150	PVC	0.028	25.3	0.0	0.02	0.00	25.3	2	0.0	0.02	0.00	25.3	2
SP-0414	1988	95.9	200	PVC	0.086	96.1	0.9	0.07	0.01	95.2	1	1.0	0.07	0.01	95.1	1
SP-0415	1988	44.6	200	PVC	0.010	33.3	0.1	0.03	0.00	33.3	2	0.1	0.03	0.00	33.3	2
SP-0416	1988	41.8	200	PVC	0.314	183.9	1.0	0.05	0.01	182.9	1	1.1	0.05	0.01	182.8	1
SP-0417	1988	57.0	150	Unknown	0.076	41.9	0.2	0.05	0.01	41.7	2	0.2	0.05	0.01	41.7	2
SP-0418	1988	42.1	150	PVC	0.010	15.2	0.1	0.06	0.01	15.1	2	0.1	0.06	0.01	15.1	2
SP-0419	1988	28.3	150	PVC	0.010	15.2	0.1	0.05	0.00	15.1	2	0.1	0.05	0.01	15.1	2
SP-0420	1988	61.2	200	PVC	0.017	43.2	5.4	0.24	0.13	37.7	1	6.1	0.26	0.14	37.0	1
SP-0421	1988	50.0	200	PVC	0.021	47.3	5.7	0.23	0.12	41.6	1	6.4	0.25	0.14	40.9	1
SP-0422	1988	65.7	150	PVC	0.049	33.6	0.2	0.06	0.01	33.3	2	0.4	0.07	0.01	33.2	2
SP-0423	1988	57.6	150	PVC	0.080	43.0	0.4	0.07	0.01	42.5	1	1.4	0.12	0.03	41.6	1
SP-0424	1988	79.5	150	PVC	0.023	22.9	0.5	0.10	0.02	22.4	2	1.6	0.18	0.07	21.3	2
SP-0425	1988	74.6	150	PVC	0.078	42.6	0.6	0.08	0.01	42.0	1	1.7	0.14	0.04	40.9	1
SP-0426	1989	30.2	200	PVC	0.117	112.1	0.0	0.00	0.00	112.1	2	0.0	0.00	0.00	112.1	2
SP-0427	1989	15.0	200	PVC	0.040	65.7	0.0	0.01	0.00	65.7	2	0.0	0.01	0.00	65.7	2
SP-0428	1989	35.6	200	PVC	0.040	65.7	0.0	0.01	0.00	65.7	2	0.0	0.01	0.00	65.7	2
SP-0429	1989	42.2	200	PVC	0.009	30.3	0.1	0.04	0.00	30.2	2	0.1	0.04	0.00	30.2	2
SP-0430	1989	23.6	200	PVC	0.010	33.1	0.1	0.04	0.00	33.0	2	0.1	0.04	0.00	33.0	2
SP-0431	1989	38.3	200	PVC	0.077	91.2	0.1	0.03	0.00	91.1	2	0.2	0.03	0.00	91.1	2
SP-0432	1989	18.3	200	PVC	0.077	90.8	0.2	0.03	0.00	90.6	2	0.2	0.03	0.00	90.6	2
SP-0433	1989	70.5	200	PVC	0.089	98.0	0.2	0.04	0.00	97.8	2	0.3	0.04	0.00	97.8	2
SP-0434	1990	44.1	200	PVC	0.059	79.5	0.2	0.03	0.00	79.3	2	0.2	0.04	0.00	79.3	2
SP-0435	1990	46.4	200	PVC	0.077	91.1	0.3	0.04	0.00	90.8	2	0.4	0.05	0.00	90.7	2
SP-0436	1990	27.7	200	PVC	0.017	42.7	0.5	0.08	0.01	42.2	2	0.5	0.08	0.01	42.1	2
SP-0437	1990	28.2	200	PVC	0.010	32.1	0.5	0.09	0.02	31.6	2	0.6	0.09	0.02	31.5	2
SP-0438	1990	19.2	200	AC	0.020	46.7	0.6	0.08	0.01	46.2	2	0.6	0.08	0.01	46.1	2
SP-0439	1991	36.1	150	PVC	0.014	18.3	0.4	0.10	0.02	17.9	2	0.4	0.10	0.02	17.9	2
SP-0440	1991	33.3	250	PVC	0.007	50.5	0.4	0.06	0.01	50.1	2	0.4	0.06	0.01	50.1	2
SP-0441	1990	32.3	200	PVC	0.020	46.5	0.4	0.06	0.01	46.2	2	0.5	0.07	0.01	46.0	2
SP-0442	1990	55.1	200	PVC	0.023	50.2	0.4	0.06	0.01	49.8	2	0.5	0.07	0.01	49.7	2
SP-0443	1990	102.8	200	PVC	0.000	6.5	0.2	0.11	0.03	6.3	2	0.2	0.11	0.03	6.3	2

Pipe ID	Install Year	Length (m)	Diameter (mm)	Material	Slope (/)	Full Flow Capacity (L/s)	2021 PWWF 5-Year 24-Hour I&I					OCP PWWF 5-Year 24-Hour I&I w/ Climate Change				
							Flow (L/s)	d/D	q/Q	Flow Remaining to d/D = 1 (L/s)	LoF	Flow (L/s)	d/D	q/Q	Flow Remaining to d/D = 1 (L/s)	LoF
SP-0444	1990	63.1	200	PVC	0.030	56.8	0.3	0.05	0.01	56.4	2	0.3	0.06	0.01	56.4	2
SP-0445	1990	46.5	200	PVC	0.033	59.3	0.5	0.06	0.01	58.8	2	0.5	0.07	0.01	58.8	2
SP-0446	1990	47.8	200	PVC	0.008	30.0	0.5	0.09	0.02	29.5	2	0.5	0.09	0.02	29.5	2
SP-0447	1990	50.7	200	PVC	0.052	75.0	0.5	0.06	0.01	74.5	2	0.5	0.06	0.01	74.5	2
SP-0448	1990	109.3	200	PVC	0.069	86.4	0.7	0.07	0.01	85.7	1	0.8	0.07	0.01	85.6	1
SP-0449	1993	46.4	200	PVC	0.024	51.0	2.0	0.13	0.04	49.0	1	10.1	0.30	0.20	40.9	1
SP-0450	1993	11.8	200	PVC	0.005	23.4	2.0	0.20	0.09	21.4	2	10.1	0.46	0.43	13.4	2
SP-0451	1993	7.6	200	PVC	0.049	72.8	0.0	0.00	0.00	72.8	2	0.0	0.00	0.00	72.8	2
SP-0452	1993	68.6	200	PVC	0.038	63.7	2.0	0.12	0.03	61.7	1	10.2	0.27	0.16	53.5	1
SP-0453	1993	75.5	200	PVC	0.069	86.2	2.0	0.11	0.02	84.1	1	10.2	0.23	0.12	75.9	1
SP-0454	1994	34.9	200	PVC	0.011	35.1	0.8	0.10	0.02	34.4	2	8.8	0.34	0.25	26.4	1
SP-0455	1994	51.0	200	PVC	0.030	57.0	0.8	0.08	0.01	56.2	2	8.8	0.27	0.15	48.2	1
SP-0456	1994	82.9	200	PVC	0.039	64.8	0.8	0.08	0.01	64.1	2	8.8	0.25	0.14	56.0	1
SP-0457	1994	14.2	200	PVC	0.102	105.0	0.8	0.06	0.01	104.2	1	8.8	0.20	0.08	96.2	1
SP-0458	1994	97.8	200	PVC	0.060	80.4	0.2	0.04	0.00	80.2	2	0.2	0.04	0.00	80.2	2
SP-0459	1994	44.2	200	PVC	0.010	32.8	0.0	0.02	0.00	32.8	2	0.0	0.02	0.00	32.8	2
SP-0460	1994	56.9	200	PVC	0.052	74.5	0.3	0.04	0.00	74.3	2	0.3	0.04	0.00	74.3	2
SP-0461	1994	49.7	200	PVC	0.053	75.2	0.1	0.02	0.00	75.1	2	0.1	0.03	0.00	75.1	2
SP-0462	1994	47.9	200	PVC	0.056	77.7	0.1	0.03	0.00	77.6	2	0.1	0.03	0.00	77.6	2
SP-0463	1994	49.3	200	PVC	0.015	39.6	0.7	0.09	0.02	38.9	2	0.9	0.10	0.02	38.7	2
SP-0464	1994	35.5	200	PVC	0.037	63.0	0.1	0.03	0.00	62.9	2	0.1	0.03	0.00	62.9	2
SP-0465	1994	22.4	200	PVC	0.038	63.9	0.1	0.03	0.00	63.8	2	0.1	0.03	0.00	63.8	2
SP-0466	1994	39.1	200	PVC	0.037	62.7	0.1	0.04	0.00	62.6	2	0.2	0.04	0.00	62.6	2
SP-0467	1994	63.7	200	PVC	0.028	55.0	0.9	0.09	0.02	54.1	2	1.1	0.10	0.02	53.9	2
SP-0468	1994	108.5	300	PVC	0.013	111.4	4.2	0.13	0.04	107.2	1	40.3	0.42	0.36	71.1	1
SP-0469	1994	78.8	200	PVC	0.030	57.0	0.3	0.05	0.01	56.7	2	0.3	0.06	0.01	56.7	2
SP-0470	1994	101.6	300	PVC	0.018	128.7	4.2	0.12	0.03	124.5	1	44.2	0.40	0.34	84.5	1
SP-0471	1994	38.6	300	PVC	0.010	98.4	4.2	0.14	0.04	94.2	2	44.2	0.47	0.45	54.2	1
SP-0472	1994	65.6	300	PVC	0.050	215.3	4.2	0.10	0.02	211.1	1	44.2	0.31	0.21	171.1	1
SP-0473	1994	32.1	300	PVC	0.053	223.3	4.2	0.10	0.02	219.1	1	44.2	0.30	0.20	179.1	1
SP-0474	1994	75.7	300	PVC	0.105	313.9	4.2	0.08	0.01	309.7	1	44.2	0.25	0.14	269.7	1
SP-0475	1994	47.3	300	PVC	0.301	530.4	4.2	0.06	0.01	526.2	1	44.2	0.20	0.08	486.2	1
SP-0476	1994	34.7	300	PVC	0.090	290.1	4.2	0.08	0.01	285.9	1	44.2	0.26	0.15	245.9	1
SP-0477	1994	31.6	300	PVC	0.601	749.4	4.2	0.05	0.01	745.2	1	44.2	0.17	0.06	705.2	1
SP-0478	1995	106.0	300	PVC	0.013	111.5	4.1	0.13	0.04	107.4	1	40.2	0.42	0.36	71.3	1
SP-0479	1995	84.6	150	PVC	0.015	18.4	0.1	0.05	0.00	18.4	2	0.1	0.05	0.00	18.4	2
SP-0480	1995	5.1	150	PVC	0.002	6.7	0.1	0.07	0.01	6.6	2	0.1	0.07	0.01	6.6	2
SP-0481	1995	77.5	150	PVC	0.002	7.0	0.2	0.11	0.03	6.8	2	0.2	0.12	0.03	6.8	2
SP-0482	1995	47.3	200	PVC	0.003	17.2	0.2	0.08	0.01	16.9	2	0.3	0.09	0.02	16.9	2
SP-0483	1995	27.7	200	PVC	0.008	29.3	0.3	0.07	0.01	29.0	2	0.3	0.08	0.01	29.0	2
SP-0484	1995	48.5	200	PVC	0.010	32.8	0.1	0.03	0.00	32.7	2	0.1	0.03	0.00	32.7	2
SP-0485	1995	54.6	200	AC	0.204	148.3	0.3	0.03	0.00	148.0	1	0.3	0.04	0.00	148.0	1

Pipe ID	Install Year	Length (m)	Diameter (mm)	Material	Slope (/)	Full Flow Capacity (L/s)	2021 PWWF 5-Year 24-Hour I&I					OCP PWWF 5-Year 24-Hour I&I w/ Climate Change				
							Flow (L/s)	d/D	q/Q	Flow Remaining to d/D = 1 (L/s)	LoF	Flow (L/s)	d/D	q/Q	Flow Remaining to d/D = 1 (L/s)	LoF
SP-0486	1995	64.2	200	AC	0.200	146.7	0.5	0.04	0.00	146.2	1	0.6	0.05	0.00	146.1	1
SP-0488	1996	100.0	300	PVC	0.037	187.0	2.5	0.08	0.01	184.5	1	10.5	0.16	0.06	176.5	1
SP-0489	1996	67.7	300	PVC	0.009	91.1	2.5	0.11	0.03	88.6	2	10.5	0.23	0.12	80.5	1
SP-0490	1996	106.3	300	PVC	0.009	92.9	2.5	0.11	0.03	90.4	2	10.5	0.23	0.11	82.3	1
SP-0491	1996	42.9	300	PVC	0.010	94.6	2.9	0.12	0.03	91.7	2	21.9	0.33	0.23	72.7	1
SP-0492	1996	64.0	300	PVC	0.009	91.3	3.0	0.12	0.03	88.3	2	21.9	0.33	0.24	69.4	1
SP-0493	1996	42.6	300	PVC	0.011	99.4	3.0	0.12	0.03	96.4	2	23.3	0.33	0.23	76.1	1
SP-0494	1996	59.7	300	PVC	0.017	127.6	3.0	0.11	0.02	124.6	1	23.4	0.29	0.18	104.3	1
SP-0495	1996	69.4	300	PVC	0.011	100.5	3.0	0.12	0.03	97.5	2	23.4	0.33	0.23	77.2	1
SP-0496	1996	100.5	300	PVC	0.015	117.8	3.1	0.11	0.03	114.6	2	23.5	0.30	0.20	94.3	1
SP-0497	1996	95.2	300	PVC	0.020	136.3	3.1	0.11	0.02	133.1	1	23.5	0.28	0.17	112.8	1
SP-0498	1996	101.4	300	PVC	0.031	171.0	3.1	0.09	0.02	167.8	1	23.5	0.25	0.14	147.5	1
SP-0499	1996	106.9	200	PVC	0.097	102.4	0.1	0.03	0.00	102.3	2	0.1	0.03	0.00	102.3	2
SP-0500	1996	55.2	200	PVC	0.130	118.4	0.2	0.03	0.00	118.2	2	0.2	0.03	0.00	118.2	2
SP-0501	1996	67.0	200	PVC	0.018	44.2	0.3	0.06	0.01	43.9	2	0.4	0.07	0.01	43.9	2
SP-0502	1996	52.4	200	PVC	0.146	125.3	0.4	0.04	0.00	124.8	1	0.5	0.04	0.00	124.8	1
SP-0503	1996	40.3	150	PVC	0.010	15.2	0.2	0.08	0.01	15.0	2	0.2	0.08	0.01	15.0	2
SP-0504	1996	24.9	150	PVC	0.010	15.2	0.2	0.07	0.01	15.1	2	0.2	0.08	0.01	15.0	2
SP-0505	1996	31.7	150	PVC	0.010	15.2	0.2	0.07	0.01	15.1	2	0.2	0.08	0.01	15.0	2
SP-0507	1996	37.7	150	PVC	0.055	35.6	0.2	0.06	0.01	35.3	2	0.3	0.06	0.01	35.3	2
SP-0508	1996	9.6	150	PVC	0.108	50.0	0.4	0.07	0.01	49.6	1	1.2	0.11	0.02	48.8	1
SP-0509	1996	37.1	150	PVC	0.047	33.1	0.2	0.05	0.01	32.9	2	0.2	0.05	0.01	32.9	2
SP-0510	1996	44.7	150	PVC	0.139	56.7	0.2	0.04	0.00	56.6	2	0.2	0.04	0.00	56.5	1
SP-0511	1996	49.0	150	PVC	0.158	60.5	0.4	0.06	0.01	60.0	1	1.2	0.10	0.02	59.2	1
SP-0512	1996	14.8	150	PVC	0.099	47.9	0.4	0.07	0.01	47.5	1	1.3	0.12	0.03	46.6	1
SP-0514	1997	71.7	200	PVC	0.035	61.7	0.1	0.03	0.00	61.7	2	0.1	0.03	0.00	61.7	2
SP-0515	1997	72.8	200	PVC	0.021	48.0	1.2	0.11	0.03	46.8	2	1.3	0.11	0.03	46.7	2
SP-0518	1998	83.3	150	AC	0.146	58.1	0.1	0.04	0.00	58.0	2	0.1	0.04	0.00	58.0	2
SP-0519	1998	109.6	150	AC	0.129	54.7	0.3	0.05	0.01	54.5	1	0.3	0.05	0.01	54.4	1
SP-0520	1998	55.4	150	PVC	0.010	15.2	0.1	0.07	0.01	15.1	2	0.2	0.07	0.01	15.1	2
SP-0521	2001	59.9	300	PVC	0.068	252.4	2.5	0.07	0.01	249.9	1	10.2	0.14	0.04	242.2	1
SP-0522	2002	97.1	300	PVC	0.065	246.3	2.5	0.07	0.01	243.8	1	9.2	0.13	0.04	237.1	1
SP-0525	2005	64.7	200	PVC	0.016	41.8	0.2	0.04	0.00	41.6	2	0.2	0.05	0.01	41.6	2
SP-0526	2005	75.1	200	PVC	0.024	51.2	0.1	0.03	0.00	51.1	2	0.1	0.03	0.00	51.1	2
SP-0527	2005	43.9	200	PVC	0.020	46.4	0.4	0.06	0.01	46.1	2	0.4	0.07	0.01	46.0	2
SP-0528	2005	74.6	200	PVC	0.016	41.4	0.4	0.07	0.01	41.0	2	0.5	0.07	0.01	41.0	2
SP-0529	2005	66.2	200	PVC	0.011	33.7	0.5	0.08	0.01	33.3	2	0.5	0.09	0.02	33.2	2
SP-0530	2005	77.3	200	PVC	0.045	69.6	0.5	0.06	0.01	69.1	2	0.6	0.07	0.01	69.0	2
SP-0531	1994	54.2	200	PVC	0.053	75.2	0.6	0.06	0.01	74.7	2	0.8	0.07	0.01	74.4	1
SP-0532	2005	14.3	200	PVC	0.024	51.2	0.0	0.02	0.00	51.2	2	0.0	0.02	0.00	51.2	2
SP-0533	2006	24.5	150	PVC	0.079	42.8	0.1	0.03	0.00	42.7	2	0.1	0.03	0.00	42.7	2
SP-0534	2006	110.2	200	PVC	0.044	69.0	0.3	0.05	0.01	68.7	2	0.4	0.06	0.01	68.6	2

Pipe ID	Install Year	Length (m)	Diameter (mm)	Material	Slope (/)	Full Flow Capacity (L/s)	2021 PWWF 5-Year 24-Hour I&I					OCP PWWF 5-Year 24-Hour I&I w/ Climate Change				
							Flow (L/s)	d/D	q/Q	Flow Remaining to d/D = 1 (L/s)	LoF	Flow (L/s)	d/D	q/Q	Flow Remaining to d/D = 1 (L/s)	LoF
SP-0535	2006	110.0	200	PVC	0.065	83.4	0.7	0.06	0.01	82.8	1	0.8	0.07	0.01	82.7	1
SP-0536	2006	77.0	200	PVC	0.053	75.3	0.8	0.07	0.01	74.5	1	0.9	0.08	0.01	74.4	1
SP-0537	2005	31.2	300	PVC	0.095	298.0	0.0	0.00	0.00	298.0	2	0.0	0.00	0.00	298.0	2
SP-0538	2006	17.4	200	PVC	0.054	76.2	0.1	0.02	0.00	76.2	2	0.1	0.02	0.00	76.2	2
SP-0539	2006	68.6	200	PVC	0.025	51.9	0.2	0.04	0.00	51.8	2	0.2	0.04	0.00	51.8	2
SP-0540	2006	58.5	200	PVC	0.004	20.1	0.3	0.09	0.02	19.8	2	0.4	0.09	0.02	19.8	2
SP-0541	2006	63.7	200	PVC	0.019	45.6	0.6	0.08	0.01	45.0	2	0.6	0.08	0.01	44.9	2
SP-0542	2006	41.9	200	PVC	0.004	20.9	0.7	0.12	0.03	20.2	2	0.7	0.13	0.04	20.2	2
SP-0543	2006	11.7	200	PVC	0.004	20.1	0.3	0.08	0.01	19.8	2	0.3	0.08	0.01	19.8	2
SP-0544	2006	99.2	200	PVC	0.131	118.7	0.1	0.03	0.00	118.5	2	0.2	0.03	0.00	118.5	2
SP-0545	2006	47.7	200	PVC	0.137	121.3	0.3	0.04	0.00	121.1	1	0.3	0.04	0.00	121.0	1
SP-0546	2006	36.3	200	PVC	0.136	121.0	0.3	0.04	0.00	120.7	1	0.3	0.04	0.00	120.7	1
SP-0547	2006	7.1	200	PVC	0.126	116.5	0.3	0.04	0.00	116.2	1	0.3	0.04	0.00	116.2	1
SP-0548	2006	40.7	200	PVC	0.031	57.9	0.0	0.02	0.00	57.9	2	0.0	0.02	0.00	57.9	2
SP-0549	2006	20.1	200	PVC	0.026	53.3	0.3	0.05	0.01	53.0	2	0.3	0.05	0.01	53.0	2
SP-0550	2009	60.0	200	PVC	0.005	24.0	0.0	0.00	0.00	24.0	2	0.0	0.00	0.00	24.0	2
SP-0551	2009	6.8	200	PVC	0.032	58.9	0.0	0.00	0.00	58.9	2	0.0	0.00	0.00	58.9	2
SP-0552	2007	67.9	200	PVC	0.039	65.0	0.0	0.01	0.00	65.0	2	0.0	0.01	0.00	65.0	2
SP-0553	2007	108.5	200	PVC	0.044	68.5	0.3	0.05	0.01	68.2	2	0.3	0.05	0.01	68.2	2
SP-0554	2007	79.9	200	PVC	0.025	51.5	0.6	0.08	0.01	50.9	2	0.7	0.08	0.01	50.8	2
SP-0555	2007	61.3	200	PVC	0.032	58.5	2.0	0.13	0.03	56.5	1	2.2	0.13	0.04	56.2	1
SP-0556	2007	61.6	200	PVC	0.026	52.9	2.0	0.13	0.04	50.9	1	2.3	0.14	0.04	50.6	1
SP-0557	2007	10.8	200	PVC	0.096	101.9	2.0	0.10	0.02	99.9	1	2.2	0.10	0.02	99.6	1
SP-0558	2007	21.9	100	PVC	0.010	5.2	0.0	0.00	0.00	5.2	2	0.0	0.00	0.00	5.2	2
SP-0559	2009	44.3	150	PVC	0.014	18.0	0.1	0.04	0.00	18.0	2	0.1	0.04	0.00	17.9	2
SP-0560	2011	85.7	200	PVC	0.015	39.9	0.1	0.03	0.00	39.9	2	0.1	0.03	0.00	39.9	2
SP-0561	2011	62.7	200	PVC	0.009	31.6	0.0	0.01	0.00	31.5	2	0.8	0.11	0.02	30.8	2
SP-0562	2011	11.4	200	PVC	0.006	25.7	0.1	0.04	0.00	25.6	2	0.8	0.12	0.03	24.9	2
SP-0563	2011	48.3	200	PVC	0.007	28.3	0.1	0.05	0.01	28.2	2	0.9	0.12	0.03	27.4	2
SP-0564	2011	37.2	200	PVC	0.006	25.8	0.1	0.05	0.01	25.7	2	0.9	0.13	0.04	24.9	2
SP-0565	2011	56.0	200	PVC	0.012	36.1	0.2	0.05	0.01	35.9	2	1.0	0.11	0.03	35.2	2
SP-0566	2011	40.4	200	PVC	0.012	36.1	0.0	0.03	0.00	36.1	2	0.0	0.03	0.00	36.1	2
SP-0567	2011	48.2	200	PVC	0.005	24.1	0.3	0.08	0.01	23.8	2	1.2	0.15	0.05	22.9	2
SP-0568	2011	9.4	200	PVC	0.029	55.6	0.2	0.04	0.00	55.5	2	0.2	0.05	0.00	55.4	2
SP-0569	2011	82.3	200	PVC	0.017	42.6	0.2	0.05	0.01	42.4	2	1.1	0.11	0.03	41.5	2
SP-0570	2011	107.1	200	PVC	0.005	23.3	0.1	0.05	0.00	23.2	2	0.9	0.14	0.04	22.4	2
SP-0571	2011	49.8	200	PVC	0.004	21.8	0.0	0.03	0.00	21.8	2	0.9	0.14	0.04	21.0	2
SP-0572	2011	77.7	200	PVC	0.010	33.5	1.0	0.12	0.03	32.5	2	3.0	0.20	0.09	30.5	2
SP-0573	2011	17.5	200	PVC	0.013	37.6	1.0	0.11	0.03	36.6	2	3.0	0.19	0.08	34.6	2
SP-0574	2011	73.8	200	PVC	0.009	31.9	1.0	0.12	0.03	30.9	2	3.1	0.21	0.10	28.9	2
SP-0575	2011	71.7	200	PVC	0.015	40.4	1.0	0.11	0.03	39.4	2	3.1	0.19	0.08	37.4	1
SP-0576	1977	45.8	200	AC	0.004	20.0	0.0	0.00	0.00	20.0	2	0.0	0.02	0.00	20.0	2

							2021 PWWF 5-Year 24-Hour I&I					OCP PWWF 5-Year 24-Hour I&I w/ Climate Change				
Pipe ID	Install Year	Length (m)	Diameter (mm)	Material	Slope (/)	Full Flow Capacity (L/s)	Flow (L/s)	d/D	q/Q	Flow Remaining to d/D = 1 (L/s)	LoF	Flow (L/s)	d/D	q/Q	Flow Remaining to d/D = 1 (L/s)	LoF
SP-0577	2011	7.5	200	PVC	0.058	79.0	0.0	0.00	0.00	79.0	2	0.0	0.00	0.00	79.0	2
SP-0578	2011	34.8	300	PVC	0.014	115.8	1.2	0.07	0.01	114.7	2	3.3	0.12	0.03	112.6	2
SP-0579	2011	31.5	300	PVC	0.053	222.6	1.2	0.05	0.01	221.4	1	3.6	0.09	0.02	219.0	1
SP-0580	2011	49.3	300	PVC	0.050	217.2	1.2	0.05	0.01	216.1	1	3.6	0.09	0.02	213.6	1
SP-0581	2011	97.2	300	PVC	0.045	204.1	1.3	0.06	0.01	202.9	1	3.7	0.09	0.02	200.4	1
SP-0582	2010	11.4	200	PVC	0.058	78.8	0.1	0.03	0.00	78.7	2	0.1	0.03	0.00	78.6	2
SP-0583	1972	97.9	150	Unknown	0.003	8.9	0.2	0.10	0.02	8.7	2	0.0	0.00	0.00	8.9	1
SP-0584	2006	43.1	200	PVC	0.013	37.4	0.7	0.09	0.02	36.7	2	0.7	0.10	0.02	36.7	2
SP-0586	2010	51.0	200	PVC	0.016	41.1	0.1	0.04	0.00	41.0	2	0.2	0.04	0.00	40.9	2
SP-0588	2008	16.8	150	Unknown	0.024	23.7	0.9	0.13	0.04	22.9	2	0.9	0.13	0.04	22.8	2
SP-0589	2008	15.3	200	PVC	0.039	64.8	0.0	0.02	0.00	64.8	2	0.0	0.02	0.00	64.8	2
SP-0590	2006	55.8	200	PVC	0.060	80.5	0.2	0.04	0.00	80.4	2	0.2	0.04	0.00	80.4	2
SP-0591	1996	38.6	300	PVC	0.008	85.3	2.9	0.13	0.03	82.4	2	21.9	0.35	0.26	63.4	1
SP-0592	2006	17.5	150	PVC	0.018	20.5	0.0	0.04	0.00	20.5	2	0.1	0.04	0.00	20.5	2
SP-0593	1998	1.7	200	Unknown	0.047	70.9	3.1	0.14	0.04	67.8	1	23.5	0.40	0.33	47.5	1
SP-0594	1995	45.7	150	PVC	0.005	10.4	0.0	0.05	0.00	10.4	2	0.0	0.05	0.01	10.4	2
SP-0595	1982	11.5	200	Unknown	0.004	19.9	0.0	0.00	0.00	19.9	2	0.0	0.00	0.00	19.9	2
SP-0596	1973	49.7	150	AC	0.161	61.1	0.1	0.03	0.00	61.1	2	0.1	0.03	0.00	61.0	2
SP-0597	Unknown	85.0	150	Unknown	0.000	1.7	0.4	0.32	0.22	1.4	2	0.4	0.33	0.23	1.3	2
SP-0598A	1972	35.7	200	AC	0.068	85.7	5.4	0.17	0.06	80.3	1	6.4	0.19	0.07	79.3	1
SP-0598B	2020	39.2	300	PVC	0.057	230.1	1.3	0.06	0.01	228.8	1	1.6	0.06	0.01	228.5	1
SP-0599	2015	46.6	200	HDPE	0.092	99.4	0.1	0.03	0.00	99.3	2	0.2	0.03	0.00	99.2	2
SP-0600	1971	50.1	200	AC	0.007	27.0	3.2	0.23	0.12	23.9	2	0.8	0.12	0.03	26.3	2
SP-0601	1971	69.9	200	AC	0.018	43.7	3.4	0.19	0.08	40.2	1	1.0	0.11	0.02	42.6	2
SP-0602	1972	14.4	150	AC	0.010	15.2	0.1	0.06	0.01	15.1	2	0.1	0.07	0.01	15.1	2
SP-0604	2012	111.5	250	PVC	0.010	60.4	0.2	0.04	0.00	60.2	2	8.2	0.25	0.14	52.2	1
SP-0605A	2014	25.7	450	PVC	0.014	333.0	0.0	0.00	0.00	333.0	2	0.0	0.00	0.00	333.0	2
SP-0605B	2012	3.4	250	PVC	0.010	60.7	0.2	0.04	0.00	60.5	2	7.3	0.23	0.12	53.4	1
SP-0606A	2014	53.4	300	PVC	0.095	298.0	0.0	0.00	0.00	298.0	2	0.0	0.00	0.00	298.0	2
SP-0606B	1977	2.5	150	AC	0.041	30.8	0.1	0.04	0.00	30.7	2	0.1	0.04	0.00	30.7	2
SP-0608	2012	7.6	150	PVC	0.032	27.2	0.0	0.00	0.00	27.2	2	0.0	0.00	0.00	27.2	2
SP-0609	2015	75.2	200	PVC	0.021	47.2	2.9	0.17	0.06	44.3	1	3.5	0.18	0.07	43.8	1
SP-0610	2015	97.0	200	PVC	0.029	55.9	3.0	0.16	0.05	52.9	1	3.6	0.17	0.06	52.4	1
SP-0611	2015	24.4	300	PVC	0.037	185.7	3.0	0.09	0.02	182.7	1	3.6	0.10	0.02	182.2	1
SP-0612	2015	14.1	300	PVC	0.031	169.1	5.4	0.12	0.03	163.6	1	6.1	0.13	0.04	162.9	1
SP-0613	2015	6.9	200	PVC	0.182	139.9	2.4	0.09	0.02	137.5	1	2.6	0.09	0.02	137.3	1
SP-0615	2016	37.3	200	PVC	0.006	25.2	0.1	0.04	0.00	25.1	2	0.1	0.04	0.00	25.1	2
SP-0616	2016	23.3	200	PVC	0.010	32.6	0.1	0.04	0.00	32.5	2	0.1	0.05	0.00	32.5	2
SP-0617	2014	52.7	200	PVC	0.007	27.5	0.1	0.04	0.00	27.4	2	0.1	0.04	0.00	27.4	2
SP-0618	2011	26.3	150	PVC	0.005	11.2	0.0	0.04	0.00	11.2	2	0.0	0.04	0.00	11.2	2
SP-0619	2017	96.6	200	PVC	0.006	25.0	0.2	0.06	0.01	24.8	2	0.2	0.07	0.01	24.7	2
SP-0620	2017	102.5	200	PVC	0.012	35.2	0.1	0.04	0.00	35.1	2	0.2	0.05	0.01	35.0	2

Pipe ID	Install Year	Length (m)	Diameter (mm)	Material	Slope (/)	Full Flow Capacity (L/s)	2021 PWWF 5-Year 24-Hour I&I					OCP PWWF 5-Year 24-Hour I&I w/ Climate Change				
							Flow (L/s)	d/D	q/Q	Flow Remaining to d/D = 1 (L/s)	LoF	Flow (L/s)	d/D	q/Q	Flow Remaining to d/D = 1 (L/s)	LoF
SP-0621	2017	5.7	200	PVC	0.010	33.6	0.0	0.00	0.00	33.6	2	0.0	0.00	0.00	33.6	2
PPE-1002	Unknown	5.0	200	PVC	0.005	22.3	0.3	0.08	0.01	22.0	2	0.3	0.08	0.01	22.0	2
PPE-1003	Unknown	30.0	200	PVC	0.015	39.5	0.9	0.10	0.02	38.7	2	0.9	0.11	0.02	38.6	2
PPE-1004	Unknown	58.4	200	PVC	0.137	121.5	2.2	0.09	0.02	119.3	1	2.9	0.11	0.02	118.6	1
PPE-1005	Unknown	11.3	200	AC	0.028	55.1	0.1	0.04	0.00	55.0	2	0.4	0.06	0.01	54.7	2
PPE-1006	Unknown	42.8	200	AC	0.028	55.1	0.1	0.03	0.00	55.0	2	0.4	0.06	0.01	54.7	2
PPE-1007	Unknown	10.0	600	Unknown	0.100	1,941.7	93.7	0.15	0.05	1,848.0	2	132.6	0.18	0.07	1,809.0	2

**Manhole Modeling Results**

Manhole ID	Depth (m)	Diameter (mm)	Invert Elevation (m)	Crown Elevation (m)	Rim Elevation (m)	2021 PWWF 5-Year 24-Hour I&I HGL (m)	OCP PWWF 5-Year 24-Hour I&I w/ Climate Change HGL (m)
SH-0001	1.50	1,050	117.38	117.53	118.88	117.53	117.54
SH-0002	1.59	1,050	112.41	112.61	114.00	112.43	112.43
SH-0003	1.51	1,050	117.37	117.52	118.88	117.39	117.39
SH-0004	1.28	1,050	121.89	122.09	123.17	121.92	121.92
SH-0006	1.70	1,050	99.80	99.95	101.50	99.80	99.80
SH-0007	2.50	1,050	99.00	99.20	101.50	99.01	99.01
SH-0008	1.60	1,050	94.70	94.90	96.30	94.71	94.71
SH-0009	1.20	1,050	86.50	86.70	87.70	86.51	86.51
SH-0010	1.40	1,050	81.10	81.30	82.50	81.11	81.12
SH-0011	1.16	1,050	52.30	52.50	53.46	52.32	52.32
SH-0012	1.40	1,050	105.80	106.10	107.20	105.85	105.85
SH-0014	0.88	1,050	16.52	16.72	17.40	16.56	16.57
SH-0015	1.39	1,050	17.96	18.16	19.35	18.00	18.01
SH-0016	1.59	1,050	68.81	68.96	70.40	68.82	68.82
SH-0017	1.08	1,050	123.91	124.11	124.99	123.94	123.94
SH-0018	0.81	1,050	117.94	118.09	118.75	117.98	117.96
SH-0019	3.21	1,050	117.18	117.38	120.39	117.23	117.20
SH-0020	1.82	1,050	123.17	123.37	124.99	123.20	123.20
SH-0021	2.32	1,050	101.58	101.83	103.90	101.65	101.64
SH-0022	2.20	1,050	104.81	105.01	107.01	104.84	104.84
SH-0023	2.81	1,050	106.91	107.11	109.72	106.95	106.94
SH-0024	1.58	1,050	113.29	113.49	114.87	113.32	113.31
SH-0025	1.77	1,050	114.93	115.13	116.70	114.97	114.96
SH-0026	2.22	1,050	115.00	115.20	117.22	115.06	115.05
SH-0027	2.08	1,050	115.60	115.80	117.68	115.65	115.63
SH-0028	1.95	1,050	95.92	96.12	97.87	95.93	95.93
SH-0029	1.93	1,050	67.29	67.49	69.22	67.30	67.31
SH-0030	1.72	1,050	69.33	69.53	71.05	69.35	69.35
SH-0031	2.19	1,050	70.07	70.27	72.26	70.08	70.08
SH-0032	1.72	1,050	71.15	71.35	72.87	71.16	71.16
SH-0033	1.34	1,050	62.66	62.81	64.00	62.67	62.67
SH-0034	1.50	1,050	61.62	61.77	63.12	61.63	61.63
SH-0035	1.28	1,050	52.47	52.67	53.75	52.49	52.49
SH-0036	1.67	1,050	51.85	52.05	53.52	51.86	51.86
SH-0037	1.60	1,050	43.02	43.22	44.62	43.03	43.03
SH-0038	1.33	1,050	45.00	45.15	46.33	45.01	45.01

Manhole ID	Depth (m)	Diameter (mm)	Invert Elevation (m)	Crown Elevation (m)	Rim Elevation (m)	2021 PWWF 5-Year 24-Hour I&I HGL (m)	OCP PWWF 5-Year 24-Hour I&I w/ Climate Change HGL (m)
SH-0039	1.88	1,050	29.69	29.89	31.57	29.70	29.70
SH-0040	1.92	1,050	20.66	20.86	22.58	20.67	20.67
SH-0041	1.51	1,050	27.78	27.98	29.29	27.79	27.79
SH-0042	1.62	1,050	33.92	34.07	35.54	33.92	33.92
SH-0043	1.55	1,050	21.76	21.91	23.31	21.78	21.78
SH-0044	1.63	1,050	23.43	23.58	25.06	23.44	23.44
SH-0045	1.39	1,050	11.39	11.59	12.78	11.41	11.41
SH-0046	2.35	1,050	12.46	12.66	14.81	12.48	12.48
SH-0047	1.75	1,050	9.83	10.03	11.58	9.84	9.84
SH-0048	1.72	1,050	13.93	14.13	15.65	13.94	13.94
SH-0049	2.23	1,050	15.00	15.15	17.23	15.01	15.01
SH-0050	2.87	1,050	74.21	74.41	77.08	74.23	74.23
SH-0051	1.14	1,050	80.88	81.08	82.02	80.89	80.89
SH-0052	0.30	1,050	85.38	85.58	85.68	85.39	85.39
SH-0053	1.26	1,050	81.98	82.13	83.24	81.99	81.99
SH-0054	1.94	1,050	77.99	78.14	79.93	78.00	78.00
SH-0055	3.94	1,050	5.99	6.19	9.93	6.01	6.01
SH-0056	1.83	1,050	67.05	67.25	68.88	67.07	67.07
SH-0057	1.44	1,050	72.09	72.29	73.53	72.09	72.09
SH-0058	1.75	1,050	75.77	75.97	77.52	75.77	75.77
SH-0059	1.71	1,050	54.70	54.90	56.41	54.74	54.75
SH-0060	1.65	1,050	63.57	63.77	65.22	63.61	63.61
SH-0061	1.46	1,050	69.13	69.33	70.59	69.17	69.18
SH-0062	1.44	1,050	74.21	74.41	75.65	74.25	74.26
SH-0063	1.86	1,050	47.54	47.74	49.40	47.58	47.59
SH-0064	2.01	1,050	40.08	40.28	42.09	40.11	40.12
SH-0065	1.58	1,050	18.96	19.16	20.54	18.98	18.98
SH-0066	1.16	1,050	27.32	27.52	28.48	27.33	27.33
SH-0067	1.29	1,050	31.96	32.16	33.25	31.97	31.97
SH-0068	2.06	1,050	33.32	33.52	35.38	33.34	33.34
SH-0069	1.83	1,050	39.01	39.21	40.84	39.02	39.02
SH-0070	2.19	1,050	45.11	45.31	47.30	45.12	45.12
SH-0071	2.32	1,050	52.27	52.47	54.59	52.28	52.28
SH-0072	1.94	1,050	57.55	57.75	59.49	57.56	57.56
SH-0073	2.22	1,050	62.12	62.32	64.34	62.13	62.13
SH-0074	0.90	1,050	44.48	44.68	45.38	44.49	44.49
SH-0075	1.68	1,050	59.76	59.91	61.44	59.77	59.77

Manhole ID	Depth (m)	Diameter (mm)	Invert Elevation (m)	Crown Elevation (m)	Rim Elevation (m)	2021 PWWF 5-Year 24-Hour I&I HGL (m)	OCP PWWF 5-Year 24-Hour I&I w/ Climate Change HGL (m)
SH-0076	1.46	1,050	63.58	63.73	65.04	63.59	63.59
SH-0077	4.74	1,050	34.24	34.49	38.98	34.25	34.25
SH-0078	1.71	1,050	39.34	39.54	41.05	39.35	39.35
SH-0079	2.50	1,050	46.32	46.47	48.82	46.32	46.32
SH-0080	1.50	1,050	40.11	40.26	41.60	40.11	40.11
SH-0081	1.93	1,050	48.45	48.60	50.38	48.46	48.46
SH-0082	1.38	1,050	49.02	49.17	50.40	49.04	49.04
SH-0083	1.50	1,050	53.39	53.54	54.89	53.41	53.41
SH-0084	1.32	1,050	39.61	39.81	40.93	39.62	39.62
SH-0085	1.69	1,050	33.30	33.50	34.99	33.31	33.31
SH-0086	2.41	1,050	29.16	29.41	31.57	29.17	29.18
SH-0087	1.30	1,050	29.82	29.97	31.12	29.83	29.83
SH-0088	1.87	1,050	0.29	0.59	2.16	0.40	0.42
SH-0089	1.82	1,050	26.10	26.30	27.92	26.10	26.10
SH-0090	2.75	1,050	30.65	30.85	33.40	30.65	30.65
SH-0091	1.81	1,050	25.65	25.80	27.46	25.66	25.66
SH-0092	1.47	1,050	24.16	24.31	25.63	24.17	24.17
SH-0093	2.00	1,050	15.67	15.92	17.67	15.69	15.69
SH-0094	1.66	1,050	16.14	16.34	17.80	16.16	16.16
SH-0095	2.34	1,050	24.20	24.40	26.54	24.21	24.21
SH-0096	1.36	1,050	25.95	26.15	27.31	25.96	25.96
SH-0097	2.30	1,050	23.63	23.88	25.93	23.65	23.65
SH-0098	1.07	1,050	23.04	23.19	24.11	23.05	23.05
SH-0099	1.85	1,050	17.35	17.50	19.20	17.36	17.36
SH-0100	1.87	1,050	13.09	13.24	14.96	13.10	13.10
SH-0101	1.91	1,050	12.59	12.79	14.50	12.60	12.60
SH-0102	1.75	1,050	10.01	10.21	11.76	10.02	10.02
SH-0103	2.36	1,050	8.94	9.19	11.30	8.96	8.96
SH-0104	3.60	1,050	7.34	7.59	10.94	7.36	7.36
SH-0105	1.84	1,050	10.38	10.58	12.22	10.38	10.38
SH-0106	1.38	1,050	14.19	14.39	15.57	14.19	14.19
SH-0107	2.22	1,050	1.46	1.71	3.68	1.50	1.50
SH-0108	2.52	1,050	18.81	19.01	21.33	18.82	18.82
SH-0109	2.79	1,050	-0.33	0.02	2.46	-0.09	0.02
SH-0110	1.53	1,050	-0.03	0.27	1.50	0.09	0.10
SH-0111	2.01	1,050	0.45	0.70	2.46	0.52	0.52
SH-0112	1.45	1,050	1.01	1.26	2.46	1.06	1.06

Manhole ID	Depth (m)	Diameter (mm)	Invert Elevation (m)	Crown Elevation (m)	Rim Elevation (m)	2021 PWWF 5-Year 24-Hour I&I HGL (m)	OCP PWWF 5-Year 24-Hour I&I w/ Climate Change HGL (m)
SH-0113	1.14	1,050	1.32	1.57	2.46	1.37	1.38
SH-0114	0.77	1,050	1.79	1.99	2.56	1.80	1.80
SH-0115	0.98	1,050	1.91	2.11	2.89	1.92	1.92
SH-0116	0.72	1,050	2.10	2.30	2.82	2.12	2.12
SH-0117	2.79	1,050	97.36	97.56	100.15	97.37	97.37
SH-0118	0.95	1,050	33.52	33.72	34.47	33.56	33.56
SH-0120	1.63	1,050	26.02	26.22	27.65	26.03	26.03
SH-0121	1.42	1,050	1.20	1.40	2.62	1.26	1.27
SH-0125	1.84	1,050	9.46	9.66	11.30	9.48	9.48
SH-0126	2.17	1,050	3.56	3.76	5.73	3.60	3.60
SH-0127	2.32	1,050	1.18	1.38	3.50	1.22	1.22
SH-0128	2.70	1,050	0.12	0.32	2.82	0.15	0.15
SH-0129	1.88	1,050	4.13	4.33	6.01	4.17	4.17
SH-0130	1.62	1,050	6.09	6.24	7.71	6.10	6.10
SH-0131	1.17	1,050	6.93	7.08	8.10	6.94	6.94
SH-0132	2.10	1,050	4.60	4.80	6.70	4.65	4.65
SH-0133	1.99	1,050	9.56	9.76	11.55	9.58	9.58
SH-0134	1.56	1,050	1.48	1.63	3.04	1.49	1.50
SH-0135	2.25	1,050	0.76	0.96	3.01	0.83	0.84
SH-0136	1.51	1,050	1.59	1.79	3.10	1.66	1.67
SH-0137	1.68	1,050	2.61	2.81	4.29	2.64	2.65
SH-0138	1.46	1,050	1.61	1.76	3.07	1.62	1.62
SH-0139	3.81	1,050	6.27	6.47	10.08	6.32	6.32
SH-0140	4.11	1,050	4.45	4.65	8.56	4.50	4.50
SH-0141	3.62	1,050	2.75	2.95	6.37	2.80	2.80
SH-0142	2.22	1,050	11.54	11.74	13.76	11.55	11.55
SH-0143	5.59	1,050	7.80	8.00	13.39	7.84	7.84
SH-0144	5.32	1,050	7.51	7.71	12.83	7.55	7.55
SH-0145	4.08	1,050	7.07	7.27	11.15	7.13	7.13
SH-0146	2.92	1,050	6.81	7.01	9.73	6.87	6.87
SH-0147	2.65	1,050	6.52	6.72	9.17	6.59	6.59
SH-0148	2.80	1,050	9.66	9.86	12.46	9.68	9.68
SH-0149	2.80	1,050	10.24	10.44	13.04	10.26	10.26
SH-0150	4.03	1,050	9.32	9.52	13.35	9.34	9.34
SH-0151	3.69	1,050	9.60	9.75	13.29	9.62	9.62
SH-0152	2.54	1,050	13.03	13.18	15.57	13.04	13.04
SH-0153	1.17	1,050	11.63	11.83	12.80	11.64	11.64

Manhole ID	Depth (m)	Diameter (mm)	Invert Elevation (m)	Crown Elevation (m)	Rim Elevation (m)	2021 PWWF 5-Year 24-Hour I&I HGL (m)	OCP PWWF 5-Year 24-Hour I&I w/ Climate Change HGL (m)
SH-0154	2.24	1,050	11.14	11.34	13.38	11.15	11.15
SH-0155	2.14	1,050	8.86	9.06	11.00	8.87	8.87
SH-0156A	1.70	1,050	15.63	15.83	17.33	15.65	15.65
SH-0156B	2.40	1,050	141.90	142.10	144.30	141.91	141.91
SH-0157	2.76	1,050	-0.32	-0.07	2.44	-0.26	-0.25
SH-0158	6.03	1,050	-0.99	-0.64	5.04	-0.68	-0.67
SH-0159	2.81	1,050	-0.35	0.00	2.46	-0.25	-0.24
SH-0160	2.61	1,050	11.37	11.57	13.98	11.38	11.38
SH-0161	1.05	1,050	0.78	0.98	1.83	0.79	N/A
SH-0162	1.03	1,050	0.61	0.81	1.64	0.62	N/A
SH-0163	1.34	1,050	4.08	4.28	5.42	4.13	4.13
SH-0174	1.12	1,050	111.24	111.44	112.36	111.25	111.25
SH-0175	1.22	1,050	106.90	107.10	108.12	106.91	106.91
SH-0176	1.83	1,050	101.88	102.08	103.71	101.89	101.90
SH-0177	5.15	1,050	92.91	93.11	98.06	92.92	92.92
SH-0179	1.83	1,050	86.19	86.39	88.02	86.22	86.23
SH-0180	1.45	1,050	95.81	96.01	97.26	95.83	95.83
SH-0181	1.83	1,050	79.04	79.24	80.87	79.08	79.08
SH-0182	1.37	1,050	78.13	78.33	79.50	78.17	78.17
SH-0183	2.44	1,050	85.67	85.87	88.11	85.68	85.68
SH-0184	1.83	1,050	85.17	85.37	87.00	85.19	85.19
SH-0185	1.47	1,050	75.23	75.43	76.70	75.27	75.28
SH-0186	7.29	1,050	69.71	69.86	77.00	69.73	69.73
SH-0187	0.99	1,050	123.18	123.33	124.17	123.21	123.24
SH-0188	1.57	1,050	118.81	118.96	120.38	118.86	118.83
SH-0189	2.91	1,050	118.52	118.67	121.43	118.57	118.54
SH-0190	1.40	1,050	118.80	118.95	120.20	118.86	118.82
SH-0191	1.32	1,050	79.25	79.45	80.57	79.25	79.25
SH-0192	1.24	1,050	25.64	25.84	26.88	25.64	25.64
SH-0193	12.82	1,050	48.52	48.67	61.34	48.53	48.53
SH-0194	2.80	1,050	48.06	48.21	50.87	48.08	48.08
SH-0195	1.13	1,050	34.71	34.91	35.84	34.72	34.72
SH-0196	2.20	1,050	21.73	21.93	23.93	21.75	21.75
SH-0197	2.55	1,050	35.49	35.64	38.05	35.51	35.51
SH-0198	7.00	1,050	36.31	36.46	43.31	36.32	36.32
SH-0199	2.37	1,050	19.74	19.94	22.11	19.76	19.76
SH-0200	1.97	1,050	32.27	32.42	34.24	32.28	32.28

Manhole ID	Depth (m)	Diameter (mm)	Invert Elevation (m)	Crown Elevation (m)	Rim Elevation (m)	2021 PWWF 5-Year 24-Hour I&I HGL (m)	OCP PWWF 5-Year 24-Hour I&I w/ Climate Change HGL (m)
SH-0201	1.00	1,050	31.86	32.01	32.86	31.86	31.86
SH-0202	0.48	1,050	22.52	22.67	23.00	22.53	22.53
SH-0203	1.13	1,050	22.15	22.30	23.28	22.16	22.16
SH-0204	1.93	1,050	21.06	21.26	22.99	21.08	21.08
SH-0205	2.45	1,050	22.95	23.25	25.40	22.96	22.96
SH-0206	3.46	1,050	23.84	24.14	27.30	23.85	23.85
SH-0207	5.30	1,050	24.35	24.65	29.65	24.36	24.36
SH-0208	5.21	1,050	23.20	23.50	28.41	23.21	23.21
SH-0210	1.08	1,050	15.82	16.12	16.90	15.83	15.83
SH-0211	4.97	1,050	15.83	16.13	20.80	15.87	15.87
SH-0212	2.19	1,050	21.61	21.91	23.80	21.62	21.62
SH-0213	11.62	1,050	21.55	21.70	33.18	21.57	21.57
SH-0214	1.21	1,050	14.36	14.66	15.57	14.38	14.38
SH-0215	1.52	1,050	13.29	13.59	14.81	13.30	13.31
SH-0216	1.04	1,050	12.68	12.98	13.72	12.69	12.69
SH-0217	0.87	1,050	6.78	7.03	7.65	6.79	6.79
SH-0218	7.12	1,050	121.85	122.00	128.97	121.85	121.85
SH-0220	1.38	1,050	123.16	123.36	124.54	123.18	123.19
SH-0221	1.49	1,050	84.52	84.67	86.01	84.53	84.53
SH-0222	1.95	1,050	95.17	95.32	97.12	95.18	95.18
SH-0223	1.59	1,050	15.61	15.76	17.20	15.62	15.63
SH-0224	1.52	1,050	14.55	14.70	16.07	14.56	14.56
SH-0225	1.69	1,050	10.55	10.75	12.24	10.57	10.57
SH-0226	2.29	1,050	13.74	13.94	16.03	13.76	13.76
SH-0227	3.04	1,050	12.49	12.69	15.53	12.51	12.51
SH-0228	2.55	1,050	10.36	10.56	12.91	10.39	10.39
SH-0229	1.72	1,050	9.99	10.19	11.71	10.02	10.02
SH-0230	2.03	1,050	9.75	9.95	11.78	9.77	9.77
SH-0231	2.54	1,050	12.22	12.42	14.76	12.23	12.23
SH-0232	2.50	1,050	15.95	16.15	18.45	15.96	15.96
SH-0233	1.89	1,050	15.45	15.65	17.34	15.46	15.46
SH-0234	1.79	1,050	24.91	25.11	26.70	24.92	24.92
SH-0235	1.86	1,050	26.10	26.30	27.96	26.12	26.12
SH-0236	1.24	1,050	25.26	25.46	26.50	25.27	25.27
SH-0237	1.42	1,050	13.76	13.96	15.18	13.77	13.77
SH-0238	0.71	1,050	18.38	18.58	19.09	18.39	18.39
SH-0239	1.07	1,050	21.09	21.29	22.16	21.10	21.10

Manhole ID	Depth (m)	Diameter (mm)	Invert Elevation (m)	Crown Elevation (m)	Rim Elevation (m)	2021 PWWF 5-Year 24-Hour I&I HGL (m)	OCP PWWF 5-Year 24-Hour I&I w/ Climate Change HGL (m)
SH-0240	1.55	1,050	10.72	10.92	12.27	10.74	10.74
SH-0241	2.22	1,050	9.14	9.34	11.36	9.15	9.15
SH-0242	1.45	1,050	11.98	12.18	13.43	11.99	11.99
SH-0243	1.83	1,050	16.61	16.81	18.44	16.62	16.62
SH-0244	1.22	1,050	17.15	17.35	18.37	17.16	17.16
SH-0245	1.37	1,050	17.00	17.15	18.37	17.00	17.00
SH-0246	2.94	1,050	16.10	16.30	19.04	16.11	16.11
SH-0247	2.55	1,050	14.82	15.02	17.37	14.84	14.84
SH-0248	1.19	1,050	14.63	14.78	15.82	14.64	14.64
SH-0249	5.12	1,050	14.13	14.28	19.25	14.15	14.15
SH-0250	2.31	1,050	137.19	137.49	139.50	137.21	137.23
SH-0251	2.04	1,050	137.92	138.12	139.96	137.95	137.96
SH-0252	3.50	1,050	138.41	138.61	141.91	138.41	138.41
SH-0253	1.50	1,050	138.71	138.91	140.21	138.71	138.71
SH-0254	1.62	1,050	137.80	138.00	139.42	137.81	137.81
SH-0255	1.56	1,050	135.97	136.17	137.53	135.98	135.98
SH-0256	1.55	1,050	128.81	129.01	130.36	128.84	128.87
SH-0257	1.19	1,050	126.31	126.51	127.50	126.34	126.37
SH-0258	1.57	1,050	123.94	124.14	125.51	123.98	124.02
SH-0259	1.92	1,050	128.04	128.24	129.96	128.05	128.05
SH-0260	1.25	1,050	131.12	131.32	132.37	131.14	131.17
SH-0261	2.44	1,050	92.37	92.57	94.81	92.40	92.41
SH-0262	1.68	1,050	129.70	129.90	131.38	129.72	129.72
SH-0263	2.52	1,050	131.98	132.18	134.50	132.00	132.00
SH-0264	1.66	1,050	134.40	134.55	136.06	134.41	134.41
SH-0265	1.83	1,050	127.12	127.32	128.95	127.14	127.14
SH-0266	1.98	1,050	123.71	123.91	125.69	123.74	123.74
SH-0267	1.98	1,050	126.72	126.92	128.70	126.73	126.73
SH-0268	1.83	1,050	120.91	121.11	122.74	120.93	120.93
SH-0269	2.13	1,050	132.57	132.77	134.70	132.58	132.58
SH-0270	1.83	1,050	130.13	130.33	131.96	130.14	130.14
SH-0271	4.86	1,050	122.22	122.42	127.08	122.24	122.25
SH-0272	1.67	1,050	122.38	122.53	124.05	122.39	122.39
SH-0273	0.93	1,050	126.08	126.28	127.01	126.09	126.09
SH-0274	2.13	1,050	122.09	122.29	124.22	122.11	122.11
SH-0275	1.59	1,050	121.59	121.74	123.18	121.60	121.60
SH-0276	1.52	1,050	118.83	119.03	120.35	118.85	118.85

Manhole ID	Depth (m)	Diameter (mm)	Invert Elevation (m)	Crown Elevation (m)	Rim Elevation (m)	2021 PWWF 5-Year 24-Hour I&I HGL (m)	OCP PWWF 5-Year 24-Hour I&I w/ Climate Change HGL (m)
SH-0277	1.89	1,050	115.39	115.54	117.28	115.40	115.40
SH-0278	1.89	1,050	115.11	115.31	117.00	115.13	115.13
SH-0279	1.51	1,050	114.98	115.18	116.49	115.00	115.00
SH-0280	2.13	1,050	111.12	111.32	113.25	111.15	111.15
SH-0281	1.52	1,050	101.07	101.27	102.59	101.10	101.10
SH-0282	1.98	1,050	105.54	105.74	107.52	105.55	105.56
SH-0283	1.52	1,050	113.20	113.40	114.72	113.21	113.21
SH-0284	2.74	1,050	115.56	115.76	118.30	115.57	115.57
SH-0285	2.74	1,050	117.06	117.26	119.80	117.06	117.06
SH-0286	2.37	1,050	102.54	102.74	104.91	102.55	102.55
SH-0287	2.80	1,050	96.16	96.36	98.96	96.17	96.18
SH-0288	3.05	1,050	118.14	118.34	121.19	118.16	118.16
SH-0289	0.97	1,050	6.86	7.06	7.83	6.87	6.87
SH-0290	1.50	1,050	6.98	7.18	8.48	6.99	6.99
SH-0291	1.40	1,050	11.88	12.08	13.28	11.89	11.89
SH-0292	0.86	1,050	5.03	5.18	5.89	5.04	5.05
SH-0293	1.63	1,050	4.03	4.23	5.66	4.05	4.05
SH-0294	0.50	1,050	2.00	2.20	2.50	2.02	2.02
SH-0295	3.15	1,050	6.63	6.83	9.78	6.64	6.64
SH-0296	2.15	1,050	136.55	136.75	138.70	136.55	136.55
SH-0297	2.31	1,050	137.82	138.02	140.13	137.83	137.83
SH-0298	2.00	1,050	4.16	4.36	6.16	4.16	4.17
SH-0299	1.22	1,050	12.45	12.60	13.67	12.46	12.46
SH-0300	1.80	1,050	133.65	133.85	135.45	133.67	133.69
SH-0301	2.17	1,050	132.22	132.42	134.39	132.23	132.23
SH-0303	3.42	1,050	109.15	109.35	112.57	109.16	109.16
SH-0304	1.63	1,050	114.32	114.47	115.95	114.33	114.33
SH-0305	5.89	1,050	109.79	109.99	115.68	109.80	109.80
SH-0306	5.73	1,050	109.61	109.81	115.34	109.64	109.64
SH-0307	7.28	1,050	110.51	110.71	117.79	110.53	110.53
SH-0308	6.31	1,050	110.93	111.08	117.24	110.95	110.95
SH-0309	4.87	1,050	111.42	111.57	116.29	111.43	111.43
SH-0310	3.05	1,050	112.49	112.64	115.55	112.50	112.50
SH-0311	0.80	1,050	111.50	111.70	112.30	111.51	111.51
SH-0312	3.40	1,050	110.70	110.90	114.10	110.71	110.71
SH-0313	1.70	1,050	108.50	108.70	110.20	108.51	108.51
SH-0314	1.66	1,050	101.74	101.94	103.40	101.75	101.75

Manhole ID	Depth (m)	Diameter (mm)	Invert Elevation (m)	Crown Elevation (m)	Rim Elevation (m)	2021 PWWF 5-Year 24-Hour I&I HGL (m)	OCP PWWF 5-Year 24-Hour I&I w/ Climate Change HGL (m)
SH-0315	1.70	1,050	100.00	100.25	101.70	100.10	100.09
SH-0316	1.69	1,050	66.41	66.66	68.10	66.46	66.46
SH-0317	5.55	1,050	54.45	54.70	60.00	54.50	54.50
SH-0318	1.96	1,050	99.54	99.79	101.50	99.59	99.59
SH-0319	1.75	1,050	89.63	89.88	91.38	89.67	89.67
SH-0320	3.20	1,050	75.33	75.58	78.53	75.37	75.37
SH-0321	1.99	1,050	62.31	62.56	64.30	62.35	62.34
SH-0322	1.80	1,050	95.20	95.35	97.00	95.21	95.21
SH-0323	1.80	1,050	90.20	90.40	92.00	90.21	90.21
SH-0324	1.30	1,050	83.90	84.10	85.20	83.91	83.91
SH-0325	3.33	1,050	48.47	48.77	51.80	48.59	48.58
SH-0326	4.22	1,050	48.25	48.55	52.47	48.36	48.36
SH-0327	3.66	1,050	48.12	48.42	51.78	48.23	48.23
SH-0328	2.12	1,050	133.93	134.13	136.05	133.94	133.94
SH-0329	2.12	1,050	138.97	139.17	141.09	138.98	138.98
SH-0330	2.12	1,050	134.21	134.51	136.33	134.23	134.23
SH-0331	2.12	1,050	142.84	143.04	144.96	142.85	142.85
SH-0332	0.51	1,050	0.54	0.79	1.05	0.57	N/A
SH-0333	0.38	1,050	0.70	0.95	1.08	0.73	N/A
SH-0334	0.38	1,050	0.72	0.97	1.10	0.75	N/A
SH-0335	0.44	1,050	0.74	0.99	1.18	0.77	N/A
SH-0336	1.04	1,050	0.97	1.22	2.01	1.00	N/A
SH-0337	1.03	1,050	1.15	1.40	2.18	1.18	N/A
SH-0338	1.99	1,050	0.08	0.33	2.07	0.16	0.17
SH-0339	1.41	1,050	0.28	0.53	1.69	0.31	N/A
SH-0340	1.11	1,050	0.43	0.68	1.54	0.47	N/A
SH-0341	0.41	1,050	0.51	0.76	0.92	0.54	N/A
SH-0342	1.01	1,050	1.17	1.42	2.18	1.20	N/A
SH-0343	2.12	1,050	134.39	134.59	136.51	134.41	134.41
SH-0344	1.13	1,050	18.30	18.50	19.43	18.31	N/A
SH-0345	1.64	1,050	9.60	9.80	11.24	9.62	9.62
SH-0346	1.21	1,050	16.67	16.82	17.88	16.69	16.69
SH-0347	1.23	1,050	17.82	17.97	19.05	17.84	17.84
SH-0348	0.60	1,050	18.50	18.65	19.10	18.53	18.53
SH-0349	0.71	1,050	39.27	39.42	39.98	39.28	39.28
SH-0350	0.68	1,050	39.90	40.05	40.58	39.92	39.92
SH-0351	3.51	1,050	103.70	103.90	107.21	103.74	103.74

Manhole ID	Depth (m)	Diameter (mm)	Invert Elevation (m)	Crown Elevation (m)	Rim Elevation (m)	2021 PWWF 5-Year 24-Hour I&I HGL (m)	OCP PWWF 5-Year 24-Hour I&I w/ Climate Change HGL (m)
SH-0352	1.76	1,050	101.47	101.62	103.23	101.48	101.48
SH-0353	1.92	1,050	97.26	97.41	99.18	97.26	97.26
SH-0354	0.98	1,050	88.48	88.68	89.46	88.49	88.49
SH-0355	9.09	1,050	88.94	89.14	98.03	88.95	88.95
SH-0356	2.31	1,050	97.74	97.94	100.05	97.76	97.76
SH-0357	1.94	1,050	96.71	96.91	98.65	96.72	96.72
SH-0358	1.59	1,050	101.77	101.97	103.36	101.78	101.78
SH-0359	1.69	1,050	104.02	104.22	105.71	104.03	104.03
SH-0360	1.67	1,050	106.54	106.74	108.21	106.55	106.55
SH-0361	2.98	1,050	104.62	104.82	107.60	104.63	104.63
SH-0362	2.64	1,050	104.74	104.94	107.38	104.79	104.79
SH-0363	0.95	1,050	41.31	41.46	42.26	41.32	41.32
SH-0364	1.32	1,050	15.38	15.53	16.70	15.39	15.40
SH-0365	0.86	1,050	21.22	21.37	22.08	21.23	21.24
SH-0366	0.48	1,050	23.02	23.17	23.50	23.04	23.05
SH-0367	1.89	1,050	27.61	27.76	29.50	27.62	27.63
SH-0368	1.88	1,050	120.70	120.90	122.58	120.70	120.70
SH-0369	1.81	1,050	40.99	41.19	42.80	40.99	40.99
SH-0370	3.24	1,050	39.56	39.76	42.80	39.57	39.57
SH-0371	2.50	1,050	39.20	39.40	41.70	39.21	39.21
SH-0372	1.89	1,050	38.96	39.16	40.85	38.97	38.97
SH-0373	1.70	1,050	36.00	36.20	37.70	36.01	36.01
SH-0374	3.10	1,050	34.60	34.80	37.70	34.61	34.61
SH-0375	1.70	1,050	28.30	28.50	30.00	28.31	28.31
SH-0376	2.37	1,050	134.68	134.88	137.05	134.69	134.69
SH-0377	1.82	1,050	141.98	142.18	143.80	141.99	141.99
SH-0378	2.21	1,050	139.39	139.59	141.60	139.40	139.40
SH-0379	3.59	1,050	135.81	136.01	139.40	135.83	135.83
SH-0380	2.56	1,050	135.34	135.54	137.90	135.36	135.36
SH-0381	2.38	1,050	135.07	135.27	137.45	135.09	135.09
SH-0382	2.25	1,050	127.40	127.60	129.65	127.43	127.43
SH-0383	2.50	1,050	128.69	128.89	131.19	128.70	128.70
SH-0384	2.41	1,050	129.34	129.59	131.75	129.35	129.36
SH-0385	2.39	1,050	129.58	129.83	131.97	129.60	129.60
SH-0386	1.35	1,050	130.10	130.25	131.45	130.12	130.12
SH-0387	2.66	1,050	96.45	96.70	99.11	96.49	96.49
SH-0388	2.96	1,050	104.04	104.24	107.00	104.05	104.05

Manhole ID	Depth (m)	Diameter (mm)	Invert Elevation (m)	Crown Elevation (m)	Rim Elevation (m)	2021 PWWF 5-Year 24-Hour I&I HGL (m)	OCP PWWF 5-Year 24-Hour I&I w/ Climate Change HGL (m)
SH-0389	2.91	1,050	106.69	106.89	109.60	106.70	106.70
SH-0390	1.41	1,050	107.09	107.29	108.50	107.11	107.11
SH-0391	3.70	1,050	108.61	108.81	112.31	108.62	108.62
SH-0392	1.87	1,050	108.65	108.85	110.52	108.67	108.67
SH-0393	1.70	1,050	110.50	110.70	112.20	110.51	110.51
SH-0394	2.25	1,050	131.52	131.72	133.77	131.54	131.57
SH-0395	2.26	1,050	134.11	134.31	136.37	134.13	134.16
SH-0396	2.41	1,050	134.17	134.37	136.58	134.21	134.26
SH-0397	2.44	1,050	135.29	135.49	137.73	135.32	135.35
SH-0398	1.48	1,050	141.52	141.72	143.00	141.54	141.57
SH-0399	1.68	1,050	136.74	136.94	138.42	136.75	136.78
SH-0400	1.84	1,050	139.98	140.18	141.82	140.00	140.03
SH-0401	1.99	1,050	141.91	142.11	143.90	141.92	141.92
SH-0402	1.72	1,050	147.78	147.98	149.50	147.79	147.79
SH-0403	1.80	1,050	142.20	142.40	144.00	142.21	142.21
SH-0404	1.71	1,050	139.59	139.79	141.30	139.60	139.60
SH-0405	2.10	1,050	136.90	137.10	139.00	136.92	136.92
SH-0406	1.57	1,050	136.18	136.38	137.75	136.20	136.20
SH-0407	1.66	1,050	138.46	138.66	140.12	138.47	138.47
SH-0408	1.98	1,050	139.77	139.97	141.75	139.78	139.78
SH-0409	1.69	1,050	137.61	137.81	139.30	137.62	137.62
SH-0410	1.45	1,050	100.94	101.24	102.39	100.98	101.07
SH-0411	0.81	1,050	99.50	99.80	100.31	99.54	99.62
SH-0412	2.00	1,050	73.24	73.44	75.24	73.25	73.26
SH-0413	1.49	1,050	75.62	75.82	77.11	75.63	75.63
SH-0414	1.06	1,050	97.70	98.00	98.76	97.74	97.84
SH-0415	0.96	1,050	97.30	97.60	98.26	97.33	97.39
SH-0416	1.53	1,050	94.05	94.35	95.58	94.08	94.14
SH-0417	1.41	1,050	92.34	92.64	93.75	92.36	92.42
SH-0418	1.64	1,050	84.36	84.66	86.00	84.38	84.42
SH-0419	1.62	1,050	70.12	70.42	71.74	70.15	70.20
SH-0420	1.62	1,050	67.00	67.30	68.62	67.02	67.05
SH-0421	2.65	1,050	102.35	102.65	105.00	102.39	102.47
SH-0422	1.59	1,050	103.16	103.36	104.75	103.17	103.17
SH-0423	1.52	1,050	103.17	103.32	104.69	103.18	103.18
SH-0424	3.15	1,050	104.41	104.56	107.56	104.42	104.42
SH-0425	3.15	1,050	102.89	103.04	106.04	102.91	102.91

Manhole ID	Depth (m)	Diameter (mm)	Invert Elevation (m)	Crown Elevation (m)	Rim Elevation (m)	2021 PWWF 5-Year 24-Hour I&I HGL (m)	OCP PWWF 5-Year 24-Hour I&I w/ Climate Change HGL (m)
SH-0426	2.40	1,050	102.73	102.93	105.12	102.74	102.74
SH-0428	1.53	1,050	43.75	43.95	45.28	43.76	43.76
SH-0429	1.50	1,050	32.58	32.78	34.08	32.59	32.59
SH-0430	2.22	1,050	117.82	118.12	120.04	117.84	117.87
SH-0431	1.95	1,050	114.08	114.38	116.03	114.11	114.15
SH-0432	2.15	1,050	113.48	113.78	115.63	113.51	113.55
SH-0433	4.12	1,050	112.50	112.80	116.62	112.54	112.60
SH-0434	4.63	1,050	112.09	112.39	116.72	112.13	112.19
SH-0435	2.61	1,050	111.22	111.52	113.83	111.26	111.32
SH-0436	2.16	1,050	110.77	111.07	112.93	110.80	110.86
SH-0437	3.18	1,050	109.73	110.03	112.91	109.77	109.83
SH-0438	1.81	1,050	108.98	109.28	110.79	109.01	109.07
SH-0439	1.91	1,050	107.49	107.79	109.40	107.52	107.57
SH-0440	2.14	1,050	105.52	105.82	107.66	105.55	105.60
SH-0441	2.59	1,050	96.45	96.65	99.04	96.46	96.46
SH-0442	3.95	1,050	86.03	86.23	89.98	86.04	86.04
SH-0443	2.70	1,050	78.84	79.04	81.54	78.85	78.85
SH-0444	1.33	1,050	83.50	83.70	84.83	83.50	83.50
SH-0445	2.76	1,050	77.62	77.82	80.38	77.63	77.63
SH-0446	1.90	1,050	69.97	70.17	71.87	69.99	69.99
SH-0447	0.92	1,050	29.08	29.23	30.00	29.09	29.10
SH-0448	0.90	1,050	36.80	36.95	37.70	36.81	36.82
SH-0449	1.36	1,050	37.84	37.99	39.20	37.85	37.86
SH-0450	1.45	1,050	44.05	44.20	45.50	44.06	44.06
SH-0452	1.50	1,050	57.90	58.05	59.40	57.91	57.91
SH-0453	1.90	1,050	128.20	128.50	130.10	128.22	128.24
SH-0454	2.14	1,050	121.90	122.20	124.04	121.92	121.94
SH-0455	2.03	1,050	102.04	102.24	104.07	102.07	102.07
SH-0456	1.69	1,050	106.10	106.30	107.79	106.11	106.12
SH-0457	1.84	1,050	113.22	113.42	115.06	113.23	113.23
SH-0458	2.27	1,050	118.10	118.30	120.37	118.11	118.11
SH-0459	1.66	1,050	120.03	120.18	121.69	120.03	120.03
SH-0460	1.27	1,050	147.83	148.03	149.10	147.84	147.84
SH-0461	2.04	1,050	146.00	146.20	148.04	146.01	146.01
SH-0462	1.65	1,050	145.12	145.32	146.77	145.13	145.14
SH-0463	2.52	1,050	143.93	144.13	146.45	143.95	143.95
SH-0464	1.89	1,050	143.23	143.43	145.12	143.24	143.24

Manhole ID	Depth (m)	Diameter (mm)	Invert Elevation (m)	Crown Elevation (m)	Rim Elevation (m)	2021 PWWF 5-Year 24-Hour I&I HGL (m)	OCP PWWF 5-Year 24-Hour I&I w/ Climate Change HGL (m)
SH-0465	2.63	1,050	139.75	139.95	142.38	139.76	139.76
SH-0466	1.46	1,050	147.05	147.25	148.51	147.06	147.06
SH-0467	2.92	1,050	104.31	104.51	107.23	104.33	104.33
SH-0468	2.67	1,050	104.53	104.73	107.20	104.55	104.55
SH-0469	2.11	1,050	102.52	102.72	104.63	102.55	102.55
SH-0470	2.50	1,050	95.22	95.42	97.72	95.23	95.23
SH-0471	2.12	1,050	82.23	82.43	84.35	82.24	82.24
SH-0472	1.54	1,050	75.70	75.90	77.24	75.71	75.71
SH-0473	1.92	1,050	75.17	75.37	77.09	75.18	75.18
SH-0474	1.61	1,050	70.23	70.43	71.84	70.24	70.24
SH-0475	1.30	1,050	128.44	128.64	129.74	128.46	128.46
SH-0476	1.96	1,050	130.04	130.24	132.00	130.07	130.07
SH-0477	2.36	1,050	131.99	132.29	134.35	132.02	132.02
SH-0478	2.13	1,050	133.96	134.16	136.09	133.98	133.98
SH-0479	1.51	1,050	138.70	138.90	140.21	138.71	138.71
SH-0480	1.26	1,050	102.74	102.94	104.00	102.74	102.74
SH-0481	2.92	1,050	103.08	103.28	106.00	103.10	103.10
SH-0482	1.81	1,050	4.49	4.69	6.30	4.54	4.54
SH-0483	1.60	1,050	107.28	107.48	108.88	107.29	107.29
SH-0484	4.39	1,050	121.39	121.54	125.78	121.40	121.40
SH-0485	1.22	1,050	120.93	121.08	122.15	120.96	119.25
SH-0486	1.50	1,050	70.03	70.18	71.53	70.04	70.04
SH-0487	2.38	1,050	65.16	65.36	67.54	65.18	65.18
SH-0488	1.95	1,050	11.18	11.38	13.13	11.22	11.22
SH-0489	1.94	1,050	47.45	47.60	49.39	47.46	47.46
SH-0490	0.38	1,050	27.62	27.82	28.00	27.63	27.63
SH-0491	1.90	1,050	21.12	21.32	23.02	21.15	21.15
SH-0492	2.26	1,050	143.26	143.46	145.52	143.27	143.29
SH-0493	2.68	1,050	142.41	142.61	145.09	142.42	142.44
SH-0494	2.53	1,050	142.99	143.19	145.52	142.99	143.01
SH-0495	2.64	1,050	142.34	142.54	144.98	142.35	142.36
SH-0496	2.73	1,050	141.98	142.18	144.71	141.99	142.01
SH-0497	2.76	1,050	141.75	141.95	144.51	141.76	141.77
SH-0498	2.36	1,050	141.07	141.27	143.43	141.09	141.11
SH-0499	2.46	1,050	141.33	141.53	143.79	141.35	141.36
SH-0500	1.97	1,050	142.72	142.92	144.69	142.73	142.74
SH-0501	2.08	1,050	140.26	140.46	142.34	140.28	140.30

Manhole ID	Depth (m)	Diameter (mm)	Invert Elevation (m)	Crown Elevation (m)	Rim Elevation (m)	2021 PWWF 5-Year 24-Hour I&I HGL (m)	OCP PWWF 5-Year 24-Hour I&I w/ Climate Change HGL (m)
SH-0502	2.98	1,050	140.03	140.23	143.01	140.06	140.07
SH-0503	2.87	1,050	139.33	139.53	142.20	139.35	139.37
SH-0504	3.34	1,050	138.24	138.44	141.58	138.27	138.29
SH-0505	1.81	1,050	136.69	136.99	138.50	136.71	136.72
SH-0506	1.68	1,050	135.02	135.32	136.70	135.04	135.05
SH-0507	1.87	1,050	132.53	132.83	134.40	132.55	132.56
SH-0508	1.09	1,050	134.31	134.51	135.40	134.32	134.32
SH-0511	1.58	1,050	76.42	76.62	78.00	76.43	76.43
SH-0512	4.41	1,050	111.79	112.09	116.20	111.83	111.89
SH-0513	2.09	1,050	107.41	107.71	109.50	107.44	107.49
SH-0514	0.87	1,050	70.13	70.28	71.00	70.13	70.14
SH-0515	2.12	1,050	117.38	117.53	119.50	117.43	117.43
SH-0516A	2.98	1,050	30.52	30.82	33.50	30.52	30.52
SH-0517	1.05	1,050	25.45	25.90	26.50	25.45	25.45
SH-0518	1.03	1,050	146.37	146.57	147.40	146.38	146.38
SH-0519	3.80	1,050	115.38	115.53	119.18	115.39	115.39
SH-0520	2.17	1,050	88.63	88.83	90.80	88.66	88.67
SH-0521	2.36	1,050	116.84	117.04	119.20	116.88	116.86
SH-0524	1.48	1,050	141.92	142.17	143.40	141.94	141.99
SH-0525	1.93	1,050	143.07	143.32	145.00	143.08	143.13
SH-0528	3.67	1,050	116.43	116.63	120.10	116.46	116.47
SH-0529	2.29	1,050	114.87	115.07	117.16	114.90	114.90
SH-0530	2.13	1,050	112.05	112.35	114.18	112.08	112.08
SH-0531	2.57	1,050	111.15	111.45	113.72	111.19	111.19
SH-0532	1.64	1,050	110.72	111.02	112.36	110.75	110.75
SH-0533	1.14	1,050	25.10	25.55	26.24	25.10	25.10
SH-0534	0.90	1,050	147.50	147.70	148.40	147.51	147.51
SH-0535	1.32	1,050	147.28	147.48	148.60	147.29	147.29
SH-0537	1.85	1,050	143.08	143.28	144.93	143.09	143.09
SH-0538	1.71	1,050	143.14	143.34	144.85	143.14	143.14
SN-0004A	1.64	1,050	7.86	8.06	9.50	7.87	7.87
SN-0004B	2.09	1,050	48.01	48.39	50.10	48.05	48.09
SN-0005	4.91	1,050	33.49	33.79	38.40	33.49	33.49
SN-0009	0.78	1,050	7.03	7.23	7.81	7.03	7.03
SN-0013	1.02	1,050	18.34	18.54	19.36	18.35	N/A
SN-0015	0.80	1,050	45.80	45.95	46.60	45.81	45.81
SN-0016	5.16	1,050	14.93	15.08	20.09	14.94	14.94

Manhole ID	Depth (m)	Diameter (mm)	Invert Elevation (m)	Crown Elevation (m)	Rim Elevation (m)	2021 PWWF 5-Year 24-Hour I&I HGL (m)	OCP PWWF 5-Year 24-Hour I&I w/ Climate Change HGL (m)
SN-0018	1.39	1,050	148.18	148.38	149.57	148.18	148.18
SN-0019	3.33	1,050	106.03	106.23	109.36	106.04	106.04
SN-0020	2.21	1,050	105.47	105.67	107.68	105.48	105.48
SN-0021	2.46	1,050	138.92	139.02	141.38	138.92	138.92
SN-0027	2.20	1,050	103.70	103.85	105.90	103.71	103.71
SN-0028	1.80	1,050	143.68	143.88	145.48	143.69	143.69
SN-0030	2.93	1,050	141.34	141.54	144.27	141.35	141.35
SN-0031	2.83	1,050	143.48	143.68	146.31	143.49	143.51
SN-0034	1.95	1,050	137.19	137.39	139.14	137.19	137.19
SN-0035A	2.26	1,050	77.94	78.09	80.20	77.94	77.95
SN-0036B	0.33	1,050	115.77	115.92	116.10	115.78	115.78
SN-0039A	9.85	1,050	103.06	103.26	112.91	103.06	103.06
SN-0044	9.02	1,050	22.58	22.73	31.60	22.60	22.60
20	1.00	1,050	39.90	40.05	40.90	39.91	39.91
24	0.80	1,050	135.70	135.85	136.50	135.72	135.72
JCT-1005	1.20	1,050	3.88	3.98	5.07	3.88	3.88
JCT-1006	1.51	1,050	3.53	3.73	5.04	3.53	3.54
JCT-1007	3.54	1,050	8.07	8.22	11.61	8.08	8.08
JCT-1008	6.04	1,050	50.83	50.98	56.87	50.83	50.83
JCT-1009	5.59	1,050	41.54	41.74	47.13	41.56	41.56
JCT-1010	1.62	1,050	11.80	12.00	13.41	11.80	11.80
JCT-1011	0.53	1,050	7.55	7.65	8.08	7.55	7.55
JCT-1012	1.61	1,050	6.10	6.25	7.71	6.11	6.11
JCT-1013	2.46	1,050	15.66	15.81	18.12	15.66	15.66
JCT-1014	1.64	1,050	38.12	38.27	39.76	38.13	38.13
JCT-1015	14.11	1,050	49.67	49.82	63.78	49.68	49.68
JCT-1016	4.72	1,050	49.22	49.37	53.94	49.22	49.22
JCT-1017	1.39	1,050	96.71	96.91	98.09	96.71	96.71
JCT-1018	3.11	1,050	119.15	119.30	122.26	119.16	119.16
JCT-1019	4.23	1,050	142.35	142.55	146.58	142.36	142.36
JCT-1020	3.53	1,050	105.82	106.02	109.35	105.82	105.82
JCT-1021	2.76	1,050	101.42	101.62	104.18	101.43	101.43
JCT-1022	2.02	1,050	102.57	102.77	104.59	102.59	102.59
JCT-1023	1.21	1,050	41.59	41.79	42.80	41.60	41.60
JCT-1024	1.91	1,050	134.49	134.69	136.40	134.49	134.49
JCT-1025	2.24	1,050	101.58	101.78	103.82	101.58	101.58
JCT-1026	0.99	1,050	1.51	1.76	2.50	1.52	1.53

Manhole ID	Depth (m)	Diameter (mm)	Invert Elevation (m)	Crown Elevation (m)	Rim Elevation (m)	2021 PWWF 5-Year 24-Hour I&I HGL (m)	OCP PWWF 5-Year 24-Hour I&I w/ Climate Change HGL (m)
JCT-1027	2.39	1,050	101.89	102.04	104.28	101.90	101.90
JCT-1028	1.66	1,050	101.75	101.90	103.41	101.76	101.76
JCT-1029	1.87	1,050	97.15	97.35	99.02	97.17	97.17
JCT-1030	2.14	1,050	18.99	19.14	21.14	18.99	18.99
JCT-1031	2.47	1,050	63.80	63.95	66.27	63.81	63.81
JCT-1032	0.25	1,050	20.75	20.95	21.00	20.75	20.75
JCT-1033	4.64	1,050	16.26	16.41	20.90	16.27	16.27
JCT-1034	18.78	1,050	22.38	22.53	41.15	22.39	22.39
JCT-1035	11.35	1,050	47.91	48.06	59.26	47.92	47.92
JCT-1036	4.67	1,050	115.84	115.94	120.51	115.87	115.87
JCT-1037	3.06	1,050	115.54	115.74	118.60	115.60	115.58
JCT-1038	9.91	1,050	33.13	33.28	43.04	33.14	33.15
JCT-1039	1.00	1,050	2.24	2.44	3.24	2.24	2.24
JCT-1040	1.81	1,050	115.82	115.97	117.63	115.83	115.83
JCT-1041	1.50	1,050	12.84	12.99	14.34	12.85	12.85
JCT-1042	0.55	1,050	2.99	3.09	3.54	3.00	3.00
JCT-1043	1.05	1,050	2.32	2.52	3.37	2.33	2.33
JCT-1044	8.44	1,050	10.53	10.68	18.97	10.54	10.54
JCT-1045	8.24	1,050	10.13	10.28	18.36	10.14	10.14
JCT-1046	3.25	1,050	9.88	10.03	13.13	9.89	9.89
JCT-1047	3.34	1,050	20.15	20.30	23.49	20.16	20.16
JCT-1048	1.11	1,050	13.44	13.54	14.55	13.45	13.45
JCT-1049	2.63	1,050	104.57	104.77	107.20	104.59	104.59
JCT-1050	1.65	1,050	141.37	141.57	143.02	141.37	141.37
JCT-1051	1.66	1,050	47.84	47.99	49.50	47.85	47.85
JCT-1052	5.46	1,050	142.24	142.44	147.70	142.25	142.25
JCT-1053	0.88	1,050	137.63	137.83	138.50	137.63	137.63
JCT-1054	1.86	1,050	119.14	119.29	121.00	119.16	119.88
JCT-1055	0.42	1,050	140.58	140.78	141.00	140.58	140.58
JCT-1056	3.69	1,050	102.81	102.96	106.50	102.82	102.82
JCT-1057	3.91	1,050	102.60	102.80	106.50	102.61	102.61
JCT-1058	1.82	1,050	138.45	138.65	140.28	138.45	138.45
JCT-1059	5.02	1,050	47.99	48.14	53.00	48.00	48.00
JCT-1060	1.89	1,050	143.11	143.36	145.00	143.12	143.17
JCT-1061	0.85	1,050	85.48	85.63	86.33	85.49	85.49
JCT-1062	1.42	1,050	25.88	26.03	27.30	25.88	25.88
JCT-1063	1.84	1,050	86.96	87.16	88.80	86.96	86.96

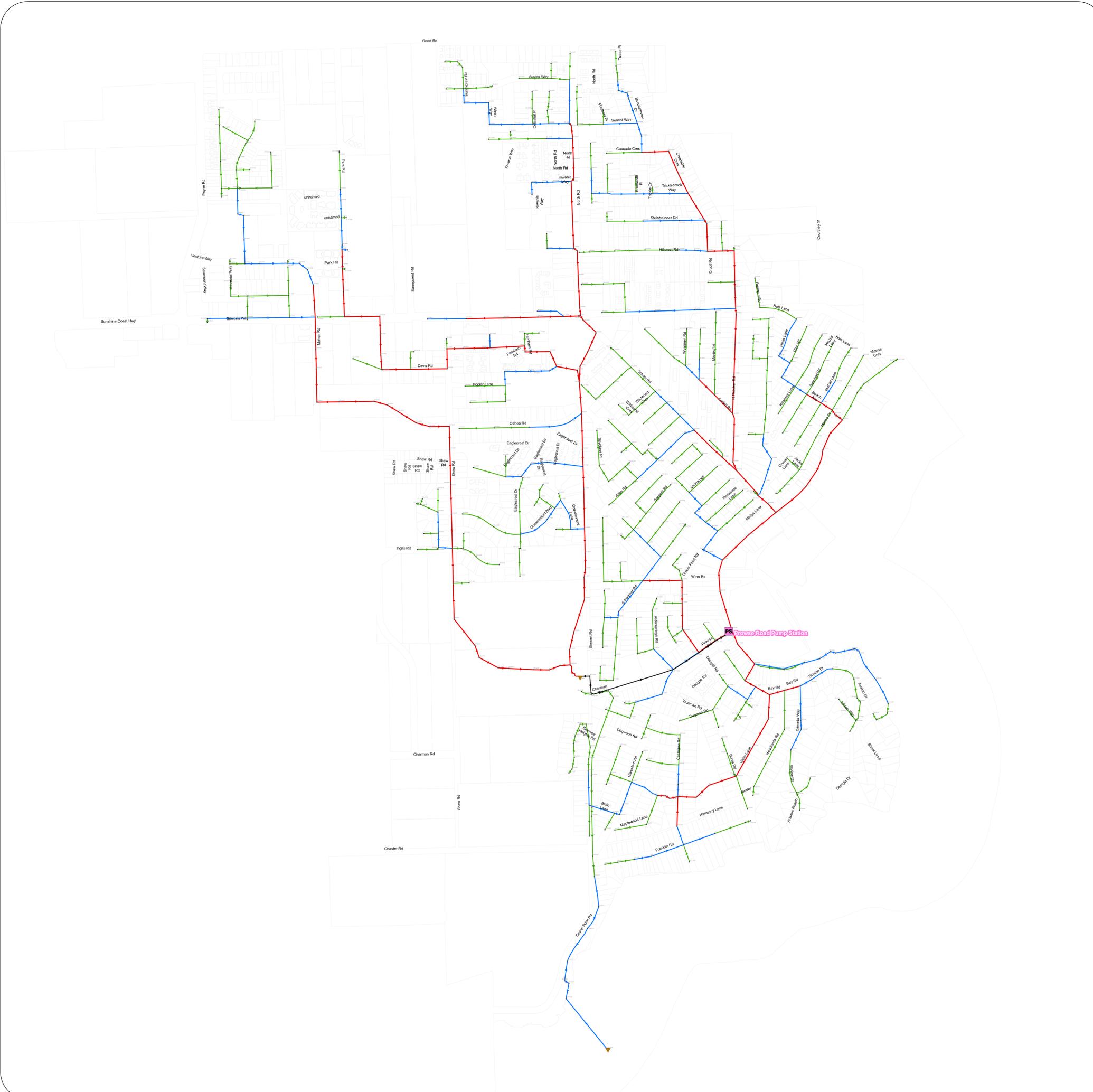
Manhole ID	Depth (m)	Diameter (mm)	Invert Elevation (m)	Crown Elevation (m)	Rim Elevation (m)	2021 PWWF 5-Year 24-Hour I&I HGL (m)	OCP PWWF 5-Year 24-Hour I&I w/ Climate Change HGL (m)
JCT-1064	1.53	1,050	141.47	141.62	143.00	141.48	141.48
JCT-1070	1.56	1,050	135.97	136.17	137.53	135.97	135.98
JCT-1071	1.31	1,050	40.69	41.29	42.00	40.99	40.99



## **Appendix B      Consequence of Failure Maps**

### Legend

- Parcel
  - Outfall
  - Forcemain
  - Pump Station
  - Manholes
- Gravity Main CoF Rating**
- CoF of 3 = 50% of system pipe length     \*q <= 0.246 L/s
  - CoF of 4 = 25% of system pipe length     \*0.246 L/s < q <= 0.720 L/s
  - CoF of 5 = 25% of system pipe length     \*q > 0.720 L/s

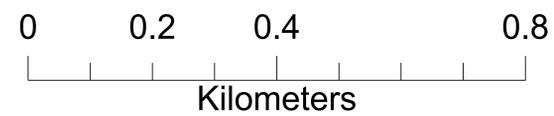


**2021 Scenario  
Consequence of Failure  
Gravity Main Results**



Project: **Town of Gibsons Wastewater Strategic Plan**  
 Project ID: **2022-046-GIB**  
 Client: **Town of Gibsons**  
 Date: **March 2023**  
 Created by: **SZ**  
 Reviewed by: **WdS**

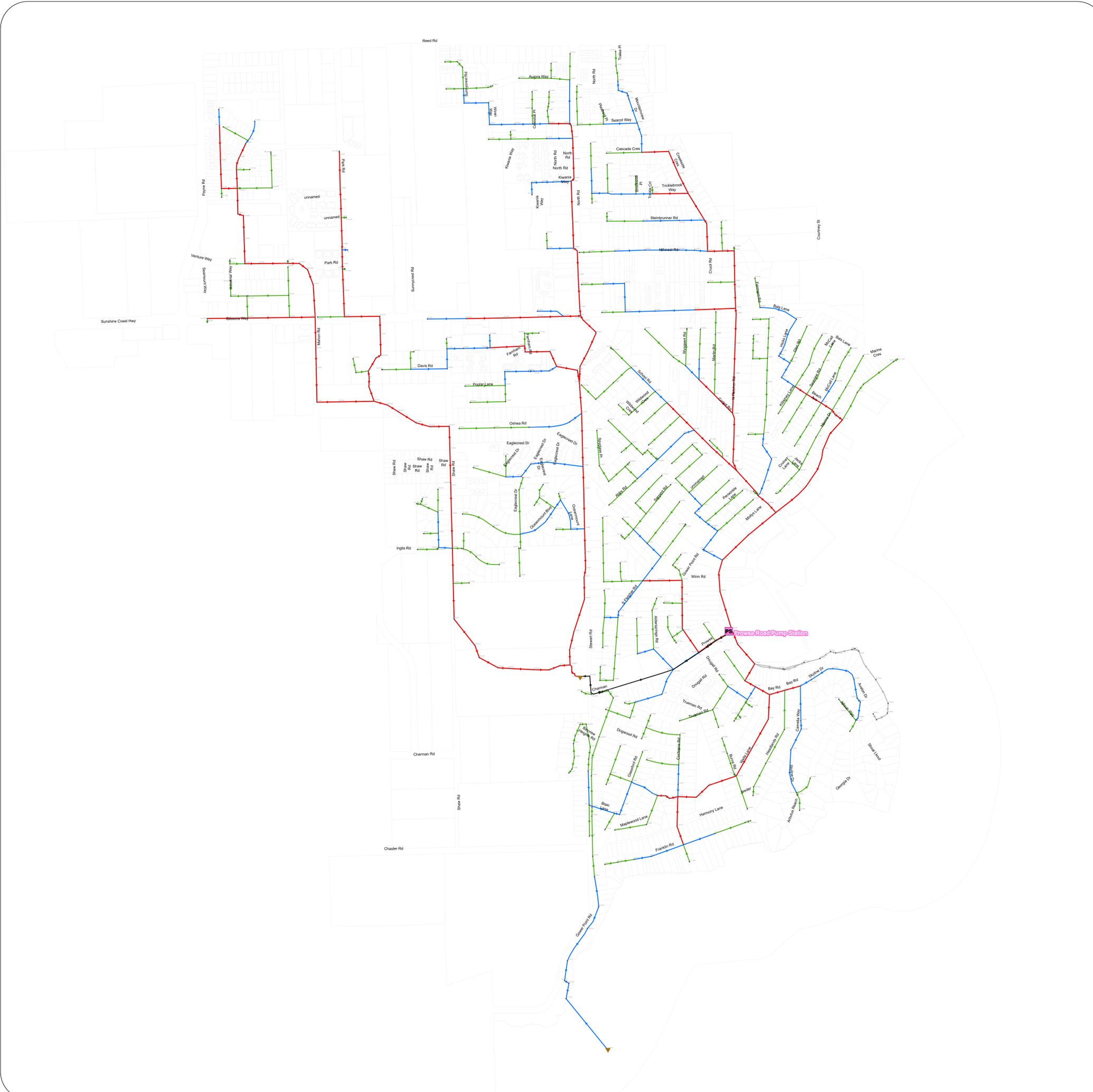
DISCLAIMER: GeoAdvice does not warrant in any way the accuracy and completeness of the information shown on this map. Field verification of the accuracy and completeness of the information shown on this map is the sole responsibility of the user.



**Figure B.1**

### Legend

- Parcel
  - Outfall
  - Forcemain
  - Pump Station
  - Manholes
- Gravity Main CoF Rating**
- CoF of 3 = 50% of system pipe length \*q <= 0.246 L/s
  - CoF of 4 = 25% of system pipe length \*0.246 L/s < q <= 0.720 L/s
  - CoF of 5 = 25% of system pipe length \*q > 0.720 L/s

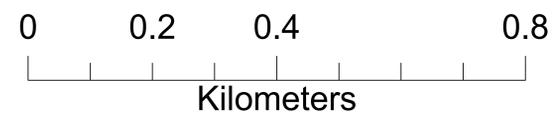


**OCP Scenario  
Consequence of Failure  
Gravity Main Results**



Project: **Town of Gibsons Wastewater Strategic Plan**  
 Project ID: **2022-046-GIB**  
 Client: **Town of Gibsons**  
 Date: **March 2023**  
 Created by: **SZ**  
 Reviewed by: **WdS**

DISCLAIMER: GeoAdvice does not warrant in any way the accuracy and completeness of the information shown on this map. Field verification of the accuracy and completeness of the information shown on this map is the sole responsibility of the user.



**Figure B.2**



## **Appendix C      Detailed Gravity Main Upgrade Recommendations**

Project	Pipe ID	Slope (/)	Length (m)	Existing Diameter (mm)	Upgrade Diameter (mm)	Design Flow (L/s)	Design Full Flow (L/s)	Design q/Q	Design d/D
1	PPE-DIVERSION-1*	0.012	18.1	N/A	200	17.9	35.3	0.51	0.50
1	PPE-DIVERSION-2*	0.010	45.5	N/A	200	17.9	32.9	0.54	0.53
1	PPE-DIVERSION-3*	0.048	21.2	N/A	200	18.1	72.0	0.25	0.34
1	PPE-DIVERSION-4*	0.058	26.0	N/A	200	18.1	78.9	0.23	0.33
1	PPE-DIVERSION-5*	0.012	46.9	N/A	200	18.1	36.0	0.50	0.50
1	PPE-DIVERSION-6*	0.010	43.0	N/A	150	0.3	15.3	0.02	0.10
1	PPE-DIVERSION-7*	0.019	38.5	N/A	150	0.3	20.8	0.02	0.09
2	SP-0106	0.000	97.2	350	450	34.0	41.0	0.83	0.70
2	SP-0147**	0.005	118.8	350	450	34.3	209.8	0.16	0.27

\*White Tower Park sewer diversion. Capacity estimated based on provided drawings.

\*\*Upgrade recommended for diameter continuity.

# UNIT COSTING METHODOLOGY REVISION 1

This memo outlines the proposed methodology for the preparation of capital cost estimates for the linear system upgrades within the Sanitary Sewer Strategic Plan.

Unit rates include ,mains, manholes, tie-ins, service connections, road restoration (trench only), and disposal of old pipe (where applicable). Note that there has considerable cost escalation and volatility in the market in the last 3 years and as such these costs are subject to fluctuation. The costs presented below include a 30% allowance for inflation from 2021 to 2023 as well as a 40% contingency and 10% engineering allowance. No allowance is included for internal costs such as administration or borrowing.

Pipe Size (mm)	Cost per Lineal Meter (\$/m)		
	2022 Proposed		
	0-2m depth	2-4m depth	4-6m depth
200	\$2,708	\$4,408	\$5,192
250	\$2,728	\$4,428	\$5,212
300	\$2,818	\$4,518	\$5,302
350	\$2,898	\$4,598	\$5,382
375	\$2,919	\$4,618	\$5,402
400	\$3,004	\$4,703	\$5,487
450	\$3,089	\$4,788	\$5,572
525	\$3,672	\$5,381	\$6,185
600	\$3,873	\$5,582	\$6,385
675	\$4,283	\$6,012	\$6,855
750	\$4,533	\$6,262	\$7,105

### Multipliers for Different Road Classifications

Highway/Arterial/Coast	1.20
Collector	1.00
Local	0.90
Strata	n/a
Lane	0.75
Right of way	0.75

A detailed breakdown on the unit costs is provided in the attached spreadsheet tables.

Sincerely,

**URBAN SYSTEMS LTD.**



Steve Brubacher, P. Eng.  
Principal

/sb

**SANITARY PIPE COST PER METRE (0-2m depth) DERIVATION**

ASSUMPTIONS: Average trench width of 2m cut straight down (utilize 6' trench box)

Item	Description	Unit	Quantity	100mm to 450mm		525mm and 600mm		675mm and 750mm	
				Unit Price	Total	Unit Price	Total	Unit Price	Total
<b>A. SITE PREPARATION</b>									
1.01	Asphalt cutting	lin.m.	2	7.00	\$14.00	7.00	\$14.00	7.00	\$14.00
1.02	Imported Fill	cu.m.	4	50.00	\$200.00	50.00	\$200.00	50.00	\$200.00
<b>SUBTOTAL - SECTION A</b>					<b>\$214</b>		<b>\$214</b>		<b>\$214</b>
<b>B. ROAD WORK RESTORATION</b>									
2.01	Granular subbase (200mm depth)	sq.m.	2	11.20	\$22.40	11.20	\$22.40	11.20	\$22.40
2.02	100mm Asphalt & 150mm Base	sq.m.	2	150.00	\$300.00	150.00	\$300.00	150.00	\$300.00
<b>SUBTOTAL - SECTION B</b>					<b>\$322</b>		<b>\$322</b>		<b>\$322</b>
<b>C. SANITARY SEWERS</b>									
3.01	Manhole complete incl. removal of existing (1 per 50m)	ea.	0.02	5,420.00	\$108.40	6,800.00	\$136.00	10,800.00	\$216.00
3.02	Removal of existing pipe	lin.m.	1	60.00	\$60.00	75.00	\$75.00	75.00	\$75.00
3.03	Connection to existing (assume 2 directions)	ea.	0.02	5,400.00	\$108.00	11,600.00	\$232.00	11,600.00	\$232.00
3.04	100mm Lot service connection c/w 200mm IC (1 per 10m)	ea.	0.1	3,050.00	\$305.00	3,050.00	\$305.00	3,050.00	\$305.00
<b>SUBTOTAL - SECTION C</b>					<b>\$581</b>		<b>\$748</b>		<b>\$828</b>
<b>SUMMARY</b>					<b>\$1,117.80</b>		<b>\$1,284.40</b>		<b>\$1,364.40</b>

Pipe Size (mm)	200	250	300	350	375	400	450	525	600	675	750
Pipe Cost	\$235.00	\$245.00	\$290.00	\$330.00	\$340.00	\$382.50	\$425.00	\$550.00	\$650.00	\$775.00	\$900.00
Extra Costs	\$1,117.80	\$1,117.80	\$1,117.80	\$1,117.80	\$1,117.80	\$1,117.80	\$1,117.80	\$1,284.40	\$1,284.40	\$1,364.40	\$1,364.40
Subtotal	\$1,352.80	\$1,362.80	\$1,407.80	\$1,447.80	\$1,457.80	\$1,500.30	\$1,542.80	\$1,834.40	\$1,934.40	\$2,139.40	\$2,264.40
Inflation (30%)	\$405.84	\$408.84	\$422.34	\$434.34	\$437.34	\$450.09	\$462.84	\$550.32	\$580.32	\$641.82	\$679.32
Contingency (40%)	\$703.46	\$708.66	\$732.06	\$752.86	\$758.06	\$780.16	\$802.26	\$953.89	\$1,005.89	\$1,112.49	\$1,177.49
Engineering (10%)	\$246.21	\$248.03	\$256.22	\$263.50	\$265.32	\$273.05	\$280.79	\$333.86	\$352.06	\$389.37	\$412.12
<b>TOTAL UNIT COST</b>	<b>\$2,708.31</b>	<b>\$2,728.33</b>	<b>\$2,818.42</b>	<b>\$2,898.50</b>	<b>\$2,918.52</b>	<b>\$3,003.60</b>	<b>\$3,088.69</b>	<b>\$3,672.47</b>	<b>\$3,872.67</b>	<b>\$4,283.08</b>	<b>\$4,533.33</b>

Note: Manhole Price Breakdown:

Pipe Size	Frame/ Base/ Cover / Removal	Vertical Metres \$ per m	Total
100-450mm	\$3,900.00	\$760.00	\$5,420.00
525-600mm	\$4,800.00	\$1,000.00	\$6,800.00
675-750mm	\$7,800.00	\$1,500.00	\$10,800.00

**SANITARY PIPE COST PER METRE (2-4m depth) DERIVATION**

ASSUMPTIONS: Average trench width of 2m with 8' trench box  
Top 1.6m at 1:1 slope, with total width of 5.2m

Item	Description	Unit	Quantity	100mm to 450mm		525mm and 600mm		675mm and 750mm	
				Unit Price	Total	Unit Price	Total	Unit Price	Total
<b>A. SITE PREPARATION</b>									
1.01	Asphalt cutting	lin.m.	2	7.00	\$14.00	7.00	\$14.00	7.00	\$14.00
1.02	Imported Fill	cu.m.	11	50.00	\$550.00	50.00	\$550.00	50.00	\$550.00
<b>SUBTOTAL - SECTION A</b>					<b>\$564</b>		<b>\$564</b>		<b>\$564</b>
<b>B. ROAD WORK RESTORATION</b>									
2.01	Granular subbase (200mm depth)	sq.m.	5	11.20	\$56.00	11.20	\$56.00	11.20	\$56.00
2.02	100mm Asphalt & 150mm Base	sq.m.	5	150.00	\$750.00	150.00	\$750.00	150.00	\$750.00
<b>SUBTOTAL - SECTION B</b>					<b>\$806</b>		<b>\$806</b>		<b>\$806</b>
<b>C. SANITARY SEWERS</b>									
3.01	Manhole complete (1 per 50m)	ea.	0.02	6,180.00	\$123.60	7,800.00	\$156.00	12,300.00	\$246.00
3.02	Removal of existing pipe	lin.m.	1	60.00	\$60.00	75.00	\$75.00	75.00	\$75.00
3.03	Connection to existing (assume 2 directions)	ea.	0.02	5,400.00	\$108.00	11,600.00	\$232.00	11,600.00	\$232.00
3.04	100mm Lot service connection c/w 200mm IC (1 per 10m)	ea.	0.1	3,050.00	\$305.00	3,050.00	\$305.00	3,050.00	\$305.00
<b>SUBTOTAL - SECTION C</b>					<b>\$597</b>		<b>\$768</b>		<b>\$858</b>
<b>SUMMARY</b>					<b>\$1,966.60</b>		<b>\$2,138.00</b>		<b>\$2,228.00</b>

Pipe Size (mm)	200	250	300	350	375	400	450	525	600	675	750
Pipe Cost	\$235.00	\$245.00	\$290.00	\$330.00	\$340.00	\$382.50	\$425.00	\$550.00	\$650.00	\$775.00	\$900.00
Extra Costs	\$1,966.60	\$1,966.60	\$1,966.60	\$1,966.60	\$1,966.60	\$1,966.60	\$1,966.60	\$2,138.00	\$2,138.00	\$2,228.00	\$2,228.00
Subtotal	\$2,201.60	\$2,211.60	\$2,256.60	\$2,296.60	\$2,306.60	\$2,349.10	\$2,391.60	\$2,688.00	\$2,788.00	\$3,003.00	\$3,128.00
Inflation (30%)	\$660.48	\$663.48	\$676.98	\$688.98	\$691.98	\$704.73	\$717.48	\$806.40	\$836.40	\$900.90	\$938.40
Contingency (40%)	\$1,144.83	\$1,150.03	\$1,173.43	\$1,194.23	\$1,199.43	\$1,221.53	\$1,243.63	\$1,397.76	\$1,449.76	\$1,561.56	\$1,626.56
Engineering (10%)	\$400.69	\$402.51	\$410.70	\$417.98	\$419.80	\$427.54	\$435.27	\$489.22	\$507.42	\$546.55	\$569.30
<b>TOTAL UNIT COST</b>	<b>\$4,407.60</b>	<b>\$4,427.62</b>	<b>\$4,517.71</b>	<b>\$4,597.79</b>	<b>\$4,617.81</b>	<b>\$4,702.90</b>	<b>\$4,787.98</b>	<b>\$5,381.38</b>	<b>\$5,581.58</b>	<b>\$6,012.01</b>	<b>\$6,262.26</b>

Note: Manhole Price Breakdown:

Pipe Size	Frame/ Base/ Cover / Removal	Vertical Metres \$ per m	Total
100-450mm	\$3,900.00	\$760.00	\$6,180.00
525-600mm	\$4,800.00	\$1,000.00	\$7,800.00
675-750mm	\$7,800.00	\$1,500.00	\$12,300.00

**SANITARY PIPE COST PER METRE (4-6m depth) DERIVATION**

ASSUMPTIONS: Average trench width of 2m with 8' and 6' trench boxes  
Top 1.8m at 1:1 slope, with total width of 5.6m

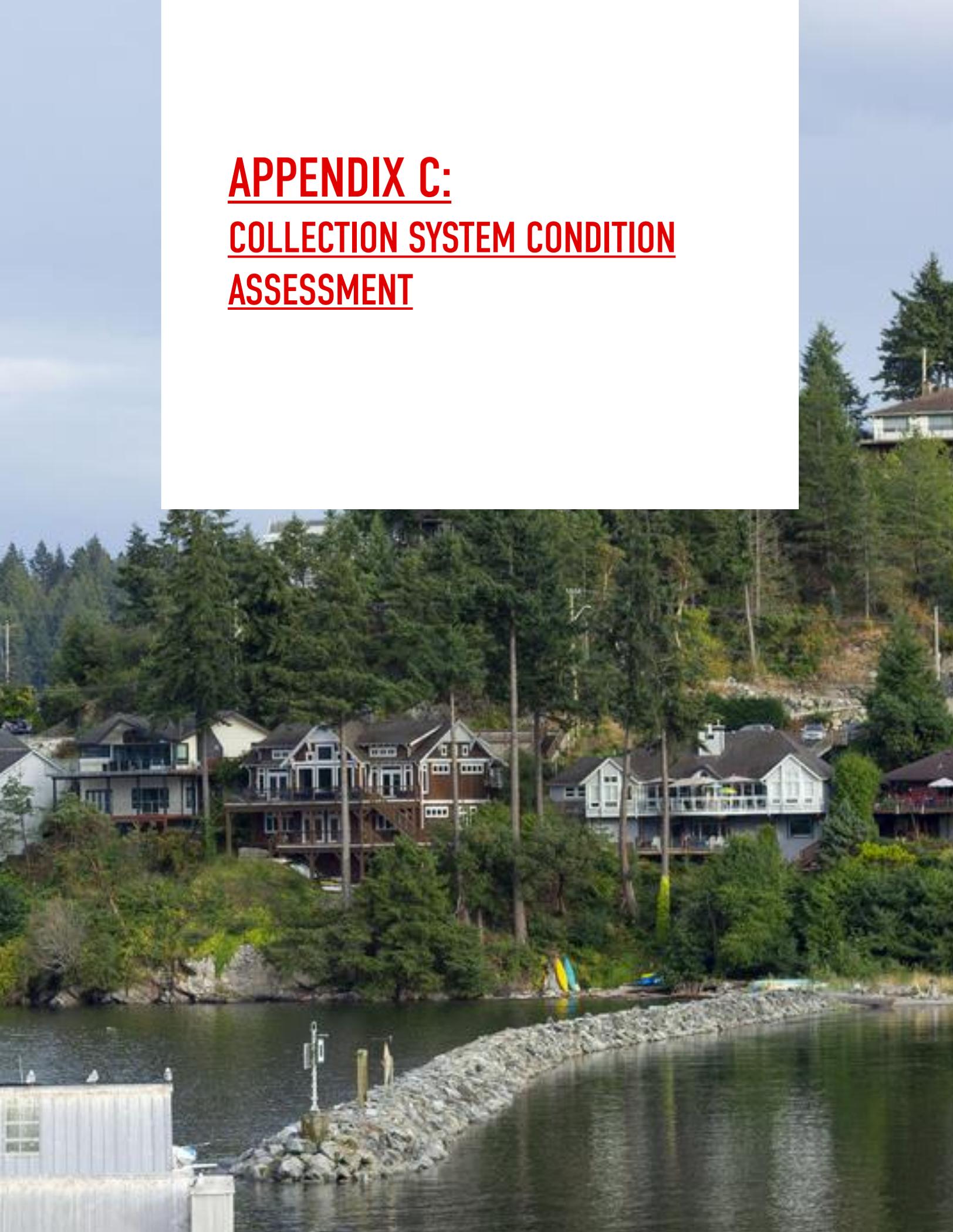
Item	Description	Unit	Quantity	100mm to 450mm		525mm and 600mm		675mm and 750mm	
				Unit Price	Total	Unit Price	Total	Unit Price	Total
<b>A. SITE PREPARATION</b>									
1.01	Asphalt cutting	lin.m.	2	7.00	\$14.00	7.00	\$14.00	7.00	\$14.00
1.02	Imported Fill	cu.m.	15	50.00	\$750.00	50.00	\$750.00	50.00	\$750.00
<b>SUBTOTAL - SECTION A</b>					<b>\$764</b>		<b>\$764</b>		<b>\$764</b>
<b>B. ROAD WORK RESTORATION</b>									
2.01	Granular subbase (200mm depth)	sq.m.	6	11.20	\$67.20	11.20	\$67.20	11.20	\$67.20
2.02	100mm Asphalt & 150mm Base	sq.m.	6	150.00	\$900.00	150.00	\$900.00	150.00	\$900.00
<b>SUBTOTAL - SECTION B</b>					<b>\$967</b>		<b>\$967</b>		<b>\$967</b>
<b>C. SANITARY SEWERS</b>									
3.01	Manhole complete (1 per 50m)	ea.	0.02	7,700.00	\$154.00	9,800.00	\$196.00	15,300.00	\$306.00
3.02	Removal of existing pipe	lin.m.	1	60.00	\$60.00	75.00	\$75.00	75.00	\$75.00
3.03	Connection to existing (assume 2 directions)	ea.	0.02	5,400.00	\$108.00	11,600.00	\$232.00	11,600.00	\$232.00
3.04	100mm Lot service connection c/w 200mm IC (1 per 10m)	ea.	0.1	3,050.00	\$305.00	3,050.00	\$305.00	3,050.00	\$305.00
<b>SUBTOTAL - SECTION C</b>					<b>\$627</b>		<b>\$808</b>		<b>\$918</b>
<b>SUMMARY</b>					<b>\$2,358.20</b>		<b>\$2,539.20</b>		<b>\$2,649.20</b>

Pipe Size (mm)	200	250	300	350	375	400	450	525	600	675	750
Pipe Cost	\$235.00	\$245.00	\$290.00	\$330.00	\$340.00	\$382.50	\$425.00	\$550.00	\$650.00	\$775.00	\$900.00
Extra Costs	\$2,358.20	\$2,358.20	\$2,358.20	\$2,358.20	\$2,358.20	\$2,358.20	\$2,358.20	\$2,539.20	\$2,539.20	\$2,649.20	\$2,649.20
Subtotal	\$2,593.20	\$2,603.20	\$2,648.20	\$2,688.20	\$2,698.20	\$2,740.70	\$2,783.20	\$3,089.20	\$3,189.20	\$3,424.20	\$3,549.20
Inflation (30%)	\$777.96	\$780.96	\$794.46	\$806.46	\$809.46	\$822.21	\$834.96	\$926.76	\$956.76	\$1,027.26	\$1,064.76
Contingency (40%)	\$1,348.46	\$1,353.66	\$1,377.06	\$1,397.86	\$1,403.06	\$1,425.16	\$1,447.26	\$1,606.38	\$1,658.38	\$1,780.58	\$1,845.58
Engineering (10%)	\$471.96	\$473.78	\$481.97	\$489.25	\$491.07	\$498.81	\$506.54	\$562.23	\$580.43	\$623.20	\$645.95
<b>TOTAL UNIT COST</b>	<b>\$5,191.59</b>	<b>\$5,211.61</b>	<b>\$5,301.70</b>	<b>\$5,381.78</b>	<b>\$5,401.80</b>	<b>\$5,486.88</b>	<b>\$5,571.97</b>	<b>\$6,184.58</b>	<b>\$6,384.78</b>	<b>\$6,855.25</b>	<b>\$7,105.50</b>

Note: Manhole Price Breakdown:

Pipe Size	Frame/ Base/ Cover / Removal	Vertical Metres \$ per m	Total
100-450mm	\$3,900.00	\$760.00	\$7,700.00
525-600mm	\$4,800.00	\$1,000.00	\$9,800.00
675-750mm	\$7,800.00	\$1,500.00	\$15,300.00

# APPENDIX C: COLLECTION SYSTEM CONDITION ASSESSMENT



# CONDITION RISK METHODOLOGY

This memo outlines the proposed methodology for assessing and rating condition risks for sewer pipes in the Gibsons Sewer Strategic Plan. The methodology is broken down into three parts: an assessment of the likelihood of failure, an assessment of the consequence of failure, and a risk score. These condition risk scores will be used in conjunction with capacity risk scores (methodology outlined under separate cover) for developing the prioritized capital plan for the Town.

## Part 1 – Likelihood of Failure

The likelihood or probability of condition-based asset failure for pipes is typically based on the structural integrity of the pipe, or the Internal Condition Grade (ICGs). Where available, the ICGs have been supplied by the Town and will be developed with a methodology consistent with the WRc Sewer Rehabilitation Manual resulting in a rating between 1 and 5. When ICGs are not available, asset age and materials as outlined in Table 1 will be applied as a suitable proxy. However, asset age is significantly less reliable than ICG when used as an indicator of the likelihood of failure. Therefore, a 5 rating is only applicable where actual, field-level condition data is available i.e. ICG scores, and the maximum rating likelihood based on asset age is 4. This approach intends to contain the number of false positives that emerge due to asset age and it also further encourages expanded use and collection of field-level data.

For the future condition likelihood of failure age will be used as the criteria since the deterioration rate of an ICG score can be highly variable. It is recommended that ICG scores be redeveloped at least once every 10 years and at least 5 years prior to estimated pipe replacement timing.

**Table 1 – Condition Ranking for Likelihood of Failure**

Likelihood of Failure	Criteria	
	ICG Score	Asset Age
5	5	n/a
4	4	Asset age is $\geq 133\%$ of useful life
3	3	Asset age is $\geq 100\%$ to $< 133\%$ of useful life
2	2	Asset age is $\geq 80\%$ to $< 100\%$ of useful life
1	1	Asset age is $< 80\%$ of useful life

The following useful life estimates are employed in accordance with the Towns Asset Management Plan.

- PVC/POLY = 80 Years
- Asbestos Cement/Unknown = 50 Years
- Ductile Iron = 50 Years
- HDPE/PE = 50 Years
- Vitrified Clay = 50 Years
- Relined AC/CP/VC (AC-R/CP-R/VC-R) = 50 Years

In addition, condition-based capital projects that are triggered by asset age will only be sequenced beyond the 5-year horizon allowing the Town to collect field-level data that reconciles age risks and ICG ratings prior to committing to the upgrade.

Repair costs will be included in the recommended capital plan where costs are provided by the Town for condition triggered projects. The remainder are to be projects flagged for investigation, with costing for full replacement to be provided.

## Part 2 – Consequence of Failure

The consequence of failure is based on the actual location of the infrastructure and the financial consequence that might occur if the infrastructure failed.

A proxy for *cost to restore service* is the road classification for which the pipe is located. Table 2 outlines the projected daily 2-way volume and its associated road classification. For example, a failure within an *Arterial* road presents greater traffic control and road reconstruction requirements than a failure within a local road. The City's GIS data set is used to analyze if a pipe is physically located in a road and if it is, what the road classification (and associated volume) is. Table 2 also summarizes the consequence of failure ranking by road classification.

**Table 2 – Consequence of Failure by Road Classification**

Road Classification	Consequence Of Failure
Arterial/Highway	5
Coast Line	5
Collector	4
Local	2
Strata	n/a not owned by the Town
Lane	2
Statutory Right of Way	3

## Modified Consequence Score

Some sewer mains present an increased level of consequence should they fail due to their location. For the analysis, we consider mains that are located adjacent to or within the corridor of a sensitive watercourse or ocean. Overall, in instances where the sewer mains met the identified criteria, the original consequence score based on road classification are modified as presented in Table 3.

**Table 3 – Modified Consequence Score**

Original Score	• Based on road classification	1	2	3	4	5
Modified Score	<ul style="list-style-type: none"> <li>• Crossing or adjacent to a sensitive watercourse or ocean (30m Buffer)</li> <li>• within 2m proximity to a structure</li> <li>• located in a high-risk seismic zone (where identified by the Town)</li> <li>• at depth &gt;5m</li> </ul>	1	3	4	5	5

## Part 3 – Risk Score

The risk score combines the likelihood of asset failure and the consequence of failure into a single 1 to 5 rating. A risk score of 5 represents the highest risk and a score of 1 the least risk. Table 5 correlates the consequence and the likelihood of failure to the risk score using the input values that arise from all the tables outlined above.

**Table 5 – Risk Score**

Consequence	5	2	3	4	5	5
	4	2	3	4	5	5
	3	2	2	3	4	4
	2	1	2	2	3	3
	1	1	1	2	2	3
		1	2	3	4	5
		Likelihood of Failure				

It is important to recognize that an asset assessed as *moderate* or *low risk* may transition to having a higher risk over time simply due to the aging of the asset. Further, if new condition

assessment data suggests that an asset is in better condition than its age would indicate, there would be a different risk outcome. With this in mind, there must be emphasis on keeping the risk assessment current.



*Infrastructure Management  
Consultants*



## Town of Gibsons / Urban Systems

### Condition assessment of asbestos cement sanitary sewer mains (2022)

#### ***Submitted to***

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July 12, 2023

## 1.0 EXECUTIVE SUMMARY

MJ Pawlowski and Associates ('MJP') was retained by Urban Systems to condition assess of asbestos cement sanitary sewer mains in the Town of Gibsons. Urban Systems provided MJP with a database (~30,977.1m; 430 CCTV reports) containing asbestos cement, concrete, ductile iron, polyethylene, and polyvinyl chloride pipe. C3 Mainline Inspections Inc. of Lake Cowichan, BC conducted the CCTV surveys between March 16, 2022 and June 29, 2022.

**This assessment focussed on the ~18,120.4m (245 reports) of asbestos cement pipe only.** Note that some mains in this survey program had not been sufficiently pre-cleaned, affecting the ability to visually discern features of surface wear.

### A. Findings:

- Approximately 92% of mains have ICGs of 1 or 2.
- Eleven (11) mains have structural defects requiring rehabilitation
- Thirty-three (33) mains have signs of infiltration, mainly minor
- Twenty-five (25) mains have encrustation accumulations, light to medium
- Twenty-three (23) mains have areas of root incursions
- Twenty-nine (29) mains have grease accumulations, mainly minor
- Twenty-eight (28) mains have debris accumulations between 5 and 20% of the cross-sectional diameter of pipe
- Twenty-one (21) mains have obstructions (rocks, intruding gaskets, etc.)
- Thirty-four (34) mains have laterals with issues, mainly encrustation buildup
- Fifteen (15) mains require attention by Town of Gibsons personnel (manhole locating, service connection cleaning)
- Forty (40) mains require re-CCTV inspection due to deficient surveys
- Seven (7) mains require records investigation

### B. Recommendations and cost estimate summary

Tables ES-1 and ES-2 provide our recommendations and preliminary cost estimates.

<b>Table ES-1: Preliminary cost estimate summary</b>			
<b>Technology</b>	<b>No.</b>	<b>No. of Mains</b>	<b>Cost estimate</b>
External Point Repairs ("Dig-up" (EPR) (NB: 2 EPRS in one main)	8	7	\$207,234.50
Trenchless Point Repairs (mini-liners) (TPR)	6	6	\$42,425.10
Mainline joint chemical grouting	--	6	\$27,719.60
Lateral interface grouting		1	7,255.10
Re-CCTV inspection	--	41	\$35,611.30
<b>Total rehabilitation/maintenance cost estimate</b>			<b>\$320,245.60</b>

Town of Gibsons / Urban Systems - Condition assessment of asbestos cement sanitary sewer mains (2022)

Table ES-2: Preliminary cost estimates per main

Item	PLR	Rpt No (FURB-)	Location	U/S MH	D/S MH	Dir	Diam (mm)	Mat	tLen (m)	EPR	TPR	Mainline joint grout	Lateral interface grout	Re-CCTV	Records Investigation	Field Investigation/Maintenance	Total per Main
1	SP-0005	116	Gibsons Way	SH-0004	SH-0001	D	150	CO	104.2	\$26,354.60							\$26,354.60
2	SP-0033	439	Farnham Rd	0033a	0033b	D	100	AC	39.0					\$500.00			\$500.00
3	SP-0035	438	Farnham Rd	0519a	SH-0519	U	150	AC	43.5					\$500.00			\$500.00
4	SP-0037	001	O'Shea Rd	SH-0117A	SH-0117	U	200	AC	59.0					\$531.00			\$531.00
5	SP-0038	124	Oshea Rd	SH-0117	SH-0028	D	200	AC	73.0					\$657.00			\$657.00
6	SP-0039	139	O'Shea Rd	SH-0028	SH-0008	D	200	AC	73.0		\$6,449.00						\$6,449.00
7	SP-0045	281	Wyngaert Rd	SH-0052	SH-0051	U	200	AC	109.2		\$6,919.60						\$6,919.60
8	SP-0048	282	Wyngaert Rd	SH-0054	SH-0050	U	200	AC	60.0			\$3,517.85		\$540.00			\$4,057.85
9	SP-0052	280	Martin Rd	SH-0057	SH-0056	D	200	AC	92.7			\$6,129.79					\$6,129.79
10	SP-0057	293	N Fletcher Rd	SH-0059	SH-0063	D	200	AC	76.5	\$25,994.50							\$25,994.50
11	SP-0073	300	Hicks Ln	SH-0083	SH-0082	D	150	AC	112.6					\$1,013.40			\$1,013.40
12	SP-0080	303	Killarney Ln	SH-0084	SH-0085	U	200	AC	99.5					\$895.50			\$895.50
13	SP-0109	396	Persephone Ln	SH-0038	SH-0037	D	150	AC	116.0					\$1,394.00			\$1,394.00
14	SP-0114	408	Periwinkle Ln	SH-0044	SH-0043	D	150	PVC	71.0					\$639.00			\$639.00
15	SP-0115	409	Periwinkle Ln	SH-0043	SH-0040	D	150	PVC	77.0					\$693.00			\$693.00
16	SP-0129	144	South Fletcher Rd	SH-0039	SH-0041	U	200	AC	30.0					\$500.00			\$500.00
17	SP-0137	411	Gower Point Rd	SH-0129	SH-0164	D	200	AC	88.5								--
18	SP-0143	412	Prowse Rd	SH-0126	SH-0127	D	200	AC	62.0							•	--
19	SP-0150	382	Bay Rd	SH-0138	SH-0135	D	150	AC	108.0					\$972.00		•	\$972.00
20	SP-0151	375	Franklin Rd	SH-0152	SH-0151	D	150	AC	50.7							•	--
21	SP-0152	197	Franklin Rd	SH-0151	SH-0150	U	200	AC	50.9			\$3,365.76					\$3,365.76
22	SP-0154	207	Cochrane Rd	SH-0143X	SH-0143	U	200	AC	55.0					\$500.00			\$500.00
23	SP-0156	209	Franklin Rd	SH-0149	SH-0148	D	200	AC	96.1	\$26,249.30				\$864.90			\$27,114.20
24	SP-0164	221/232	Wells Lane	SH-0139	SH-0140	D/U	200	AC	96.0					\$864.00			\$864.00
25	SP-0165	230	Wells Lane	SH-0140	SH-0141	D	200	AC	93.5	\$26,215.50							\$26,215.50
26	SP-0172	251/383	Bay Rd	SH-0121	SH-0135	D/D	200	AC	36.0					\$674.00			\$674.00
27	SP-0184	199	Hillcrest Rd	SH-0261	SH-0520	D	200	AC	45.1							•	--
28	SP-0188	205	Hillcrest Rd	SH-0179	SH-0181	D	200	AC	96.1		\$6,749.30						\$6,749.30

Town of Gibsons / Urban Systems - Condition assessment of asbestos cement sanitary sewer mains (2022)

Table ES-2: Preliminary cost estimates per main

Item	PLR	Rpt No (FURB-)	Location	U/S MH	D/S MH	Dir	Diam (mm)	Mat	tLen (m)	EPR	TPR	Mainline joint grout	Lateral interface grout	Re-CCTV	Records Investigation	Field Investigation/ Maintenance	Total per Main
29	SP-0191	289	Crucil Rd	SH-0182	SH-0185	U	200	AC	62.4	\$25,811.20	\$7,661.20						\$33,472.40
30	SP-0198	320	Gibsons Way	SH-0175	SH-0176	U	150	AC	86.0					\$1,474.00			\$1,474.00
31	SP-0201	322	Gibsons Way	SH-0180	SH-0184	D	200	AC	124.2						•		--
32	SP-0210	131	Davis Rd	SH-0190	SH-0189	D	150	AC	86.0					\$1,124.00			\$1,124.00
33	SP-0211	442	Davis Rd	0189a	SH-0189	U	150	AC	64.0					\$576.00			\$576.00
34	SP-0216	393	Sargent Rd	SH-0194a	SH-0194	U	150	AC	100.5						•		--
35	SP-0217	397	Persephone Ln	SH-0198	SH-0197	D	150	AC	82.0					\$738.00			\$738.00
36	SP-0218	398	Persephone Ln	SH-0197	SH-0195	D	150	AC	78.5					\$706.50			\$706.50
37	SP-0220	400	South Fletcher Rd	SH-0608	SH-0196	D	150	AC	116.0					\$1,894.00	•		\$1,894.00
38	SP-0223	395	Sargent Rd	SH-0489	SH-0195	D	150	AC	60.0					\$890.00			\$890.00
39	SP-0224	422	Sargent Rd	SH-0889a	SH-0489	U	150	AC	47.0					\$500.00			\$500.00
40	SP-0235	334/335	Gower Point Rd	SH-0533	SH-0207	D/U	300	AC/PVC	125.0					\$1,125.00			\$1,125.00
41	SP-0236	336	Gower Point Rd	SH-0207	SH-0206	D	300	AC	123.3					\$1,109.70			\$1,109.70
42	SP-0237	337	Gower Point Rd	SH-0206	SH-0208	D	300	AC	97.7					\$879.30			\$879.30
43	SP-0239	343	Gower Point Rd	SH-0205	SH-0212	U	300	AC	124.0					\$1,116.00			\$1,116.00
44	SP-0245	351	Gower Point Rd	SH-0214	SH-0215	D	300	AC	115.5					\$1,739.50			\$1,739.50
45	SP-0246	352	Gower Point Rd	SH-0215	SH-0216	D	300	AC	61.0					\$549.00		•	\$549.00
46	SP-0247	353	Gower Point Rd	SH-0216	SH-0217	D	300	AC	15.0					\$500.00		•	\$500.00
47	SP-0248	354	Gower Point Rd	SH-0217	0217a	D	300	DI	47.0					\$500.00		•	\$500.00
48	SP-0249	355	Gower Point Rd	0217a	0217b	D	300	DI	2.0							•	--
49	SP-0250	271/275	North Rd	SH-0382	SH-0220	D/U	200	PVC	116.0	\$51,508.00	\$7,008.00				•	•	\$58,516.00
50	SP-0256	273	Hillcrest Rd	SH-0285	SH-0284	D	200	AC	29.3			\$1,937.46					\$1,937.46
51	SP-0262	284	Wyngaert Rd	SH-0222	SH-0221	U	150	AC	122.0					\$1,098.00			\$1,098.00
52	SP-0269	421	Beachcomber Ln	SH-0239	SH-0238	D	200	AC	50.0					\$500.00		•	\$500.00
53	SP-0276	193	Maplewood Lane	SH-0231	SH-0228	D	200	AC	92.7				\$7,255.10			•	\$7,255.10
54	SP-0292	376	Blackberry Ln	SH-0248	SH-0240	U	150	AC	98.0					\$1,232.00		•	\$1,232.00
55	SP-0294	374	Franklin Rd	SH-0152a	SH-0152	U	200	AC	39.0					\$500.00		•	\$500.00
56	SP-0302	031	Industrial Way	SH-0301A	SH-0301	U	200	AC	96.1			\$6,354.61					\$6,354.61

**Table ES-2: Preliminary cost estimates per main**

Item	PLR	Rpt No (FURB-)	Location	U/S MH	D/S MH	Dir	Diam (mm)	Mat	tLen (m)	EPR	TPR	Mainline joint grout	Lateral interface grout	Re-CCTV	Records Investigation	Field Investigation/Maintenance	Total per Main
57	SP-0319	184	North Rd	SH-0270	SH-0271	D	200	AC	72.5					\$1,002.50			\$1,002.50
58	SP-0327	173	Creekside Cr	SH-0280	SH-0455	D	200	AC	97.0			\$6,414.13					\$6,414.13
59	SP-0337	219	Burns Rd	SH-0289	SH-0295	U	200	AC	67.0					\$603.00	•		\$603.00
60	SP-0349	414	Alder Springs Rd	SH-0299a	SH-0299	U	150	AC	2.0							•	--
61	SP-0350	032	Industrial Way	SH-0301X	SH-0301	U	200	AC	127.0					\$1,493.00	•		\$1,493.00
62	SP-0352	441	Poplar Ln	SH-0304	SH-0308	D	150	AC	122.0					\$1,448.00			\$1,448.00
63	SP-0362	083	Oshea Rd	SH-0313	SH-0314	D	200	PVC	126.0		\$7,638.00						\$7,638.00
64	SP-0422	426	Skyline Dr	SH-0363	0363a	D	150	AC	2.0							•	--
65	SP-0433	349	Gower Point Rd	SH-0374	SH-0375	U	200	PVC	7.8	\$25,101.40							\$25,101.40
66	SP-0486	401	Winn Rd	SH-0429	SH-0199	U	150	AC	64.0					\$576.00			\$576.00
<b>Total preliminary cost estimates</b>										<b>\$207,234.50</b>	<b>\$42,425.10</b>	<b>\$27,719.60</b>	<b>\$7,255.10</b>	<b>\$35,611.30</b>	<b>--</b>	<b>--</b>	<b>\$320,245.60</b>

**CONTENTS**

**1.0 EXECUTIVE SUMMARY ..... 2**

*Table ES-1: Preliminary cost estimate summary ..... 2*

*Table ES-2: Preliminary cost estimates per main ..... 3*

**2.0 INTRODUCTION ..... 8**

**3.0 CCTV MAINLINE SEWER INSPECTIONS – STRUCTURAL REVIEW ..... 9**

    3.1 MATERIAL DISTRIBUTION ..... 9

*Table 3.1: Material Distribution ..... 9*

    3.2 DUPLICATE PIPE LENGTH REFERENCES (PLRs) ..... 10

*Table 3.2: Duplicate Pipe Length References (PLRs) ..... 10*

    3.3 INTERNAL CONDITION GRADES (ICG’s) AS A PERCENTAGE OF PROGRAM ..... 11

*Table 3.3: Internal Condition Grades ..... 11*

    3.4 STRUCTURAL REVIEW ..... 11

        Fig. 3.4a: PLR SP-0005 – Hole in concrete pipe at ~75.1m ..... 11

        Fig. 3.4b: PLR SP-0039 – Field-patched hole with IR at 63.6m ..... 11

*Table 3.4: Structural Review ..... 12*

        Fig. 3.4c: PLR SP-0045 – Two holes & surface spalling medium at ~64.8m ..... 12

        Fig. 3.4d: PLR SP-0057 – Hole at interface of service at ~43.3m ..... 12

        Fig. 3.4e: PLR SP-0156 – Hole with IR at ~83.3m ..... 13

        Fig. 3.4f: PLR SP-0165 – SSLJ with IRJ at 93.3m just before drop SH-0141 ..... 13

        Fig. 3.4g: PLR SP-0188 – Patched hole with RF & IS at ~65.8m ..... 13

        Fig. 3.4h: PLR SP-0191 – poorly patch hole with IR at ~8.8m ..... 13

        Fig. 3.4i: PLR SP-0191 – small hole with roots & staining at ~37.2m ..... 13

        Fig. 3.4j: PLR SP-0250 – Joint displaced large at ~15.3m ..... 13

        Fig. 3.4k: PLR SP-0362 – Fractures with EL at ~79.2 & 79.9m ..... 14

        Fig. 3.4l: PLR SP-0433 – SA at ~7.8m due to JD.L. - possible collapse ..... 14

**4.0 CCTV MAINLINE SEWER INSPECTIONS – OPERATIONAL REVIEW ..... 15**

    4.1 INFILTRATION / ENCRUSTATION ..... 15

        Fig. 4.1a: PLR SP-0052 – Spalling & infiltration runner at ~30.2m ..... 15

        Fig. 4.1b: PLR SP-0567 – Infiltration gusher at interface of MH SH-0498 ..... 15

        Fig. 4.1c: PLR SP-0082 – 20% Encrustation at ~96.7m ..... 15

        Fig. 4.1d: PLR SP-0275 – 20% encrustation at ~0.2m ..... 15

*Table 4.1a: Instances of infiltration per main ..... 16*

    4.2 ROOTS ..... 17

*Table 4.2: Instances of Root Incursions ..... 18*

        Fig. 4.2a: PLR SP-0198 – 40% Root Mass at ~68m ..... 18

        Fig. 4.2b: PLR SP-0223 – 80% Root Mass at ~11.6m ..... 18

    4.3 GREASE ..... 19

*Table 4.3: Mains with grease ..... 19*

        Fig. 4.3a: PLR SP-0023 –5% grease accumulations at 0m ..... 20

        Fig. 4.3b: PLR SP-0307 – 10% grease accumulations at ..... 20

    4.4 DEBRIS/OBSTRUCTIONS ..... 20

*Table 4.4a: Debris ..... 20*

*Table 4.4b: Obstructions ..... 21*

        Fig. 4.4a: PLR SP-0274 – 20% sanitary debris at ~86.7m ..... 21

        Fig. 4.4b: PLR SP-0400 – Piece of PVC pipe catching debris ..... 21

    4.5 LATERAL CONCERNS ..... 22

*Table 4.5: Lateral concerns ..... 22*

        Fig. 4.5a: PLR SP 0295 – Roots from service at ~23.7m ..... 23

        Fig. 4.5b: PLR SP-0337 – service 100% blocked with encrustation ..... 23

        Fig. 4.5c: PLR SP-0379 – 25% gravel at ~38.6m ..... 23

        Fig. 4.5d: PLR SP-0522 – 50% sanitary debris backing up in service ..... 23

        Fig. 4.5e: PLR SP-0615 – ponding in service at ~27.2m ..... 23

4.6	OPERATIONAL MAINTENANCE .....	24
	<i>Table 4.6: Operational Maintenance</i> .....	24
4.7	DEFICIENT SURVEYS .....	25
	<i>Table 4.7: Deficient surveys</i> .....	25
4.8	RECORDS INVESTIGATION .....	27
	<i>Table 4.8: Records investigation</i> .....	27
<b>5.0</b>	<b>MAINLINE REHABILITATION RECOMMENDATIONS AND COST ESTIMATES .....</b>	<b>28</b>
5.1	PRELIMINARY COST ESTIMATE SUMMARY .....	28
	<i>Table 5.1: Preliminary cost estimate summary</i> .....	28
5.2	STRUCTURAL REHABILITATION PRELIMINARY COST ESTIMATES .....	28
	<i>Table 5.2: Structural rehabilitation cost estimates</i> .....	28
5.3	MAINLINE JOINT CHEMICAL GROUTING PRELIMINARY COST ESTIMATES.....	29
	<i>Table 5.3: Mainline joint chemical grouting cost estimates</i> .....	29
5.4	LATERAL INTERFACE CHEMICAL GROUTING PRELIMINARY COST ESTIMATE.....	29
	<i>Table 5.4: Lateral interface chemical grouting cost estimates</i> .....	29
5.5	RE-CCTV INSPECTION COST ESTIMATES.....	29
	<i>Table 5.5: Re-CCTV inspection cost estimates</i> .....	29
5.6	OPERATIONAL MAINTENANCE RECOMMENDATIONS .....	31
<b>APPENDIX - General conditions.....</b>		<b>33</b>

## 2.0 INTRODUCTION

MJ Pawlowski and Associates ('MJP') was retained by Urban Systems to condition assess of asbestos cement sanitary sewer mains in the Town of Gibsons. C3 Mainline Inspections Inc. of Lake Cowichan, BC conducted the CCTV surveys between March 16, 2022 and June 29, 2022.

Urban Systems provided MJP with a database and CCTV videos (~30,977.1m; 430 CCTV reports) for asbestos cement, concrete, ductile iron, polyethylene and polyvinyl chloride pipe.

**This assessment focussed primarily on the ~18,120.4m (245 reports) of asbestos cement pipe. Note that a comprehensive review of the non-asbestos cement pipes was not performed.** During our review of the database, we found some other mains which require attention, and they are noted in this report.

Note some mains in this survey had not been sufficiently pre-cleaned, affecting the ability to visually discern the degree of surface wear.

CCTV data collection is compliant with the U.K. water industry, engineering, and operations committee, "Manual of Sewer Condition Classification" (1993 edition and 1996 addendum).

The procedure adopted for data analysis is based on the Water Research Center's (WRc) Sewerage Rehabilitation Manual (4<sup>th</sup> edition). This method establishes the framework for an integrated approach to the overall management of sewer systems. The sewer defect coding system provides the ability to identify defects of both a structural and operational nature including observed locations of infiltrating ground water.

The defect codes and additional data pertinent to each sewer section are entered into a CCTV inspection database specifically developed to provide an efficient manner by which to manage large volumes of digital data. There are several fields in the CCTV inspection report which may have blank entries due to a lack of available information. Typically, these fields include items such as manhole invert elevations, year of construction, and the sewer category as defined by the WRc protocol. These fields do not describe the condition of the pipe and therefore have no bearing on the actual calculation of condition grades. However, information such as depth can have an influence on the potential choice of technology and method for rehabilitation.

The numbering system adopted for each individual manhole-to-manhole section or Pipe Length Reference (PLR) for this CCTV inspection program is derived from information provided by Urban Systems and the Town of Gibsons. The prefix ("F22URB-") of the individual CCTV reports is derived from MJP's proprietary ACCESS database.

### 3.0 CCTV MAINLINE SEWER INSPECTIONS – STRUCTURAL REVIEW

#### 3.1 Material Distribution

The Town of Gibsons Sanitary 2022 CCTV database encompasses a total of ~30,977.1m of sewer mains consisting of asbestos cement (AC), concrete (CO), ductile iron (DI), polyethylene (PE) and polyvinyl chloride (PVC) ranging in diameter from 100mm to 450mm. *Table 3.1* shows the material distribution on a project wide basis.

<b>Table 3.1: Material Distribution</b>		
<b>Material</b>	<b>Diameter (mm)</b>	<b>Length (m)</b>
Asbestos Cement (AC)	100	39.0
	150	4,391.3
	200	12,798.2
	300	891.9
<b>Total m AC pipe</b>		<b>18,120.4</b>
Concrete (CO)	150	228.0
<b>Total m CO pipe</b>		<b>228.0</b>
Ductile Iron (DI)	300	49.0
<b>Total m DI pipe</b>		<b>49.0</b>
Polyethylene (PE)	200	93.0
<b>Total m PE pipe</b>		<b>93.0</b>
Polyvinyl Chloride (PVC)	100	56.0
	150	1,563.1
	200	7,364.7
	250	885.5
	300	2,358.7
	350	233.0
	450	25.7
<b>Total m PVC pipe</b>		<b>12,486.7</b>
<b>Totals</b>		<b>30,977.1</b>

Note: Distances are approximate due to material changes and abandoned surveys (SA). Most total lengths were adjusted to reflect GIS record lengths as measured in the Town of Gibson GIS system.

### 3.2 Duplicate Pipe Length References (PLRs)

There were twenty-nine (29) duplicate Pipe Length References in this survey.

Table 3.2: Duplicate Pipe Length References (PLRs)										
Item	PLR	Rpt No (F22URB-)	Location	U/S MH	D/S MH	Dir	Diam (mm)	Mat	tLen (m)	ICG
1	DP-0248	446/452	Eaglecrest Rd	DH-0157	DH-0146	D/U	250	PVC	65.0	1/1
2	SP-0023	428/440	Shaw Rd	SH-0018	SH-0019	D/D	150	AC	61.2	1/1
3	SP-0027	136/434	Shaw Rd North	SH-0027	SH-0026	D/U	200	AC	119.2	1/1
4	SP-0043	95/96	Abbs Rd	SH-0030	SH-0029	D/U	200	AC	110.0	1/1
5	SP-0108	140/143	Sargent Rd	SH-0035	SH-0036	U/D	200	AC	108.0	1/1
6	SP-0125	316/317	Mccall Ln	SH-0098	SH-0099	D/U	150	AC	69.8	1/1
7	SP-0164	221/232	Wells Lane	SH-0139	SH-0140	D/U	200	AC	96.0	1/1
8	SP-0172	251/383	Bay Rd	SH-0121	SH-0135	D/D	200	AC	36.0	1/1
9	SP-0235	334/335	Gower Point Rd	SH-0533	SH-0207	D/U	300	AC/PVC	125.0	1/1
10	SP-0250	271/275	North Rd	SH-0382	SH-0220	D/U	200	PVC/AC	116.0	4/1
11	SP-0259	192/194	Hillcrest Rd	SH-0282	SH-0286	D/U	200	AC	107.0	1/1
12	SP-0267	417/418	Alder Springs Rd	SH-0225	SH-0125	D/U	150	AC	87.5	1/1
13	SP-0270	146/254	Glassford Rd	SH-0238	SH-0237	U/U	200	AC	86.0	1/1
14	SP-0271	147/256	Glassford Rd	SH-0237	SH-0125	D/D	200	AC	84.0	1/1
15	SP-0290	169/170	Jesse's Lane	SH-0243	SH-0242	U/D	200	AC	105.0	2/1
16	SP-0293	168/180	Cochrane Rd	SH-0240	SH-0241	D/U	200	AC	58.3	1/1
17	SP-0307	105/107	Gibsons Way	SH-0260	SH-0256	D/U	200	AC	127.0	1/1
18	SP-0396	258/259	Arbutus Reach	SH-0350	SH-0349	D/U	150	PVC	45.2	1/1
19	SP-0399	265/443	Camella Way	SH-0348	SH-0347	U/U	150	PVC	71.0	1/1
20	SP-0403	242/371	Bay Rd	SH-0345	SH-0137	U/D	200	AC	51.6	1/1
21	SP-0412	59/61	Oceanmount Blvd	SH-0356	SH-0357	D/U	200	PVC	69.5	1/1
22	SP-0430	341/342	Bayview Hts Rd	SH-0372	SH-0371	D/D	200	PVC	24.2	1/1
23	SP-0457	38/41	Park Rd	SH-0399	SH-0397	U/D	200	PVC	12.9	1/1
24	SP-0468	74/75	Shaw Rd North	SH-0410	SH-0411	D/U	300	PVC	109.0	1/1
25	SP-0481	129/429	Inglis Rd	SH-0425	SH-0426	U/U	150	PVC	78.0	1/1
26	SP-0522	100/108	Mahon Rd	SH-0453	SH-0454	U/D	300	PVC	97.9	1/1
27	SP-0544	89/91	Spyglass Pl	SH-0470	SH-0471	U/D	200	PVC	110.4	1/1
28	SP-0567	5/17	Gerussi Lane	SH-0499	SH-0498	D/D	200	PVC	46.5	1/1
29	SP-0599	201/274	Hillcrest Rd	SH-0177	SH-0520	U/U	200	PE	46.5	1/1

Dir – survey direction (upstream/downstream); tLen – total length; MH – manhole; ICG – Internal Condition Grade

There are frequently valid reasons for more than one inspection of a particular sewer section. These can include surveys abandoned (identified by the designated code “SA”) due to some form of obstruction. These inspections become a “duplicate” PLR once the main is re-inspected from either the same or reverse direction, although the report itself is not a duplicate as it typically covers a different portion or altered view of the main.

### 3.3 Internal Condition Grades (ICG's) as a Percentage of Program

Four hundred and thirty (430) mains (all pipe materials) were inspected for this project.

Table 3.3 provides a breakdown of computed *Internal Condition Grades* (ICG's) as a percentage of the inspected mains.

Table 3.3: Internal Condition Grades		
Internal Condition Grade	Number of Mains (PLRs)	% of Program
1	397	92.3
2	16	3.7
3	0	0.0
4	15	3.5
5	2	0.5
<b>Totals</b>	<b>430</b>	<b>100.0</b>

The computerized analysis and grade calculation indicate that approximately ninety-six percent (96%) of the mains surveyed have an Internal Condition Grade (ICG) of 1 and 2.

An ICG of 1 indicates that the main is in satisfactory structural condition with virtually no structural defects. An ICG of 2 indicates the presence of minor defects. In accordance with the WRC's Sewerage Rehabilitation Manual, sewer mains with an ICG of 1 or 2 are not normally reviewed in detail for structural evaluation purposes.

Typically, a detailed review of only the mains with ICG's of 3 and greater is carried out with the purpose of confirming the severity of the structural deficiency at the peak score location as well as the remainder of the main which is reflected by the total score.

### 3.4 Structural Review

CCTV reports and videos were reviewed for structural grades  $\geq 3$  or the presence of defects such as open/displaced joints, surface wear, cracks, fractures and holes. Eleven (11) mains require structural rehabilitation.



**Fig. 3.4a:** PLR SP-0005 – Hole in concrete pipe at ~75.1m



**Fig. 3.4b:** PLR SP-0039 – Field-patched hole with IR at 63.6m

Table 3.4: Structural Review										
Item	PLR	Rpt No. (F22URB-)	Location	U/S MH	D/S MH	Dir	Diam (mm)	Mat	tLen (m)	Review Comments
1	SP-0005	116	Gibsons Way	SH-0004	SH-0001	D	150	CO	104.2	Concrete pipe. Hole at 75.1m
2	SP-0039	139	O'Shea Rd	SH-0028	SH-0008	D	200	AC	73.0	Field-patched hole with IR at 63.6m
3	SP-0045	281	Wyngaert Rd	SH-0052	SH-0051	U	200	AC	109.2	2 holes & SSM at 64.8m
4	SP-0057	293	N Fletcher Rd	SH-0059	SH-0063	D	200	AC	76.5	Hole at interface of service at 43.3m
5	SP-0156	209	Franklin Rd	SH-0149	SH-0148	D	200	AC	96.1	Hole with IR at 83.3m
6	SP-0165	230	Wells Lane	SH-0140	SH-0141	D	200	AC	93.5	SSLJ with IRJ at 93.3m just before drop SH-0141
7	SP-0188	205	Hillcrest Rd	SH-0179	SH-0181	D	200	AC	96.1	Patched hole with RF & IS at 65.8m
8	SP-0191	289	Crucil Rd	SH-0182	SH-0185	U	200	AC	62.4	Large poorly patched hole with IR at 8.8m, 3 small holes with RF & IS between 37 & 40m
9	SP-0250	271	North Rd	SH-0382	SH-0220	D	200	PVC	116	SA at 110 due to JDL. ReTV incomplete
		275	North Rd	SH-0382	SH-0220	U	200	AC	116.0	Field-patched with EM at 75.3m
10	SP-0362	083	Oshea Rd	SH-0313	SH-0314	D	200	PVC	126.0	SA at 15.7 due to JDL. ReTV incomplete
11	SP-0433	349	Gower Point Rd	SH-0374	SH-0375	U	200	PVC	7.8	Fractures with EL at 79.2 & 79.9m
										SA at 7.8m due to JDL. - possible collapse. No reverse - no explanation

IS – Infiltration Seeper  
 IR – Infiltration Runner  
 E(L/M) – encrustation medium/light  
 JDL – joint displaced large

RF – Roots Fine  
 SA – Survey abandoned  
 SSM – surface spalling medium  
 SSLJ – surface spalling large at joint



**Fig. 3.4c:** PLR SP-0045 – Two holes & surface spalling medium at ~64.8m



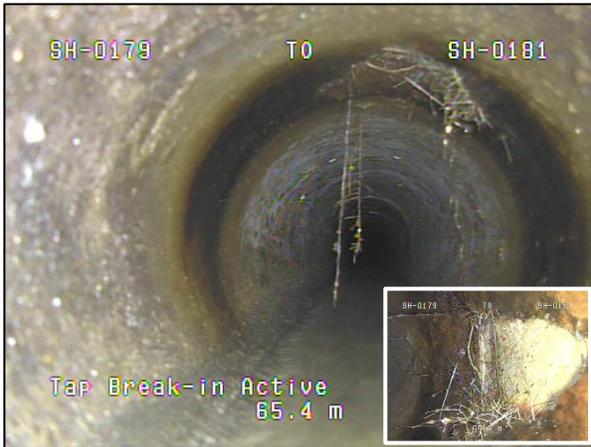
**Fig. 3.4d:** PLR SP-0057 – Hole at interface of service at ~43.3m



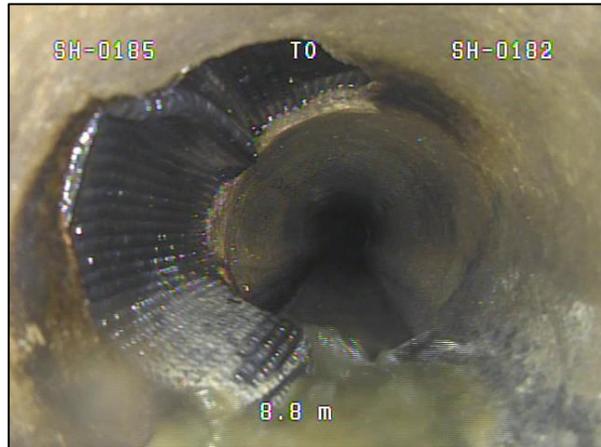
**Fig. 3.4e:** PLR SP-0156 – Hole with IR at ~83.3m



**Fig. 3.4f:** PLR SP-0165 – SSLJ with IRJ at 93.3m just before drop SH-0141



**Fig. 3.4g:** PLR SP-0188 – Patched hole with RF & IS at ~65.8m



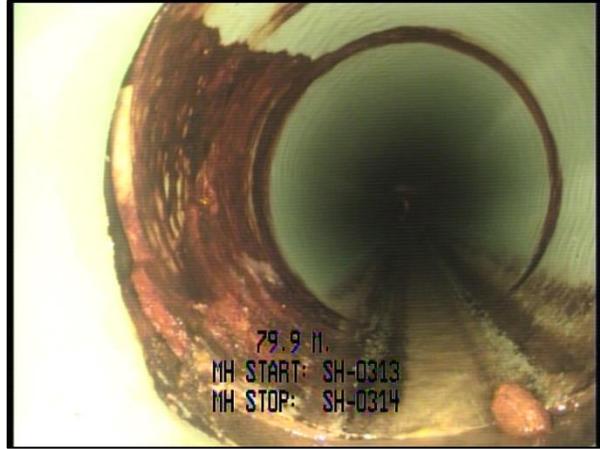
**Fig. 3.4h:** PLR SP-0191 – poorly patch hole with IR at ~8.8m



**Fig. 3.4i:** PLR SP-0191 – small hole with roots & staining at ~37.2m



**Fig. 3.4j:** PLR SP-0250 – Joint displaced large at ~15.3m



**Fig. 3.4k:** PLR SP-0362 – Fractures with EL at ~79.2 & 79.9m



**Fig. 3.4l:** PLR SP-0433 – SA at ~7.8m due to JDL. - possible collapse.

## 4.0 CCTV mainline sewer inspections – Operational Review

### 4.1 Infiltration / Encrustation

The CCTV data has identified thirty-three (33) mains with infiltration and twenty-five (25) mains with encrustation. The WRC Manual of Sewer Condition Classification identifies infiltration or encrustation in the sewer main as follows:

- IS – Infiltration Seeper
- IR – Infiltration Runner
- E (L,M,H) – Encrustation
- J = at joint
- ID – Infiltration Dripper
- IG – Infiltration Gusher
- (Light, Medium, Heavy)

The codes ID (Infiltration Dripper), IR (Infiltration Runner) and IG (Infiltration Gusher) represent the more severe forms of infiltration.



**Fig. 4.1a:** PLR SP-0052 – Spalling & infiltration runner at ~30.2m



**Fig. 4.1b:** PLR SP-0567 – Infiltration gusher at interface of MH SH-0498



**Fig. 4.1c:** PLR SP-0082 – 20% Encrustation at ~96.7m



**Fig. 4.1d:** PLR SP-0275 – 20% encrustation at ~0.2m

**Table 4.1a: Instances of infiltration per main**

Item	PLR	Rpt No. (F22URB-)	Location	U/S MH	D/S MH	Dir	Diam (mm)	Mat	tLen (m)	IS	ISJ	IDJ	IR	IRJ	IG	Totals
1	DP-0224	448	Oceanmount Blvd	DH-0145	DH-0146	D	250	PVC	77.8	1						1
2	SH-0251	276	North Rd	SH-0220	SH-0288	D	200	AC	74.9		2					2
3	SH-0285	359	Blain Ln	SH-0234	SH-0246	D	200	AC	82.5	1						1
4	SP-0029	436	Farnham Rd	SH-0025	SH-0024	D	200	AC	76.0		1					1
5	SP-0039	139	O'Shea Rd	SH-0028	SH-0008	D	200	AC	73.0				1			1
6	SP-0045	281	Wyngaert Rd	SH-0052	SH-0051	U	200	AC	109.2	1	1					2
7	SP-0048	282	Wyngaert Rd	SH-0054	SH-0050	U	200	AC	60.0	1				1		2
8	SP-0052	280	Martin Rd	SH-0057	SH-0056	D	200	AC	92.7				1			1
9	SP-0076	297	Glen Rd	SH-0079	SH-0080	D	150	AC	110.8	1						1
10	SP-0152	197	Franklin Rd	SH-0151	SH-0150	U	200	AC	50.9			1				1
11	SP-0156	209	Franklin Rd	SH-0149	SH-0148	D	200	AC	96.1				1			1
12	SP-0165	230	Wells Lane	SH-0140	SH-0141	D	200	AC	93.5					1		1
13	SP-0188	205	Hillcrest Rd	SH-0179	SH-0181	D	200	AC	96.1	1						1
14	SP-0189	208	Crucil Rd	SH-0183	SH-0181	D	200	AC	82.9	1						1
15	SP-0191	289	Crucil Rd	SH-0182	SH-0185	U	200	AC	62.4	3	1		1			5
16	SP-0198	320	Gibsons Way	SH-0175	SH-0176	U	150	AC	86.0				2			2
17	SP-0201	322	Gibsons Way	SH-0180	SH-0184	D	200	AC	124.2		1					1
18	SP-0233	166	South Fletcher Rd	SH-0204	SH-0199	D	200	AC	117.8	1						1
19	SP-0250	271	North Rd	SH-0382	SH-0220	D	200	PVC	116.0	1						1
20	SP-0256	273	Hillcrest Rd	SH-0285	SH-0284	D	200	AC	29.3				1			1
21	SP-0266	415	Alder Springs Rd	SH-0299	SH-0225	D	150	AC	118.4		1					1
22	SP-0273	185	Glassford Rd	SH-0226	SH-0227	U	200	AC	74.6	1						1
23	SP-0275	191	Maplewood Lane	SH-0232	SH-0231	U	200	AC	96.7	3						3
24	SP-0293	168/180	Cochrane Rd	SH-0240	SH-0241	D/U	200	AC	58.0	1	1					2
25	SP-0302	31	Industrial Way	SH-0301A	SH-0301	U	200	AC	96.1	1			1			2
26	SP-0315	158	Cascade Cr	SH-0266	SH-0268	D	200	AC	83.0	1		1				2
27	SP-0316	159	Creekside Cr	SH-0268	SH-0279	D	200	AC	77.7		1					1
28	SP-0327	173	Creekside Cr	SH-0280	SH-0455	D	200	AC	97.0			1				1
29	SP-0362	83	Oshea Rd	SH-0313	SH-0314	D	200	PVC	126.0		2					2
30	SP-0434	178	Tralee Pl	SH-0378A	SH-0378	D	200	PVC	44.4		1					1
31	SP-0567	17	Gerussi Lane	SH-0499	SH-0498	D	200	PVC	46.5						1	1
32	SP-0576	18	Venture Way	SH-0252	SH-0504	D	200	AC	45.0	1						1
33	SP-0598a	202	Hillcrest Rd	SH-0520	SH-0179	D	200	AC	36.6		1					1
<b>Totals</b>										<b>20</b>	<b>13</b>	<b>3</b>	<b>8</b>	<b>2</b>	<b>1</b>	<b>47</b>

Table 4.1b: Instances of encrustation per main															
Item	PLR	Rpt No. (F22URB-)	Location	U/S MH	D/S MH	Dir	Diam (mm)	Mat	tLen (m)	%	EL	ELJ	EM	EMJ	Totals
1	SP-0048	282	Wyngaert Rd	SH-0054	SH-0050	U	200	AC	60.0			1			1
2	SP-0082	307	Killarney Ln	SH-0087	SH-0086	D	150	AC	97.2	20			1		1
3	SP-0143	412	Prowse Rd	SH-0126	SH-0127	D	200	AC	62.0	15			1		1
4	SP-0152	197	Franklin Rd	SH-0151	SH-0150	U	200	AC	50.9	5				1	1
5	SP-0153	200	Franklin Rd	SH-0150	SH-0143	D	200	AC	102.1	5			1		1
6	SP-0163	216	Burns Rd	SH-0142	SH-0139	D	200	AC	102.7		1				1
7	SP-0250	271	North Rd	SH-0382	SH-0220	D	200	PVC	116.0	5			1	1	2
8	SP-0256	273	Hillcrest Rd	SH-0285	SH-0284	D	200	AC	29.3	15			1		1
9	SP-0259	192	Hillcrest Rd	SH-0282	SH-0286	D	200	AC	107.0			1			1
10	SP-0265	416	Alder Springs Rd	SH-0224	SH-0225	U	150	AC	51.6			1			1
11	SP-0266	415	Alder Springs Rd	SH-0299	SH-0225	D	150	AC	118.4	5 to 20			1	2	3
12	SP-0273	185	Glassford Rd	SH-0226	SH-0227	U	200	AC	74.6	10				1	1
13	SP-0275	191	Maplewood Lane	SH-0232	SH-0231	U	200	AC	96.7	20			1		1
14	SP-0276	193	Maplewood Lane	SH-0231	SH-0228	D	200	AC	92.7	5 to 15	3		5		8
15	SP-0290	169	Jesse'S Lane	SH-0243	SH-0242	U	200	AC	105.0		1				1
16	SP-0291	167	Cochrane Rd	SH-0242	SH-0240	D	200	AC	89.8		2				2
17	SP-0307	107	Gibsons Way	SH-0260	SH-0256	U	200	AC	127.0		1				1
18	SP-0313	155	Mountainview Dr	SH-0265	SH-0266	D	200	AC	48.5			1			1
19	SP-0315	158	Cascade Cr	SH-0266	SH-0268	D	200	AC	83.0			1			1
20	SP-0327	173	Creekside Cr	SH-0280	SH-0455	D	200	AC	97.0	15				1	1
21	SP-0342	149	North Rd	SH-0296	SH-0328	U	200	AC	78.9			1			1
22	SP-0352	441	Poplar Ln	SH-0304	SH-0308	D	150	AC	122.0			1			1
23	SP-0365	85	Oshea Rd	SH-0315	SH-0318	D	250	PVC	110.0			1			1
24	SP-0435	179	Tralee Pl	SH-0378	SH-0379	D	200	PVC	46.7			1			1
25	SP-0500	88	Spyglass Rd	SH-0442	SH-0443	D	200	PVC	55.3	5	1		1		2
<b>Totals</b>											<b>9</b>	<b>9</b>	<b>13</b>	<b>6</b>	<b>37</b>

## 4.2 Roots

Twenty-three (23) mains were reported with roots.

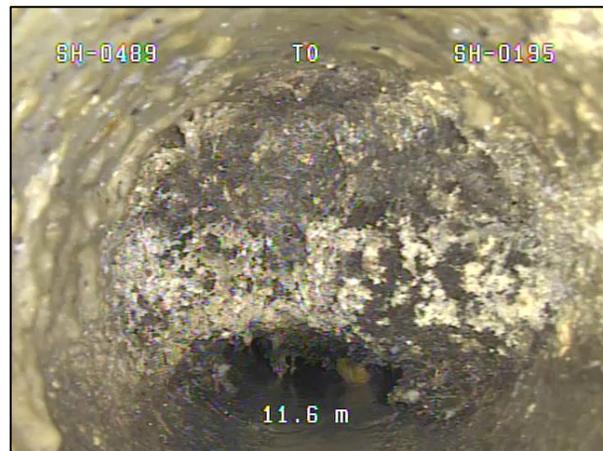
Root penetration into the sewer main can have a harmful effect on the hydraulic efficiency of the main. Excessive amounts of roots can cause partial blockage to the sewer flow and act as a restrictive bottleneck upon which debris can accumulate. *Table 4.2* identifies the mains with intruding roots.

**Table 4.2: Instances of Root Incursions**

Item	PLR	Rpt No. (F22URB-)	Location	U/S MH	D/S MH	Dir	Diam (mm)	Mat	tLen (m)	RM(J) %	RF	RFJ	RT	RM	RMJ	Totals
1	SH-0285	359	Blain Ln	SH-0234	SH-0246	D	200	AC	82.5		1					1
2	SP-0029	436	Farnham Rd	SH-0025	SH-0024	D	200	AC	76.0	15				1		1
3	SP-0109	396	Persephone Ln	SH-0038	SH-0037	D	150	AC	116.0	20					1	1
4	SP-0167	234	Headlands Rd	SH-0153	SH-0154	U	200	AC	77.7			1				1
5	SP-0188	205	Hillcrest Rd	SH-0179	SH-0181	D	200	AC	96.1		1					1
6	SP-0191	289	Crucil Rd	SH-0182	SH-0185	U	200	AC	62.4		3	1				4
7	SP-0198	320	Gibsons Way	SH-0175	SH-0176	U	150	AC	86.0	40			1	1		2
8	SP-0216	393	Sargent Rd	SH-0194a	SH-0194	U	150	AC	100.5	5				1		1
9	SP-0223	395	Sargent Rd	SH-0489	SH-0195	D	150	AC	60.0	80				1		1
10	SP-0241	345	Gower Point Rd	SH-0211	SH-0210	D	300	AC	94.7		1					1
11	SP-0245	351	Gower Point Rd	SH-0214	SH-0215	D	300	AC	115.5	75					1	1
12	SP-0260	195	Hillcrest Rd	SH-0286	SH-0287	D	200	AC	45.6	20					1	1
13	SP-0266	415	Alder Springs Rd	SH-0299	SH-0225	D	150	AC	118.4			1				1
14	SP-0268	420	Relic'S Ln	SH-0120	SH-0239	D	200	AC	79.2			1				1
15	SP-0283	357	Gower Point Rd	SH-0235	SH-0234	D	200	PVC	104.4			1				1
16	SP-0292	376	Blackberry Ln	SH-0248	SH-0240	U	150	AC	98.0	30				1		1
17	SP-0295	385	Glasford Rd	SH-0249	SH-0227	U	200	PVC	70.0	15				1		1
18	SP-0296	373	Beachcomber Ln	SH-0249b	SH-0249	U	150	AC	33.8		2					2
19	SP-0319	184	North Rd	SH-0270	SH-0271	D	200	AC	72.5	25			1			1
20	SP-0350	032	Industrial Way	SH-0255	SH-0301	U	200	AC	127.0	30					1	1
21	SP-0401	269	Camella Way	SH-0346	SH-0345	D	150	AC	103.6	35		1			1	2
22	SP-0435	179	Tralee Pl	SH-0378	SH-0379	D	200	PVC	46.7		1					1
23	SP-0601	135	Shaw Rd North	SH-0521	SH-0027	D	200	AC	70.4	15					1	1
<b>Totals</b>											<b>9</b>	<b>6</b>	<b>2</b>	<b>6</b>	<b>6</b>	<b>29</b>



**Fig. 4.2a:** PLR SP-0198 – 40% Root Mass at ~68m



**Fig. 4.2b:** PLR SP-0223 – 80% Root Mass at ~11.6m

### 4.3 Grease

Twenty-nine (29) mains have observations of grease.

The accumulation of grease in sanitary sewer mains can potentially have a detrimental impact on the daily operation of the sewer system. Accumulations of grease can affect the hydraulic capacity of the mainline sewer with the possibility of full blockage of sewer flows, which in turn may cause back-ups into private properties possibly resulting in insurance claims. Excessive quantities of grease entering the sewer system may interfere with the operation of sewer lift stations and associated valves and screens resulting in preventable maintenance costs.

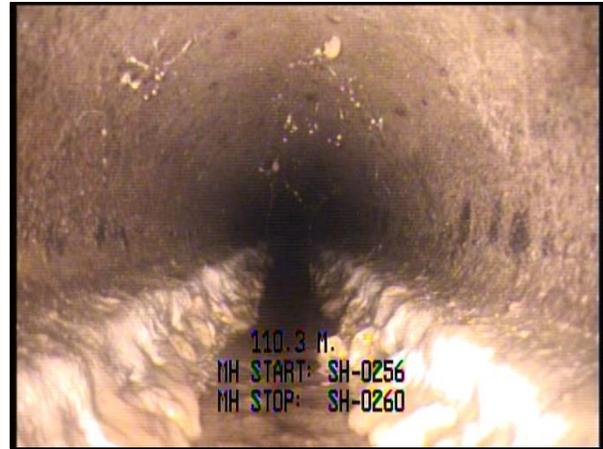
**Table 4.3: Mains with grease**

Item	PLR	Rpt No. (F22URB-)	Location	U/S MH	D/S MH	Dir	Diam (mm)	Mat	tLen (m)	Cont (m)	%
1	SP-0023	428/440	Shaw Rd	SH-0018	SH-0019	D/D	150	AC	61.2		5 to 10
2	SP-0027	136/434	Shaw Rd North	SH-0027	SH-0026	D	200	AC	119.2		5
3	SP-0029	436	Farnham Rd	SH-0025	SH-0024	D	200	AC	76.0		10
4	SP-0092	328	Marine Dr	SH-0101	SH-0102	D	200	AC	112.3		5
5	SP-0093	329	Marine Dr	SH-0102	SH-0103	U	200	AC	96.9		5
6	SP-0125	316	Mccall Ln	SH-0098	SH-0099	D	150	AC	69.8		5
7	SP-0127	318	Mccall Ln	SH-0099	SH-0093	D	150	AC	85.2		5
8	SP-0137	411	Gower Point Rd	SH-0129	SH-0164	D	200	AC	88.5		5
9	SP-0159	204	Chochrane Rd	SH-0144	SH-0145	D	200	AC	88.4		5
10	SP-0172	251	Bay Rd	SH-0121	SH-0135	D	200	AC	36.0	7.4	5
11	SP-0206	113	Gibsons Way	SH-0258	SH-0485	D	200	PVC	110.4		5
12	SP-0210	131	Davis Rd	SH-0190	SH-0189	D	150	AC	86.0	4.0	5
13	SP-0266	415	Alder Springs Rd	SH-0299	SH-0225	D	150	AC	118.4		5
14	SP-0267	418	Alder Springs Rd	SH-0225	SH-0125	U	150	AC	87.5		5
15	SP-0307	105/107	Gibsons Way	SH-0260	SH-0256	D/U	200	AC	127.0	7.0	5 to 10
16	SP-0310	109	Gibsons Way	SH-0259	SH-0257	U	200	AC	80.3	38.0	5
17	SP-0311	112	Gibsons Way	SH-0257X	SH-0258	D	200	PVC	105.7		5
18	SP-0351	103	Gibsons Way	SH-0300	SH-0260	D	200	AC	122.4	10.0	5
19	SP-0352	441	Poplar Ln	SH-0304	SH-0308	D	150	AC	122.0		5
20	SP-0401	269	Camella Way	SH-0346	SH-0345	D	150	AC	103.6		5
21	SP-0468	074	Shaw Rd North	SH-0410	SH-0411	D	300	PVC	109.0		5
22	SP-0470	076	Shaw Rd North	SH-0411	SH-0414	D	300	PVC	98.7	98.4	5
23	SP-0489	042	Oshea Rd	SH-0431	SH-0432	U	300	PVC	66.2	65.0	5
24	SP-0490	043	Oshea Rd	SH-0432	SH-0433	D	300	PVC	104.8	104.8	5
25	SP-0491	047	Oshea Rd	SH-0433	SH-0434	U	300	PVC	42.8	39.1	5
26	SP-0583	132	Davis Rd	SH-0188X	SH-0188	U	150	PVC	9.7	2.6	5
27	SP-0584	070	Oceanmount Blvd Gibson	SH-0481	SH-0469	D	200	PVC	41.9	4.1	5
28	SP-0601	135	Shaw Rd North	SH-0521	SH-0027	D	200	AC	70.4	3.0	5
29	SP-0617	211	Aurora Way	SH-0518	SH-0461	D	200	PVC	53.3		5 to 10

Cont – continuous metres



**Fig. 4.3a:** PLR SP-0023 –5% grease accumulations at 0m



**Fig. 4.3b:** PLR SP-0307 – 10% grease accumulations at

#### 4.4 Debris/Obstructions

Twenty-eight (28) mains have observations of debris. Twenty-one (21) mains have obstructions.

**Table 4.4a: Debris**

Item	PLR	Rpt No. (F22URB-)	Location	U/S MH	D/S MH	Dir	Diam (mm)	Mat	tLen (m)	Cont (m)	%
1	DP-0249	450	Eaglecrest Rd	DH-0110	DH-0146	D	250	PVC	46.8		5
2	SP-0023	440	Shaw Rd	SH-0018	SH-0019	D	150	AC	61.2		5
3	SP-0040	92	Abbs Rd	SH-0032	SH-0031	D	200	AC	97.0		5
4	SP-0043	95/96	Abbs Rd	SH-0030	SH-0029	D/U	200	AC	110.0		10
5	SP-0080	303	Killarney Ln	SH-0084	SH-0085	U	200	AC	99.5		15
6	SP-0109	396	Persephone Ln	SH-0038	SH-0037	D	150	AC	116.0		15
7	SP-0156	209	Franklin Rd	SH-0149	SH-0148	D	200	AC	96.1		5
8	SP-0163	216	Burns Rd	SH-0142	SH-0139	D	200	AC	102.7		5
9	SP-0164	232	Wells Lane	SH-0139	SH-0140	U	200	AC	96.0		10
10	SP-0169	239	Headlands Rd	SH-0155	SH-0137	D	200	AC	117.3		5
11	SP-0172	251	Bay Rd	SH-0121	SH-0135	D	200	AC	36.0		5
12	SP-0233	166	South Fletcher Rd	SH-0204	SH-0199	D	200	AC	117.8		5
13	SP-0272	182	Glassford Rd	SH-0233	SH-0227	U	200	AC	93.9		5
14	SP-0274	188	Glassford Rd	SH-0227	SH-0228	D	200	AC	86.9		20
15	SP-0275	191	Maplewood Lane	SH-0232	SH-0231	U	200	AC	96.7		5
16	SP-0289	171	Glassford Rd	SH-0244	SH-0243	U	200	AC	36.0	9.0	5
17	SP-0302	031	Industrial Way	SH-0301A	SH-0301	U	200	AC	96.1		5
18	SP-0331	272	Trueman Rd	SH-0291	SH-0290	D	150	AC	105.4		5
19	SP-0333	379	Dougall Rd	SH-0292	SH-0293	U	150	AC	44.6		10
20	SP-0337	219	Burns Rd	SH-0289	SH-0295	U	200	AC	67.0		5
21	SP-0347	248	Dougall Rd	SH-0298	SH-0294	U	200	AC	75.5		5
22	SP-0352	441	Poplar Ln	SH-0304	SH-0308	D	150	AC	122.0		5
23	SP-0499	087	Spyglass Pl	SH-0441	SH-0442	D	200	PVC	106.6		5
24	SP-0550	071	Inglis Rd	SH-0480X	SH-0480	U	200	PVC	58.2	38.0	5
25	SP-0551	072	Inglis Rd	SH-0480	SH-0469	D	200	PVC	6.0		5
26	SP-0560	011	Woodsworth Rd	SH-0493X	SH-0493	U	200	PVC	84.7		20
27	SP-0561	010	Wright Rd	SH-0494	SH-0493	U	200	PVC	61.5		5
28	SP-0620	006	Goddard Rd	SH-0537	SH-0156B	D	200	PVC	100.9		5

Table 4.4b: Obstructions												
Item	PLR	Rpt No. (F22URB-)	Location	U/S MH	D/S MH	Dir	Diam (mm)	Mat	tLen (m)	Dist (m)	%	Remarks
1	SH-0251	276	North Rd	SH-0220	SH-0288	D	200	AC	74.9	41.9	5	Intruding gasket
2	SP-0023	428	Shaw Rd	SH-0018	SH-0019	D	150	AC	4.8	4.5	15	Unknown under water
3	SP-0038	124	Oshea Rd	SH-0117	SH-0028	D	200	AC	73.0	57.5	10	Rock
4	SP-0042	94	Abbs Rd	SH-0446	SH-0030	D	200	AC	87.3	4.1	5	Rock
5	SP-0108	140	Sargent Rd	SH-0035	SH-0036	U	200	AC	108.0	89.8	15	Unknown
6	SP-0109	396	Persephone Ln	SH-0038	SH-0037	D	150	AC	116.0	93.2	10	Lump of cement?
7	SP-0132	402	Winn Rd	SH-0199	SH-0156a	U	200	AC	47.3	0.2	5	Rock
8	SP-0135	404	Gower Point Rd	SH-0132	SH-0482	U	200	AC	23.0	4.9	15	Unknown
9	SP-0163	216	Burns Rd	SH-0142	SH-0139	D	200	AC	102.7	0.3	5	Rock
10	SP-0199	323	Gibsons Way	SH-0483	SH-0176	U	200	AC	72.4	21.4	5	Intruding gasket
11	SP-0229	419	South Fletcher Rd	SH-0202	SH-0203	U	150	AC	75.0	8.7	5	Intruding gasket
12	SP-0235	334	Gower Point Rd	SH-0533	SH-0207	D	300	AC	125.0	37.0	10	Chisel
13	SP-0250	275	North Rd	SH-0382	SH-0220	U	200	AC	116.0	1.4	10	Piece of concrete
14	SP-0300	019	Venture Way	SH-0504	SH-0251	D	200	AC	42.0	10.2	5	Unknown caught in joint
15	SP-0331	272	Trueman Rd	SH-0291	SH-0290	D	150	AC	105	41.4	5	Intruding gasket
										105.0	5	Rock
16	SP-0341	187	North Rd	SH-0297	SH-0296	U	20	PVC	38.9	37.7	5	Intruding gasket
17	SP-0352	441	Poplar Ln	SH-0304	SH-0308	D	150	AC	122.0	64.5	15	Rock
18	SP-0400	267	Camella Way	SH-0347	SH-0346	D	150	PVC	23.8	22.9	25	Piece of PVC pipe catching debris
19	SP-0401	269	Camella Way	SH-0346	SH-0345	D	150	AC	104	13.4	5	Exposed gasket
										47.4	5	Exposed gasket
20	SP-0435	179	Tralee Pl	SH-0378	SH-0379	D	200	PVC	46.7	37.7	10	Exposed gasket
21	SP-0528	227	Sunnycrest Ln	SH-0462	SH-0463	U	200	PVC	75.4	74.8	15	Sticks & debris



**Fig. 4.4a:** PLR SP-0274 – 20% sanitary debris at ~86.7m



**Fig. 4.4b:** PLR SP-0400 – Piece of PVC pipe catching debris

#### 4.5 Lateral concerns

Thirty-four (34) mains have lateral issues, mainly encrustation, as noted in *Table 4.5* below.

Table 4.5: Lateral concerns												
Item	PLR	Rpt No. (F22URB-)	Location	U/S MH	D/S MH	Dir	Diam (mm)	Mat	tLen (m)	Dist (m)	Clock Ref.	Remarks
1	DP-0162	455	Oceanmount Blvd	DH-0148	DH-0149	D	350	PVC	73.5	2.3	2	CNI 75mm
2	SP-0027	434	Shaw Rd North	SH-0027	SH-0026	U	200	AC	119.2	107.3	3	25% grease
3	SP-0029	436	Farnham Rd	SH-0025	SH-0024	D	200	AC	76.0	74.0	9	With roots from interface
4	SP-0057	293	N Fletcher Rd	SH-0059	SH-0063	D	200	AC	76.5	43.2	1	Hole at interface
5	SP-0136	406	Gower Point Rd	SH-0482	SH-0129	D	200	AC	77.7	2.5	3	10% debris
6	SP-0142	148	Gower Point Rd	SH-0125	SH-0126	D	200	AC	93.2	92.6	3	CNI 75mm
7	SP-0143	412	Prowse Rd	SH-0126	SH-0127	D	200	AC	62.0	44.0	2	90% encrustation
8	SP-0153	200	Franklin Rd	SH-0150	SH-0143	D	200	AC	102.1	23.6	2	EM from interface
9	SP-0163	216	Burns Rd	SH-0142	SH-0139	D	200	AC	102.7	76.3	10	EL at interface
10	SP-0165	230	Wells Lane	SH-0140	SH-0141	D	200	AC	93.5	43.8	2	EL at interface
										52.7	10	EL at interface
11	SP-0171	245	Bay Rd	SH-0136	SH-0121	U	200	AC	48.7	6.8	10	10% debris
12	SP-0184	199	Hillcrest Rd	SH-0261	SH-0520	D	200	AC	45.1	44.2	10	100% encrustation
13	SP-0216	393	Sargent Rd	SH-0194a	SH-0194	U	150	AC	100.5	24.1	10	10% roots
14	SP-0220	400	South Fletcher Rd	SH-0192	SH-0196	D	150	AC	116.0	104.5	3	CNI 25mm
15	SP-0250	271	North Rd	SH-0382	SH-0220	D	200	PVC	116.0	43.2	1	100% encrustation
16	SP-0266	415	Alder Springs Rd	SH-0299	SH-0225	D	150	AC	118.4	2.0	2	EM from interface
17	SP-0274	188	Glassford Rd	SH-0227	SH-0228	D	200	AC	86.9	69.5	10	30% encrustation
18	SP-0276	193	Maplewood Lane	SH-0231	SH-0228	D	200	AC	92.7	27.3	2	EM from interface
										36.4	10	100% encrustation
19	SP-0276	193	Maplewood Lane	SH-0231	SH-0228	D	200	AC	92.7	55.0	10	EM from interface
										65.5	2	EM from interface
										85.0	1	EM from interface
20	SP-0290	169	Jesse'S Lane	SH-0243	SH-0242	U	200	AC	105.0	10.8	2	With EL at interface
21	SP-0291	167	Cochrane Rd	SH-0242	SH-0240	D	200	AC	89.8	51.4	10	With EL at interface
										69.7	10	With EL at interface
22	SP-0292	376	Blackberry Ln	SH-0248	SH-0240	U	150	AC	98.0	62.1	11	100% roots
23	SP-0293	168	Cochrane Rd	SH-0240	SH-0241	D	200	AC	46.9	22.1	10	EL from interface
24	SP-0295	385	Glasford Rd	SH-0249	SH-0227	U	200	PVC	70.0	23.7	12	With roots
25	SP-0296	373	Beachcomber Ln	SH-0249b	SH-0249	U	150	AC	33.8	31.1	2	RF from interface
										31.9	2	25% roots
26	SP-0307	105/107	Gibsons Way	SH-0260	SH-0256	D/U	200	AC	127.0	8.9/117.9	2	CNI 75mm
27	SP-0318	183	Seacot Way	SH-0269	SH-0270	D	200	AC	78.4	73.4	9	10% roots & encrustation in service
28	SP-0334	247	Bay Rd	SH-0294	SH-0121	U	200	AC	44.9	5.3	10	Offset at interface
29	SP-0337	219	Burns Rd	SH-0289	SH-0295	U	200	AC	67.0	36.4	10	100% encrustation
30	SP-0379	250	North Rd	SH-0329	SH-0343	D	200	PVC	133.9	38.6	3	25% debris (looks like tarred gravel)
31	SP-0436	152	Mountainview Dr	SH-0379	SH-0380	U	200	PVC	27.6	25.7	12	100% encrustation
32	SP-0522	100	Mahon Rd	SH-0453	SH-0454	U	300	PVC	97.9	31.3	10	50% sanitary debris backing up in service
33	SP-0615	212	Sunnycrest Ln	SH-0534	SH-0535	U	200	PVC	37.5	27.2	9	Ponding In service
34	SP-0617	211	Aurora Way	SH-0518	SH-0461	D	200	PVC	53.3	2.7	9	Ponding In service

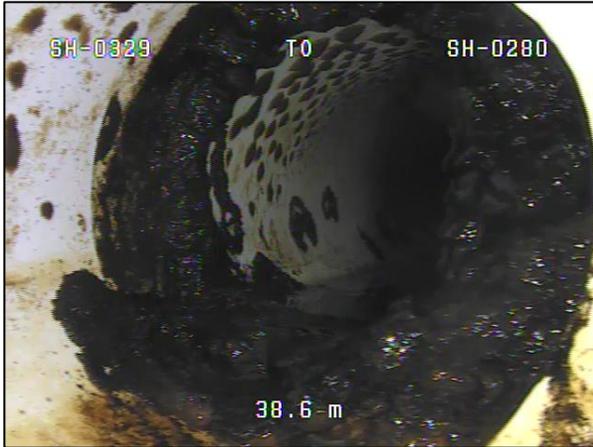
CNI – intruding connection



**Fig. 4.5a:** PLR SP 0295 – Roots from service at ~23.7m



**Fig. 4.5b:** PLR SP-0337 – service 100% blocked with encrustation



**Fig. 4.5c:** PLR SP-0379 – 25% gravel at ~38.6m



**Fig. 4.5d:** PLR SP-0522 – 50% sanitary debris backing up in service



**Fig. 4.5e:**  
PLR SP-0615 – ponding in service at ~27.2m

#### 4.6 Operational Maintenance

Fifteen (15) mains require attention by Town of Gibsons personnel, mainly manhole locating and service connection cleaning.

**Table 4.6: Operational Maintenance**

Item	PLR	Rpt No. (F22URB-)	Location	U/S MH	D/S MH	Dir	Diam (mm)	Mat	tLen (m)	Review Comments
1	SP-0143	412	Prowse Rd	SH-0126	SH-0127	D	200	AC	62.0	Service at 44m 90% encrustation
2	SP-0150	382	Bay Rd	SH-0138	SH-0135	D	150	AC	2.0	SA due to "could not locate SH-0138. WL too high downstream"
3	SP-0151	375	Franklin Rd	SH-0152	SH-0151	D	150	AC	50.7	Drop SH-0151 surcharged
4	SP-0184	199	Hillcrest Rd	SH-0261	SH-0520	D	200	AC	45.1	Service at 44.2m 100% blocked with encrustation
5	SP-0246	352	Gower Point Rd	SH-0215	SH-0216	D	300	AC	2.0	No survey. Could not locate either MH
6	SP-0247	353	Gower Point Rd	SH-0216	SH-0217	D	300	AC	2.0	No survey. Could not locate either MH
7	SP-0248	354	Gower Point Rd	SH-0217	0217a	D	300	DI	2.0	No survey. Could not locate either MH
8	SP-0249	355	Gower Point Rd	0217a	0217b	D	300	DI	2.0	No manholes. Could not inspect
9	SP-0250	271	North Rd	SH-0382	SH-0220	D	200	PVC	116.0	Service at 43.2m 100% encrustation
10	SP-0269	421	Beachcomber Ln	SH-0239	SH-0238	D	200	AC	2.0	No survey. Could not locate either MH
11	SP-0276	193	Maplewood Lane	SH-0231	SH-0228	D	200	AC	92.7	Services at 27.3, 36.4 ,55 ,65.2 & 85m with EM at interface
12	SP-0292	376	Blackberry Ln	SH-0248	SH-0240	U	150	AC	62.2	Service at 62.1m 100% roots
13	SP-0294	374	Franklin Rd	SH-0152a	SH-0152	U	200	AC	2.0	SA at 2m due to "no access for inspection. no upstream MH"
14	SP-0349	414	Alder Springs Rd	SH-0299a	SH-0299	U	150	AC	2.0	SA at 0m – "no upstream MH. benching too tight in downstream"
15	SP-0422	426	Skyline Dr	SH-0363	0363a	D	150	AC	2.0	SA due to "could not locate. No downstream MH"

SA – survey abandoned



**Fig. 4.6a:**

PLR SP-0151 – surcharged drop

#### 4.7 Deficient surveys

Forty (40) mains have deficient surveys due to

Table 4.7: Deficient surveys										
Item	PLR	Rpt No. (F22URB-)	Location	U/S MH	D/S MH	Dir	Diam (mm)	Mat	tLen (m)	Review Comments
1	SP-0033	439	Farnham Rd	0033a	0033b	D	100	AC	39.0	SA at 2m due to pipe size
2	SP-0035	438	Farnham Rd	0519a	SH-0519	U	150	AC	43.5	SA due to "no upstream MH. downstream benching is too tight"
3	SP-0037	1	O'Shea Rd	SH-0117A	SH-0117	U	200	AC	59.0	SA at 2m due to access. No reverse, no explanation
4	SP-0038	124	Oshea Rd	SH-0117	SH-0028	D	200	AC	73.0	SA at 57.9m due to OB - rock. No reverse - no explanation
5	SP-0048	282	Wyngaert Rd	SH-0054	SH-0050	U	200	AC	60.0	SA at 53.2m due to loss of traction (traveling U/S). No reverse - no explanation
6	SP-0073	300	Hicks Ln	SH-0083	SH-0082	D	150	AC	112.6	PQV - Cobwebs on lens throughout survey
7	SP-0109	396	Persephone Ln	SH-0038	SH-0037	D	150	AC	116.0	SA at 93.8m due to OB - unknown under WL. No reverse - no explanation
8	SP-0114	408	Periwinkle Ln	SH-0044	SH-0043	D	150	PVC	71.0	No survey due to access
9	SP-0115	409	Periwinkle Ln	SH-0043	SH-0040	D	150	PVC	77.0	No survey due to access
10	SP-0129	144	South Fletcher Rd	SH-0039	SH-0041	U	200	AC	30.0	SA at 9.3m due to configuration of service. No reverse - no explanation
11	SP-0150	382	Bay Rd	SH-0138	SH-0135	D	150	AC	108.0	SA due to "could not locate sh-0138. wl too high downstream"
12	SP-0154	207	Cochrane Rd	SH-0143X	SH-0143	U	200	AC	55.0	"SA wrong pipe size.?"
13	SP-0156	209	Franklin Rd	SH-0149	SH-0148	D	200	AC	96.1	Too dirty to see wear
14	SP-0164	221/232	Wells Lane	SH-0139	SH-0140	D/U	200	AC	96.0	SA both directions due to WL. Reverse complete, but PQV
15	SP-0172	251/383	Bay Rd	SH-0121	SH-0135	D/D	200	AC	36.0	SA at 33.8/2m due to WL & grease/surcharged/debris
16	SP-0198	320	Gibsons Way	SH-0175	SH-0176	U	150	AC	86.0	SA at 68.6m due to RM. Holes with IR & roots at 62 & 68m (and another one seen beyond SA)
17	SP-0210	131	Davis Rd	SH-0190	SH-0189	D	150	AC	86.0	SA at 25.1m due to UNSAFE TO PROCEED. No reverse - no explanation.
18	SP-0211	442	Davis Rd	0189a	SH-0189	U	150	AC	64.0	SA - No survey - Surcharged/Debris
19	SP-0217	397	Persephone Ln	SH-0198	SH-0197	D	150	AC	82.0	SA at 2m - COULD NOT INSPECT. LANE IS TOO NARROW, NO OTHER
20	SP-0218	398	Persephone Ln	SH-0197	SH-0195	D	150	AC	78.5	SA at 2m - LANE IS TOO NARROW - NO OTHER EXIT
21	SP-0220	400	South Fletcher Rd	SH-0608	SH-0196	D	150	AC	116.0	SA at 104.7m due to CNI. No reverse - no explanation

**Table 4.7: Deficient surveys**

Item	PLR	Rpt No. (F22URB-)	Location	U/S MH	D/S MH	Dir	Diam (mm)	Mat	tLen (m)	Review Comments
22	SP-0223	395	Sargent Rd	SH-0489	SH-0195	D	150	AC	60.0	SA at 11.9m due to RM. No reverse or root-cut & reTV. No explanation
23	SP-0224	422	Sargent Rd	SH-0889a	SH-0489	U	150	AC	47.0	SA at 2m – “no upstream mh. benching too tight downstream”
24	SP-0235	334/335	Gower Point Rd	SH-0533	SH-0207	D/U	300	AC/PVC	125.0	Videos (SA at 0.83m) do not match Rpts
25	SP-0236	336	Gower Point Rd	SH-0207	SH-0206	D	300	AC	123.3	Video (SA at 13m) does not match Rpt
26	SP-0237	337	Gower Point Rd	SH-0206	SH-0208	D	300	AC	97.7	Video (SA at 16.3m) does not match Rpt
27	SP-0239	343	Gower Point Rd	SH-0205	SH-0212	U	300	AC	124.0	Video (SA at 0m) does not match Rpt
28	SP-0245	351	Gower Point Rd	SH-0214	SH-0215	D	300	AC	115.5	SA at 24.8m due to CU
29	SP-0246	352	Gower Point Rd	SH-0215	SH-0216	D	300	AC	61.0	“NF – not found”
30	SP-0247	353	Gower Point Rd	SH-0216	SH-0217	D	300	AC	15.0	No survey. Could not locate either MH
31	SP-0248	354	Gower Point Rd	SH-0217	0217a	D	300	DI	47.0	No survey. Could not locate either MH
32	SP-0262	284	Wyngaert Rd	SH-0222	SH-0221	U	150	AC	122.0	SA at 18.4m due to loss of traction (traveling U/S). No reverse - no explanation.
33	SP-0269	421	Beachcomber Ln	SH-0239	SH-0238	D	200	AC	50.0	No survey. Could not locate either MH
34	SP-0292	376	Blackberry Ln	SH-0248	SH-0240	U	150	AC	98.0	SA at 62.2m due to RM. No reverse or root-cut & reTV - no explanation
35	SP-0294	374	Franklin Rd	SH-0152a	SH-0152	U	200	AC	39.0	SA at 2m due to “no access for inspection. No upstream MH”
36	SP-0319	184	North Rd	SH-0270	SH-0271	D	200	AC	72.5	SA at 24.9m due to hole with tap root. No reverse - no explanation
37	SP-0337	219	Burns Rd	SH-0289	SH-0295	U	200	AC	67.0	SA at 108.1 due to loss of traction (traveling U/S). No reverse - no explanation
38	SP-0350	32	Industrial Way	SH-0301X	SH-0301	U	200	AC	127.0	SA at 52.9m due to RM at Joint. No reverse or root-cut & reTV - no explanation
39	SP-0352	441	Poplar Ln	SH-0304	SH-0308	D	150	AC	122.0	SA at 64.6m due to WL & OB (rock?). No reverse - no explanation
40	SP-0486	401	Winn Rd	SH-0429	SH-0199	U	150	AC	64.0	SA at 44.4m due to loss of traction (traveling U/S). No reverse - no explanation

#### 4.8 Records investigation

Seven (7) mains require records investigation due to data discrepancies between field surveys and Town of Gibsons records.

Table 4.8: Records investigation											
Item	PLR	Rpt No. (F22URB-)	Location	U/S MH	D/S MH	Dir	Diam (mm)	Mat	tLen (m)	Review Comments	Recommendations
1	SP-0137	411	Gower Point Rd	SH-0129	SH-0164	D	200	AC	88.5	PLR & MH numbering discrepancy	Investigate: Update records - PLR & MH numbering
2	SP-0201	322	Gibsons Way	SH-0180	SH-0184	D	200	AC	124.2	New MH at 32.4m?	Investigate: Update records - new MH at 32.4m
3	SP-0216	393	Sargent Rd	SH-0194a	SH-0194	U	150	AC	100.5	SH-0194a. "not shown on map"	Investigate: Update records - SH-0194a
4	SP-0250	271	North Rd	SH-0382	SH-0220	D	200	PVC	116.0	"cleanout" (not on map) at 40.2m	Investigate: Update records "Cleanout" (not on map) at 40.2m
5	SP-0220	400	South Fletcher Rd	SH-0608	SH-0196	D	150	AC	104.7	SA at 104.7m due to CNI. No reverse - no explanation	Trim CNI & reTV
6	SP-0337	219	Burns Rd	SH-0289	SH-0295	U	200	AC	108.1	SA at 108.1m but total length is only 67m	Investigate: total length
7	SP-0350	032	Industrial Way	SH-0301X	SH-0301	U	200	AC	52.9	Changed FH MH to SH-0255 from SH-0301x	Investigate: MH numbering

## 5.0 Mainline rehabilitation recommendations and cost estimates

Rehabilitation/maintenance recommendations and cost estimates are provided in *Tables 5.1 to 5.6*.

### 5.1 Preliminary cost estimate summary

Table 5.1: Preliminary cost estimate summary			
Technology	No.	No. of Mains	Cost estimate
External Point Repairs ("Dig-up" (EPR) (NB: 2 EPRS in one main)	8	7	\$207,234.50
Trenchless Point Repairs (mini-liners) (TPR)	6	6	\$42,425.10
Mainline joint chemical grouting	--	6	\$27,719.60
Lateral interface grouting		1	7,255.10
Re-CCTV inspection	--	41	\$35,611.30
<b>Total rehabilitation/maintenance cost estimate</b>			<b>\$320,245.60</b>

### 5.2 Structural rehabilitation preliminary cost estimates

Table 5.2: Structural rehabilitation cost estimates											
Item	PLR	Rpt No. (F22URB-)	Location	U/S MH	D/S MH	Dir	Diam (mm)	Mat	tLen (m)	Recommendations	Costs
1	SP-0005	116	Gibsons Way	SH-0004	SH-0001	D	150	CO	104.2	EPR at 75.1m to repair hole. (too rough for trenchless point repair)	\$26,354.60
2	SP-0039	139	O'Shea Rd	SH-0028	SH-0008	D	200	AC	73.0	TPR for 1m from 63 to 64m, may need a shot of grout to stop inflow	\$6,449.00
3	SP-0045	281	Wyngaert Rd	SH-0052	SH-0051	U	200	AC	109.2	TPR for 1m from 64.5 to 65.5m	\$6,919.60
4	SP-0057	293	N Fletcher Rd	SH-0059	SH-0063	D	200	AC	76.5	EPR at 43.3m to repair hole at interface of service	\$25,994.50
5	SP-0156	209	Franklin Rd	SH-0149	SH-0148	D	200	AC	96.1	EPR at 83.3m to repair hole	\$26,249.30
6	SP-0165	230	Wells Lane	SH-0140	SH-0141	D	200	AC	93.5	EPR at 93.3m to repair leaky SSLJ	\$26,215.50
7	SP-0188	205	Hillcrest Rd	SH-0179	SH-0181	D	200	AC	96.1	TPR for 1m from 65.5 to 66.5m	\$6,749.30
8	SP-0191	289	Crucil Rd	SH-0182	SH-0185	U	200	AC	62.4	EPR at 8.8m to repair poorly patched hole. TPR for 3m from 37.5 to 40.5m from MC over 3 small holes & over joint with roots at 40.1m	\$33,472.40
9	SP-0250	271	North Rd	SH-0382	SH-0220	D	200	PVC	116.0	EPR at 110m to repair JDL	\$26,508.00
		275	North Rd	SH-0382	SH-0220	U	200	AC	116.0	TPR for 1m from 75 to 76m	\$7,008.00
10	SP-0362	83	Oshea Rd	SH-0313	SH-0314	D	200	PVC	126.0	EPR at 15.7m (from D/S SH-0220) to repair JDL	\$25,000.00
11	SP-0433	349	Gower Point Rd	SH-0374	SH-0375	U	200	PVC	7.8	TPR for 2m from 78.5 to 80.5m	\$7,638.00
<b>Total cost estimate for structural rehabilitation</b>											<b>\$249,659.60</b>

### 5.3 Mainline joint chemical grouting preliminary cost estimates

Table 5.3: Mainline joint chemical grouting cost estimates										
Item	PLR	Rpt No. (F22URB-)	Location	U/S MH	D/S MH	Dir	Diam (mm)	Mat	tLen (m)	Costs
1	SP-0048	282	Wyngaert Rd	SH-0054	SH-0050	U	200	AC	53.2	\$3,517.85
2	SP-0052	280	Martin Rd	SH-0057	SH-0056	D	200	AC	92.7	\$6,129.79
3	SP-0152	197	Franklin Rd	SH-0151	SH-0150	U	200	AC	50.9	\$3,365.76
4	SP-0256	273	Hillcrest Rd	SH-0285	SH-0284	D	200	AC	29.3	\$1,937.46
5	SP-0302	31	Industrial Way	SH-0301A	SH-0301	U	200	AC	96.1	\$6,354.61
6	SP-0327	173	Creekside Cr	SH-0280	SH-0455	D	200	AC	97.0	\$6,414.13
Total cost estimate for mainline joint chemical grouting										\$27,719.60

### 5.4 Lateral interface chemical grouting preliminary cost estimate

Table 5.4: Lateral interface chemical grouting cost estimates										
Item	PLR	Rpt No. (F22URB-)	Location	U/S MH	D/S MH	Dir	Diam (mm)	Mat	tLen (m)	Costs
1	SP-0276	193	Maplewood Lane	SH-0231	SH-0228	D	200	AC	92.7	\$7,255.10
Total cost estimate for lateral interface chemical grouting										\$7,255.10

### 5.5 Re-CCTV inspection cost estimates

Table 5.5: Re-CCTV inspection cost estimates											
Item	PLR	Rpt No. (F22URB-)	Location	U/S MH	D/S MH	Dir	Diam (mm)	Mat	tLen (m)	Recommendations	Costs
1	SP-0033	439	Farnham Rd	0033a	0033b	D	100	AC	39.0	ReTV using smaller camera	\$500.00
2	SP-0035	438	Farnham Rd	0519a	SH-0519	U	150	AC	43.5	ReTV using different camera	\$500.00
3	SP-0037	001	O'Shea Rd	SH-0117A	SH-0117	U	200	AC	59.0	ReTV from MH SH-0117A	\$531.00
4	SP-0038	124	Oshea Rd	SH-0117	SH-0028	D	200	AC	73.0	Clean (remove OB at 57.8m) & reTV	\$657.00
5	SP-0048	282	Wyngaert Rd	SH-0054	SH-0050	U	200	AC	60.0	ReTV from MH SH-0054	\$540.00
6	SP-0073	300	Hicks Ln	SH-0083	SH-0082	D	150	AC	112.6	Clean & reTV	\$1,013.40
7	SP-0080	303	Killarney Ln	SH-0084	SH-0085	U	200	AC	99.5	Clean & reTV	\$895.50
8	SP-0109	396	Persephone Ln	SH-0038	SH-0037	D	150	AC	116.0	Clean & reTV	\$1,394.00
9	SP-0114	408	Periwinkle Ln	SH-0044	SH-0043	D	150	PVC	71.0	ReTV using different camera	\$639.00
10	SP-0115	409	Periwinkle Ln	SH-0043	SH-0040	D	150	PVC	77.0	ReTV using different camera	\$693.00
11	SP-0129	144	South Fletcher Rd	SH-0039	SH-0041	U	200	AC	30.0	ReTV using smaller camera	\$500.00
12	SP-0150	382	Bay Rd	SH-0138	SH-0135	D	150	AC	108.0	ReTV after locating	\$972.00

**Table 5.5: Re-CCTV inspection cost estimates**

Item	PLR	Rpt No. (F22URB-)	Location	U/S MH	D/S MH	Dir	Diam (mm)	Mat	tLen (m)	Recommendations	Costs
13	SP-0154	207	Cochrane Rd	SH-0143X	SH-0143	U	200	AC	55.0	ReTV using proper equipment from U/S MH if possible	\$500.00
14	SP-0156	209	Franklin Rd	SH-0149	SH-0148	D	200	AC	96.1	Clean & reTV	\$864.90
15	SP-0164	221/232	Wells Lane	SH-0139	SH-0140	D/U	200	AC	96.0	Clean & reTV	\$864.00
16	SP-0172	251/383	Bay Rd	SH-0121	SH-0135	D/D	200	AC	36.0	Clean & reTV reduced flow	\$674.00
17	SP-0198	320	Gibsons Way	SH-0175	SH-0176	U	150	AC	86.0	Root-cut & reTV (will require rehab after new inspection)	\$1,474.00
18	SP-0210	131	Davis Rd	SH-0190	SH-0189	D	150	AC	86.0	Clean & reTV reduced flow	\$1,124.00
19	SP-0211	442	Davis Rd	0189a	SH-0189	U	150	AC	64.0	Clean & reTV	\$576.00
20	SP-0217	397	Persephone Ln	SH-0198	SH-0197	D	150	AC	82.0	ReTV using different equipment?	\$738.00
21	SP-0218	398	Persephone Ln	SH-0197	SH-0195	D	150	AC	78.5	ReTV using different equipment?	\$706.50
22	SP-0220	400	South Fletcher Rd	SH-0608	SH-0196	D	150	AC	116.0	Trim CNI & reTV	\$1,894.00
23	SP-0223	395	Sargent Rd	SH-0489	SH-0195	D	150	AC	60.0	Root-cut & reTV	\$890.00
24	SP-0224	422	Sargent Rd	SH-0889a	SH-0489	U	150	AC	47.0	ReTV using different equipment	\$500.00
25	SP-0235	334/335	Gower Point Rd	SH-0533	SH-0207	D/U	300	AC/PVC	125.0	ReTV reduced flow	\$1,125.00
26	SP-0236	336	Gower Point Rd	SH-0207	SH-0206	D	300	AC	123.3	ReTV or locate correct video	\$1,109.70
27	SP-0237	337	Gower Point Rd	SH-0206	SH-0208	D	300	AC	97.7	ReTV or locate correct video	\$879.30
28	SP-0239	343	Gower Point Rd	SH-0205	SH-0212	U	300	AC	124.0	ReTV or locate correct video	\$1,116.00
29	SP-0245	351	Gower Point Rd	SH-0214	SH-0215	D	300	AC	115.5	ReTV reduced flow	\$1,739.50
30	SP-0246	352	Gower Point Rd	SH-0215	SH-0216	D	300	AC	61.0	CCTV once located	\$549.00
31	SP-0247	353	Gower Point Rd	SH-0216	SH-0217	D	300	AC	15.0	CCTV once located	\$500.00
32	SP-0248	354	Gower Point Rd	SH-0217	0217a	D	300	DI	47.0	CCTV once located	\$500.00
33	SP-0262	284	Wyngaert Rd	SH-0222	SH-0221	U	150	AC	122.0	ReTV from U/S MH SH-0222	\$1,098.00
34	SP-0269	421	Beachcomber Ln	SH-0239	SH-0238	D	200	AC	50.0	CCTV once located	\$500.00
35	SP-0292	376	Blackberry Ln	SH-0248	SH-0240	U	150	AC	98.0	Root-cut & reTV from MH SH-0248	\$1,232.00
36	SP-0294	374	Franklin Rd	SH-0152a	SH-0152	U	200	AC	39.0	ReTV after access located	\$500.00
37	SP-0319	184	North Rd	SH-0270	SH-0271	D	200	AC	72.5	Root-cut & reTV (will require rehab after new inspection)	\$1,002.50
38	SP-0337	219	Burns Rd	SH-0289	SH-0295	U	200	AC	67.0	Clean & reTV from MH SH-0289	\$603.00
39	SP-0350	32	Industrial Way	SH-0301X	SH-0301	U	200	AC	127.0	Root-cut & reTV	\$1,493.00
40	SP-0352	441	Poplar Ln	SH-0304	SH-0308	D	150	AC	122.0	Clean & reTV reduced flow	\$1,448.00
41	SP-0486	401	Winn Rd	SH-0429	SH-0199	U	150	AC	64.0	Clean & reTV using proper equipment from U/S MH if possible	\$576.00
<b>Total cost estimate for re-CCTV inspection</b>											<b>\$34,715.80</b>

## 5.6 Operational maintenance recommendations

Cost estimates for operational maintenance recommendations are not provided as this work is expected to be performed “in-house”.

Table 5.6: Operational maintenance recommendations										
Item	PLR	Rpt No. (F22URB-)	Location	U/S MH	D/S MH	Dir	Diam (mm)	Mat	tLen (m)	Recommendations
1	SP-0143	412	Prowse Rd	SH-0126	SH-0127	D	200	AC	62.0	Clear encrustation from service at 44m
2	SP-0150	382	Bay Rd	SH-0138	SH-0135	D	150	AC	2.0	Locate MH SH-0138
3	SP-0151	375	Franklin Rd	SH-0152	SH-0151	D	150	AC	50.7	Determine cause of surcharge
4	SP-0184	199	Hillcrest Rd	SH-0261	SH-0520	D	200	AC	45.1	Clear encrustation from service at 44.2m
5	SP-0246	352	Gower Point Rd	SH-0215	SH-0216	D	300	AC	2.0	Locate MHs SH-0215 & SH-0216 and make accessible
6	SP-0247	353	Gower Point Rd	SH-0216	SH-0217	D	300	AC	2.0	Locate MHs SH-0216 & SH-0217 and make accessible
7	SP-0248	354	Gower Point Rd	SH-0217	0217a	D	300	DI	2.0	Locate MHs SH-0217 & SH-0217A and make accessible
8	SP-0249	355	Gower Point Rd	0217a	0217b	D	300	DI	2.0	Locate MHs SH-0217A & SH-0217B and make accessible
9	SP-0250	271	North Rd	SH-0382	SH-0220	D	200	PVC	116.0	Clear service at 43.2m
10	SP-0269	421	Beachcomber Ln	SH-0239	SH-0238	D	200	AC	2.0	Locate MHs SH-0238 & SH-0239 and make accessible
11	SP-0276	193	Maplewood Lane	SH-0231	SH-0228	D	200	AC	92.7	Clear services at 27.3, 36.4, 55.0, 65.2 & 85m
12	SP-0292	376	Blackberry Ln	SH-0248	SH-0240	U	150	AC	62.2	Clear roots from service at 62.1m
13	SP-0294	374	Franklin Rd	SH-0152a	SH-0152	U	200	AC	2.0	Locate access to PLR SP-0294
14	SP-0349	414	Alder Springs Rd	SH-0299a	SH-0299	U	150	AC	2.0	Locate U/S MH
15	SP-0422	426	Skyline Dr	SH-0363	0363a	D	150	AC	2.0	Locate access to MHs SH-0363 & SH-0363A

This report entitled

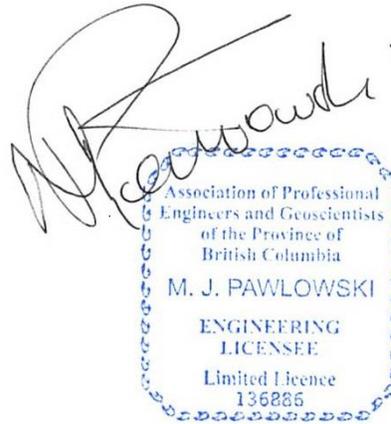
**TOWN OF GIBSONS / URBAN SYSTEMS**  
**CONDITION ASSESSMENT OF ASBESTOS CEMENT**  
**SANITARY SEWER MAINS (2022)**

is respectfully submitted by:

**M.J. Pawlowski & Associates**



Marek Pawlowski, ASCT, Eng.L.



July 12<sup>th</sup>, 2023

## APPENDIX – General Conditions

1. **Standard of Care** | This Report has been prepared in accordance with generally accepted engineering consulting practices in this area. No other warranty, express or implied, is made.
2. **Complete Report** | In order to understand the suggestions, recommendations, and opinions expressed herein, reference must be made to the whole of the Report. M.J. Pawlowski & Associates is not responsible for use by any party of portions of the Report without reference to the whole Report.
3. **Basis of the Report** | The Report has been prepared for the specific site, development, design objectives, and purpose that were described by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the document are only valid to the extent that there has been no material alteration to, or variation from, any of the said descriptions provided unless specifically requested by the Client to review and revise the Report in light of such alteration or variation.
4. **Use of the Report** | The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. No other party may make use of, or rely upon, the Report or any portion thereof without written consent. Any use which a third party makes of the Report, or any portion of the Report, is the sole responsibility of such third parties. M.J. Pawlowski & Associates accepts no responsibility for damages suffered by any third party resulting from unauthorized use of the Report.
5. **Interpretation of the Report** | All investigations involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated, and all persons making use of such documents or records should be aware of, and accept, this risk. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling.

The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided by others. M.J. Pawlowski & Associates has relied in good faith upon representations, information, and instructions provided by the Client and others. M.J. Pawlowski & Associates does not accept responsibility for any deficiency, misstatement, or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of persons providing information.
6. **Independent Judgments of Client** | The information, interpretations, and conclusions in the Report are based on interpretation of conditions revealed through limited investigation conducted within a defined scope of services. M.J. Pawlowski & Associates does not accept responsibility for independent conclusions, interpretations, interpolations, and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes decisions made to either purchase or sell land.
7. **Exclusion / Limitation of Liability** | M.J. Pawlowski & Associates shall not be liable for damages including, but not limited to, direct, indirect, consequential and resulting damages arising out of or in connection with the use of or reliance upon the report by any party other than the Client. **THE LIABILITY OF M.J. PAWLOWSKI & ASSOCIATES TO THE CLIENT FOR ALL CLAIMS, ACTIONS, JUDGMENTS AND EXPENSES RELATING TO, OR RESULTING FROM, ANY LOSS OR DAMAGE ARISING IN ANY MANNER OUT OF THE USE OF OR RELIANCE UPON THE REPORT BY THE CLIENT, SHALL IN NOT EXCEED THE AGGREGATE AMOUNT PAID BY THE CLIENT TO M.J. PAWLOWSKI & ASSOCIATES IN RESPECT OF THE SERVICES PROVIDED BY M.J. PAWLOWSKI & ASSOCIATES.**



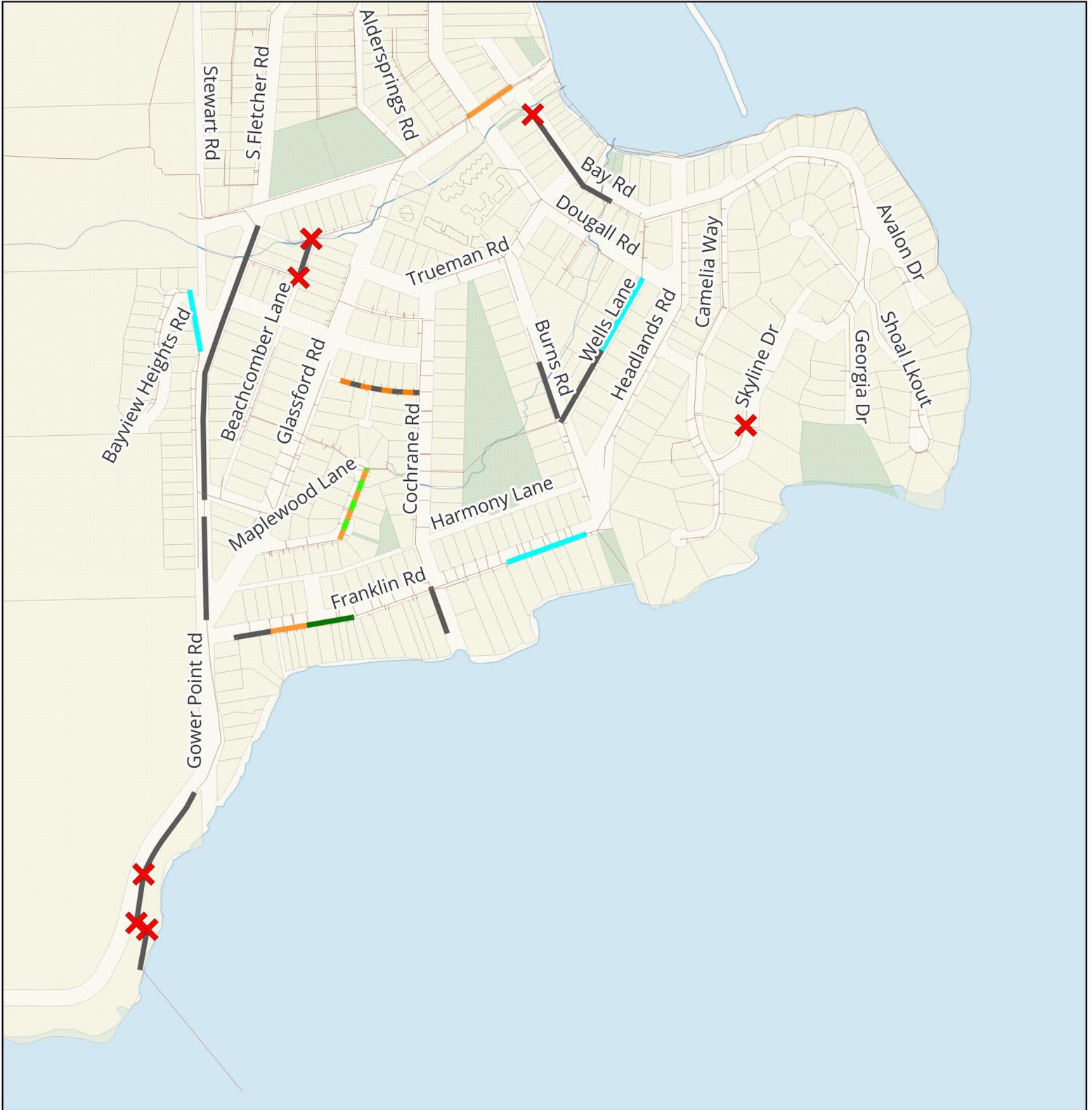
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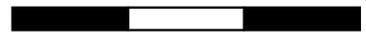
# Town of Gibsons 2022 Sanitary Sewer Rehabilitation Recommendations.



## LEGEND

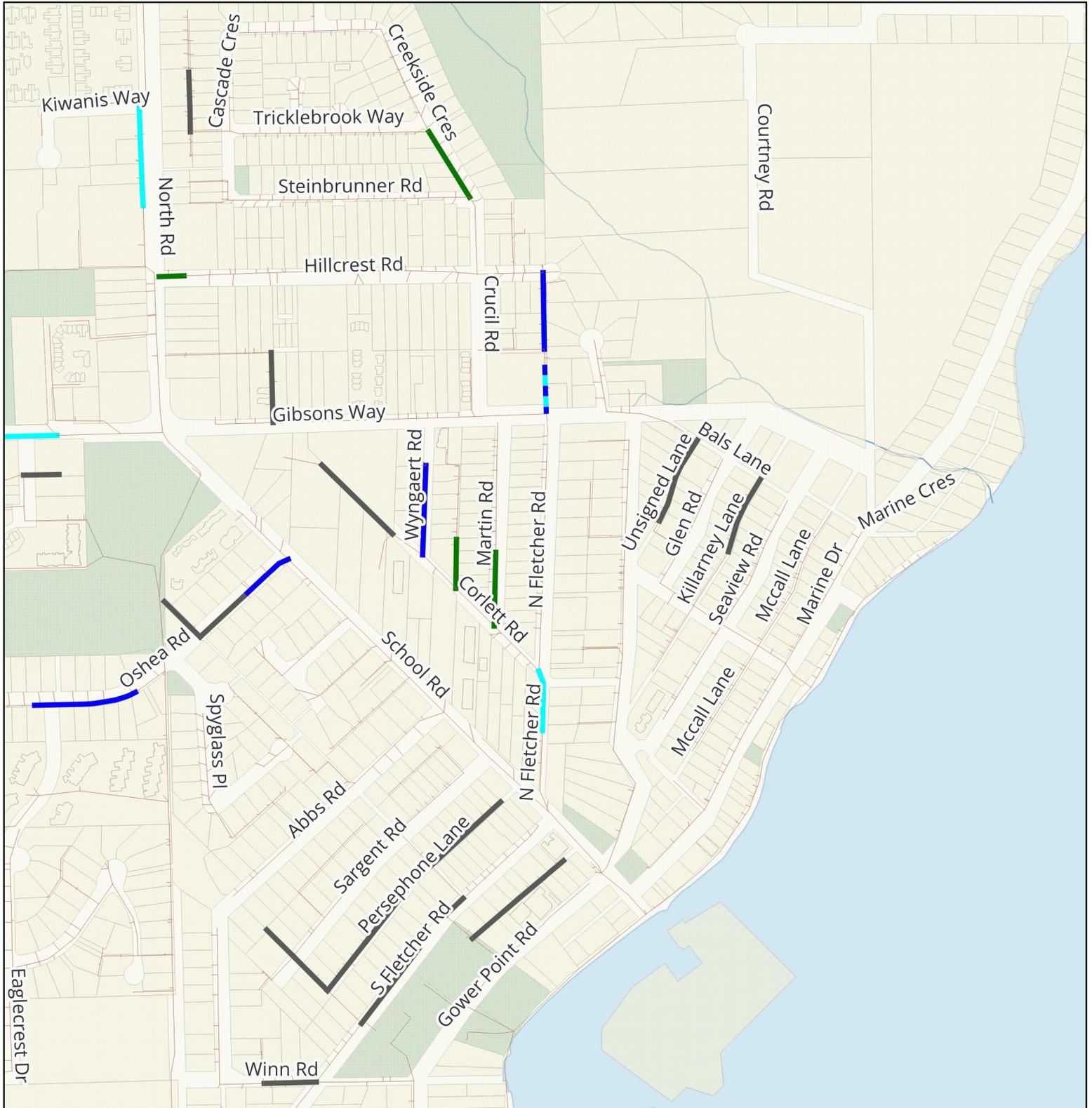
- X Locate MH
- EPR
- Grout Jnt
- Grout Lateral
- Maintenance
- ReTV
- TPR
- Sanitary Sewers

100 200 300 m



Date: 2023-07-18  
 Source: ToG  
 J. Doolin

# Town of Gibsons 2022 Sanitary Sewer Rehabilitation Recommendations.



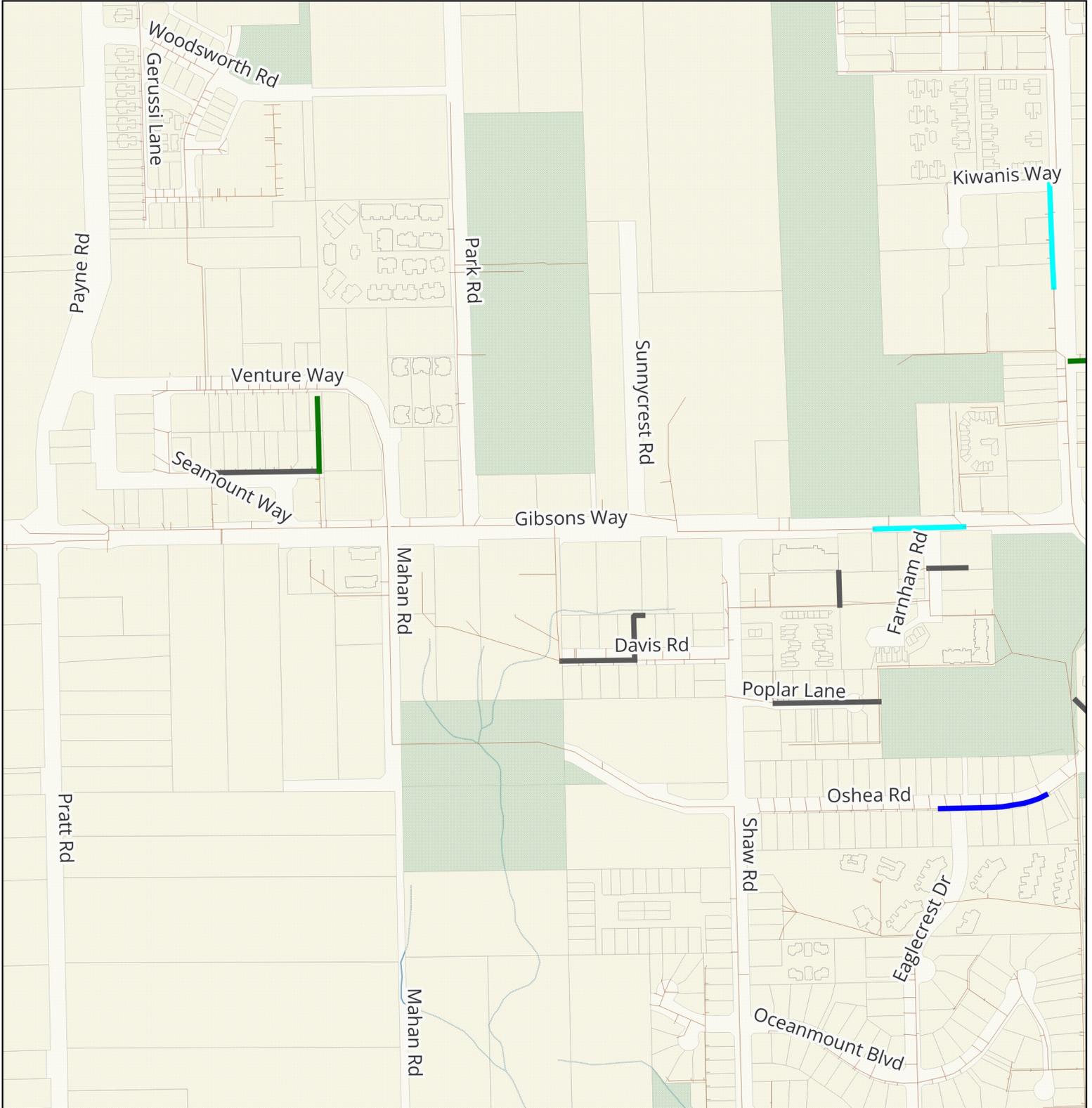
## LEGEND

-  Locate MH
-  EPR
-  Grout Jnt
-  Grout Lateral
-  Maintenance
-  ReTV
-  TPR
-  Sanitary Sewers



Date: 2023-07-18  
 Source: ToG  
 J. Doolin

# Town of Gibsons 2022 Sanitary Sewer Rehabilitation Recommendations.



## LEGEND

- ✕ Locate MH
- EPR
- Grout Jnt
- Grout Lateral
- Maintenance
- ReTV
- TPR
- Sanitary Sewers



Date: 2023-07-18  
 Source: ToG  
 J. Doolin



## Technical Memorandum

**To:** Steve Brubacher, P.Eng.  
 Urban Systems

July 28, 2023  
 MJP ref. URB-23-2116

**From:** Marek Pawlowski, AScT, Eng.L.

**Re:** Town of Gibsons / Urban Systems - 2019 CCTV Grades 4 and 5 Review

MJ Pawlowski and Associates ('MJP') was retained by Urban Systems to review the asbestos cement sanitary sewer mains the Town of Gibsons graded "4" or "5" from the 2019 CCTV surveys. Urban Systems provided MJP with CCTV footage, accompanying PDF documents and pictures. Urban Systems did not provide a database. Superior City Services of Surrey, BC conducted the CCTV surveys from October 7 to 31, 2019.

MJP identified fourteen (14) sewer mains graded "4" or "5". Three (3) of these sewer mains were resurveyed in 2022 and are addressed in MJP's 2022 condition assessment (SP-0045, SP-0057, SP-0198). The following lists the eleven (11) sewer mains with grade "4" or "5" with MJP's estimated reclassification and recommended actions.

Item	PLR	Location	U/S MH	D/S MH	Mat	Direction	Diam (mm)	Survey Length (m)	Grade	MJP Est. Grade	Recommended Action
1	SP-0063	Gibsons Way	SH-0075	SH-0071	AC	U	150	42.90	5	4	Resurvey, grout holes
2	SP-0074	Hicks Lane	SH-0082	SH-0081	AC	D	150	13.40	5	2	No action required, resurvey in 10 years
3	SP-0075	Hicks Lane	SH-0081	SH-0072	AC	D	150	41.00	5	3	No action required, resurvey in 10 years
4	SP-0079	Beach Ave	SH-0077	SH-0086	AC	D	200	48.60	5	3	No action required, resurvey in 10 years
5	SP-0082	Killarney Lane	SH-0087	SH-0086	AC	D	150	96.20	5	2	No action required, resurvey in 10 years
6	SP-0088	Beach Ave	SH-0093	SH-0103	AC	D	200	38.80	4	3	No action required, resurvey in 10 years
7	SP-0090	Marine Dr	SH-0105	SH-0103	AC	D	200	80.40	5	3	No action required, resurvey in 10 years
8	SP-0091	Marine Dr	SH-0100	SH-0101	AC	U	150	67.20	5	3	No action required, resurvey in 5 years
9	SP-0122	Seaview Rd	SH-0089	SH-0097	AC	D	200	111.50	5	3	No action required, resurvey in 10 years
10	SP-0125	McCall Lane	SH-0098	SH-0099	AC	D	150	68.30	5	3	No action required, resurvey in 10 years
11	SP-0203	Fairmont Rd	SH-0186	SH-0016	AC	D	150	90.50	5	2	No action required, resurvey in 10 years

**A. Findings, estimated grade reclassifications and recommended actions of eleven (11) asbestos cement sanitary sewer mains:**

Our findings, estimated grade reclassifications and recommended actions are based on the visible areas of the sewer mains. No data base was provided, so MJP is only able to estimate the grade reclassification.

MJP's general observation is that these eleven (11) sewer mains have been over-coded. From our observations, over-coding has occurred using "SMW" where "SSS" is more applicable. In

the PACP® Condition Grading System, Appendix C<sup>1</sup>, page C-36, surface missing wall “SMW” has a structural grade of 5, whereas surface spalling slight “SSS” has a structural grade of 2.

The following details MJ’s observations for the eleven (11) sewer mains:

**SP-0063:** SCS Code: 5      MJ est. Code: 4

There is an infiltration weeper “IF” at 0.2m, and visible holes “HSV” at 10.3m and 40.2m. Observable wear “SRI” at 5 and 7 o’clock. Survey abandoned at 42.9m. Some sort of blockage in this sewer main was observed after the survey abandoned point.

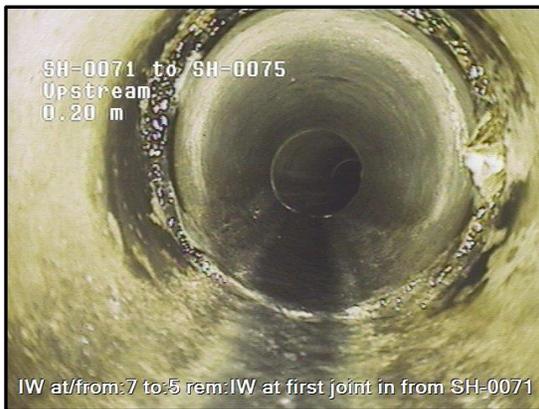


Fig. 1: SP-0063 – IW at 0.2m



Fig 2: SP-0063 – HSV at 10.3m

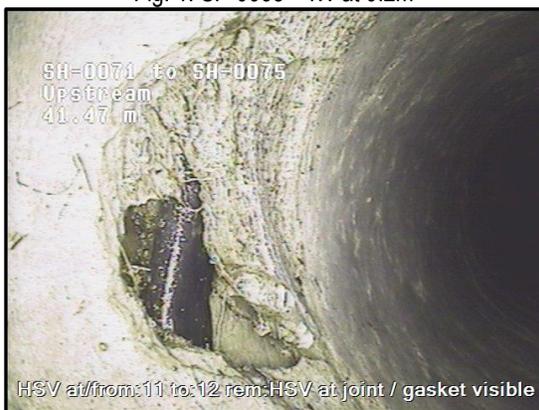


Fig. 3: SP-0063 – HSV at 41.5m

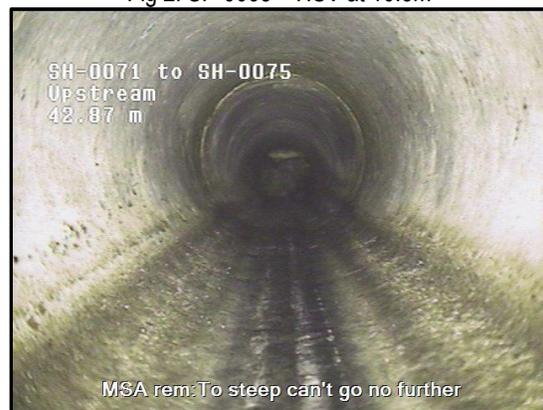


Fig. 4: SP-0063 – MSA at 42.9m – possible blockage

**Recommendations:** Need to re-survey as incomplete. Investigate holes and suggest repair using mainline chemical grouting technology. May need to install manhole as downstream and upstream access needed for chemical grouting equipment.

**SP-0074:** SCS Code: 5      MJ est. Code: 2

There is observable wear “SRI” at 5 and 7 o’clock. The surface missing wall “SMW” at 1.0m and 4.3m are observed as surface spalling slight “SSS”.

<sup>1</sup> Pipeline Assessment Certification Program, Version 7.0.0 May 2015, Copyright ©2015, NASSCO



Fig. 5: SP-0074 – should be SSS at 1.0m



Fig 6: SP-0074 – should be SSS at 4.3m

*Recommendations:* No action at this time. Resurvey in 10 years.

**SP-0075:** SCS Code: 5      MJP est. Code: 3

There is observable wear “SRI” at 5 and 7 o`clock. Minor erosion visible.

*Recommendations:* No action at this time. Future relining may be recommended. Resurvey in 10 years.

**SP-0079:** SCS Code: 5      MJP est. Code: 3

There is observable wear “SRI” at 5 and 7 o`clock. Minor erosion visible otherwise sewer main in good condition. The surface missing wall “SMW” at 48.3m is observed as surface spalling slight “SSS”.



Fig. 7: SP-0079 – should be SSS at 48.3m

*Recommendations:* No action at this time. Future relining may be recommended. Resurvey in 10 years.

**SP-0082:** SCS Code: 5      MJP est. Code: 2

There is observable wear “SRI” at 5 and 7 o’clock. Minor surface roughness visible otherwise sewer main in good condition. The surface missing wall “SMW” at 67.2m is observed as surface spalling slight “SSS”.



Fig. 8: SP-0082 – should be SSS at 67.2m

*Recommendations:* No action at this time. Resurvey in 10 years.

**SP-0088:** SCS Code: 4      MJP est. Code: 3

There is observable wear “SRI” at 5 and 7 o’clock. Minor surface roughness visible otherwise sewer main in good condition. The fracture multiple “FM” at 2.9m appears over-coded as there are small cracks visible with some staining, but no visible offset typically visible in fractures.



Fig. 9: SP-0088 – should be coded as crack “C”

*Recommendations:* No action at this time. Resurvey in 10 years

**SP-0090:** SCS Code: 5      MJP est. Code: 3

There is observable wear “SRI” at 5 and 7 o’clock. Minor surface roughness visible otherwise sewer main in good condition. The surface missing wall “SMW” at 21.1m is observed as surface spalling slight “SSS”.



Fig. 10: SP-0090 – should be SSS at 21.1m

*Recommendations:* No action at this time. Resurvey in 10 years

**SP-0091:** SCS Code: 5      MJP est. Code: 3

There is observable wear “SRI” at 5 and 7 o’clock. The surface missing wall “SMW” at 42.6m, 50.7m and 59.2m are observed as surface spalling slight “SSS”. Cracks multiple “CM” with bulge is observed at 31.9m which most likely was caused when the sewer main was installed due to a rock pressing against the pipe.

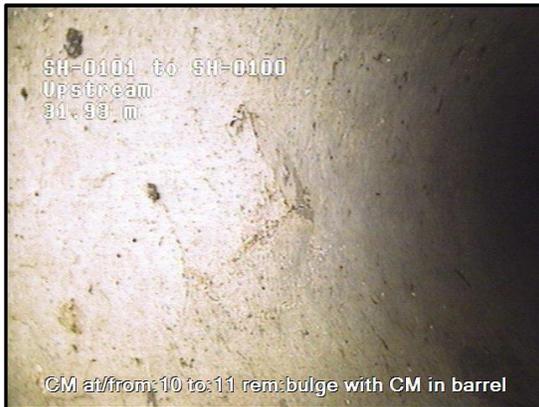


Fig. 11: SP-0091 – CM at 31.9m

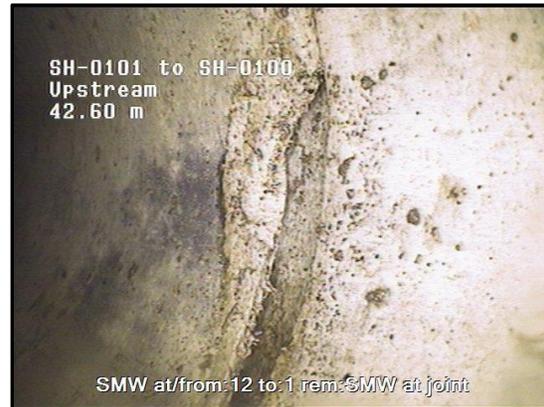


Fig 12: SP-0091– should be SSS at 42.6m

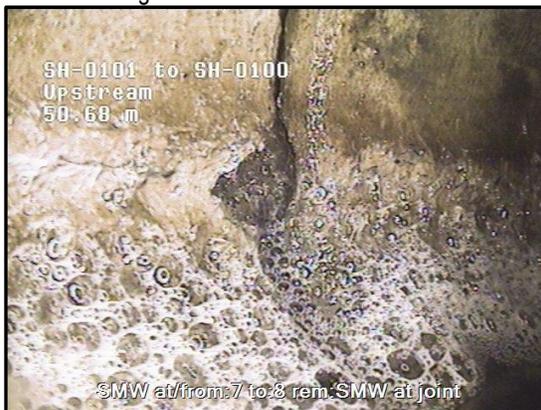


Fig. 13: SP-0091 – should be SSS at 50.7m



Fig. 14: SP-0091 – should be SSS at 59.2m

*Recommendations:* No action at this time. Future relining may be recommended. Resurvey in 5 years.

**SP-0122:** SCS Code: 5      MJP est. Code: 3

There is observable wear “SRI” at 5 and 7 o’clock. Minor surface roughness visible otherwise sewer main in good condition. The surface missing wall “SMW” at 25.8m is observed as surface spalling slight “SSS”.

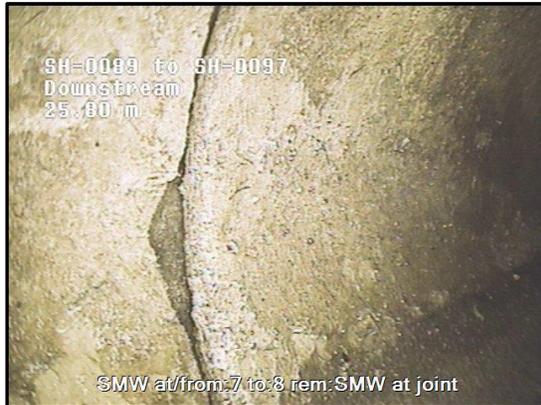


Fig. 15: SP-0122 – should be SSS at 25.8m

*Recommendations:* No action at this time. Future relining may be recommended. Resurvey in 10 years.

**SP-0125:** SCS Code: 5      MJP est. Code: 3

There is observable wear “SRI” at 5 and 7 o’clock. Minor surface roughness visible otherwise sewer main in good condition. The surface missing wall “SMW” at 59.6m is observed as surface spalling slight “SSS”. Roots observed at 0.0m, 0.7m, 34.6m and 36.6m.



Fig. 16: SP-0125 – should be SSS at 59.6m

*Recommendations:* No action at this time. Roots near SH-0098 can be easily accessed if desired to be removed. Resurvey in 10 years.

**SP-0203:** SCS Code: 5      MJP est. Code: 2

There is observable wear “SRI” at 5 and 7 o’clock. Minor surface roughness visible otherwise sewer main in good condition. The surface missing wall “SMW” at 53.1m is observed as surface spalling slight “SSS”.

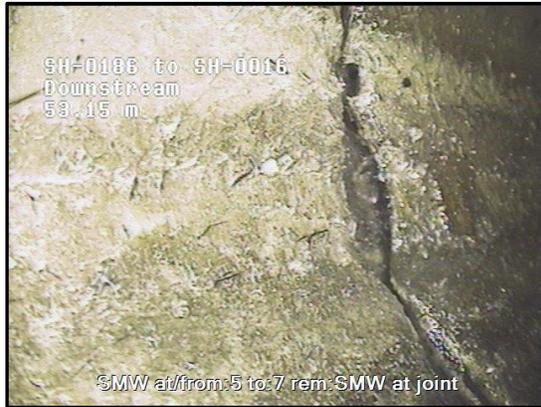


Fig. 17: SP-0125 – should be SSS at 53.1m

*Recommendations:* No action at this time. Resurvey in 10 years.

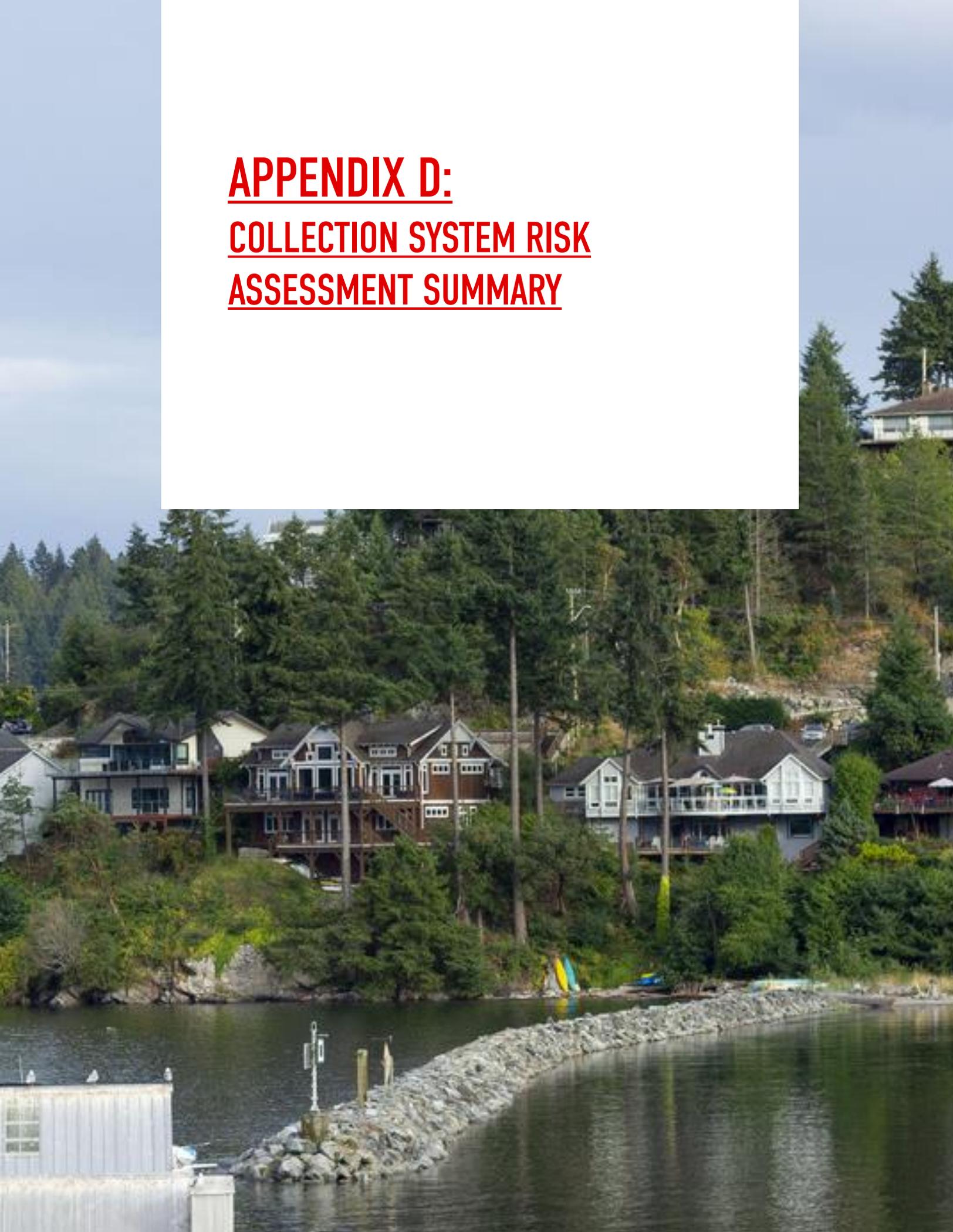
Submitted by,

**M. J. Pawlowski & Associates**

A handwritten signature in blue ink that reads "M. J. Pawlowski".

Marek J. Pawlowski, ASCT, Eng.L.

**APPENDIX D:**  
**COLLECTION SYSTEM RISK**  
**ASSESSMENT SUMMARY**





Asset ID	Model ID	ESRI OID	Pipe Type	Upstream MH	Downstream MH	Capacity Modified Consequence of Failure EX, CAP, COF, MOD	Likelihood of Failure FUTURE1, CAP, LOF	Future Capacity		Risk Assessment		Priority and Recommendations		Conditions	Recommendations	Cost Estimate
								Modified Consequence of Failure FUTURE1, CAP, COF, MOD	Exists Condition Risk EX, COND, RISK	Exists Capacity Risk EX, CAP, RISK	Future Condition Risk FUTURE1, COND, RISK	Future Capacity Risk FUTURE1, CAP, RISK	Exists Priority Rank			
20140815101023	1506	4002	Outfall	SH-0517	SH-0533	1	1	1	1	1	1	1	1	NA	NA	
20140815101428	1507	4003	Outfall	SH-0519A	SH-0517	1	1	1	1	1	1	1	1	NA	NA	
20150601101078	1508	4010	Low Pressure	SH-0517	SH-0520	1	1	1	1	1	1	1	1	NA	NA	
20150601101015	1509	4013	Gravty	SH-0517	SH-0520	4	2	4	2	4	2	3	3	NA	NA	
20150601101106	1508	4017	Gravty	SH-0521	SH-0527	1	1	1	1	1	1	1	1	NA	NA	
20150601101121	us	2088	Gravty	SH-0521	SH-0521	5	1	5	1	5	1	3	3	NA	NA	
20160108110042	2092	4006	Gravty	SH-0529	SH-0530	1	1	1	1	1	1	1	1	NA	NA	
20160108110043	us	2091	Gravty	SH-0529	SH-0530	1	1	1	1	1	1	1	1	NA	NA	
20160108110045	1967	4007	Gravty	JCT-1059	ACT-1061	1	2	1	2	1	2	2	2	NA	NA	
20160108110047	2096	4002	Gravty	SH-0529	SH-0530	1	1	1	1	1	1	1	1	NA	NA	
20160108110133	1984	4033	Gravty	JCT-1060	SH-0525	3	1	3	1	3	1	3	3	NA	NA	
20170321110127	1988	4037	Gravty	ACT-1061	SH-0525	3	2	3	2	3	2	3	3	NA	NA	
20170321110127	1970	4039	Low Pressure			1	1	1	1	1	1	1	1	NA	NA	
20170321110127	1971	4040	Low Pressure			1	1	1	1	1	1	1	1	NA	NA	
20170321110127	1972	4041	Low Pressure			1	2	1	2	1	2	1	2	NA	NA	
20170321110127	1973	4042	Gravty	JCT-1062	SH-0512	1	2	1	2	1	2	1	2	NA	NA	
20170601110028	1978	4045	Gravty	SH-0528	SH-0528	3	1	3	1	3	1	3	3	NA	NA	
20170601110028	1977	4046	Gravty	SH-0529	SH-0530	5	2	5	2	5	2	3	3	NA	NA	
20170601110028	1978	4047	Gravty	SH-0529	SH-0530	5	2	5	2	5	2	3	3	NA	NA	
20170601110028	1979	4048	Gravty	SH-0529	SH-0530	5	2	5	2	5	2	3	3	NA	NA	
20170601110028	1980	4049	Gravty	SH-0529	SH-0530	5	2	5	2	5	2	3	3	NA	NA	
20170601110028	2090	4055	Gravty	SH-0532	SH-0512	5	2	5	2	5	2	3	3	NA	NA	
20170601110028	2094	4057	Gravty	SH-0532	SH-0512	5	2	5	2	5	2	3	3	NA	NA	
20170601110028	2095	4058	Gravty	JCT-1063	SH-0512	3	2	3	2	3	2	3	3	NA	NA	
20170601110028	1984	4059	Gravty	SH-0534	SH-0535	3	2	3	2	3	2	3	3	NA	NA	
20170601110028	1985	4060	Gravty	SH-0535	SH-0536	3	2	3	2	3	2	3	3	NA	NA	
20170601110028	1986	4061	Gravty	SH-0536	SH-0441	2	2	2	2	2	2	2	2	NA	NA	
20180412100124	2028	4093	Gravty	JCT-1064	SH-0449	3	1	3	1	3	1	3	3	NA	NA	
20180412100124	2037	4102	Gravty	SH-0158B	SH-0030	3	2	3	2	3	2	3	3	NA	NA	
20180412100124	2038	4103	Gravty	SH-0337	SH-0158B	3	1	3	1	3	1	3	3	NA	NA	
20180412100124	2039	4104	Gravty	SH-0338	SH-0337	3	2	3	2	3	2	3	3	NA	NA	
20210101100842	2062	4147	Gravty	SH-0330	SH-0477	5	2	5	2	5	2	3	3	NA	NA	
2021121510014	2063	4148	Gravty	SH-0330	SH-0477	5	2	5	2	5	2	3	3	NA	NA	
PPE-1007	2102	0	Foreman			2	2	2	2	2	2	2	2	NA	NA	
PPE-DIVERSION-1	2103	0	Foreman			2	2	2	2	2	2	2	2	NA	NA	
PPE-DIVERSION-2	2104	0	Foreman			2	2	2	2	2	2	2	2	NA	NA	
PPE-DIVERSION-3	2105	0	Foreman			2	2	2	2	2	2	2	2	NA	NA	
PPE-DIVERSION-4	2106	0	Foreman			2	2	2	2	2	2	2	2	NA	NA	
PPE-DIVERSION-5	2107	0	Foreman			2	2	2	2	2	2	2	2	NA	NA	
PPE-DIVERSION-6	2108	0	Foreman			2	2	2	2	2	2	2	2	NA	NA	
PPE-DIVERSION-7	2109	0	Foreman			2	2	2	2	2	2	2	2	NA	NA	
SP-001	1363	3425	Foreman			1	1	1	1	1	1	1	1	NA	NA	
SP-002	1360	3426	Foreman			1	1	1	1	1	1	1	1	NA	NA	
SP-003	1361	3427	Foreman			1	1	1	1	1	1	1	1	NA	NA	
SP-004	1362	3428	Foreman			1	1	1	1	1	1	1	1	NA	NA	
SP-005	1363	3429	Foreman			1	1	1	1	1	1	1	1	NA	NA	
SP-006	1364	3430	Foreman			1	1	1	1	1	1	1	1	NA	NA	
SP-007	1365	3431	Foreman			1	1	1	1	1	1	1	1	NA	NA	
SP-008	1366	3432	Foreman			1	1	1	1	1	1	1	1	NA	NA	
SP-009	1367	3433	Low Pressure			1	1	1	1	1	1	1	1	NA	NA	
SP-010	1368	3434	Low Pressure			1	1	1	1	1	1	1	1	NA	NA	
SP-011	1369	3435	Low Pressure			1	1	1	1	1	1	1	1	NA	NA	
SP-012	1370	3436	Low Pressure			1	1	1	1	1	1	1	1	NA	NA	
SP-013	1371	3437	Low Pressure			1	1	1	1	1	1	1	1	NA	NA	
SP-014	1362	3438	Low Pressure			1	1	1	1	1	1	1	1	NA	NA	
SP-015	1363	3439	Low Pressure			1	1	1	1	1	1	1	1	NA	NA	
SP-016	1364	3440	Low Pressure			1	1	1	1	1	1	1	1	NA	NA	
SP-017	1365	3441	Gravty			1	2	1	2	1	2	1	2	NA	NA	
SP-018	1366	3442	Gravty	SH-0003	SH-0002	3	1	3	1	3	1	3	3	NA	NA	
SP-019	1367	3443	Gravty	SH-0004	SH-0001	5	3	5	3	5	3	3	3	NA	NA	
SP-020	1368	3444	Gravty	SH-0005	SH-0002	3	2	3	2	3	2	3	3	NA	NA	
SP-021	1369	3445	Gravty	SH-0006	SH-0003	3	2	3	2	3	2	3	3	NA	NA	
SP-022	1370	3446	Gravty	SH-0007	SH-0004	3	2	3	2	3	2	3	3	NA	NA	
SP-023	1371	3447	Gravty	SH-0008	SH-0005	3	2	3	2	3	2	3	3	NA	NA	
SP-024	1372	3448	Gravty	SH-0009	SH-0006	3	2	3	2	3	2	3	3	NA	NA	
SP-025	1373	3449	Gravty	SH-0010	SH-0007	3	2	3	2	3	2	3	3	NA	NA	
SP-026	1374	3450	Gravty	SH-0011	SH-0008	3	2	3	2	3	2	3	3	NA	NA	
SP-027	1375	3451	Gravty	SH-0012	SH-0009	3	2	3	2	3	2	3	3	NA	NA	
SP-028	1376	3452	Gravty	SH-0013	SH-0010	3	2	3	2	3	2	3	3	NA	NA	
SP-029	1377	3453	Gravty	SH-0014	SH-0011	3	2	3	2	3	2	3	3	NA	NA	
SP-030	1378	3454	Gravty	SH-0015	SH-0012	3	2	3	2	3	2	3	3	NA	NA	
SP-031	1379	3455	Gravty	SH-0016	SH-0013	3	2	3	2	3	2	3	3	NA	NA	
SP-032	1380	3456	Gravty	SH-0017	SH-0014	3	2	3	2	3	2	3	3	NA	NA	
SP-033	1381	3457	Gravty	SH-0018	SH-0015	3	2	3	2	3	2	3	3	NA	NA	
SP-034	1382	3458	Gravty	SH-0019	SH-0016	3	2	3	2	3	2	3	3	NA	NA	
SP-035	1383	3459	Gravty	SH-0020	SH-0017	3	2	3	2	3	2	3	3	NA	NA	
SP-036	1384	3460	Gravty	SH-0021	SH-0018	3	2	3	2	3	2	3	3	NA	NA	
SP-037	1385	3461	Gravty	SH-0022	SH-0019	3	2	3	2	3	2	3	3	NA	NA	
SP-038	1386	3462	Gravty	SH-0023	SH-0020	3	2	3	2	3	2	3	3	NA	NA	
SP-039	1387	3463	Gravty	SH-0024	SH-0021	3	2	3	2	3	2	3	3	NA	NA	
SP-040	1388	3464	Gravty	SH-0025	SH-0022	3	2	3	2	3	2	3	3	NA	NA	
SP-041	1389	3465	Gravty	SH-0026	SH-0023	3	2	3	2	3	2	3	3	NA	NA	
SP-042	1390	3466	Gravty	SH-0027	SH-0024	3	2	3	2	3	2					

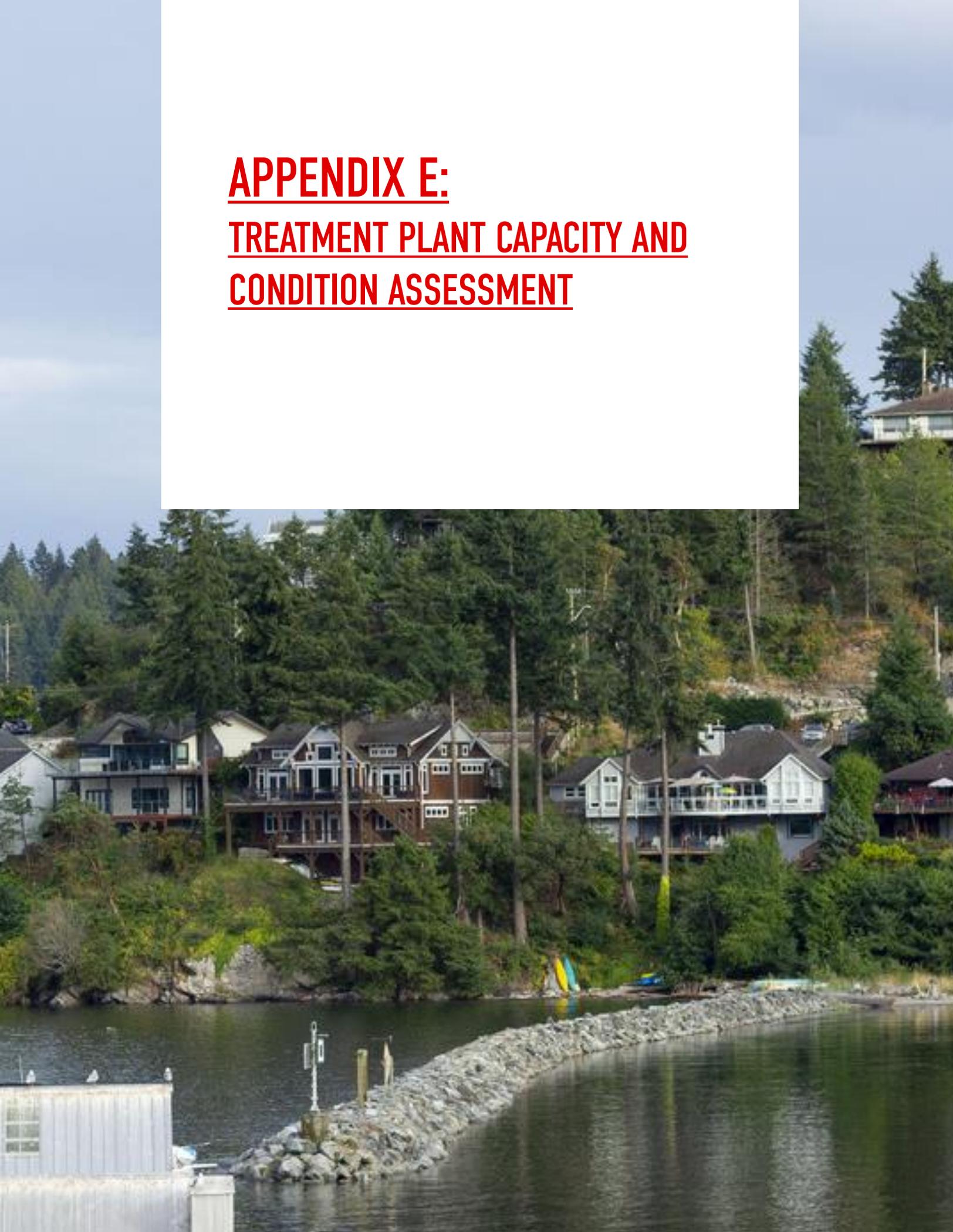


Asset ID	Model ID	ESRI OID	Pipe Type	Upstream MH	Downstream MH	Capacity	Future Capacity		Risk Assessment		Priority		Prioritization and Recommendations		Cost Estimate	
							Modified Consequence of Failure EX. CAP. COF. MOD.	Likelihood of Failure FUTURE1. CAP. COF. MOD.	Existing Condition Risk EX. COND. RISK	Existing Capacity Risk EX. CAP. RISK	Future Condition Risk FUTURE1. COND. RISK	Future Capacity Risk FUTURE1. CAP. RISK	Existing Priority Rank	Future Priority Rank		Condition Recommendations
SP-0164	1556	3631	Gravty	SH-0139	SH-0140	3	3	3	3	3	3	3	3	ReTV	\$	864.00
SP-0166	1556	3632	Gravty	SH-0141	SH-0142	3	3	3	3	3	3	3	3	ReTV	\$	26,215.50
SP-0168	1557	3633	Gravty	SH-0143	SH-0144	3	3	3	3	3	3	3	3	ReTV	\$	674.00
SP-0167	1561	3637	Gravty	SH-0153	SH-0154	3	3	3	3	3	3	3	3	ReTV	\$	674.00
SP-0168	1560	3638	Gravty	SH-0154	SH-0155	3	3	3	3	3	3	3	3	ReTV	\$	674.00
SP-0169	1559	3636	Gravty	SH-0155	SH-0157	3	3	3	3	3	3	3	3	ReTV	\$	674.00
SP-0170	1556	3634	Gravty	SH-0137	SH-0138	3	3	3	3	3	3	3	3	ReTV	\$	674.00
SP-0171	1564	3635	Gravty	SH-0139	SH-0141	3	3	3	3	3	3	3	3	ReTV	\$	674.00
SP-0172	1563	3639	Gravty	SH-0123	SH-0135	3	3	3	3	3	3	3	3	ReTV	\$	674.00
SP-0173	1562	3638	Gravty	SH-0138	SH-0139	3	3	3	3	3	3	3	3	ReTV	\$	674.00
SP-0174	1576	3652	Gravty	SH-0161	SH-0162	4	9999	10000	4	3	3	3	3	ReTV	\$	674.00
SP-0175	1577	3653	Gravty	SH-0162	SH-0163	4	9999	10000	4	3	3	3	3	ReTV	\$	674.00
SP-0176	1619	3695	Gravty	SH-0158	WW.PROWISE	5	2	5	4	3	3	3	3	ReTV	\$	674.00
SP-0179	1417	3483	Gravty	JCT-1001	SH-0133	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0180	1487	3603	Gravty	JCT-1051	SH-0486	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0186	1595	3671	Gravty	SH-0177	SH-0177	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0188	1486	3642	Gravty	SH-0173	SH-0181	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0189	1581	3657	Gravty	SH-0183	SH-0181	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0190	1467	3643	Gravty	SH-0183	SH-0182	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0191	1596	3672	Gravty	SH-0182	SH-0185	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0192	1571	3654	Gravty	SH-0178	SH-0178	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0198	1579	3656	Gravty	SH-0175	SH-0176	4	2	5	3	3	3	3	3	ReTV	\$	674.00
SP-0199	1479	3556	Gravty	SH-0485	SH-0176	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0200	1480	3556	Gravty	SH-0176	SH-0176	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0201	1481	3557	Gravty	SH-0189	SH-0184	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0202	1482	3558	Gravty	SH-0184	SH-0184	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0203	1383	3459	Gravty	SH-0186	SH-0016	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0204	1688	3724	Gravty	SH-0208	SH-0208	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0207	1667	3733	Gravty	SH-0485	SH-0485	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0208	1666	3732	Gravty	SH-0485	SH-0186	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0209	1665	3731	Gravty	SH-0186	SH-0186	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0210	1664	3730	Gravty	SH-0186	SH-0186	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0211	1663	3729	Gravty	JCT-1-1013	SH-0189	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0212	1663	3729	Gravty	SH-0189	SH-0018	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0213	1488	3644	Gravty	SH-0188	SH-0006	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0214	1442	3618	Gravty	JCT-1015	SH-0190	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0215	1447	3453	Gravty	SH-0190	SH-0194	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0216	1443	3619	Gravty	JCT-1-1019	SH-0194	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0217	1377	3453	Gravty	SH-0190	SH-0197	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0218	1378	3452	Gravty	SH-0190	SH-0196	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0219	1572	3648	Gravty	SH-0196	SH-0196	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0220	1580	3650	Gravty	SH-0192	SH-0196	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0221	1394	3470	Gravty	SH-0196	SH-0199	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0222	1379	3469	Gravty	SH-0196	SH-0489	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0223	1414	3490	Gravty	SH-0489	SH-0195	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0224	1824	3990	Gravty	JCT-1005	SH-0486	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0225	1916	3992	Gravty	JCT-1-1031	SH-0075	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0226	1863	3978	Gravty	JCT-1-1048	SH-0190	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0227	1369	3475	Gravty	SH-0200	SH-0200	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0228	1388	3474	Gravty	SH-0201	SH-0202	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0229	1387	3473	Gravty	SH-0201	SH-0203	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0230	1396	3472	Gravty	SH-0203	SH-0491	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0231	1395	3471	Gravty	SH-0213	SH-0491	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0232	1574	3650	Gravty	SH-0491	SH-0491	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0233	1573	3649	Gravty	SH-0204	SH-0199	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0234	1500	3620	Gravty	SH-0203	SH-0207	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0236	1805	3881	Outfall	SH-0207	SH-0206	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0237	1785	3861	Outfall	SH-0208	SH-0208	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0238	1786	3862	Outfall	SH-0208	SH-0205	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0239	1787	3863	Outfall	SH-0208	SH-0206	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0240	1788	3864	Outfall	SH-0210	SH-0211	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0241	1806	3882	Outfall	SH-0211	SH-0210	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0242	1807	3883	Outfall	SH-0210	SH-0212	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0243	1822	3986	Gravty	SH-0244	SH-0213	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0244	1823	3987	Gravty	JCT-1-1034	SH-0213	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0245	1837	3913	Gravty	SH-0214	SH-0215	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0246	1739	3860	Gravty	SH-0215	SH-0216	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0247	1790	3866	Gravty	SH-0216	SH-0217	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0248	1838	3914	Gravty	SH-0217	JCT-1-1026	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0249	1808	3884	Gravty	JCT-1-1028	SH-0200	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0250	1696	3762	Gravty	SH-0352	SH-0220	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0251	1697	3763	Gravty	SH-0352	SH-0220	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0252	1662	3728	Gravty	SH-0218	SH-0484	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0253	1668	3734	Gravty	SH-0484	SH-0484	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0254	1688	3764	Gravty	SH-0238	SH-0628	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0255	1689	3765	Gravty	SH-0238	SH-0484	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0256	1690	3766	Gravty	SH-0238	SH-0484	3	2	3	2	2	2	2	2	ReTV	\$	674.00
SP-0257	1692	3768	Gravty	SH-0238	SH-0484	3	2	3	2	2	2	2				



Asset ID	Model ID	ESRI OID	Pipe Type	Upstream MH	Downstream MH	Capacity Modified Consequence of Failure EX CAP COP MOD	Likelihood of Failure FUTURE CAP COP MOD	Future Capacity Modified Consequence of Failure FUTURE CAP COP MOD	Existing Condition Risk EX COND RISK	Existing Capacity Risk EX CAP RISK	Risk Assessment		Existing Priority Rank	Prioritization and Recommendations		Cost Estimate
											Future Condition Risk FUTURE COND RISK	Future Capacity Risk FUTURE CAP RISK		Future Priority Rank	Condition Recommendations	
SP-0393	1603	3679	Gravity	SH-0344	SH-0344	2	1	1	2	2	2	2	NA	Priority 3a		
SP-0394	1403	3479	Gravity	SH-0344	SH-0344	2	1	1	2	2	2	2	NA	Priority 3a		
SP-0395	1388	3442	Gravity	SH-0344	SH-0344	2	1	1	2	2	2	2	NA	Priority 3a		
SP-0397	1434	3510	Gravity	SH-0344	SH-0344	3	1	1	2	2	2	2	NA	Priority 3a		
SP-0398	1446	3541	Gravity	SH-0344	SH-0344	3	1	1	2	2	2	2	NA	Priority 3a		
SP-0399	1371	3447	Gravity	SH-0344	SH-0344	4	1	1	2	2	2	2	NA	Priority 3a		
SP-0400	1370	3446	Gravity	SH-0344	SH-0344	4	1	1	2	2	2	2	NA	Priority 3a		
SP-0401	1570	3681	Gravity	SH-0344	SH-0344	4	1	1	2	2	2	2	NA	Priority 3a		
SP-0402	1369	3445	Gravity	SH-0344	SH-0344	4	1	1	2	2	2	2	NA	Priority 3a		
SP-0403	1469	3445	Gravity	SH-0344	SH-0344	4	1	1	2	2	2	2	NA	Priority 3a		
SP-0404	1706	3782	Gravity	SH-0351	SH-0401	5	1	1	2	2	2	2	NA	Priority 3a		
SP-0405	1698	3771	Gravity	SH-0351	SH-0401	5	1	1	2	2	2	2	NA	Priority 3a		
SP-0406	1757	3633	Gravity	SH-0350	SH-0350	3	1	1	2	2	2	2	NA	Priority 3a		
SP-0407	1758	3634	Gravity	SH-0350	SH-0350	3	1	1	2	2	2	2	NA	Priority 3a		
SP-0408	1714	3701	Gravity	JCT-1001	SH-0350	4	1	1	2	2	2	2	NA	Priority 3a		
SP-0409	1714	3702	Gravity	SH-0351	SH-0350	2	1	1	2	2	2	2	NA	Priority 3a		
SP-0410	1713	3700	Gravity	SH-0352	SH-0350	2	1	1	2	2	2	2	NA	Priority 3a		
SP-0411	1709	3635	Gravity	SH-0350	SH-0350	2	1	1	2	2	2	2	NA	Priority 3a		
SP-0412	1712	3700	Gravity	JCT-1001	SH-0350	3	1	1	2	2	2	2	NA	Priority 3a		
SP-0413	1811	3887	Gravity	SH-0353	SH-0352	3	1	1	2	2	2	2	NA	Priority 3a		
SP-0414	1780	3636	Gravity	SH-0350	SH-0350	3	1	1	2	2	2	2	NA	Priority 3a		
SP-0415	1725	3601	Gravity	SH-0355	SH-0354	4	1	1	2	2	2	2	NA	Priority 3a		
SP-0416	1726	3602	Gravity	SH-0354	SH-0350	5	1	1	2	2	2	2	NA	Priority 3a		
SP-0417	1813	3889	Gravity	SH-0355	JCT-1002	4	1	1	2	2	2	2	NA	Priority 3a		
SP-0418	1809	3886	Gravity	JCT-1002	SH-0352	2	1	1	2	2	2	2	NA	Priority 3a		
SP-0419	1812	3888	Gravity	JCT-1003	SH-0352	3	1	1	2	2	2	2	NA	Priority 3a		
SP-0420	1704	3780	Gravity	SH-0012	SH-0362	5	1	1	2	2	2	2	NA	Priority 3a		
SP-0421	1705	3781	Gravity	SH-0362	SH-0362	5	1	1	2	2	2	2	NA	Priority 3a		
SP-0422	1444	3530	Gravity	SH-0363	JCT-1014	3	1	1	2	2	2	2	NA	Priority 3a		
SP-0423	1367	3443	Gravity	SH-0367	SH-0366	1	1	1	2	2	2	2	NA	Priority 3a		
SP-0424	1568	3644	Gravity	SH-0364	SH-0365	2	1	1	2	2	2	2	NA	Priority 3a		
SP-0425	1368	3444	Gravity	SH-0365	SH-0364	4	1	1	2	2	2	2	NA	Priority 3a		
SP-0426	1427	3503	Gravity	SH-0368	SH-0367	3	1	1	2	2	2	2	NA	Priority 3a		
SP-0427	1752	3628	Gravity	JCT-1003	SH-0369	2	1	1	2	2	2	2	NA	Priority 3a		
SP-0428	1717	3703	Gravity	SH-0368	SH-0370	2	1	1	2	2	2	2	NA	Priority 3a		
SP-0429	1718	3704	Gravity	SH-0370	SH-0371	2	1	1	2	2	2	2	NA	Priority 3a		
SP-0430	1716	3705	Gravity	SH-0371	SH-0372	2	1	1	2	2	2	2	NA	Priority 3a		
SP-0431	1720	3706	Gravity	SH-0372	SH-0373	2	1	1	2	2	2	2	NA	Priority 3a		
SP-0432	1721	3707	Gravity	SH-0373	SH-0374	2	1	1	2	2	2	2	NA	Priority 3a		
SP-0433	1722	3708	Gravity	SH-0374	SH-0375	2	1	1	2	2	2	2	NA	Priority 3a		
SP-0434	1594	3670	Gravity	SH-0377	SH-0378	2	1	1	2	2	2	2	NA	Priority 3a		
SP-0435	1593	3669	Gravity	SH-0378	SH-0379	2	1	1	2	2	2	2	NA	Priority 3a		
SP-0436	1592	3668	Gravity	SH-0379	SH-0380	4	1	1	2	2	2	2	NA	Priority 3a		
SP-0437	1447	3501	Gravity	SH-0380	SH-0381	4	1	1	2	2	2	2	NA	Priority 3a		
SP-0438	1448	3504	Gravity	SH-0381	SH-0378	4	1	1	2	2	2	2	NA	Priority 3a		
SP-0439	1663	3739	Gravity	SH-0386	SH-0385	4	1	1	2	2	2	2	NA	Priority 3a		
SP-0440	1781	3887	Gravity	SH-0387	SH-0386	4	1	1	2	2	2	2	NA	Priority 3a		
SP-0441	1684	3760	Gravity	SH-0384	SH-0383	4	1	1	2	2	2	2	NA	Priority 3a		
SP-0442	1665	3761	Gravity	SH-0383	SH-0382	4	1	1	2	2	2	2	NA	Priority 3a		
SP-0443	1716	3762	Gravity	SH-0382	SH-0381	4	1	1	2	2	2	2	NA	Priority 3a		
SP-0444	1703	3763	Gravity	SH-0381	SH-0380	4	1	1	2	2	2	2	NA	Priority 3a		
SP-0445	1708	3764	Gravity	SH-0381	SH-0380	4	1	1	2	2	2	2	NA	Priority 3a		
SP-0446	1709	3765	Gravity	SH-0386	SH-0385	4	1	1	2	2	2	2	NA	Priority 3a		
SP-0447	1710	3766	Gravity	SH-0385	SH-0384	4	1	1	2	2	2	2	NA	Priority 3a		
SP-0448	1711	3767	Gravity	SH-0386	SH-0387	4	1	1	2	2	2	2	NA	Priority 3a		
SP-0449	1744	3820	Gravity	SH-0387	SH-0386	4	1	1	2	2	2	2	NA	Priority 3a		
SP-0450	1743	3819	Gravity	SH-0386	SH-0385	5	1	1	2	2	2	2	NA	Priority 3a		
SP-0451	1744	3820	Gravity	JCT-1104	SH-0385	5	1	1	2	2	2	2	NA	Priority 3a		
SP-0452	1742	3818	Gravity	SH-0385	SH-0384	5	1	1	2	2	2	2	NA	Priority 3a		
SP-0453	1743	3819	Gravity	SH-0384	SH-0383	5	1	1	2	2	2	2	NA	Priority 3a		
SP-0454	1748	3824	Gravity	SH-0384	SH-0383	5	1	1	2	2	2	2	NA	Priority 3a		
SP-0455	1747	3823	Gravity	SH-0386	SH-0400	4	1	1	2	2	2	2	NA	Priority 3a		
SP-0456	1746	3822	Gravity	SH-0385	SH-0399	4	1	1	2	2	2	2	NA	Priority 3a		
SP-0457	1745	3821	Gravity	SH-0389	SH-0397	4	1	1	2	2	2	2	NA	Priority 3a		
SP-0458	1668	3744	Gravity	SH-0401	SH-0401	3	1	1	2	2	2	2	NA	Priority 3a		
SP-0459	1667	3743	Gravity	JCT-1019	SH-0401	4	1	1	2	2	2	2	NA	Priority 3a		
SP-0460	1666	3742	Gravity	SH-0401	SH-0399	3	1	1	2	2	2	2	NA	Priority 3a		
SP-0461	1679	3756	Gravity	SH-0403	SH-0404	3	1	1	2	2	2	2	NA	Priority 3a		
SP-0462	1680	3757	Gravity	SH-0404	SH-0405	3	1	1	2	2	2	2	NA	Priority 3a		
SP-0463	1681	3758	Gravity	SH-0405	SH-0406	3	1	1	2	2	2	2	NA	Priority 3a		
SP-0464	1675	3751	Gravity	SH-0405	SH-0407	3	1	1	2	2	2	2	NA	Priority 3a		
SP-0465	1676	3752	Gravity	SH-0407	SH-0408	3	1	1	2	2	2	2	NA	Priority 3a		
SP-0466	1677	3753	Gravity	SH-0409	SH-0406	2	1	1	2	2	2	2	NA	Priority 3a		
SP-0467	1678	3754	Gravity	SH-0408	SH-0403	2	1	1	2	2	2	2	NA	Priority 3a		
SP-0468	1773	3849	Gravity	SH-0410	SH-0411	5	1	1	2	2	2	2	NA	Priority 3a		
SP-0469	1810	3890	Gravity	SH-0411	SH-0412	5	1	1	2	2	2	2	NA	Priority 3a		
SP-0470	1774	3850	Gravity	SH-0411	SH-0414	5	1	1	2	2	2	2	NA	Priority 3a		
SP-0471	1775	3851	Gravity	SH-0414	SH-0415	5	1	1	2	2	2	2	NA	Priority 3a		
SP-0472	1776	3852	Gravity	SH-0415	SH-0416	5	1	1	2	2	2	2	NA	Priority 3a		
SP-0473	1777	3853	Gravity	SH-0416	SH-0417	5	1	1	2	2	2	2	NA	Priority 3a		
SP-0474	1778	3854	Gravity	SH-0417	SH-0418	5	1	1	2	2	2	2	NA	Priority 3a		
SP-0475	1779	3855	Gravity	SH-0418	SH-0419	5	1	1	2	2	2	2	NA	Priority 3a		
SP-0476	1780	3856	Gravity	SH-0419	SH-0420	5	1	1	2	2	2	2	NA	Priority 3a		
SP-0477	1781	3857	Gravity	SH-0420	SH-0408	5	1	1	2	2	2	2	NA	Priority 3a		
SP-0478	1772	3848	Gravity	SH-0421	SH-0410	5	1	1	2	2	2	2	NA	Priority 3a		
SP-0479	1647	3723	Gravity	SH-0422	SH-0421	2	1	1	2	2	2	2	NA	Priority 3a		
SP-0480	1684	3740	Gravity	SH-0423	SH-0422	3	1	1	2	2	2	2	NA	Priority 3a		
SP-0481	1665	3741	Gravity	SH-0423	SH-0422	3	1	1	2	2	2	2	NA	Priority 3a		
SP-0482	1753	3629	Gravity	SH-0426	JCT-1067	3	1	1	2	2	2	2	NA	Priority 3a		
SP-0483	1771	3827	Gravity	JCT-1001	SH-0421	3	1	1	2	2	2	2	NA	Priority 3a		
SP-0484	1750	3628	Gravity	JCT-1001	SH-0410	3	1	1	2	2	2	2	NA	Priority 3a		
SP-0485	1566	3662	Gravity	SH-0428	SH-0429	3	1	1	2	2	2	2	NA	Priority 3a		
SP-0486	1567	3663	Gravity	SH-0429	SH-0430	3	1	1	2	2	2	2	NA	Priority 3a		
SP-0488	1771	3847	Gravity	SH-0430	SH-0431	5	1	1	2	2	2	2	NA	Priority 3a		
SP-0489	1770	3846														

**APPENDIX E:**  
**TREATMENT PLANT CAPACITY AND**  
**CONDITION ASSESSMENT**



DATE: January 4, 2024  
FILE: 1300.0147.01  
SUBJECT: Gibsons Wastewater Treatment Plant Capacity & Condition Analysis

PAGE: 1 of 22

DATE: January 4, 2024  
TO: Rob Knowles, Town of Gibsons  
CC: Ryan Desrochers, Town of Gibsons  
Trevor Rutley, Town of Gibsons  
Steve Brubacher, Urban Systems  
FROM: Aya Costa, Urban Systems  
Matt Smith, Urban Systems  
FILE: 1300.0147.01  
SUBJECT: Gibsons Wastewater Treatment Plant Capacity & Condition Analysis\_r1

## 1.0 INTRODUCTION

Capacity & condition analyses, as well as a risk assessment for capital project prioritization were prepared as part of developing the Gibsons Sewer Strategic Plan. The analysis methodology was as follows:

1. In person site visit and interview with Gibsons Operations staff to determine condition of existing treatment plant equipment.
2. Background review of design information including drawings and reports pertaining to the treatment plant to determine existing equipment design capacities.
3. Future flows and loads projection (10,000 people and buildout scenarios) to estimate when current equipment will need replacement due to insufficient capacity.
4. Risk assessment based on capacity and condition analysis results for capital project prioritization.
5. Develop a potential path forward for treatment plant capacity upgrades.
6. Prepare Class D cost estimates and implementation timelines for future capital projects and studies.

## 1.1 MEMORANDUM STRUCTURE

The following memorandum is structured as follows:

- Overview of current, as well as projected 10,000 people and buildout flows and loads;
- Overview of capacity and condition analyses of existing treatment process;
- Overview of upgrade requirements for each process unit;
- Presentation of risk assessment based on capacity/condition assessment for upgrade project prioritization;
- Timeline and cost estimates for upgrade projects.

## 2.0 FLOWS AND LOADS

### 2.1 FLOWS

A summary of current and estimated future flows is outlined below (Table 2.1). The remaining sections in Section 2.1 outline the methodology used to estimate flows.

**Table 2.1** Current Flows and Future Flow Estimates

Flow Scenario	Current (MLD)	10,000 people (MLD)	Buildout (MLD)
<b>AADF</b>	1.6	2.5	3.8
<b>MDF</b>	3.4	5.3	8.2
<b>PWWF</b>	6.4	10.5	13.9

Notes:

1. AADF = Average Annual Day Flow
2. MDF = Maximum Day Flow
3. PWWF = Peak Wet Weather Flow, equal to the peak instantaneous flow (PIF).

### 2.1.1 Current Flows

Influent flow data from the past five (5) years (2018-2022) was used as the basis to determine existing flows and loads, as well as solids production. The average annual day flow (AADF) and maximum day flow (MDF) were established using Method 2 from the *Design of Water Resource Recovery Facilities WEF Manual of Practice No. 8* (WEF). Method 2 was applied over other methods outlined by WEF as it resulted in values that were deemed to result in conservative, but not exaggerated values.

AADF and MDF from the dataset were used to establish AADF to MDF peaking factors, as well as calculate a per capita AADF using the current population, these are outlined in Table 2.2.

**Table 2.2** Per Capita AADF and AADF to MDF Peaking Factors using Methods 1, 2, and 5

Method	AADF (L/ca/d)	AADF to MDF Multiplier
<b>Method 1</b>	238	1.5
<b>Method 2</b>	247	2.2
<b>Method 5</b>	248	2.5

Notes:

1. Method 1: Data filtered to exclude outliers defined as less than the 5<sup>th</sup> percentile, or greater than the 95<sup>th</sup> percentile, corresponding to two (2) standard deviations.
2. Method 2: Data filtered to exclude outliers defined as less than the 0.3<sup>rd</sup> percentile, or greater than the 99.7<sup>th</sup> percentile, corresponding to three (3) standard deviations.
3. Method 5: All data is included.

GeoAdvice estimated the PWWF at 94 L/s; however, Town operators have changed operation to reduce peak flow from the Prowse Road Lift Station to the WWTP. As such, the current PWWF is estimated to be 74 L/s.

### 2.1.2 Future Flows

Future flows were established for 10,000 people and buildout (15,512 people). The future AADF was determined using the per capita AADF (established using WEF method 2), multiplied by the respective population. The AADF to MDF was then applied to estimate the future MDF values. Future flows are outlined in Table 2.1.

## 2.2 LOADS

A summary of estimated current future loading (BOD and TSS) is outlined below (Table 2.3). The remaining sections in **Section 2.2** outline the methodology used.

**Table 2.3** Current Loads and Future Load Estimates

Flow	Current (kg/d)	10,000 people (kg/d)	Buildout (kg/d)
<b>BOD</b>			
<b>Daily Average</b>	442	700	1086
<b>Daily Max</b>	962	1523	2362
<b>TSS</b>			
<b>Daily Average</b>	442	700	1086
<b>Daily Max</b>	1188	1880	2916

### 2.2.1 TSS/BOD Load Estimation

Loads to the treatment plant were estimated using the existing population and assumed average loading of 70 g/ca/day (Water Environment Federation, 2018). The peaking factors are included in Table 2.4.

**Table 2.4** Average Day to Max Day BOD and TSS Peaking Factors

Parameter	Daily Load Peaking Factors
<b>BOD</b>	2.2
<b>TSS</b>	2.7

Notes:

1. Peaking factors to calculate max day loading from average day loading were established using the AADF (with WEF method 2) and peaking factor equations outlined in the WEF manual (method 2).

Future loads were calculated using the same methodology as for current loads, with future populations (10,000 and buildout). The same average to maximum day peaking factors used for current loads were applied to estimate future loads.

## 2.3 SOLIDS PRODUCTION

The solids processing system includes the thickener, aerobic digester, and centrifuge. The system receives waste activated sludge (WAS) from the SBR and processes the material prior to being trucked offsite. WAS quantities

# URBAN SYSTEMS MEMORANDUM

DATE: January 4, 2024

FILE: 1300.0147.01

PAGE: 4 of 22

SUBJECT: Gibsons Wastewater Treatment Plant Capacity & Condition Analysis

for design were estimated by taking the max 60 day average sewage flow, because the solids retention time in the digester is approximately 60 days for a Class B Biosolids, which is the quality the solids processing system was originally designed to achieve. All the wastewater flow data (no data excluded) was used to determine a 60 average day flows. The maximum of all average 60-day flows each year was taken to be the max 60-day average day flow for that year. A peaking factor was then established for AADF to max 60-day average flow. The average peaking factor from the last 5 years (2018-2022) was then used as the design peaking factor to estimate the max 60-day average flow for 10,000 and buildout populations. A literature value of 0.25 kg solids/m<sup>3</sup> (Water Environment Federation, 2018) wastewater was then applied to calculate solids production from flows.

**Table 2.5** Solids Flows (solid component of WAS from SBRs)

WAS Flows (solids mass) (kg/d)	2018	2019	2020	2021	2022	5-year avg	10,000	Buildout
	528	414	485	554	459	<b>488</b>	<b>771</b>	<b>1,196</b>

The WAS is processed by the thickener (to 3% solids) and digester prior to dewatering by the centrifuge, therefore the quantity of sludge to the centrifuge is a function of digester operation. Currently the digester is operated at lower solids percent for ease of aeration; therefore, the average sludge solid content is around 1.8%. The original design percent solid produced by the digester is 4%; however, operational experience has shown that 4% is not desirable for digester operation and any future design should reflect this. 1.8% solid was used in evaluating existing and future system requirements. Current and future sludge flow estimated are outlined in Table 2.6.

**Table 2.6** Estimated Current and Future Sludge Flows to Centrifuge

	Unit	2018	2019	2020	2021	2022	5-year avg	10,000 ppl	Buildout
<b>Mass sludge to centrifuge</b>	tonnes /day	23.4	18.4	21.5	24.6	20.4	<b>21.7</b>	34.2	53.1
<b>Volume sludge to centrifuge</b>	m <sup>3</sup> /day	23.3	18.3	21.4	24.5	20.3	<b>21.6</b>	<b>34.1</b>	<b>52.8</b>

### 3.0 CAPACITY ANALYSIS

A capacity analysis was completed to determine the design capacity of existing treatment equipment, as well as project when (on a population basis) that the treatment system would need to be upgraded due to a capacity shortfall.

#### 3.1 DESIGN CAPACITY VS FORECASTED FLOWS & LOADS

Table 3.1 includes a summary of the design vs forecasted buildout flows.

**Table 3.1:** Design vs Forecasted Flows

Process	Component	Existing Capacity	Future Capacity Required
<b>Buffer Tank</b>	Tank	84 L/s (peak flow) <sup>1</sup>	Assume no upgrade. Instead, upgrade headworks to PWWF capacity.
<b>Headworks</b>	Headworks Channel	78 L/s <sup>2</sup>	161 L/s
<b>Equalization Tank</b>	Tank between headworks and SBRs	N/A	Balancing storage to balance PWWF down to MDF
<b>SBR</b>	All components	6.75 MLD <sup>2</sup> 1,350 kg/d BOD <sup>2</sup>	8.2 MLD 2,362 kg/d BOD
<b>UV Channel</b>	Banks A and B	156 L/s <sup>3</sup>	No change
<b>Equalization Tank</b>	Tank	217 m <sup>3</sup> tank <sup>4</sup>	No change. Instead, upgrade outfall.
<b>Outfall</b>	All components	63 L/s <sup>5</sup>	161 L/s (based on PWWF)
<b>Thickener</b>	Rotary Drum Thickener	67 m <sup>3</sup> /d <sup>6</sup>	98 m <sup>3</sup> /d
<b>Digester</b>	All components	20 m <sup>3</sup> /day <sup>6</sup>	40 m <sup>3</sup> /d
<b>Centrifuge</b>	Centrifuge	435 kg dry solids/day <sup>6</sup>	955 kg dry solids/day
	Sludge Storage	15 m <sup>3</sup> bin (transport offsite every ~4 weeks) <sup>6</sup>	40 m <sup>3</sup> /week (transport offsite every ~3 days)
<b>Odour Control</b>	Biofilter Bed	1000 L/s	6,900 L/s

Notes:

1. Based on KWL design report for existing buffer tank (Technical Memorandum – DRAFT, 2018)
2. Based on 2034 PWWF from Stantec predesign report (2004).
3. Based on peak decant rate from Stantec predesign report (2004).
4. Based on Stantec wastewater treatment plant upgrade drawings, drawing P800 (2004)

5. Estimated flow required so that existing EQ tank is adequately sized when conveying flows through the plant when the SBR is in storm mode.
6. Based on Stantec predesign report – Technical Memorandum #1 Sludge Dewatering (2004)

### 3.2 CAPACITY AND MWR RELIABILITY REQUIREMENTS

In completing the capacity analysis, the Municipal Wastewater Regulation (MWR) reliability requirements were considered. The MWR requires that a certain percentage of the maximum flow the plant is designed to treat can be processed with the largest unit out of service. The percentage of flow can be either 50% or 75%, depending on the category of treatment plant. For this analysis, it is assumed that the Gibsons wastewater treatment plant will be a Category II treatment facility. The MWR reliability requirements apply to the current registration and plant as the plant is current registered under the MWR. Table 3.2 outlines the current/design and buildout status of the plant in meeting the MWR reliability requirements.

**Table 3.2:** MWR Reliability Category Status

Process	MWR Reliability Pass or Fail (P/F/na)	
	Current/Design	Buildout
Buffer Tank	N/A	N/A
Headworks	N/A	N/A
SBR	P	F
SBR Blowers	P	P
UV Channel <sup>1</sup>	P	P
Equalization Tank	N/A	N/A
Outfall	N/A	N/A
Thickener	N/A	N/A
Digester	P	F
Centrifuge	N/A	N/A

Notes:

1. The UV system consists of one channel with two banks. The MWR requirements for a Reliability Category II facility is that the remaining capacity with the largest unit out of service must be at least 50% the design maximum flow. The two UV banks are of equal size, so assuming one of the UV banks is out of service, the UV system capacity would be reduced by 50%. It is assumed that the UV system is designed to treat the peak SBR decant rate of 156 L/s. With one bank off the capacity is approximately 78L/s. The maximum future decant rate is expected to stay the same as the SBR decant cycles can be staggered. Therefore, the maximum flow through the UV system in the future will be 156 L/s. 50% of this flow is 78L/s, which is equal to the current design capacity of the UV system with one bank offline, therefore just meeting the MWR reliability requirements.

## 4.0 CONDITION ANALYSIS

The condition assessment was completed with input from the Town of Gibsons. Urban Systems visited the WWTP and conducted an interview with the operations staff. From this workshop, a condition score was assigned to each component of the WWTP, on a scale from one to five. These scores were determined using a condition assessment sheet with pre-determined criteria. See **Appendix 1** for assessment criteria and scores.

## 5.0 UPGRADE REQUIREMENTS

Upgrade projects were identified based on the condition and capacity analyses completed. Table 5.1 summarizes the upgrade trigger timing for each process unit and reason for upgrade.

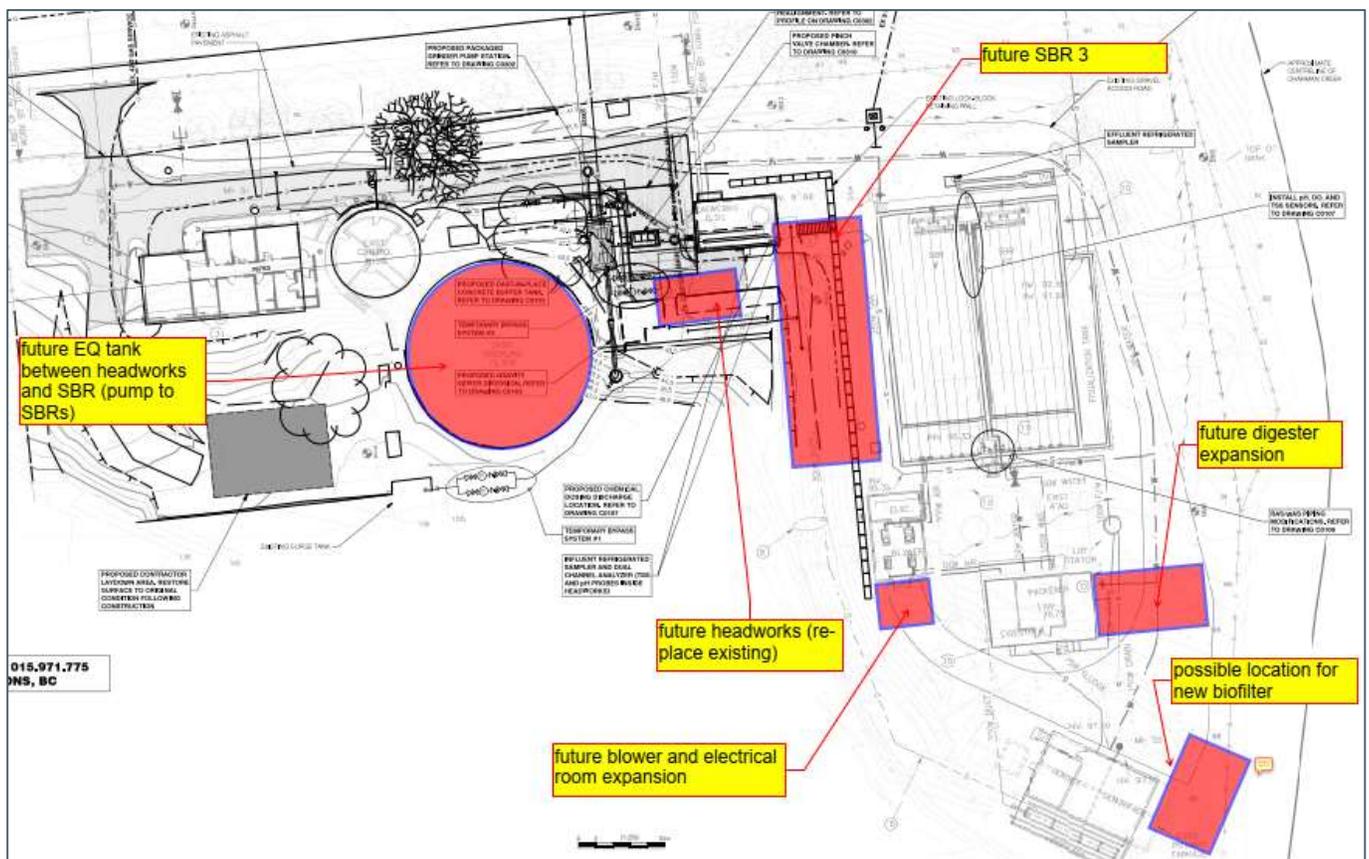
**Table 5.1** – Unit Process Upgrade Timing and Reason

Unit Process	Anticipated Years to Needing Upgrade/ Construction (yrs)	Initial Reason for Upgrade
Buffer tank	N/A	N/A
Headworks	0-2	Condition
SBRs	2-5 (blowers) 5-10 (other SBR equipment)	Condition (blowers) Capacity (other SBR equipment)
SBR EQ Tank	5-15	Capacity
UV System	5-10	Condition
Equalization Tank	>25	Condition
Effluent Outfall (Pipeline)	*to be included as part of collection system analysis	
Effluent Outfall (Diffusers)	2-10	Condition
Thickener	2-5	Condition
Aerobic Digester	0-2 (blowers) >10 (other digester equipment)	Condition (blowers) Capacity (other digester equipment)
Centrifuge 1	0-2	Condition
Centrifuge 2	10	Capacity
Odour Control	0-5	Capacity
MWR Registration <sup>1</sup>	0-5	Capacity
Generator	2-10	Condition

Table Notes:

1. MWR registration timeline is based on the plant exceeding 6,750 m<sup>3</sup>/day; however, any major changes to the treatment process would trigger an MWR reregistration. Note that minor changes could also result in the need for a registration amendment, depending on the scope of changes.

Figure 5.1 illustrates the upgrades, which will be further discussed throughout **Section 5**. This illustrates one potential path forward; however, a geotechnical investigation and pre-design study should be completed determine the optimal locations for future plant expansions that takes into consideration geohazard risks and operational space needs.



**Figure 5.1:** Layout of Future Upgrades on Existing System Map

Note that the above figure only includes expansions required for treatment processes. As flows and loads increase, the Town may need to hire additional operators to run the WWTP. More staff will place a strain on the operations building and parking area. These should be expanded to meet future operations staff needs.

## 5.1 HEADWORKS & EXISTING BUFFER TANK

The headworks system will be upgraded to the buildout PWWF. Technically the existing buffer tank provides some relief from peak flows; however, it is good practice to size headworks equipment for peak flows in the event that the buffer tank is at capacity during a peak flow event.

If the headworks is upgraded fully, the existing buffer tank will not need to be upsized.

The proposed solution to increase screening capacity is simply one option. Alternative configurations to optimize the capacity of a screening system(s) should be explored through a feasibility analysis.

## 5.2 SBR & FUTURE SBR EQUALIZATION TANK

The existing secondary treatment system consists of two Intermittent Cycle Extended Aeration System (ICEAS) Sequencing Batch Reactors (SBR). The buildout system would require two additional ICEAS SBRs to provide sufficient capacity to pass future PWWF, treat MDF, and meet MWR redundancy requirements. Adding an SBR equalization tank between the headworks and SBRs is expected to allow the SBRs to be sized to pass MDF instead of PWWF, thereby reducing the number of additional SBRs to one at buildout. The additional SBR could likely be sited adjacent to (i.e., south of) existing SBR #1. Note that this option to upgrade the secondary treatment system is simply a path forward and should be revisited during detailed design of the future expansion.

An SBR EQ tank volume of approximately 470 m<sup>3</sup> is required to equalize a 3-hour peak flow event (which is the same criteria used to size the existing buffer tank). The former trickling filter tank could potentially serve as the SBR EQ tank if further investigations indicate it is structurally sound and sufficiently leak proof. However, because of the age, size and location of the tank, it is assumed that a new tank would be constructed in its place. In this configuration, pumps will be needed to convey screened raw sewage from the headworks up to the SBR EQ tank. The sewage will then be conveyed by gravity to a new flow splitter box designed to distribute flows equally between the three future SBRs. Note that this solution is only one path forward that utilizes the existing tank footprint. Alternative locations for the future EQ tank which may not include additional pumping could be possible depending on the Town's preference for tank placement.

## 5.3 UV SYSTEM

The UV system will not have to be upgraded to meet buildout conditions from a capacity perspective, as the SBRs decant cycles can be staggered. The UV system upgrade will therefore be triggered by condition.

## 5.4 EFFLUENT OUTFALL & DOWNSTREAM EQUALIZATION TANK

Best practice is to size an outfall to hydraulically convey peak flows without requiring upstream equalization. Therefore, the EQ tank between the UV channels and outfall should not be included in the analysis and the outfall will have to be upgraded to convey the PWWF.

The outfall pipeline is currently at capacity and the outfall diffusers are in relatively poor condition. A conceptual design study is currently underway for these infrastructure upgrades.

## 5.5 SOLIDS HANDLING

### 5.5.1 Thickener

The thickener will have to be upgraded to process an estimated 98 L/min, which is 31 L/min more than the existing system is sized for. It is likely that the thickener could be upgraded and upsized to fit in the existing digester/thickener building to avoid the need for new building construction (depending on make and model available at time of construction).

### 5.5.2 Aerobic Digester

The aerobic digester capacity will have to be increased from 20 to 40 m<sup>3</sup>/day. An additional digester (two chambers), mirroring the existing system, will be required to double the existing capacity. The digesters can be constructed below ground and adjacent to the existing digester. Increasing the treatment capacity to 40 m<sup>3</sup> will comply with the MWR reliability requirements.

### 5.5.3 Centrifuge

The existing centrifuge is in poor condition and should be replaced imminently; a project to do this is currently underway. At the existing processing capacity (3 m<sup>3</sup>/hr), the one centrifuge would need to run for approximately 123 hrs each week (21 hr/day, 6 days/week) to dewater digested sludge in buildout conditions. This exceeds the amount of time any operator would want to operate a centrifuge, therefore for this analysis, it is assumed the existing centrifuge will eventually be replaced with two smaller centrifuges designed to meet 10,000 people and buildout population processing needs (with variations in run time in each future scenario). Centrifuge 1 is required now to mitigate a condition deficiency, and centrifuge 2 is required prior to the Town reaching a population of 10,000.

## 5.6 ODOUR CONTROL

The existing odour treatment system consists of a biofilter capable of treating an estimated 1000 L/s of airflow (WSP, 2018). A series of studies completed by Urban Systems in 2021 and 2022 identified the need for approximately 1,350 L/s airflow treatment capacity if the ventilation system were upgraded to treat the required number of air exchanges per hour (urban Systems, 2021, 2022). Based on previously completed studies, an additional biofilter will be required for the digesters and centrifuge room to close the existing treatment deficiency. Note that the odour control system capacity will need to be increased as the plant is expanded (i.e., digester/ headworks expansions and future SBR EQ tank). To meet future odour treatment needs beyond closing the existing treatment deficiency, it was assumed that digester air treated volumes will have to double, and headworks air treated volumes will have to increase by 50%.

## 5.7 GEOHAZARD MITIGATION UPGRADES

Due to the location of the WWTP, geohazards will need to be considered during design and construction of all future plant upgrades. The WWTP is located on a level area at the mouth of a ravine and is surrounded to the west and north-west by slopes. Thurber Engineering (Thurber) recently completed a desktop study and site reconnaissance to review the geohazard potential at the WWTP site (Thurber Engineering, 2023).

The study identified that large static landslides are not likely, but that there is a risk of smaller, more localized landslides occurring. The report notes that this risk is most concentrated near the base of the slopes, and that a landslide barrier is a potential mitigation measure for this hazard. The site currently incorporates offsets from the

slope and debris walls (lock block wall with fence behind) to help mitigate the impacts of any small landslides. However, during construction of the third SBR tank and blower/electrical room expansions, these protective measures may need to be moved back to create space for the new infrastructure.

The geohazard study also notes that landslides due to seismic activity may be a hazard at the WWTP. It is noted that damage to buildings closer to the base of slopes is more likely, compared to the tanks which are offset further. This potential hazard should be taken into consideration during design and construction of future infrastructure near the base of the slopes.

The report notes that debris floods and flows are not considered likely for the plant, however, that flood walls could be implemented if other studies identify concerns.

There is a small, two lock block high, wall adjacent to SBR #1 which will need to be removed to construct the third SBR (Figure 5.2). A new wall, closer to the slope may need to be constructed to protect the new tank structure from geohazards.



**Figure 5.2** – Lock block wall near SBR #1

## 5.8 ELECTRICAL GENERATOR

The existing electrical generator is 300 kW and was installed during the 2004 upgrade to provide backup power for essential loads in the event of a power failure event. At buildout, it is expected that up to double the backup power will be needed; however, this should be confirmed once future upgrade designs are completed. It is assumed that the future generator selection will fit in the space allotted for the existing generator.

The need for a new generator will be triggered by condition needs, headworks upgrades, or the addition of a third SBR (depending on the configuration of the upgraded headworks). For the purposes of this project, it is assumed the generator upgrade will be capacity driven (with 3<sup>rd</sup> SBR) and that future backup power needs will require a 600 kW generator. The existing generator is in good to fair condition; however, it is technically nearing the end of its design life (approximately 20 years). Because of this, it is assumed that a new generator will completely replace the existing to meet current and future backup power needs.

### 5.9 MWR REGISTRATION AMENDMENT

The Gibsons wastewater treatment plant is authorized by a Municipal Wastewater Regulation (MWR) registration. Because wastewater is discharged into a fish-bearing surface water (in this case the ocean), the Federal Wastewater Systems Effluent Regulations quality criteria also apply. Table 2.1 following outlines the existing registration to the best of our knowledge, with the Federal requirements for reference.

**Table 2.1 – Collation of Current MWR Registration**

Parameter	Regulatory Requirement (Provincial)	Regulatory Requirement (Federal)
Flow	6,750 m <sup>3</sup> /d maximum	N/A
Carbonaceous BOD5 (CBOD5)	45 mg/L maximum	25 mg/L average
Total Suspended Solids (TSS)	45 mg/L maximum	25 mg/L average
Un-ionised Ammonia	N/A	1.25 mg/L maximum
LC50 96 hour Rainbow Trout Test	Pass	Pass
pH	6.0 to 9.0	N/A
Faecal coliforms	200/100 mL assumed to be as a geometric mean of 5 consecutive samples immediately after UV disinfection until receiving environment data indicate otherwise	N/A

There are many changes that may trigger a registration amendment. As outlined in the Evaluation of In-house Reclaimed Water Use memo prepared by Quarmby Environmental, changes such as adding a new digester would not be expected to trigger an amendment; however, the addition of a new equalization tank downstream of the headworks or an addition of a third SBR would (Quarmby Environmental, 2023).

A new MWR registration will involve a thorough application process, including preparing supporting environmental and engineering documents. The expected timeline is 2-5 years, which includes the time needed to complete the technical work required for the application. During the previous registration, very limited

environmental impact assessment work on the receiving environment was completed and as such this next registration will require a full environmental impact study in order to support the application.

### 5.9.1 Upcoming Changes

Upcoming changes at the WWTP that are expected to trigger a MWR registration amendment include the SBR EQ tank (downstream of headworks and upstream of SBRs) addition, headworks upgrade/expansion and increased flows. Increased flows will in itself trigger an amendment but will also result in the need for process equipment upsizing/additions (SBR EQ tank, new SBR, which would also trigger an amendment).

The plant throughput is expected to exceed the registration amount between now (6,318 ppl) and when the community reaches a population of 10,000 people. This increase in flow through the plant will require a change to the treatment process, and trigger an MWR registration.

## 6.0 RISK ASSESSMENT & PROJECT PRIORITIZATION

A risk analysis was conducted for each unit process based on an evaluation of condition and capacity. The outputs were used to assign upgrade priority scores for project prioritization (1 to 4, where 1 is highest risk and therefore ranked highest priority). An "a" is added to the priority score if it is a capacity based priority and a "b" if a condition based priority. Table 6.1 outlines all identified upgrade projects, with a corresponding priority score (where applicable). Unit processes without upgrades scores are deemed lower risk at this time and upgrades for these should be planned for according the upgrade trigger and timing results section of the condition and capacity analysis.

# URBAN SYSTEMS MEMORANDUM

DATE: January 4, 2024

FILE: 1300.0147.01

PAG

SUBJECT: Gibsons Wastewater Treatment Plant Capacity & Condition Analysis

**Table 6.1** – Priority Scores for Upgrade Projects

Process	Component	Upgrade Priority Score	Comments
<b>MWR Registration</b>	-	2a (existing)	*timing to align with upstream headworks upgrade/replacement, EQ tank addition and/or flow increase
<b>Buffer Tank</b>	Tank	N/A	*add future EQ tank instead
	Pinch Valve	N/A	*add future EQ tank instead
<b>Headworks</b>	Existing headworks channel	2b (existing)	
	Fine Screen	2b (existing)	
	Screen conveyor/motor	2b (existing)	
	Bypass Manual Bar Screen	2b (existing)	
	Grit Removal + motor	2b (existing)	
	Grit classification + motor		
<b>SBR</b>	Splitter Box	1 (future)	
	Tanks	1 (future)	
	SBR Blowers	2b (existing)	
	WAS Pumps	1 (future)	
	Decanters + motor	1 (future)	
	Fine bubble air diffusers	1 (future)	
	WAS Flowmeter	2b (existing)	
	Instrumentation (DO Probe, pH, TSS in each SBR, effluent pH and TSS)	1 (future)	*means that new SBR will be required with new instruments.
<b>FUTURE SBR EQ tank (b/w headworks and SBRs)</b>	-	2a (future)	* to be upgraded before SBR upgrade is required to ensure MDF is being conveyed to the SBRs instead of PWWF
<b>UV System</b>	Banks A and B	2b (future)	
<b>Equalization Tank</b>	Motorized plug valve	2b (future)	
	Tank	2b (future)	
	Flowmeter	2b (future)	
<b>Outfall</b>	Pipeline	-	*included as part of collection system analysis.
	Outfall Diffusers	2b (existing)	
<b>Thickener</b>	Rotary Drum Thickener	2b (existing)	Score adjusted based on operator concerns with condition failure.
	Flowmeter		
	Instrumentation		
	Polymer System		
<b>Aerobic Digester</b>	Aerobic Digester Tanks	1 (future)	
	Aerobic Digester Blowers	2b (existing)	Score adjusted based on operator concerns with condition failure.
	Bubble aeration system	1 (future)	

Process	Component	Upgrade Priority Score	Comments
<b>Centrifuge</b>	Sludge pump (progressive cavity)	1 (future)	
	Centrifuge	2b (existing)	
	Polymer System	2b (existing)	
	Flowmeter	3b (existing)	
	Dewatered Sludge Conveyor	3a (future)	*shall be upgraded when centrifuge is upgraded
	Sludge Storage (rental)	N/A	*rental
<b>Odour Control</b>	Biofilter	4 (existing)	*upgrade or reconfiguration required with centrifuge upgrade to ensure adequate air exchange.
<b>Backup Power</b>	Generator	2b (existing)	

Criteria	
<b>Priority 1</b>	Capacity and Condition Risk score of 4+
<b>Priority 2a</b>	Capacity Risk Score only 4+
<b>Priority 2b</b>	Condition Risk Score only 4+
<b>Priority 3a</b>	Capacity LoF 4+
<b>Priority 3b</b>	Condition LoF 4+
<b>Priority 4</b>	Capacity of LoF 3

## 6.1 CONDITION AND CAPACITY ANALYSIS & PROJECT PRIORITIZATION METHODOLOGY

### 6.1.1 CAPACITY (FLOW AND LOAD)

The capacity analysis was completed twice, once for current conditions and once for buildout.

#### Likelihood of failure (LoF):

The LoF score is derived from level of service (LoS) scores (A, B, C → where A is the best case and C is worst case) LoF is a value from 1-5, where 1 is the best case (operating as designed) and 5 is the worst case (capacity exceeded). This is outlined in Table 6.2.

**Table 6.2** – Capacity LoF Scoring

LoF score	Hydraulic LoS	Load LoS	MWR Redundancy
<b>1</b>	A	A	Pass or N/A
<b>2</b>	A	A	Fail
<b>3</b>	C	B	Pass or fail or N/A
<b>3</b>	B	C	Pass or fail or N/A
<b>4</b>	C	C	Pass or N/A
<b>5</b>	C	C	fail

Notes:

1. If one of hydraulic or load LoS was not applicable, left that LoS score out.
2. A (best): flow/capacity < 0.95
3. B: 0.95 < flow/capacity < 1
4. C (worst): flow/capacity > 1

**Consequence of failure (CoF):**

CoF is a value between 1 and 5, where 1 is the best case and 5 is the worst case. This is outlined in Table 6.3.

**Table 6.3 –CoF Scoring**

CoF score	Criteria (\$)
1	1 = no impact
2	2 = moderate operational challenges. Costs <\$50,000 to mitigate issue.
3	3 = significant operational challenges, but no exceedances. Costs >\$50,000 to mitigate issue
4	4 = plant capacity exceeded –non-life threatening injury, or short-term environmental impact. Includes impact >\$50,000 for solids stream (thickener, aerobic digester, centrifuge) due to high operational costs related to system failure or being undercapacity.
5	5 = plant capacity exceeded – serious public health issue (life threatening injury), permanent or unacceptable environmental damage, operator safety is compromised.

Notes:

1. Plant capacity exceeded refers to a permit exceedance OR plant overflow.
2. Mitigation does not include replacement cost. Only the cost to mitigate the one time exceedance.

**6.1.2 CONDITION**

The asset condition has to do with the asset exceeding its design life and needing to be replaced. The condition assessment was completed for existing and buildout conditions. To estimate the buildout condition scores +2 was added if the existing civil/structural asset score was 1 and +3 was added if the existing process-mechanical/electrical asset score was 1. For all other existing scores >1, the buildout score was set to 5 as it is assumed buildout will be in 20 years.

**Likelihood of failure (LoF):**

The likelihood of failure (LoF) is based on the condition assessment scores (1-5) assigned through discussion with the Town operations staff. This relates to the existing condition of equipment – the assessment separated assets into mechanical/electrical and civil/structural assets (Tables 6.4 and 6.5)

**Table 6.4 – Process-Mechanical /Electrical Assets – LoF score and Expected Asset Life Remaining**

Expected Asset Life Remaining (yrs)	LoF Score
>10	1
5-10	2
2-5	3
0-2	4
0	5

**Table 6.5 - Civil/Structural Assets - LoF score and Expected Asset Life Remaining**

Expected Asset Life Remaining (yrs)	LoF Score
>25	1
10-25	2
2-10	3
0-2	4
0	5

**Consequence of failure (CoF):**

The same consequence of failure criteria and scores used for the capacity analysis were used in the condition assessment.

**6.1.3 Risk Scoring**

1-5 risk scores for capacity and condition were determined using the risk decision matrix below, the LoF and the CoF.

		Likelihood of Failure (LoF)				
		1	2	3	4	5
Consequence of Failure (CoF)	5	2	3	4	5	5
	4	2	3	4	5	5
	3	2	2	3	4	4
	2	1	2	2	3	3
	1	1	1	2	2	3

**6.1.4 UPGRADE PRIORITY**

The condition and capacity risk scores and LoF scores were used to rank projects from high to low priority. The project prioritization was completed using existing capacity and condition scores only. The following criteria were applied for prioritization:

Criteria	
<b>Priority 1</b>	Capacity and Condition Risk score of 4+
<b>Priority 2a</b>	Capacity Risk Score only 4+
<b>Priority 2b</b>	Condition Risk Score only 4+ and significant operational risk (through discussion with Town)
<b>Priority 3a</b>	Capacity LoF 4+
<b>Priority 3b</b>	Condition LoF 4+
<b>Priority 4</b>	Capacity of LoF 3

## **7.0 UPGRADE PROJECT TIMELINE AND COSTS**

A timeline and cost for each upgrade project, including anticipated time to initiate a study/design is outlined in Table 7.1. The timeline over which it was assumed that the buildout population will be reached is 20 years (2043). Furthermore, 10,000 people is expected to occur around year 10 (2033).

The following costs are in 2023 dollars and include a contingency allowance of 35%, as well as 25% for engineering (including pre-design, detailed design, and construction services). Borrowing costs and Gibsons administration costs are not included. It is recommended that Gibsons add appropriate inflation allowances, borrowing costs and administration costs when preparing budgets.

# URBAN SYSTEMS MEMORANDUM

DATE: January 4, 2024

FILE: 1300.0147.01

PAGE: 19 of 22

SUBJECT: Gibsons Wastewater Treatment Plant Capacity & Condition Analysis

**Table 7.1** – Upgrade Project Timelines and Cost Estimates

Upgrade Project	Project Group	Design Trigger Year	Engineering (20% of capital with contingency) (rounded)	Upgrade Trigger Year	Capital Replacement Cost, including 35% contingency (\$) (rounded)	Upgrade Trigger Year Population <sup>7</sup>	Growth Driven
Centrifuge 1	1	2023	\$205,000	2024	\$1,021,000	6,608	No
MWR Registration	1	2024	\$200,000	2024	N/A	6,608	Yes
Aerobic Digester Blowers (x2)	1	-	\$0	2024	\$78,000	6,608	No
Outfall - Diffusers (replacement)	-	2024	\$216,000	2027	\$1,080,000	7,561	Yes
Outfall - Pipeline (Phase 1)	-	2024	from collection system costs	2026	from collection system costs	6,318	No
Outfall - Diffuser Interim Repair	-	2024	\$16,200	2024	\$81,000	6,318	No
Plant Upgrading Preliminary Design and Expanded Condition Assessment	2	2024	\$400,000	N/A	N/A	NA	Yes
Outfall - Pipeline (Phase 2)	2	2024	from collection system costs	2031	from collection system costs	9,049	-
Odour Control	3	2025	\$227,000	2026	\$1,134,000	7,229	Yes
Thickener	4	2025	\$160,000	2026	\$800,000	7,229	Yes
Headworks	5	2025	\$479,000	2026	\$2,395,000	7,229	Yes
SBR Blowers (x2)	6	-	\$0	2027	\$143,000	7,561	No
UV System	7	2029	\$218,000	2031	\$1,087,000	9,049	No
FUTURE SBR EQ tank (between headworks and SBRs)	8	2031	\$352,000	2033	\$1,757,000	9,900	Yes
Generator (Backup Power)	8	2031	\$79,000	2033	\$395,000	9,900	Yes
SBR	8	2031	\$888,000	2033	\$4,438,000	9,900	Yes
Aerobic Digester	8	2031	\$684,000	2033	\$3,417,000	9,900	Yes
Centrifuge 2	8	2031	\$213,000	2033	\$1,061,000	9,900	Yes

Notes:

1. Timing and costs are based on Town of Gibsons Sanitary Outfall 2023 Inspection Report and Sanitary Marine Outfall Feasibility Assessment (2023).
2. Includes 35% contingency.
3. All values rounded up to nearest thousand.

# URBAN SYSTEMS MEMORANDUM

DATE: January 4, 2024

FILE: 1300.0147.01

PAGE: 20 of 22

SUBJECT: Gibsons Wastewater Treatment Plant Capacity & Condition Analysis

4. \*\*Costs are in 2023 \$. See capital plan for costs inflated to future years.
5. Odour control system should be upgraded partially in 2023 to mitigate current deficiencies but have set construction 2024-2025 as there is not sufficient time in 2023 remaining to complete this work. This deficiency was identified by Urban Systems in 2022 (Urban Systems, 2022).
6. Note that all costs are estimated based on a potential path forward identified for this project. Alternative upgrade configurations are possible, and the cost of these options may vary from the presented estimates.
7. Includes equivalent population from industrial, commercial and institutional.

Trigger years & Corresponding Population	Year No.	Year
<b>6,318 (current)</b>	0	2023
<b>6,608</b>	1	2024
<b>6,912</b>	2	2025
<b>7,229</b>	3	2026
<b>7,561</b>	4	2027
<b>7,909</b>	5	2028
<b>8,272</b>	6	2029
<b>8,652</b>	7	2030
<b>9,049</b>	8	2031
<b>9,465</b>	9	2032
<b>9,900 (~10,000 people)</b>	10	2033
<b>10,354</b>	11	2034
<b>10,830</b>	12	2035
<b>11,328</b>	13	2036
<b>11,848</b>	14	2037
<b>12,392</b>	15	2038
<b>12,961</b>	16	2039
<b>13,557</b>	17	2040
<b>14,179</b>	18	2041
<b>14,831</b>	19	2042
<b>15,512 (buildout)</b>	20	2043

Note: growth rate may vary, changing the timing of future upgrades. Populations include equivalent population from industrial, commercial and institutional customers.

## 8.0 CONCLUSIONS AND RECOMMENDATIONS

This memorandum provides a forecast of upgrades required at the Gibsons WWTP over the next 20 years (2023-2043) to assist the Town in making informed and proactive decisions related to upgrades, future development, and financial planning.

The work was completed on the basis of a buildout population of 15,512 people (15–20-year time horizon). The most imminent upgrades are expected to be the SBR EQ tank and upgrade/expansion of the headworks system. The upgrades will trigger an MWR registration amendment.

# URBAN SYSTEMS MEMORANDUM

DATE: January 4, 2024  
FILE: 1300.0147.01  
SUBJECT: Gibsons Wastewater Treatment Plant Capacity & Condition Analysis

PAGE: 21 of 22

The plant is expected to surpass its current registration maximum daily discharge flow at some point between 10,000 people and buildout. The flow increases, as well as process upgrades, will also trigger an MWR registration amendment. The following next steps are recommended:

1. Review upgrade project timelines and costs and incorporate these into upcoming capital plans and budgets.
2. Begin planning for SBR EQ tank and headworks upgrade in the next year.
3. Begin the planning process for a MWR registration amendment, including preliminary design for plant upgrades and an expanded condition assessment.
4. Continue to monitor population growth and check alignment with population growth forecasts. This is critical for capacity related upgrades, which may need to be completed earlier or could be delayed depending on population growth.
5. Incorporate capacity related costs into DCCs.

Sincerely,

**URBAN SYSTEMS LTD.**



Aya Costa, EIT  
Water & Wastewater Engineer

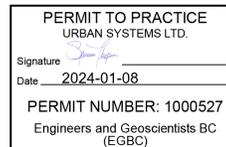
**Reviewer:**



Matt Smith, P.Eng.  
Environmental Engineer/Principal

cc: Steve Brubacher, Urban Systems

/ac  
Enclosure



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DATE: January 4, 2024  
FILE: 1300.0147.01  
SUBJECT: Gibsons Wastewater Treatment Plant Capacity & Condition Analysis

## 9.0 REFERENCES

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## Appendix 1 | WWTP Condition Assessment Criteria & Results

### Criteria - Mechanical and Electrical Assets

Grade	Condition	Description
1	Good	Sound physical condition designed to meet current standards. Operable and well-maintained. Asset likely to perform adequately with routine maintenance for 10 years or more. No work required
2	Very Good	Acceptable physical condition but not designed to current standards, or showing minor wear. Deterioration has minimal impact on asset performance. Minimal short-term failure risk but potential for deterioration or reduced performance in medium term (5-10 years). Only minor work required (if any).
3	Fair	Functionally sound, but showing some wear with minor failures and some diminished efficiency. Minor components or isolated sections of the asset need replacement or repair but asset still functions safely and at an adequate level of service. Deterioration beginning to be reflected in performance and higher attendance for maintenance. Failure unlikely within 2 years but further deterioration likely and major replacement required within next 5 years. Work required but asset is still serviceable.
4	Poor	Functioning but requires a high level of maintenance to remain operational. Likely to cause a marked deterioration in performance in short-term. Likely need to replace most or all of asset within 2 years. No immediate risk to health or safety but work required within 2 years to ensure asset remains safe. Substantial work required in short-term, asset barely serviceable.
5	Very Poor	Failed or failure imminent. Effective life exceeded and excessive maintenance costs incurred. A high risk of breakdown with a serious impact on performance. No life expectancy. Health and safety hazards exist which present a possible risk to public safety, or asset cannot be serviced/operated without risk to personnel. Major work or replacement required urgently.

### Criteria - Civil/Structural Assets

Grade	Condition	Description
1	Good	Sound physical condition. Asset likely to perform adequately without major work for 25 years or more
2	Very Good	Acceptable physical condition: minimal short-term failure risk but potential for deterioration in long-term (10 years plus). Only minor work required (if any).

## Appendix 1 | WWTP Condition Assessment Criteria & Results

<b>3</b>	Fair	Significant deterioration evident; failure unlikely within next 2 years but further deterioration likely and major replacement likely within next 10 years. Minor components or isolated sections of the asset need repair now but asset still functions safely at adequate level of service. Work required but asset is still serviceable.
<b>4</b>	Poor	Failure likely in short-term. Likely need to replace most or all of asset within 2 years. No immediate risk to health or safety but works required within 2 years to ensure asset remains safe. Substantial work required in short-term, asset barely serviceable.
<b>5</b>	Very Poor	Failed or failure imminent. Immediate need to replace most or all of asset. Health and safety hazards exist which present a possible risk to public safety, or asset cannot be serviced/operated without risk to personnel. Major work or replacement required urgently.

<b>Results</b>			
<b>Process</b>	<b>Component</b>	<b>Condition Category - process mechanical electrical (P/E) OR civil/structural (C/S)</b>	<b>Condition Score (ie LoF) (1-5)</b>
<b>MWR Registration</b>	-	na	na
<b>Buffer Tank</b>	Tank	C/S	2
	Pinch Valve	P/E	2
<b>Headworks</b>	Existing headworks channel	C/S	5
	Fine Screen (6mm)	P/E	4
	Screen conveyor/motor	P/E	4
	Bypass Manual Bar Screen (25mm and 12mm)	P/E	3
	Grit Removal + motor	P/E	4
	Grit classification + motor		

## Appendix 1 | WWTP Condition Assessment Criteria & Results

<b>SBR</b>	Splitter Box	C/S	2
	Tanks(1535m <sup>3</sup> /tank: 29x9.625x5.5m)	C/S	2
	SBR Blowers	P/E	4
	WAS Pumps	P/E	2
	Decanters + motor	P/E	2
	Fine bubble air diffusers	P/E	2
	WAS Flowmeter	P/E	3
	Instrumentation (DO Probe, pH, TSS in each SBR, effluent pH and TSS)	P/E	2
<b>UV System</b>	Banks A and B	P/E	2
<b>Equalization Tank</b>	Motorized plug valve	P/E	1
	Tank	C/S	1
	Flowmeter	P/E	1
<b>Outfall</b>	Outfall - Pipeline	C/S	2
	Outfall - Diffusers	C/S	3
<b>Thickener</b>	Rotary Drum Thickener	P/E	3
	Flowmeter		
	Instrumentation		
	Polymer System		

## Appendix 1 | WWTP Condition Assessment Criteria & Results

<b>Aerobic Digester</b>	Aerobic Digester Tanks	C/S	2
	Aerobic Digester Blowers	P/E	3
	Bubble aeration system	P/E	1
<b>Centrifuge</b>	Sludge pump (progressive cavity)	P/E	1
	Centrifuge	P/E	4
	Polymer System	P/E	4
	Flowmeter	P/E	4
	Dewatered Sludge Conveyor	C/S	2
	Sludge Storage (rental)	C/S	-
<b>Odour Control</b>	Biofilter	C/S	3

# APPENDIX F: CAPITAL PLAN



Gibsons Sanitary Sewer Strategic Plan

Assumed Inflation Rate

5%

Project	Asset	Start Year	End Year	Sequence Grouping	Existing Priority	Future Priority	Growth Driven	Growth	Potential Grants	Grant	Budget (\$2023)	Budget (Inflated)	2023	2024	2025	2026	2027	2028	2029	
Centrifuge 1 - Design	WWTP	2023	2023	1	3b	3a		0%		0%	\$ 205,000	\$ 205,000	\$ 205,000							
Centrifuge 1 - Construction	WWTP	2023	2023	1	3b	3a		0%		0%	\$ 815,000	\$ 815,000				\$ 815,000				
Aerobic Digester Blowers - replacement (x2)	WWTP	2024	2024	1	2b	3a	Yes	99%		0%	\$ 78,000	\$ 81,900		\$ 81,900						
Outfall Diffuser - Repair Design	WWTP	2024	2024		2b	1	No	0%	No	0%	\$ 16,200	\$ 17,010		\$ 17,010						
Municipal Wastewater Registration	WWTP	2024	2026		2a	1	Yes	50%	Yes	50%	\$ 200,000	\$ 210,000		\$ 100,000	\$ 75,000	\$ 35,000				
Outfall Diffuser - Repair Implementation	WWTP	2024	2024		2b	1	No	0%	No	0%	\$ 81,000	\$ 85,050		\$ 85,050						
Outfall Pipeline - Design	WWTP	2024	2024		2a	1	Yes	50%	Yes	50%	\$ 430,000	\$ 451,500		\$ 451,500						
Outfall Diffusers - Replacement Design	WWTP	2024	2025			1	Yes	50%	Yes	50%	\$ 216,000	\$ 226,800		\$ 113,400	\$ 113,400					
Prowse Road Force Main - Design	Collection	2024	2024		2b	2b		0%		0%	\$ 70,000	\$ 73,500		\$ 73,500						
Prowse Road Force Main - Construction	Collection	2024	2024		2b	2b		0%		0%	\$ 1,343,000	\$ 1,410,150		\$ 1,410,150						
Collection System Bluff Repairs (Manholes)	Collection	2024	2024		2b	2b		0%		0%	\$ 132,000	\$ 138,600		\$ 138,600						
Collection System Repairs and Reinspection	Collection	2024	2025		2b	2b		0%		0%	\$ 128,000	\$ 134,400		\$ 67,200	\$ 67,200					
Collection System Repairs and Reinspection	Collection	2024	2025		3b	3b		0%		0%	\$ 165,000	\$ 173,250		\$ 86,625	\$ 86,625					
Collection System Repairs and Reinspection	Collection	2024	2025			2b		0%		0%	\$ 20,000	\$ 21,000		\$ 10,500	\$ 10,500					
Collection System Repairs and Reinspection	Collection	2024	2025			3b		0%		0%	\$ 30,000	\$ 31,500		\$ 15,750	\$ 15,750					
Collection System Repairs and Reinspection	Collection	2024	2025					0%		0%	\$ 11,000	\$ 11,550		\$ 5,775	\$ 5,775					
Geotechnical Investigation (slope above the Gibsons Wastewater Treatment Plant)	WWTP	2024	2024	2	2b	1	Yes	50%	Yes	50%	\$ 200,000	\$ 210,000		\$ 210,000						
Plant Upgrading Preliminary Design and Expanded Condition Assessment	WWTP	2024	2024	2	1	1	Yes	50%	Yes	50%	\$ 400,000	\$ 420,000		\$ 420,000						
Odour Control - Design	WWTP	2025	2025	3	4	3a	Yes	50%	Yes	50%	\$ 227,000	\$ 250,268			\$ 250,268					
Thickener - Design	WWTP	2025	2025	4	2b	3a	Yes	99%		0%	\$ 160,400	\$ 176,400			\$ 176,400					
Headworks Upgrading - Design	WWTP	2025	2025	5	2b	1	Yes	99%		0%	\$ 479,000	\$ 528,098			\$ 528,098					
Odour Control - Construction	WWTP	2026	2027	3	4	3a	Yes	50%	Yes	50%	\$ 1,134,000	\$ 1,312,747				\$ 656,373	\$ 656,373			
Thickener - Construction	WWTP	2026	2026	4	2b	3a	Yes	99%		0%	\$ 800,000	\$ 926,100			\$ 463,050	\$ 463,050				
Headworks Upgrading - Construction	WWTP	2026	2027	5	2b	1	Yes	50%	Yes	50%	\$ 2,395,000	\$ 2,772,512				\$ 1,386,256	\$ 1,386,256			
Outfall Pipeline - Construction Phase 1	WWTP	2026	2027		2a	1	Yes	50%	Yes	50%	\$ 1,602,000	\$ 1,854,515				\$ 927,258	\$ 927,258			
Update and Recalibrate Sewer Model	Collection	2026	2026			2a	Yes	99%		0%	\$ 50,000	\$ 57,881				\$ 57,881				
Waterfront Sanitary Sewer Retreat Feasibility Study	Collection	2026	2026		2b	1	Yes	50%	Yes	50%	\$ 100,000	\$ 115,763				\$ 115,763				
SBR Blowers- replacement (x2)	WWTP	2027	2027	6	2b	1	Yes	99%		0%	\$ 143,000	\$ 173,817					\$ 173,817			
Outfall Diffusers - Replacement Construction	WWTP	2027	2028			1	Yes	50%	Yes	50%	\$ 1,080,000	\$ 1,312,747					\$ 927,258	\$ 927,258		
Waterfront Sanitary Upgrade - Design	Collection	2027	2028		2b	1	Yes	50%	Yes	50%	\$ 100,000	\$ 121,551					\$ 60,775	\$ 60,775		
Gibsons Way Sanitary Upgrade - Design	Collection	2028	2028		2a	1	Yes	99%		0%	\$ 40,000	\$ 51,051						\$ 40,000		
UV System - Design	WWTP	2029	2030	7		2b	Yes	99%		0%	\$ 218,000	\$ 292,141								\$ 146,070
Gibsons Way Sanitary Upgrade - Construction	Collection	2029	2030		2a	1	Yes	99%		0%	\$ 220,000	\$ 294,821								\$ 147,411
Waterfront Sanitary Upgrade - Construction	Collection	2029	2030		2b	1	Yes	50%	Yes	50%	\$ 560,000	\$ 750,454								\$ 375,227
UV System - Construction	WWTP	2030	2031	7		2b	Yes	99%		0%	\$ 1,087,000	\$ 1,529,518								
Outfall Pipeline - Construction Phase 2	WWTP	2031	2032			1	Yes	50%	Yes	50%	\$ 3,703,000	\$ 5,471,018								
SBR Equalization Tank - Design	WWTP	2031	2032	8		2a	Yes	50%	Yes	50%	\$ 352,000	\$ 520,064								
Generator (Backup Power) - Design	WWTP	2031	2031	8	2b		Yes	50%	Yes	50%	\$ 79,000	\$ 116,719								
SBR - Design	WWTP	2031	2032	8		1	Yes	50%	Yes	50%	\$ 888,000	\$ 1,311,980								
Aerobic Digester - Design	WWTP	2031	2032	8		3a	Yes	50%	Yes	50%	\$ 684,000	\$ 1,010,580								
Centrifuge 2 - Design	WWTP	2031	2033	8		3a	Yes	50%	Yes	50%	\$ 213,000	\$ 314,698								
New Video and Condition Assessment of System	Collection	2031	2031			2b		0%		0%	\$ 300,000	\$ 443,237								
Update and Recalibrate Sewer Model	Collection	2031	2031			2a	Yes	99%		0%	\$ 50,000	\$ 73,873								
Generator (Backup Power) - Construction	WWTP	2032	2033	8		1	Yes	50%	Yes	50%	\$ 352,000	\$ 546,068								
SBR - Construction	WWTP	2032	2033	8		1	Yes	50%	Yes	50%	\$ 4,438,000	\$ 6,884,795								
SBR Equalization Tank - Construction	WWTP	2032	2033	8		2a	Yes	50%	Yes	50%	\$ 1,757,000	\$ 2,725,684								
Aerobic Digester - Construction	WWTP	2032	2033	8		3a	Yes	50%	Yes	50%	\$ 3,417,000	\$ 5,300,889								
Collection System Repairs	Collection	2032	2033			2b		0%		0%	\$ 2,000,000	\$ 3,102,656								
Update Sanitary Sewer Strategic Plan	Collection/WWTP	2033	2033			1	Yes	99%		0%	\$ 200,000	\$ 325,779								
Centrifuge 2 - Construction	WWTP	2033	2033	8		3a		0%		0%	\$ 1,061,000	\$ 1,728,257								
Update and Recalibrate Sewer Model	Collection	2036	2036			2a	Yes	99%		0%	\$ 50,000	\$ 94,282								
New Video and Condition Assessment of System	Collection	2041	2041			2b		0%		0%	\$ 300,000	\$ 721,986								
Update and Recalibrate Sewer Model	Collection	2041	2041			2a	Yes	99%		0%	\$ 50,000	\$ 120,331								
Collection System Repairs	Collection	2042	2043			2b		0%		0%	\$ 2,000,000	\$ 5,053,900								
Update Sanitary Sewer Strategic Plan	Collection/WWTP	2043	2043			1	Yes	0.99		0	\$ 200,000	\$ 530,660								
<b>Total</b>											<b>\$ 37,029,200</b>	<b>\$ 53,634,046</b>	<b>\$ 205,000</b>	<b>\$ 3,286,960</b>	<b>\$ 1,792,065</b>	<b>\$ 3,641,581</b>	<b>\$ 4,131,737</b>	<b>\$ 1,028,033</b>	<b>\$ 668,708</b>	
<b>Current Annual Capital Spending</b>													\$ 1,500,000	\$ 1,575,000	\$ 1,653,750	\$ 1,736,438	\$ 1,823,259	\$ 1,914,422	\$ 2,010,143	
Capital Reserve Fund Contribution/Withdrawal													\$ 1,295,000	-\$ 1,711,960	-\$ 138,315	-\$ 1,905,143	-\$ 2,308,478	\$ 886,389	\$ 1,341,436	
<i>Cumulative Reserve Fund Balance</i>													\$ 1,295,000	-\$ 416,960	-\$ 555,275	-\$ 2,460,418	-\$ 4,768,896	-\$ 3,882,507	-\$ 2,541,071	
<b>Targeted Increase to Annual Capital Spending</b>													8% Annual Increase	\$ 1,500,000	\$ 1,695,000	\$ 1,915,350	\$ 2,164,346	\$ 2,445,710	\$ 2,763,653	\$ 3,122,928
Capital Reserve Fund Contribution/Withdrawal													\$ 1,295,000	-\$ 1,591,960	\$ 123,285	-\$ 1,477,235	-\$ 1,686,027	\$ 1,735,620	\$ 2,454,220	
<i>Cumulative Reserve Fund Balance</i>													\$ 1,295,000	-\$ 296,960	-\$ 173,675	-\$ 1,650,910	-\$ 3,336,937	-\$ 1,601,317	\$ 852,903	
Total													2023	2024	2025	2026	2027	2028	2029	
Grants													\$ 17,376,558	\$ -	\$ 647,450	\$ 219,334	\$ 1,560,325	\$ 1,978,960	\$ 494,016	\$ 187,613
DCC													\$ 22,569,703	\$ -	\$ 728,531	\$ 1,375,206	\$ 2,076,047	\$ 2,151,039	\$ 533,616	\$ 478,160
Remaining from Rates/Reserves													\$ 12,539,374	\$ 205,000	\$ 1,910,979	\$ 197,525	\$ 5,209	\$ 1,738	\$ 400	\$ 2,935

Gibsons Sanitary Sewer Strategic Plan

Project	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Centrifuge 1 - Design														
Centrifuge 1 - Construction														
Aerobic Digester Blowers - replacement (x2)														
Outfall Diffuser - Repair Design														
Municipal Wastewater Registration														
Outfall Diffuser - Repair Implementation														
Outfall Pipeline - Design														
Outfall Diffusers - Replacement Design														
Prowse Road Force Main - Design														
Prowse Road Force Main - Construction														
Collection System Bluff Repairs (Manholes)														
Collection System Repairs and Reinspection														
Collection System Repairs and Reinspection														
Collection System Repairs and Reinspection														
Collection System Repairs and Reinspection														
Geotechnical Investigation (slope above the Gibsons Wastewater Treatment Plant)														
Plant Upgrading Preliminary Design and Expanded Condition Assessment														
Odour Control - Design														
Thickener - Design														
Headworks Upgrading - Design														
Odour Control - Construction														
Thickener - Construction														
Headworks Upgrading - Construction														
Outfall Pipeline - Construction Phase 1														
Update and Recalibrate Sewer Model														
Waterfront Sanitary Sewer Retreat Feasibility Study														
SBR Blowers- replacement (x2)														
Outfall Difusers - Replacement Construction														
Waterfront Sanitary Upgrade - Design														
Gibsons Way Sanitary Upgrade - Design														
UV System - Design	\$ 146,070													
Gibsons Way Sanitary Upgrade - Construction	\$ 147,411													
Waterfront Sanitary Upgrade - Construction	\$ 375,227													
UV System - Construction	\$ 764,759	\$ 764,759												
Outfall Pipeline - Construction Phase 2		\$ 2,735,509	\$ 2,735,509											
SBR Equalization Tank - Design		\$ 260,032	\$ 260,032											
Generator (Backup Power) - Design		\$ 116,719												
SBR - Design		\$ 655,990	\$ 655,990											
Aerobic Digester - Design		\$ 505,290	\$ 505,290											
Centrifuge 2 - Design		\$ 157,349	\$ 157,349											
New Video and Condition Assessment of System		\$ 443,237												
Update and Recalibrate Sewer Model		\$ 73,873												
Generator (Backup Power) - Construction			\$ 273,034	\$ 273,034										
SBR - Construction			\$ 3,442,397	\$ 3,442,397										
SBR Equalization Tank - Construction			\$ 1,362,842	\$ 1,362,842										
Aerobic Digester - Construction			\$ 2,650,444	\$ 2,650,444										
Collection System Repairs			\$ 1,551,328	\$ 1,551,328										
Update Sanitary Sewer Strategic Plan				\$ 325,779										
Centrifuge 2 - Construction				\$ 864,129										
Update and Recalibrate Sewer Model							\$ 94,282							
New Video and Condition Assessment of System												\$ 721,986		
Update and Recalibrate Sewer Model												\$ 120,331		
Collection System Repairs													\$ 2,526,950	\$ 2,526,950
Update Sanitary Sewer Strategic Plan														\$ 530,660
<b>Total</b>	<b>\$ 1,433,467</b>	<b>\$ 5,712,757</b>	<b>\$ 13,594,215</b>	<b>\$ 10,469,953</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ 94,282</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ 842,317</b>	<b>\$ 2,526,950</b>	<b>\$ 3,057,610</b>
<b>Current Annual Capital Spending</b>	<b>\$ 2,110,651</b>	<b>\$ 2,216,183</b>	<b>\$ 2,326,992</b>	<b>\$ 2,443,342</b>	<b>\$ 2,565,509</b>	<b>\$ 2,693,784</b>	<b>\$ 2,828,474</b>	<b>\$ 2,969,897</b>	<b>\$ 3,118,392</b>	<b>\$ 3,274,312</b>	<b>\$ 3,438,027</b>	<b>\$ 3,609,929</b>	<b>\$ 3,790,425</b>	<b>\$ 3,979,947</b>
Capital Reserve Fund Contribution/Withdrawal	\$ 677,184	-\$ 3,496,574	-\$ 11,267,223	-\$ 8,026,611	\$ 2,565,509	\$ 2,693,784	\$ 2,734,191	\$ 2,969,897	\$ 3,118,392	\$ 3,274,312	\$ 3,438,027	\$ 2,767,612	\$ 1,263,475	\$ 922,337
<i>Cumulative Reserve Fund Balance</i>	<i>-\$ 1,863,887</i>	<i>-\$ 5,360,461</i>	<i>-\$ 16,627,684</i>	<i>-\$ 24,654,295</i>	<i>-\$ 22,088,786</i>	<i>-\$ 19,395,002</i>	<i>-\$ 16,660,810</i>	<i>-\$ 13,690,913</i>	<i>-\$ 10,572,521</i>	<i>-\$ 7,298,209</i>	<i>-\$ 3,860,181</i>	<i>-\$ 1,092,569</i>	<i>\$ 170,906</i>	<i>\$ 1,093,243</i>
<b>Targeted Increase to Annual Capital Spending</b>	<b>\$ 3,528,908</b>	<b>\$ 3,987,666</b>	<b>\$ 4,506,063</b>	<b>\$ 5,091,851</b>	<b>\$ 5,753,792</b>	<b>\$ 6,041,481</b>	<b>\$ 6,343,555</b>	<b>\$ 6,660,733</b>	<b>\$ 6,993,770</b>	<b>\$ 7,343,458</b>	<b>\$ 7,710,631</b>	<b>\$ 8,096,163</b>	<b>\$ 8,500,971</b>	<b>\$ 8,926,019</b>
Capital Reserve Fund Contribution/Withdrawal	\$ 2,095,441	-\$ 1,725,091	-\$ 9,088,152	-\$ 5,378,102	\$ 5,753,792	\$ 6,041,481	\$ 6,249,273	\$ 6,660,733	\$ 6,993,770	\$ 7,343,458	\$ 7,710,631	\$ 7,253,846	\$ 5,974,021	\$ 5,868,410
<i>Cumulative Reserve Fund Balance</i>	<i>\$ 2,948,344</i>	<i>\$ 1,223,253</i>	<i>-\$ 7,864,899</i>	<i>-\$ 13,243,001</i>	<i>-\$ 7,489,209</i>	<i>-\$ 1,447,728</i>	<i>\$ 4,801,545</i>	<i>\$ 11,462,278</i>	<i>\$ 18,456,048</i>	<i>\$ 25,799,506</i>	<i>\$ 33,510,137</i>	<i>\$ 40,763,983</i>	<i>\$ 46,738,004</i>	<i>\$ 52,606,414</i>
	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Grants	\$ 187,613	\$ 2,215,444	\$ 6,021,444	\$ 3,864,359	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
DCC	\$ 1,235,271	\$ 3,045,690	\$ 6,021,444	\$ 4,186,880	\$ -	\$ -	\$ 93,340	\$ -	\$ -	\$ -	\$ -	\$ 119,128	\$ -	\$ 525,353
Remaining from Rates/Reserves	\$ 10,582	\$ 451,623	\$ 1,551,328	\$ 2,418,715	\$ -	\$ -	\$ 943	\$ -	\$ -	\$ -	\$ -	\$ 723,189	\$ 2,526,950	\$ 2,532,257