NOTICE OF MEETING AND AGENDA
COMMITTEE OF THE WHOLE

Tuesday, December 9, 2025 8:30 AM
Village Office, 495 Hot Springs Road,
Harrison Hot Springs, BC V0M 1K0

THIS MEETING WILL BE CONDUCTED IN-PERSON AND VIA ZOOM VIDEO CONFERENCE

1. CALL TO ORDER

Meeting called to order by Mayor Talen.

2. LAND ACKNOWLEDGEMENT

Acknowledgement of Sts'ailes traditional territory.

3. INTRODUCTION OF LATE ITEMS

4. APPROVAL OF AGENDA

5. ITEMS FOR DISCUSSION

Recommendation:

THAT section 22(a) of Council Procedure Bylaw No. 1216, 2025 be suspended pursuant to section 34 of the bylaw to allow for discussion prior to a motion.

(a) DEI Training with Kelli Paddon, Equiiti Strategic (until 10:30 a.m.)

(b) Dike Upgrade Project Update (10:45 a.m.)

Presentation by Daniel Maldoff, Northwest Hydraulic Consultants and Graeme McAllister, Thurber Engineering

Recommendation:

THAT the meeting be recessed at 12:00 p.m. and reconvene at 1:00 p.m.

(c) Draft Master Plans

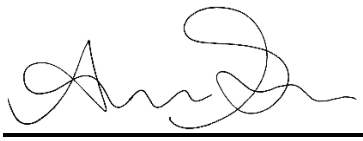
Presentation by Jace Hodgson, Director of Operations

(i) Water Master Plan **Page 1**
(ii) Sanitary Sewer Master Plan **Page 115**
(iii) Storm Sewer Master Plan **Page 197**

Recommendation:

THAT the Water, Sanitary Sewer and Storm Sewer Master Plans be adopted.

(d) Road Paving (Facio): (iv) Naismith Avenue (v) Cedar Avenue West (vi) Echo Avenue (vii)Alder Avenue
(e) Request for Crosswalk and Sidewalk on Miami River Drive at Walnut Ave (Accessibility Committee)
(f) Accessible Boardwalk and Railing at Rendall Park (Facio / Accessibility Committee)
(g) Ramp Repair from Esplanade Avenue to Beach Walkway (Facio / Accessibility Committee)
(h) Solar Lighting and Hydrants on McCombs from Emerald Avenue to McPherson Road (Facio)
6. ADJOURNMENT



Amanda Graham
Corporate Officer

Sanitary Sewer Master Plan

Village of Harrison Hot Springs

4 Dec 2025

Document Information

Project	Village of Harrison Hot Springs Sanitary Sewer Master Plan		
Report Title	Sanitary Sewer Master Plan		
Authors	Andrew Clow, MASc, PEng, Neal Whiteside, MASc, PEng		
Date	4 Dec 2025	Reference	Water Street File # 456.303
Version	0	Status	Final

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Permit to Practice

EGBC permit number 1000830.

Revision History

Version	Status	Date	Description of Revisions	Author
0	Final	4 Dec 2025	Final document	AC / NW

https://wopi.dropbox.com/wopi/files/oid_4011581496075228416/WOPIServiceId_TP_DROPBOX_PLUS/WOPIUserId_1492179059/20251017 Sanitary Sewer Master Plan.docx

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EXECUTIVE SUMMARY

Water Street Engineering Ltd. (Water Street) was retained by the Village of Harrison Hot Springs (Village) to provide engineering services for the development of the Village's Sanitary Sewer Master Plan. The objectives of the plan are to:

- Identify existing and future capacity deficiencies in the sanitary sewer system
- Develop a plan of upgrades to address deficiencies

There are two key studies that previously provided system wide master planning for the sanitary sewer utility: 2016 Village of Harrison Hot Springs Liquid Waste Management Plan (CTQ Consultants Ltd, Dec 2016) and 2003 Sanitary Sewer Modelling to Address System Deficiencies (Dayton & Knight Ltd., Jan 2003). Since the 2016 study, key upgrades include upgrading of Lift Station 1 (LS1; 2025), and LS3 (2019).

The sewer collection infrastructure is broken into nine catchments and includes the following elements:

- About 12 km of gravity sewers
- Sewage lift stations (six owned by the Village and other private lift stations owned by the Harrison Holiday Park (HHP), 520 Hot Springs Rd, Harrison RV Country Club, Springs RV Resort, and Rainbows End RV Park)
- Seven pressurized forcemains (LS1 has a dual forcemain)
- One siphon that crosses the Miami River

Water Street utilized the Village-wide Official Community Plan (OCP) to develop a population and base sanitary flow (BSF) loading assessment and forecast for the Village. Existing BSF loads were developed using source flow, population, and meter data. Future BSF loads were calculated using an OCP growth estimate. For detailed information on demand development, refer to the Population, Base Sanitary Flows, and Base Water Demands Memorandum (Water Street Engineering, 2025a).

Inflow and Infiltration (I&I) is divided into two components: groundwater infiltration (GWI) and rainfall dependant inflow and infiltration (RDII). The contribution of these two components to the sanitary sewer system were calibrated using available flow monitoring data including data collected by SFE Global and summarized in the Flow Monitoring Data Analysis Memorandum (Water Street Engineering, 2025b). The results from the monitoring analysis indicate that RDII rates are relatively high compared to other municipalities in the Lower Mainland. Reducing I&I was found to be critical to reduce capacity deficiencies throughout the sanitary sewer network and several high priority areas for I&I reduction targeting were identified.

Three loading conditions were developed for evaluating the performance of the sanitary network:

- **Dry weather flows**: Dry weather flows include a BSF and GWI derived from existing demand and flow monitoring data. BSFs are applied with diurnal patterns to simulate typical daily flows.
- **Wet weather flows – Observed**: Observed wet weather flows represent RDII rates that were derived from flow monitoring data collected in 2025 and extended to a 5-year, 24-hour storm that is adjusted for a 2050 moderate emissions climate change scenario. Existing BSFs and GWI are also included in the wet weather flow simulations.
- **Wet weather flows – OCP**: OCP loading includes BSFs that were adjusted for changes to population and assumes that BSF and GWI flows from HHSR are reduced. This loading also assumes that there is a Village-wide RDII reduction program.

Two initial sanitary networks were evaluated for each of the three loading conditions:

- The **Existing System** reflects conditions during the summer of 2025, after completion of the LS1 upgrades.
- The **Buildout System** reflects conditions after completion of the currently design upgrades that are planned for 2026.

The background review, load development, and sanitary system modelling revealed the following deficiencies after the completion of planned projects:

- RDII in the Village's sanitary system is relatively high compared to other municipalities within the Lower Mainland with similar infrastructure ages.
- Inflows from the RV parks and HHSR are undocumented.
- FM3, FM5, and FM6 will experience high velocities.
- LS3 has insufficient capacity for peak wet weather flow (PWWF) conditions.
- Gravity sewers in select locations along the main sewer trunk and near the waterfront area on Lillooet Ave and Cedar Ave have insufficient capacity for PWWF conditions.
- The Miami River Siphon has sufficient capacity for PWWF conditions. However, back-ups in the inlet chamber have been noted as occurring in the past.

Following the modelling and deficiency analysis, 26 projects were identified and include the following project types:

- Inflow and infiltration monitoring and reduction programs
- Projects to address existing capacity deficiencies
- Projects to address forecast capacity deficiencies due to growth
- System maintenance and assessment projects

From the initial 26 projects, three lift station upgrades are already planned for construction, and three projects are not recommended. Three improvement projects were classified as "High" along the trunk line to address these limitations. The replacement of the sewer along Cedar Ave (Project 4) is required to convey flow from almost the entire Village network and is close to an area with recurring sewer connection back-ups. The other two projects along this line include improvements to FM3 (Project 5) and the gravity sewer along Hot Springs Rd from 318 Hot Springs Rd (MH113) to Cedar Ave (MH40) (Project 6). The monitoring project for HHSR (Project 7) is also assessed as "High" priority because it is an area that is known to have large contribution to inflows to LS1 and the WWTP.

"Medium" priority projects included I&I investigations and reduction programs to limit design flows and prevent the need for expensive sewer replacements throughout the network. Sewers that were identified as having capacity limitations after an assumed reduction to I&I are also classified as "Medium" priority projects.

Other "Medium" priority projects include the Miami River Siphon Inlet Chamber improvements, preparing an emergency response plan, and past recommendations from the 2016 LWMP for improving the documentation and maintenance of sanitary infrastructure.

"Low" priority projects include forcemain replacements that have relatively high velocities, gravity sewer improvements that address capacity limitations when both pumps are active in LS3, and the replacement of the Miami River Siphon.

The upgraded system was modelled to reflect conditions after implementing "Very High", "High", and "Medium" priority projects, as well as Project 18. Critical deficiencies including sewer capacity and manhole surcharging are addressed with the implementation of these projects.

High-level cost estimates were prepared for each recommended project. The total costs of projects summarized by priority is as follows:

- Planned projects (3 projects): $980,000
- "High" priority projects (4 project): $1,205,000
- "Medium" priority projects (11 project): $2,195,000
- "Low" priority projects (5 project): $2,176,000
- "Conditional" priority projects (1 project): TBD

1 INTRODUCTION

1.1 PURPOSE

Water Street Engineering Ltd. (Water Street) was retained by the Village of Harrison Hot Springs (Village) to provide engineering services for the development of the Village's Sanitary Sewer Master Plan. The objectives of the plan are to:

- Identify existing and future capacity deficiencies in the sanitary sewer system
- Develop a plan of upgrades to address deficiencies

1.2 SCOPE

The scope of work for the Sanitary Sewer Master Plan included:

- Review of the existing system and background reports
- Field investigations including lift station pump testing and flow monitoring from Jan – Jun 2025.
- Review of lift station logs from 2023-2024, review of lift station SCADA data from Apr – Jun 2025.
- Development of an updated hydraulic model of the sanitary sewer system (in SewerCAD).
- Development of existing and future sanitary flows
- Evaluation of existing inflow and infiltration
- Development of a master plan to address sewer system capacity constraints.

1.3 PREVIOUS WORK

There are two key studies that previously provided system wide master planning for the sanitary sewer utility:

2016 Village of Harrison Hot Springs Liquid Waste Management Plan (CTQ Consultants Ltd, Dec 2016): The 2016 Liquid Waste Management Plan (LWMP) included both sanitary and storm systems. The sanitary sewer component of the plan was based on a design population of 4447 ca, 300 L/ca/day, and an inflow filtration rate of 0.17 L/s/ha (15,000 L/day/ha) to develop a peak design flow of 89.8 L/s (at Lift Station 1 (LS1)). The master plan recommended three capital projects (McCombs Dr sewer, Miami River Drive sewer, and replacement of the Miami River Siphon (with LS7)). The study also recommended further flow monitoring and an inventory survey. The study did note that inflow and infiltration may be higher (hence the need for flow monitoring).

2003 Sanitary Sewer Modelling to Address System Deficiencies (Dayton & Knight Ltd., Jan 2003): The 2003 study was based on an existing population of 1341 ca with growth to a population of 4420 by 2014. The 2003 planning identified a peak flow at LS1 of 71.1 L/s using the above population at an average flow of 330 L/ca/day, and an I&I allowance of 0.1 L/s (8640 L/ha/day). The study recommended replacement of LS3 (completed), the LS3 forcemain (not complete) and sewer upgrades in the LS3 direct catchment (McCombs Drive trunk sewer manhole (MH) 14 to MH26), and the siphon direct catchment (segments between LS3 and the Siphon), LS1 direct catchment (segments between the siphon and LS1).

Since the 2016 study, key upgrades include upgrading of LS1 (2025), and LS3 (2019).

1.4 LIMITATIONS

The project scope does not include evaluation of the Village's Wastewater Treatment Plant (WWTP).

The following data limitations affect the accuracy of the model and calculated results:

- Potential inaccuracies and/or missing information from the GIS shapefiles and record drawings provided to update the model. Specifically, this includes pipe materials and age of install for many sewers, missing pump information for LS 4, 5, and 6),

- Limited flow monitoring data (data was collected at two manholes from Feb to Jun 2025, SCADA data for LS1 and LS3 from Apr to Jun 2025, and lift station logbook data).
- Limitations on forecasting of expected / design sanitary sewer loads
- Inherent uncertainty in OCP forecasts (i.e. dwelling unit counts and population loading forecasts for residential and industrial, commercial, and industrial (ICI) lots)

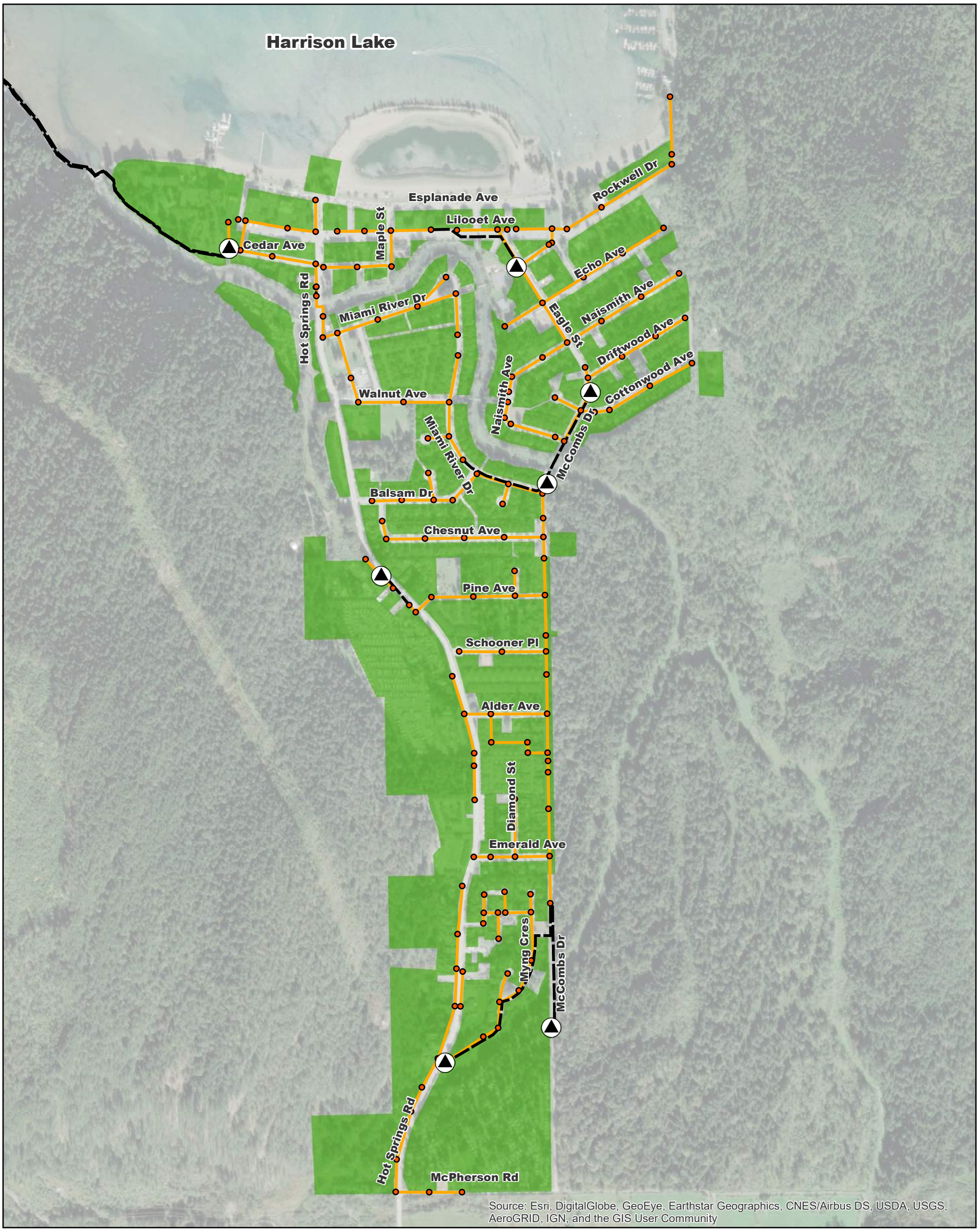
1.5 ACKNOWLEDGEMENTS

The project development, leadership, and review of interim deliverables was accomplished with the assistance of the following individuals.

- Village of Harrison Hot Springs:
  - Director of Operations
  - CWWP; Utilities Supervisor
- SFE Global (flow monitoring program)
  - Nicole Moen
  - Sam Cumyn
- Wedler Engineering (information on recent upgrades, system background):
  - Jonathan Funk, PEng; Principal

In addition to the authors, the Water Street Engineering team included: Laura Christensen, PEng; David Marshall, PEng; Connor Dickson, EIT; Jade Sangha, EIT; and Mackenzie Cameron, EIT.

We acknowledge ClimateData.ca for providing the climate information used. ClimateData.ca was created through a collaboration between the Pacific Climate Impacts Consortium (PCIC), Ouranos Inc., the Prairie Climate Centre (PCC), Environment and Climate Change Canada (ECCC), Centre de Recherche Informatique de Montréal (CRIM), and Habitat7.



Legend

- Forcemains
- Sanitary Sewer
- Serviced Lots
- Lift Stations
- Saniatry Manholes

N

0 150 300 450 m

1:10,000

WATER STREET ENGINEERING

EGBC Permit to Practice #1000830

Sanitary Sewer Master Plan

PREPARED FOR

Village of Harrison Hot Springs

PROJECT NO. 456.3

DATE 04 DEC 2025

REVISION 0

Sanitary Sewer Infrastructure Overview

Figure 1-1

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2 SYSTEM BACKGROUND

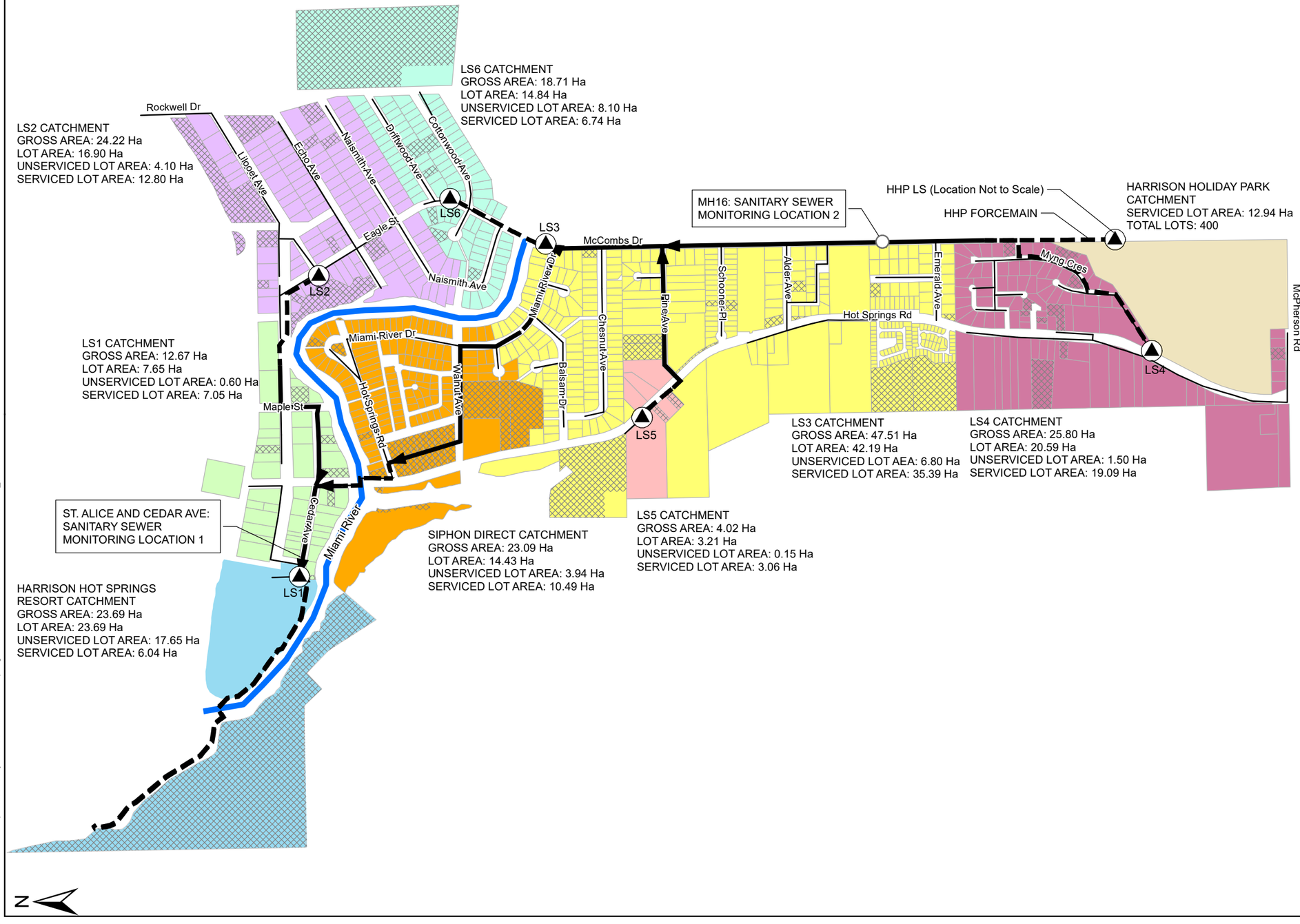
2.1 EXISTING INFRASTRUCTURE

The Village's existing sanitary sewer system is shown on Figure 2-1 (key plan) and Figure 2-2 (schematic). The sewer collection infrastructure includes the following elements:

- About 12 km of gravity sewers
- Sewage lift stations (six owned by the Village and other private lift stations owned by the Harrison Holiday Park (HHP), 520 Hot Springs Rd, Harrison RV Country Club, Springs RV Resort, and Rainbows End RV Park)
- Seven pressurized forcemains (LS1 has a dual forcemain)
- One siphon that crosses the Miami River

The sanitary sewer service area is broken into nine catchments. Each catchment contains gravity sewers flowing to a sewage lift station (LS) that pumps the collected flows. The LS pressurized forcemains typically pump to a downstream catchment where the pumped flows then flow by gravity to the next LS.

The last (and largest) LS is LS1 which pumps all the collected sewage to the WWTP via two 200 mm parallel forcemains. This station was upgraded in 2024-2025.



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WATER STREET ENGINEERING

EGBC Permit to Practice #1000830

Legend

- LIFT STATIONS
- SEWERMAIN / TRUNK SEWER
- FORCEMAIN / SIPHON
- Miami River

SANITARY CATCHMENTS

- NOT CONNECTED
- HARRISON HOT SPRINGS RESORT
- LS1 DIRECT
- LS2
- LS3 DIRECT
- LS4
- LS5
- LS6
- SIPHON DIRECT
- HARRISON HOLIDAY PARK
- LOTS NOT CURRENTLY CONNECTED TO SANITARY SYSTEM

0 150 300 450 m
1:10,000

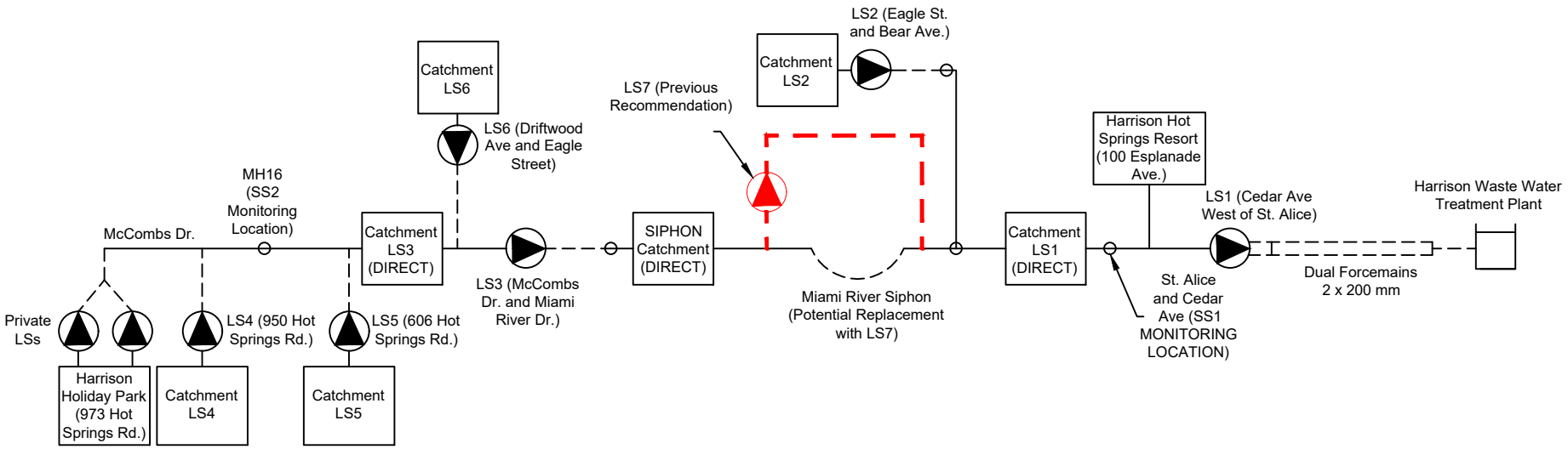
PREPARED FOR
VILLAGE OF HARRISON HOT SPRINGS

SANITARY MASTER PLAN

KEY PLAN

PROJECT NO.	DATE	REVISION
456	04 DEC 2025	0

Figure 2-1



WATER STREET ENGINEERING

EGBC PERMIT TO PRACTICE #1000830

PREPARED FOR

HARRISON HOT SPRINGS
Naturally Refreshed

PROJECT NO.
456

DATE
20 Nov 2025

REVISION
0

Village of Harrison Hot Springs
Sanitary Sewer Master Plan

Existing System Schematic

Figure 2-2

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2.2 EXISTING LOADS

Sanitary loading is unique and increases significantly during the summer months due to seasonal residents and tourists. However, winter is typically when the largest rainfall occurs and would produce the peak design flow condition (high rainfall derived inflow and infiltration (RDII)). A detailed loading analysis was completed as part of the Population, Base Sanitary Flows, and Base Water Demands Memorandum (Water Street Engineering, 2025a) provided as Appendix 1.

2.3 EXISTING DEFICIENCIES AND PAST PROJECT RECOMMENDATIONS

The 2016 LWMP identified deficiencies in the existing sanitary sewer system. The 2016 deficiencies and respective project recommendations are summarized in Table 2-1. Two additional projects were identified in the 2016 LWMP to improve the data and documentation of sanitary sewer infrastructure throughout the Village and are listed in Table 2-2.

Table 2-1: Existing Condition Deficiencies from 2016 LWMP

2016 ID	Location	Deficiency	Project	Status	WSE recommendation / project
S1	McCombs Drive	Low flow velocity and capacity	Upgrade 148 m of 300 mm sewer to 375 mm	Incomplete	23: Not recommended. Address by reducing I&I
S2	Miami River Drive	Low pipe-full flow velocity	Upgrade 88 m of 350 mm sewer to 450 mm	Incomplete	10
S3	PS-7 Siphon Replacement	Exposed pipeline in Miami River bed	Replacement of pipe and construct LS	Incomplete	14 and 17

Table 2-2: Sewer System Documentation Recommendations from 2016 LWMP

Project	Status	WSE recommendation / project
Inventory, Survey, and Infrastructure Assessment	Partially Complete	15
Flow meter installation	Incomplete	24: Not recommended. Flow monitoring completed for this study and targeted monitoring is recommended

In addition to the deficiencies described in the tables above, the 2016 LWMP identified four deficiencies where top end / dead end segments of sanitary pipe would have insufficient velocity to ensure pipe cleanout:

- Echo Avenue, from manhole S59 to S60
- Lakberg Crescent, from manhole S98 to S97
- Miami River Drive, from manhole S144 to S145
- Rockwell Drive, from manhole S148 to S149

Rather than replacing these pipes, an inspection and maintenance plan was recommended. This is included as WSE Project 16. All project recommendations from the 2016 LWMP are discussed further in Section 7 along with current recommendations.

An additional deficiency, as communicated by Village staff, is the reoccurring backup of the sewer connection into the Old Settler Pub at 200 Cedar Ave. The pub is located 250 m east (upstream) of LS1, near where discharge from the Miami River Siphon and LS2 catchment join before flowing through a gravity sewer along Cedar Ave to LS1.

2.4 SERVICE AREAS

The service areas considered are shown on Figure 2-1 and the applicable catchment areas are presented in Table 2-3.

Table 2-3: Service Area Summary

Catchment #	Gross Area (Ha)	Lot Area (Ha)	Un-serviced Lot Area (Ha)	Serviced Lot Area (Ha)
LS1 Direct	12.67	7.65	1.53	6.12
LS2	24.22	16.9	4.1	12.8
LS3 Direct	38.58	33.26	3.75	29.51
LS4	25.8	20.59	1.5	19.09
LS5	9.84	9.03	0.09	8.94
LS6	18.71	14.84	8.1	6.74
Siphon Direct	24.79	16.13	4.85	11.28
HHSR	23.69	23.69	17.65	6.04
HHP	12.95	12.94	0	12.94
Total	191.25	155.03	41.57	113.46

2.5 WASTEWATER TREATMENT PLANT

The Village's WWTP discharges to Harrison River (near the lake outlet). The Village's discharge permit is for 2,400 m^3/day (average flow of 28 L/s). The two parallel flow trains are capable of treating a total of 3,000 m^3/day however. It is also understood that space for a third treatment train exists in the current plant footprint.

Evaluation of the WWTP is outside the scope of this plan.

2.6 LIFT STATIONS

LIFT STATION #1

LS1 is located at the west end of Cedar Ave, south of the Harrison Hot Springs Resort (west of St. Alice St). LS1 was constructed in 1992 and was upgraded in 2024-5 (construction now complete). Key information for the station is summarized in Table 2-4.

LS1 conveys all flows from the Village's sanitary sewer system, all the other lift stations in the system flow into the gravity catchment (LS1 direct) for this station. LS1 flows are conveyed to the WWTP via two parallel, 910 m long, 200 mm dia PVC forcemains. The forcemains are connected and discharge to the inlet screen channel at the WWTP upstream of the equalization basin. It was noted by Village staff that there were leaks in the forcemain and there is minimal bedding below the pipe in some areas.

The wet well inlet is via a 375 mm gravity sewer (inv. el. 8.80 m). Immediately upstream the inflow splits at a MH (previous LS1, prior to 1992) with inflow from the Harrison Hot Springs Resort (200 mm dia, N. Inv el. 9.11 m) and the remainder of the flow (375 mm dia, E. Inv. el. 9.0 m).

The current LS1 pump operation (since new pump station was commissioned in Mar 2025) is as follows:

- Pumps Off at el. 8.5 m[1]
- Pump 1 On at el. 9.5 m min. speed (40.4 hz), producing 46 L/s
- Pump 1 On at el. 9.8 m, full speed (60 hz), producing 77 L/s
- Pumps 1 and 2 On at el. 10.0, both full speed, combined capacity of 103 L/s (~ 51 L/s ea pump).

The pumps have separate flow meters. The two forcemains have a cross-over valve which is normally open, so pumped flows are equally split between the two forcemains (reducing friction losses with one pump operation).

Table 2-4: LS1 Information

Component	Pre-2024	2025 Upgrade	Notes
Wet Well Cross Section(m)	2.44 x 3.05	2.261 ID	New FRP wet well inside existing conc. box culvert
Wet Well Inv. (m)	8.15	8.22	
Inlet El. (m)	8.80	No change	
Ground El. (m)	13.42	No change	
Pumping arrangement	Triplex	Duplex	
Pumps	Flygt 3152 HT Imp 434, 1750 rpm	Flygt NP3171HT Imp 454, 270 mm, 1750 rpm	
Pump Nameplate Rating	30 L/s @ 25 m TDH	58 L/s @ 25 m TDH	
Pump Motor Rating	17.5 Hp	34 Hp	
Pump Discharge Valves (mm)	150	200	
Forcemain diameter (mm)	2 x 200	No change	
Forcemain length (m)	910	No change	
Forcemain termination El. (m)	14.19	No change	Discharges to WWTP screen channel
Rated capacity	90	77	Rated capacity of 77 L/s is with 1 pump at full speed. 2 pumps full speed can output 103 L/s.

LIFT STATION #2

LS2 is located at the intersection of Bear Avenue and Eagle Street. LS2 conveys the flows from the surrounding catchment which can be seen in Figure 2-1. LS2 pumps into the LS1 catchment.

The wet well inlet is via a 300 mm gravity sewer (inv. el. 9.18 m).

LS2 was constructed in 1993 and was upgraded in 2009. The upgrades included converting the existing LS to a manhole and construction of an entire new LS2 southwest of the previous LS. Key information for the station is summarized in Table 2-5.

[1] Pump on/off elevations to be confirmed.

Table 2-5: LS2 Information

Component	2009 Upgrade	Notes
Wet Well Cross Section (m)	2.4 ID	
Wet Well Inv. (m)	7.60	
Inlet El. (m)	9.18	
Ground El. (m)	13.35	
Pumping arrangement	Duplex	
Pumps	Flygt NP-3153, MT 437	
Measured capacity	26 L/s @ 13.3 m	From model
Pump Motor Rating	12 Hp	
Pump Discharge Valves (mm)	150	
Forcemain diameter (mm)	150	
Forcemain length (m)	No change	
Forcemain termination el.	No change	

LIFT STATION #3

LS3 is located near the intersection of Miami River Dr and McCombs Dr. LS3 conveys the flows from the surrounding catchment which can be seen in Figure 2-1. LS3 pumps into the siphon catchment.

The wet well inlet is via a 300 mm gravity sewer (inv. el. 9.98 m).

LS3 was upgraded in 2019. The upgrades included building an entire new LS west of the original LS. Key information for the station is summarized in Table 2-6.

The LS3 forcemain is a 150 mm dia pipe and was only partially upgraded (first 25 m of 209 m) in 2019. This forcemain was connected to and significantly constrains the station capacity.

Table 2-6: LS3 Information

Component	2019 Upgrade	Notes
Wet Well Cross Section(m)	3.048 ID	
Wet Well Inv. (m)	8.60	
Inlet El. (m)	9.98 & 9.77	
Ground El. (m)	12.85	
Pumping arrangement	Duplex	
Pumps	Flygt NP-3153, MT 437	
Measured capacity	33 L/s @ 12.4 m TDH	From flow test
Pump Motor Rating	12 Hp	

Component	2019 Upgrade	Notes
Pump Discharge Valves (mm)	150	
Forcemain diameter (mm)	150	Material unknown
Forcemain length (m)	209	
Forcemain termination inv. el. (m)	12.03 m	

LIFT STATION #4

LS4 is located across the street from 950 Hot Springs Rd. LS4 conveys the flows from the surrounding catchment which can be seen in Figure 2-1. LS4 pumps into the LS3 catchment.

The wet well has two inlets, inlet #1 is via a 200 mm gravity sewer (inv. el. 8.78 m) and inlet #2 is via a 200 mm gravity sewer (inv. el. 10.16m).

LS4 is proposed to be upgraded, the upgrades will consist of a new wet well installed within the existing wet well. The existing pumps will continue to be used. Key information for the station is summarized in Table 2-7.

Table 2-7: LS4 Information

Component	Existing	2026 Upgrade	Notes
Wet Well Cross Section(m)	1.83 m ID	1.651 ID	
Wet Well Inv. (m)	8.56	No change	
Inlet #1 El. (m)	10.16	No change	
Inlet #2 El. (m)	8.78	No change	
Ground El. (m)	12.80	13.80	
Pumping arrangement	Duplex	No change	
Pumps	Flygt, 3101, 432 impeller	No change	
Measured Capacity or Pump Nameplate Rating	14.7 L/s @ 11.3 m TDH	No change	From observed flow at SS2 (Existing)
Pump Motor Rating	5 Hp	No change	
Pump Discharge Valves (mm)	75	No change	From model
Forcemain diameter (mm)	150	No change	
Forcemain length (m)	528	No change	
Forcemain termination El. (m)	12.17	No change	

LIFT STATION #5

LS5 is located in front of 606 Hot Springs Rd. LS5 conveys the flows from the surrounding catchment which can be seen in Figure 2-1. LS5 pumps into the LS3 direct catchment.

The wet well inlet is via three 200 mm gravity sewers (inv. el. 10.98 m, 11.10 m, and 11.98 m).

LS5 is planned to receive upgrades. The upgrades include adding a concrete riser to increase the elevation of the top of the wet well to prevent localized flooding and replacement of the existing pumps (no other changes). Key information for the station is summarized in Table 2-8.

Table 2-8: LS5 Information

Component	Existing	2026 Upgrade	Notes
Wet Well Cross Section(m)	1.83 m ID	No change	
Wet Well Inv. (m)	10.26	No change	From model
Inlet El. (m)	10.98, 11.10, 11.98	No change	From model
Ground El. (m)	14.07	No change	From model
Pumping arrangement	Single	No change	From model
Pumps	Flygt, MT440 impeller	Flygt, NP-3085, MT 462	
Measured Capacity or Pump Nameplate Rating	4.4 L/s @ 4.3 m TDH	20 L/s @ 21 m TDH	From flow test (Existing)
Pump Motor Rating	2.2 Hp	3 Hp	
Pump Discharge Valves (mm)	150	No change	From model
Forcemain diameter (mm)	75	No change	From record drawings
Forcemain length (m)	106.4	No change	From model
Forcemain termination El. (m)	11.98	No change	From model

LIFT STATION #6

LS6 is located across the street from 432 Eagle St. LS6 conveys the flows from the surrounding catchment which can be seen in Figure 2-1. LS6 pumps directly to LS3.

The wet well has two inlets, inlet #1 (inv. el. 10.57 m) and inlet #2 (inv. el. 10.59 m).

LS6 is planned for upgrades, including a new wet well installed within the existing wet well, new LS system, and a new forcemain. Key information for the station is summarized in Table 2-9.

Table 2-9: LS6 Information

Component	Existing	2026 Upgrade	Notes
Wet Well Cross Section(m)	1.83 ID	1.651 ID	
Wet Well Inv. (m)	9.82	9.82	
Inlet #1 El. (m)	10.57	No change	
Inlet #2 El. (m)	10.59	No change	
Ground El. (m)	13.05	No change	
Pumping arrangement	Duplex	No change	
Pumps	Myers, 4V150M-21	Flygt, NP-3085, MT 462	
Measured Capacity or Pump Nameplate Rating	10.5 L/s @ 3.5 m	20 L/s @ 21 m TDH	From flow test (Existing)
Pump Motor Rating	1.5 Hp	3 Hp	
Pump Discharge Valves (mm)	100	75	
Forcemain diameter (mm)	100	100 PVC	2026 Upgrade design drawings show replacement of first 11 m of FM
Forcemain length (m)	213.7	No change	
Forcemain termination El. (m)	9.98	No change	Termination at WW3

LIFT STATION HISTORICAL PERFORMANCE

Logbook data from 2021 to 2024 was evaluated and compared to historical rainfall, see Table 2-10. Note the logbook data only provides pump run hours daily, hence a pump station's capacity may be temporarily exceeded for a portion of a day even if the data indicates that average pump running time is less than 1.0 (i.e. total pump run hours < 24 for the day). Also pump malfunction / clogging could lead to erroneous conclusions. Nevertheless, the log data does provide a gauge of the relative loading on the stations.

In addition to pump run hours, the logbook data included flows from flow meter totalizers at the WWTP (effluent) and LS3 discharge.

Table 2-10: Sanitary Lift Stations Logbook Summary

#	Location	Rated Capacity (L/s)	Ave. Pumps On (from daily records)			Comments
			DW	WW	PWW	
LS1	Cedar Ave south of HHSR	77	0.31	0.63	2.76	2024/2025 Upgrade now complete (duplex station), former station was triplex station. Note pump On info is from before upgrades.
LS2	Bear Ave and Eagle St	23	0.04	0.14	0.74	2009 upgrade
LS3	McCombs and Miami River Dr	29	0.18	0.47	2.00	2019 upgrade

#	Location	Rated Capacity (L/s)	Ave. Pumps On (from daily records)			Comments
			DW	WW	PWW	
LS4	905 Hot Springs Rd	9	0.05	0.18	0.98	upgrade planned
LS5	606 Hot Springs Rd	3.2	0.02	0.35	0.84	upgrade planned
LS6	432 Eagle St	11	0.06	0.16	1.44	upgrade planned
		Flow Data		L/s		
LS3	McCombs and Miami River Dr	29	5.0	14.1	37.0	
WWTP	WWTP Effluent	28	15.9	32.9	40.5	2,400 m3/day (28 L/s) discharge permit

Note: DW = dry weather pumps on from Sep 2024 average, WW = typical wet weather pumps on from Oct 19-21,2024 (44 mm rain / 72 hr), PWW = max pumps on from Nov 14-16, 2021 (220 mm / 72 hr, peak of 110 mm on Nov 15), Data from Agassiz RCS.

Underline: design capacity of normal pump operations exceeded

The following conclusions are noted:

- The system has ample capacity during dry weather flows.
- Even with routine rainfall, the WWTP discharge permit is exceeded at times. Exceedances require the submission of a letter to Environmental compliance, and no further action has been requested to date.
- LS1, LS3 and LS6 were significantly overloaded in the Nov 2021 peak event.
- Both pumps at LS3 ran continuously during this event on Nov 16, 2021. It is understood that a sanitary sewer overflow (SSO) may have occurred during this event upstream of LS3.
- LS2, LS4 and LS5 were running near the one pump capacity during the Nov 2021 event and may have been over their rated (1-pump) capacity at times.

MIAMI RIVER SIPHON

The existing Miami River dual siphon crosses under the Miami River in the Hot Springs Rd right of way. The siphons convey all of the Village's sewer flows with the exception of the LS1 direct and LS2 catchments. The layout of the existing siphon is shown in Figure 2-3 and Figure 2-4. The details of the dual siphon are summarized in Table 2-11.

The 2003 and 2016 master plans proposed replacing the siphon with a lift station ("LS7") located near the intersection of Maimi River Dr and Hot Springs Rd and a forcemain crossing the bridge.

The 150 mm siphon conveys low flows, with higher flows being diverted to the 275 mm syphon. VHHS Operations has indicated that the screen on the inlet chamber requires frequent routine cleaning (daily work procedure).

Figure 2-3: Miami River Dual Siphon Plan (Dayton & Knight, 1977)

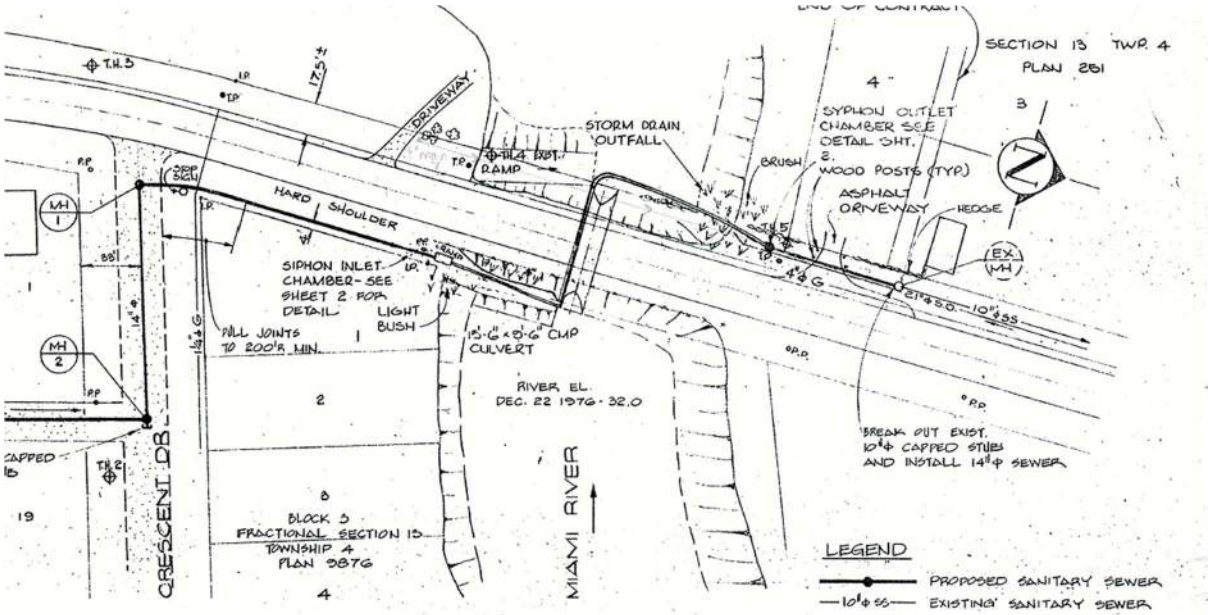


Figure 2-4: Miami River Dual Siphon Profile (Dayton & Knight, 1977)

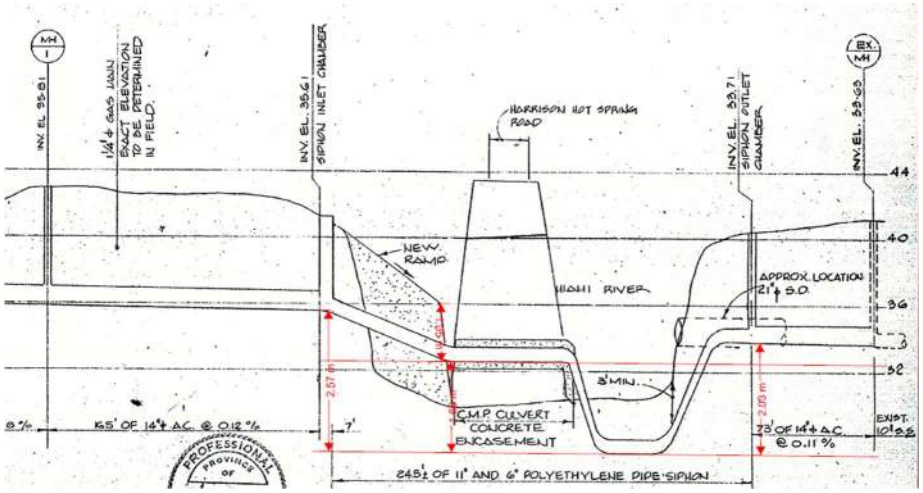


Table 2-11: Siphon / LS7 Information

Component	Existing	Notes
Siphon nominal diameters (mm)	150 275	6" HDPE 11" HDPE
Siphon length (m)	74.7	From record drawings
Inlet Chamber Cross Section (m x m)	2.13 x 1.22	Inlet has a 350 mm wide screen with overflow el of 11.28 m
Inlet Ground El. (m)	12.88	
Siphon Inlet El. (m)	10.85 10.95	6" 11"
Inlet Chamber Inv El. (m)	10.55	Settling chamber
Outlet Chamber Cross Section (m x m)	1.22 x 1.22	
Siphon Outlet Ground El. (m)	12.46	
Siphon Outlet Inv. El. (m)	10.27	Common outlet both pipes
Capacity (C=110), 6" only 11" only Combined	15 L/s 53 L/s 68 L/s	ID assumed, as not given on record drawings in calculations are approximate.

3 DESIGN CRITERIA

The design criteria used to review the system are presented in Table 3-1 and described in more detail under this section. Except where noted these are based on the Village's Subdivision and Development Servicing Bylaw (SDSB) No. 1179 (Village of Harrison Hot Springs, 2022).

3.1 SDSB DESIGN CRITERIA FOR SEWER LOADS

The SDSB includes design criteria rates for developing sanitary sewer system loads in the absence of flow monitoring data. However, these loading rates are generally conservative and would result in significantly over-designed systems if applied to an entire network. A detailed discussion of the development of sanitary load development is provided in Section 4.

3.2 SEWER LOADS FOR EVALUATION

As part of the sewer system monitoring program, the unit rates, peaking factors, and infiltration allowances in Table 3-1 were fine-tuned. These are described in more detail in Section 4 and include:

- Updating per capita (L/ca/day) loading rates
- Use of diurnal pattern to assign peaking factor per dry-weather flow monitoring
- Use of observed rainfall to assign wet-weather RDII for calibration
- Use of a design storm to forecast design wet-weather RDII

3.3 SEWER SIZING ROUGHNESS

The following roughness values are prescribed by the SDSB:

- For gravity sewers: Manning's n = 0.013 for concrete and 0.011 for PVC
- For pressure forcemains: Hazen Williams C=120 for all pipe

3.4 FLOW VELOCITIES

The following minimum design velocities are prescribed by the SDSB:

- Gravity sewers = 0.60 m/s
- Forcemains = 0.75 m/s

A maximum velocity of 4 m/s in forcemains is prescribed by the SDSB. A more limiting velocity of 2 m/s is recommended for the design of forcemains to limit headloss during normal pump operations and improve the efficiency of pump.

3.5 MINIMUM SEWER SIZES

The following minimum pipe diameters are prescribed by the SDSB:

- Residential gravity sewers: 200 mm except for dead-ends with slope of >1%, 150 mm
- Commercial gravity sewers: 250 mm except for dead-ends with slope of >0.6%, 200 mm
- Service connections: 100 mm
- Sewage forcemains: 100 mm
- Gravity sewers must be designed so that the sewer flow does not exceed d/D = 0.67 for pipes 250 mm or less, or d/D = 0.75 for pipes greater than 250 mm.

Table 3-1: Design Criteria

Component	Attribute	Min / Max / Design Value	Value	Unit	Source	Notes
Gravity Sewer	d/D	Max	0.67	n/a	VHHS	250 mm or less (equates to 80% q/Q)
Gravity Sewer	d/D	Max	0.75	n/a	VHHS	> 250 mm dia (equates to approx. 90% q/Q)
Forcemain	Diameter	Min	100	mm	VHHS & MMCD	
Gravity Sewer	Diameter	Min	200	mm	VHHS	Residential (general), 150 mm allowed for uppermost section where extension not possible, separate requirements for ICI
Pump Stations	Elevation	Min	14.55	m geo	VHHS	Min flood elevation for control panels, kiosk, and generators
Gravity Sewer	Grade / Slope	Min	0.6	%	MMCD	Only applies to upstream section of gravity sewers servicing less than 25 PE (12 DU)
Forcemain	Hazen Williams C	Design Value	120	n/a	MMCD	Except where calibration shows a different value
Forcemain	Velocity	Min	0.75	m/s	VHHS & MMCD	Minimum velocity when pump station operating with 1 pump on, full speed (i.e. once per day)
Forcemain	Velocity	Max	2	m/s	Water Street	Normal pump operations
Forcemain	Headloss Gradient	Design Value	1%		Water Street	Headloss gradient of 1 m / 100 m of length equates to 1.5 m/s for 200 mm pipe
Forcemain	Velocity	Max	4	m/s	VHHS	All pumps on
Gravity Sewer	Velocity	Min	0.6	m/s	VHHS & MMCD	Apply to new pipes only, should attain this velocity with PDWF
Gravity Sewer	Infiltration Allowance	Design Value	11,200	L/ha/day	MMCD	New pipe, not used presented for reference only (see Section 4)
Gravity Sewer	Infiltration Allowance	Design Value	22,500	L/ha/day	MMCD	Old pipes (> 25 years) and/or below groundwater table, not used presented for reference only (see Section 4)
Gravity Sewer	Infiltration Allowance	Design Value	5,184	L/ha/day	VHHS	Above groundwater table, not used presented for reference only (see Section 4)
Gravity Sewer	Infiltration Allowance	Design Value	14,688	L/ha/day	VHHS	Old pipes (pre-1980) and/or below groundwater table, not used presented for reference only (see Section 4)

Sources
MMCD: (MMCD, 2022)
VHHS: (Village of Harrison Hot Springs, 2022)

3.6 DESIGN STORM AND SEASONALITY

The nearest climate station to the Village with sufficient rainfall records to develop design storms is in Agassiz, 6 km to the south. Three quarters of precipitation in the region comes as rainfall in the winter between October and April. Summer storms are notably smaller and were not considered for the sanitary network analysis, despite higher seasonal populations. The sanitary network was evaluated using a 5-yr, 24-hr rainfall event to characterize RDII loading. As developed from Agassiz historical data, the 24-hr rainfall intensity is 3.8 mm/hr, and the yr-2050 moderate emission climate change design is 5.5 mm/hr (PCIC, 2025).

4 LOAD DEVELOPMENT

4.1 BASE SANITARY FLOWS

Water Street utilized the Village-wide Official Community Plan (OCP) to develop a population and base sanitary flow (BSF) loading assessment and forecast for the Village. Existing BSF loads were developed using source flow, population, and meter data. Future BSF loads were calculated using an OCP growth estimate. For detailed information on demand development, refer to the Population, Base Sanitary Flows, and Base Water Demands Memorandum (Water Street Engineering, 2025a) provided as Appendix 1.

The resulting BSF loads used for the master plan are shown in Table 4-1. This considers an existing and OCP serviced residential population of 1,834 ca and 2,551 ca, respectively. From calibration of the flow monitoring, as described in Section 4.2, the BSF rate was set to 160 L/PE/day for metered and 190 L/PE/day for unmetered (BSF/BD ratio of 80%). Additional BSF loads of 0.55 L/s and 4.17 L/s were applied at HHP and HHSR, respectively.

Table 4-1: Existing and future BSF summary

Use	Demand (m^3/day)	
	Existing	OCP
Winter BSF Load (BSF-W)		
ICI[1]	267	480
Residential	396	470
HHSR[2]	410	157
Total BSF-W	1,073	1,107

Notes:
1. OCP ICI includes HHP, Springs RV, and Harrison RV Country Club at full occupancy (as opposed to winter occupancy observed from flow monitoring)
2. Significant reduction in HHSR flows is included in the forecast. Note HHSR enters the system at LS1 (recommendations for the system upstream of LS1 are not dependant on this reduction.

4.2 INFLOW AND INFILTRATION

Inflow and Infiltration (I&I) is divided into two components: groundwater infiltration (GWI) and rainfall dependant inflow and infiltration (RDII). The contribution of these two components to the sanitary sewer system were calibrated using available flow monitoring data. The results from the monitoring analysis indicate that RDII rates are relatively high compared to other municipalities in the Lower Mainland. A further analysis of typical I&I rates based on pipe materials and age was completed to assess the potential I&I that is reasonably achievable for the Village's sanitary network.

FLOW MONITORING

Flow monitoring was completed by SFE Global (SFE), and the data includes flow monitoring at two gravity manholes (sites SS1 and SS2) as well as data from a rain gauge installed as part of the program. Data was gathered from 23 Jan to 17 Jun 2025 (note SS2 data period was slightly shorter). Data was also available from the Village's SCADA system for LS1 and LS3. Based on the layout of the flow monitors, the system was divided into four catchments:

- SS2: including the LS4 catchment, HHP and a portion of the gravity sewers feeding LS3.
- LS3 – SS2: including all flows into LS3 less observed flow at SS2, including LS5 and LS6 catchments and direct gravity connections.

- SS1 – LS3: including all flows into SS1 (the manhole at Cedar and St. Alice) less the LS3 flows including Lift Station 2 and local direct gravity connections.

- HHSR: including all flows out of LS1 less the flow measured at SS1 (the manhole at Cedar and St. Alice), the only connection for this catchment is the HHSR.

For detailed information on the flow monitoring data collected by SFE, refer to the Flow Monitoring Data Analysis Memorandum (Water Street Engineering, 2025b) provided as Appendix 2

Based on calibration, a global GWI rate of 2,000 L/ha/day was applied to serviced lot areas. An additional GWI of 7.3 L/s was added for the HHSR due to very high minimum night flow at LS1 and not present at SS1 site. The observed RDII rates derived from flow monitoring data are presented in Table 4-2.

Table 4-2: Observed RDII rates (from flow monitoring)

Catchment	SS2	SS1	Units
Rated 5-yr Storm RDII Rate, based on gross catchment area, existing conditions	77,500	63,400	L/ha/day
Rated 5-yr Storm RDII, Existing conditions	63,000	48,000	L/ha/day
Observed RDII	31	78	L/s

TYPICAL I&I VALUES

There is a significant range in I&I observed within Metro Vancouver (MV), as reported in the 2021-2022 MV Integrated Liquid Waste and Resource Management Plan (Metro Vancouver, 2023). I&I design (5-yr 24-hr) rates within catchments in Lower Mainland municipalities were recorded as follows in this report[2]:

- City of Maple Ridge: 5,000 to 155,000 L/ha/day
- City of Burnaby: 10,600 to 126,000 L/ha/day (excl. combined sewer areas)
- City of Coquitlam: 8,000 to 74,000 L/ha/day
- City of Pitt Meadows: 3,000 to 11,000 L/ha/day
- City of Port Coquitlam: 4,000 to 51,000 L/ha/day
- Township of Langley: 4,000 to 39,000 L/ha/day

At a high level, the main conclusion of an overview of this report is that I&I rates vary significantly by catchment even within the same municipality.

I&I VS CATCHMENT AGE AND PIPE MATERIAL

Components affecting I&I may include:

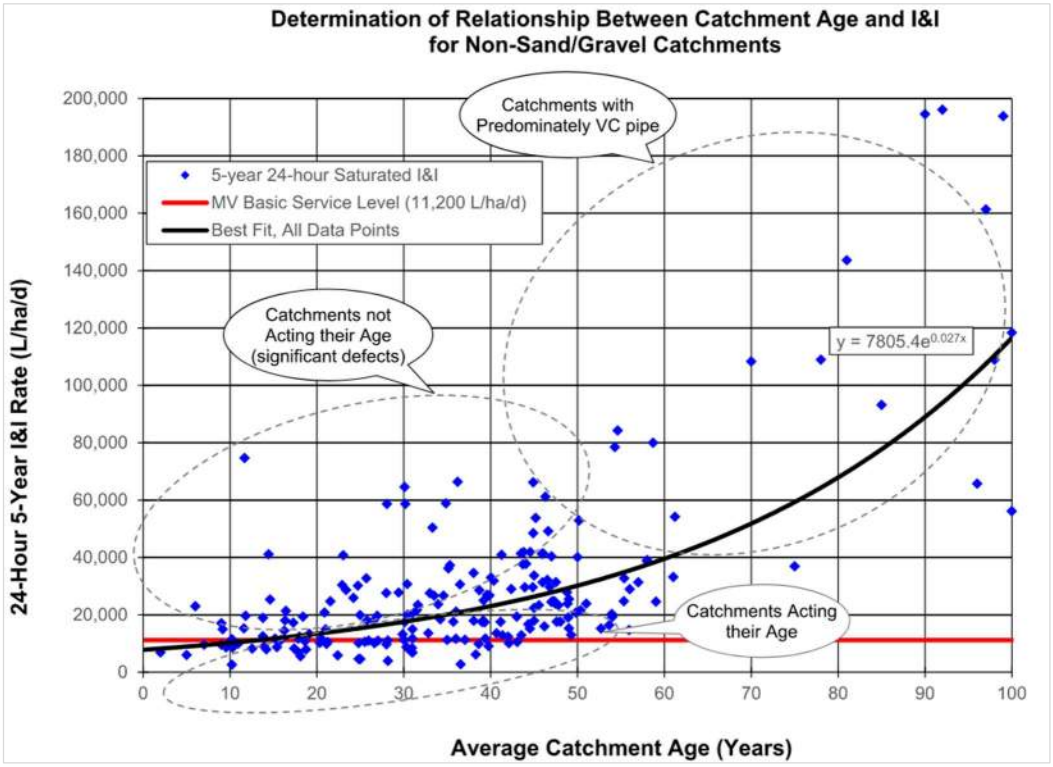
- Catchment age: Older homes may predate current standards (with roof or foundation drain connections) and pipe degradation associated with age may result in cracks or other defects.
- Pipe material: Sewers constructed from materials such as asbestos cement (AC) or vitrified clay (VC) used in older construction may be more prone to cracking with age (compared to modern pipe materials like PVC).

[2] Values are rates per gross catchment area (including serviced lots, roads, and parks etc.).

In 2022, KWL completed an I&I Management Plan Template (I&IMP) for Metro Vancouver (KWL, 2022). As part of the project, a relationship between I&I and catchment age was developed as shown in Figure 4-1.

Further analysis was completed for newer catchments (≤ 32 yrs) with primarily PVC pipe (≥ 95% PVC). No correlation with age and I&I was found, but the average 5-year, 24-hour I&I was near MV's target of 11,200 L/ha/day (at 12,688 L/ha/day). There are some outlier catchments that exhibited high I&I for their age, which is expected due to variance in construction practices.

Figure 4-1: I&I and catchment age relationship (KWL, 2022)



DESIGN I&I RATES

The Village's sanitary sewer system includes sewers from the 1970s to today. Reviewing the available record drawing information an average age of 40 years is estimated. Applying the relationships from Figure 4-1 to the Village's sanitary sewer system, it can be concluded that a rate of 22,000 L/ha/day I&I for gross area would be a reasonable assumption in the absence of significant defects in the system. This equates to an RDII rate of 27,097 L/ha/day of connected area when considering the 2,000 L/ha/day of GWI. In contrast to this, the calibrated I&I rates were 50,000 L/ha/day and 65,000 L/ha/day for catchment areas SS1 and SS2, respectively. A design existing RDII rate of 63,400 L/ha/day of serviced area was applied to the Village's system, except for SS2 catchment where a higher rate of 77,500 L/ha/day was applied.

As discussed in later sections, an RDII reduction program is recommended to reduce the current RDII rates. Without this program, peak wet weather flows will continue to cause WWTP discharges to exceed permit allowances. Accordingly, the master plan assumes a significant RDII reduction effort is successful, limiting the required hydraulic capacity improvements.

STORM SEWER DEFICIENCIES

The Storm Sewer Master Plan (Water Street Engineering, 2025c) identified the absence of any storm sewer along Hot Springs Rd north of Alder Ave. The drainage system in this area is undocumented and it is possible that storm services have been connected to the sanitary sewer contributing to high I&I. It was also noted that storm services within the Angus Estates development may connect to the existing sanitary sewer based on the limited extents of storm sewer in this area and high I&I observed in the sanitary sewer.

4.3 GROUNDWATER HGL / FLOODING POTENTIAL

As identified in the storm sewer master plan, the 2014 *Miami Creek Pump Station Hydrologic Assessment* by Northwest Hydraulic Consultants (NHC), a maximum water elevation of 12.0 m was targeted for the 200-year design event (Northwest Hydraulic Consultants Ltd., 2014) at the Miami River / Harrison Lake Dike.

Normal water levels in the Miami River at the outlet to Harrison Lake are kept between 10.9 m and 11.0 m el during freshet, and otherwise typically in the range of 9 m to 10 m el. Upstream of the lake water levels will also increase nominally. The groundwater hydraulic grade line (HGL) which impacts infiltration rates will vary seasonally with Miami River levels in this range. A significant portion of the Village's sanitary sewers (sewer inverts) are below 12.0 m el. Manhole rim elevations in some locations are also near 12.0 m although most are above 13.0 m.

To provide a high-level understanding of the location of areas most at risk to high infiltration rates sanitary manhole rim elevations and sanitary sewer inverts are mapped on Figure 4-2. This figure also highlights a number of locations without known drainage systems. Properties without drainage system are more likely to have direct cross-connections from property storm systems (roof leaders, foundation drains) to the sanitary system.

4.4 I&I REDUCTION PRIORITIES

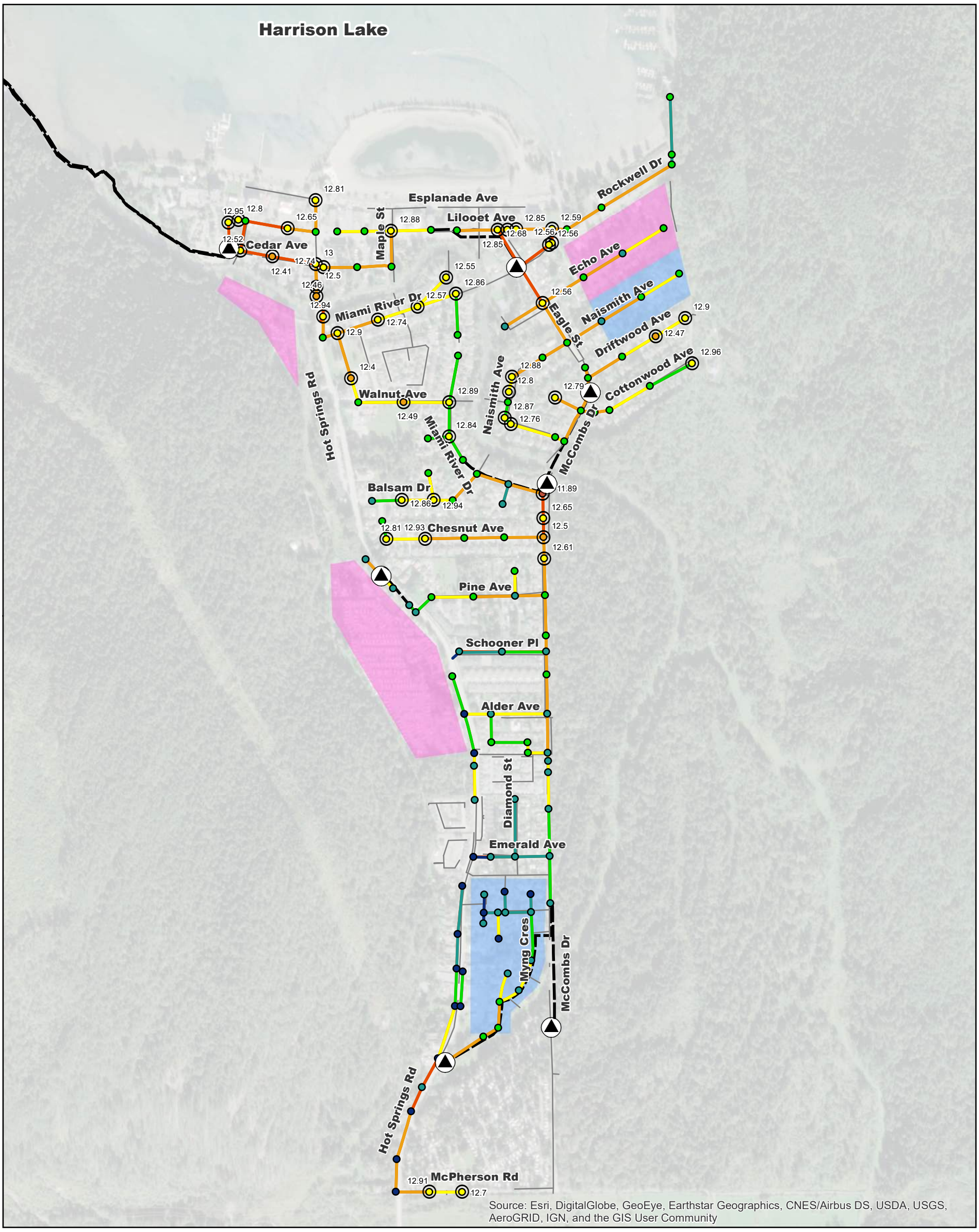
A number of high priority areas for I&I reduction targeting were identified. Areas of concern include:

1. Areas with noted high I&I from flow monitoring:
    a. Harrison Hot Springs Resort (direct measurement recommended to quantify accurately)
    b. SS2 Flow Monitoring area (upstream of MH16 including LS4 catchment, HHP catchment, and upper portion of LS3 direct catchment)
2. Areas without documented drainage systems:
    a. West side of Hot Springs Rd between Alder Ave and Miami River Dr (LS3 direct and LS5 catchments)
    b. Portions of Echo Ave and Naismith Ave east of Eagle St (LS2 catchment)
    c. HHP catchment
3. Areas with potential storm service connections to sanitary sewers
    a. Angus Estates (area bound by Hot Springs Rd to the west, Emerald Ave to the north, and Miami River to the south)
4. Areas with low MH rim elevations (in order of concern):
    a. Along McPherson Rd (LS4 catchment)
    b. Miami River Dr / Walnut Ave including siphon inlet chamber (Siphon direct catchment)
    c. Cedar Ave / Hot Springs Rd including siphon outlet chamber (LS1 direct catchment)
    d. Driftwood Ave, Naismith Ave (LS6 catchment)
    e. McCombs Dr near LS3 (LS3 direct catchment)
    f. Eagle St, Lillooet Ave (LS2 catchment)

4.5 LOADING CONDITIONS

Three loading conditions were developed for evaluating the performance of the sanitary network:

- **Dry weather flows**: Dry weather flows include a BSF and GWI derived from existing demand and flow monitoring data. BSFs are applied with diurnal patterns to simulate typical daily flows.
- **Wet weather flows – Observed**: Observed wet weather flows represent RDII rates that were derived from flow monitoring data collected in 2025 and extended to a 5-year, 24-hour storm that is adjusted for a 2050 moderate emissions climate change scenario. Existing BSFs and GWI are also included in the wet weather flow simulations.
- **Wet weather flows – OCP**: OCP loading includes BSFs that were adjusted for changes to population and assumes that BSF and GWI flows from HHSR are reduced. This loading also assumes that there is a Village-wide RDII reduction program as discussed in Section 4.2.



Legend

- Storm Sewer
- Forcemains
- No Storm System Area
- No Street Storm Sewer. Uncertain Strorm Service Connections
- MH Rim Elevation < 13.00 m
- Lift Stations

Sanitary Manhole Rim Elevations (m)

- <= 12.00
- <= 12.50
- <= 13.00
- <= 13.50
- <= 14.00
- <= 15.00

Sanitary Sewer Invert Elevations (m)

- <= 10.00
- <= 11.00
- <= 11.50
- <= 12.00
- <= 12.50
- <= 13.00

N

0 150 300 450 m

1:10,000

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Sanitary Sewer Infrastructure Elevations

Figure 4-2

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5 HYDRAULIC ANALYSIS OF EXISTING SYSTEM

The existing system was modelled to reflect conditions during the summer of 2025, after completion of the LS1 upgrades. These scenarios include the upgrades to LS1 (2025), LS2 (2009), and LS3 (2019). Gravity sewer deficiencies were evaluated for the buildout scenario in Section 6 to account for discharge from lift stations operating without capacity limitations.

5.1 DRY WEATHER FLOWS

No lift station deficiencies related to capacity were identified for average dry weather flows.

5.2 WET WEATHER FLOWS (OBSERVED, EXISTING LEVEL OF DEVELOPMENT)

Deficiencies:

- LS1: Pump 1 at full speed is insufficient to convey the peak inflow to LS1 (87.4 L/s) and Pump 2 is required to prevent surcharging of the wet well.
- LS3: There is insufficient capacity to convey peak wet weather inflows at LS3, leading to surcharging of the wet well and the manhole to the south (MH25).
- LS6: Existing LS6 pumps have insufficient head capacity to discharge when LS3 is surcharging. The wet well in LS6, as well as manholes within the LS6 catchment, surcharge as a result.

5.3 WET WEATHER FLOWS (OCP, WITH RDII REDUCTION PROGRAM)

Deficiencies:

- LS1: Pump 1 is sufficient to discharge peak inflows when running at full speed and no deficiency was identified for this scenario.
- LS3: The pumping capacity ranges from 30 L/s with one pump running to 35 L/s when both are active. The peak inflow was 40.4 L/s, exceeding the capacity of the pump station.
- LS6: Without the surcharging of LS3, LS6 has the capacity to discharge the design wet weather flows.

6 HYDRAULIC ANALYSIS AT BUILDOUT

The buildout system was modelled to reflect conditions after completion of the currently design upgrades that are planned for 2026. These scenarios include the existing system as well as upgrades to LS4, LS5, and LS6.

6.1 DRY WEATHER FLOWS

Deficiencies:

- FM3: The velocity in FM3 is calculated to reach 1.9 m/s (at flow of 34 L/s). Although this does not exceed the velocity design criteria of 2 m/s, the relatively high velocity increases headloss downstream of LS3 and limits the pump capacity. The high velocity contributes to the capacity deficiencies identified for wet weather flows.
- FM5: After upgrading the pump in LS5, the velocity in the existing FM5 will exceed 3 m/s.
- FM6: After upgrading the pump in LS6, the velocity in the existing FM6 will exceed 2.7 m/s.

6.2 WET WEATHER FLOWS (OBSERVED, WITHOUT RDII PROGRAM)

Deficiencies:

- LS1: Pump 1 at full speed is insufficient to convey the peak inflow to LS1 (99 L/s) and Pump 2 is required to prevent surcharging of the wet well.
- LS3: There is insufficient capacity to convey peak wet weather inflows at LS3, leading to surcharging of the wet well and the manhole to the south (MH25).
- LS6: Existing LS6 pumps have insufficient head capacity to discharge when LS3 is surcharging. The wet well in LS6, as well as manholes within the LS6 catchment, surcharge as a result.

Gravity sewer deficiencies were evaluated for OCP wet weather flows with the RDII Reduction Program.

6.3 WET WEATHER FLOWS (OCP, WITH RDII REDUCTION PROGRAM)

Deficiencies:

- LS3: Pump 1 was predicted to be sufficient for this scenario and Pump 2 was never activated. However, the peak inflow exceeded 50 L/s for short durations after the upgrade at LS6. With the Pump 1 capacity ranging between 30 L/s and 35 L/s, there could be cases where Pump 2 is activated.
- LS6: Without the surcharging of LS3, LS6 has the capacity to discharge the design wet weather flows.
- Gravity sewer along Lillooet Ave, Maple St, and Cedar Ave from FM2 (360 Lillooet Ave; MH74) to Hot Springs Rd: Insufficient capacity for design flows due to small pipe diameter (200 mm).
- Gravity sewer along Hot Springs Rd from 318 Hot Springs Rd (MH113) to Cedar Ave: Insufficient capacity for design flows due to small pipe diameter (250 mm).
- Gravity sewer along Cedar Ave from Hot Springs Rd to LS1 near 114 Cedar Ave: Insufficient capacity for design flows due to small pipe diameter (250 mm).
- Gravity sewer along Miami River Dr from 407 Miami River Dr (MH29) to Walnut Ave (MH30): Insufficient capacity for design flows due to shallow pipe slope (<0.1 %) assuming FM3 improvements are completed.

Discussion:

- LS1: Pump 1 is sufficient to discharge peak inflows when running at full speed and no deficiency was identified for this scenario.
- Discharge through the Miami River Siphon is predicted to reach 37 L/s for buildout scenario and as high as 40 L/s with FM3 improvements completed and two pumps active at LS3. This is below the predicted capacity of 53 L/s through the existing siphon.

Legend

- Lift Stations

Manhole Surcharging
- Well Below Crown (>0.1 m Below Crown)

Forcemain Velocity
- Within Normal Velocity Range (0.75 m/s to 2 m/s)
- Below Minimum Velocity (< 0.75 m/s)
- High Velocity (2 m/s to 4 m/s)

Pipe Surcharging
- Under Capacity (<80%)
- Near Capacity (80%-100%)
- Over Capacity (>100%)

N

0 150 300 450 m

1:10,000

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Sanitary Sewer System Performance at Buildout with PDWF

Figure 6-1

Document Path: D:\WSE Dropbox\001-Projects\456-Harrison Hot Springs Master Plans\430-GIS\data\Sanitary\ArcMap Working Folder\Figure 6□1 Sanitary Sewer System Performance at Buildout with PDWF.mxd

Legend

Lift Stations

Manhole Surcharging
- Well Below Crown (>0.1 m Below Crown)
- Near Crown (Within 0.1 m Below Crown)
- Surcharging (Above Crown)

Forcemain Velocity
- Within Normal Velocity Range (0.75 m/s to 2 m/s)
- Below Minimum Velocity (< 0.75 m/s)
- High Velocity (2 m/s to 4 m/s)

Pipe Surcharging
- Under Capacity (<80%)
- Near Capacity (80%-100%)
- Over Capacity (>100%)

N

0 150 300 450 m

1:10,000

WATER STREET ENGINEERING

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Sanitary Sewer System Performance at Buildout with PWWF

Figure 6-2

Document Path: D:\WSE Dropbox\001-Projects\456-Harrison Hot Springs Master Plans\430-GIS\data\Sanitary\ArcMap Working Folder\Figure 6-2 Sanitary Sewer System Performance at Buildout with PWWF.mxd

Legend

Lift Stations

Manhole Surcharging
- Well Below Crown (>0.1 m Below Crown)
- Near Crown (Within 0.1 m Below Crown)
- Surcharging (Above Crown)

Forcemain Velocity
- Within Normal Vel city Range (0.75 m/s to 2 m/s)
- Below Minimum Velocity (< 0.75 m/s)
- High Velocity (2 m/s to 4 m/s

Pipe Surcharging
- Under Capacity (<80%)
- Near Capacity (80%-100%)
- Over Capacity (>100%)

N

0 150 300 450 m

1:10,000

WATER STREET ENGINEERING

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Sanitary Sewer Master Plan

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Sanitary Sewer System Performance at Buildout with PWWF with RDII Reduction Program

Figure 6-3

Document Path: D:\WSE Dropbox\001-Projects\456-Harrison Hot Springs Master Plans\430-GIS\data\Sanitary\ArcMap Working Folder\Figure 6-3 Sanitary Sewer System Performance at Buildout with PWWF with RDII Reduction Program.mxd

7 PROJECT IDENTIFICATION AND PRIORITIZATION

The proposed project list is presented in Table 7-1 with project locations shown on Figure 7-1.. The proposed projects include the following project types:

- Inflow and infiltration monitoring and reduction programs
- Projects to address existing capacity deficiencies
- Projects to address forecast capacity deficiencies due to growth
- System maintenance and assessment projects

Individual project definition sheets are included in Appendix 3.

7.1 I&I MONITORING PROGRAMS

The Harrison Hot Springs Resort and three RV parks (Harrison RV Country Club, Springs RV Resort, and HHP) have large lot areas but no documentation of discharge rates to the Villages sewer infrastructure. Monitoring programs (Projects 7 and 11 to 13) are recommended for each of these sites to characterizing loading and inform future decisions on how to reduce I&I from these sites if they are found to be significant sources.

7.2 I&I REDUCTION PROGRAMS

Flow monitoring identified that I&I is high in the Village and there are a number of undocumented sources, resulting in capacity exceedances throughout the sanitary system, including permitted WWTP discharges. Reducing I&I by implementing programs will limit the number of exceedances without having to expand capacity at critical lift stations and trunk sewers. A list of areas with high priority for I&I reduction is included in Section 4.4. I&I reduction program actions are all included within a single project (Project 8). The following recommended actions (from Metro Vancouver's I&I Management Plan Template (KWL, 2022)) are outlined actions that can be applied in I&I reduction programs:

- CCTV 100% of catchment (if not already done)
- Smoke and dye testing
- Identify and eliminate cross-connections (foundation and roof drains connected to the sanitary system)
- Use a summertime flow monitoring program to identify extent and tributary area of cross-connections
- Investigate storm drainage system improvements to mitigate inflows into the sanitary system

7.3 CAPACITY IMPROVEMENT PROJECTS

As identified in Section 6.3, the are a number of gravity sewers that have insufficient capacity to fully convey design flows without exceeding design criteria flow depths. Projects to expand the capacity of gravity sewers include the replacement of pipes with larger diameters along existing alignments (Projects 4, 6, and 9).

The capacity of LS3 is primarily limited by the forcemain diameter (150 mm) and a replacement of the forcemain is recommended (Project 5). LS3 was recently refurbished with updated pumps in 2019, and new pumps are not recommended.

The gravity sewers downstream of FM3 along Miami River Dr have low slopes and insufficient capacity assuming improvements to FM3 (Project 5) are completed. Peak discharge from FM3 is estimated to be 56 L/s with one pump in LS3 active and nearly reach 100 L/s with two pumps active. The gravity sewer immediately downstream of FM3 from 413 Miami River Dr (MH28) to 407 Miami River Dr (MH29) is insufficient for instances when two pumps at LS3 are active, while the next sewer downstream from 407 Miami River Dr (MH29) to Walnut Ave (MH30) is insufficient for when a single pump is active, due to it having the shallowest slope (<0.1%). The gravity sewer along Walnut Ave from Miami River Dr (MH30) to behind 22-349 Walnut Ave (MH32) could surcharge when two pumps are active and the sewers upstream along Miami River Dr are improved.

Project 10 involves improving the capacity of the most limiting pipe from 407 Miami River Dr (MH29) to Walnut Ave (MH30). Two separate projects are included for the neighbouring gravity sewers: Project 20 covers improvements from 413 Miami River Dr (MH28) to 407 Miami River Dr (MH29), and Project 21 covers improvements from Miami River Dr (MH30) to behind 22-349 Walnut Ave (MH32). The priority of Projects 20 and 21 are lower than Project 10 because issues are only identified for when two pumps are active. However, there could be cost savings if these projects are completed at the same time.

The Miami River Siphon is along the main sewer trunk and has been observed to surcharge during wet conditions. Modelling of the siphon indicates that it should have sufficient capacity (53 L/s) for design flows (40 L/s) and that back-ups are likely caused by capacity deficiencies downstream of the siphon along Hot Springs Rd and Cedar Ave. Project 14 includes improvements to monitoring and maintenance at the inlet chamber this will allow for better assessment of inflows to the siphon and siphon performance. Project 19 is included to address capacity of the siphon (if required). This project may also be required for asset management reasons if the existing siphons are found to be at risk due to Miami River erosion or scour. It is identified as a low priority project and may not be required if inflow and infiltration reduction projects are successful in limiting peak flows to less than the siphon capacity and the condition of the siphon is acceptable.

The capacity of LS1 and FM1 was found to be sufficient for design conditions. However, it was noted by Village staff that there were leaks in the forcemain and there is minimal bedding below the pipe in some areas. Replacement of FM1 is included in Project 16 to address concerns regarding the pipe condition. The improvements include the installation of a larger forcemain to address potential capacity limitations in the future. This project could be combined with other utilities (water, fibre, and other conduits).

7.4 SYSTEM MAINTENANCE AND ASSESSMENTS

The 2016 LWMP recommended completing an inventory, survey, and infrastructure assessment. This would include surveying most sewer pipes and manholes while recording pipe sizes and materials. It is understood that this is partially completed and further work to continue the assessment is recommended (Project 17). Within this, it is recommended to include the gravity sewer along Miami River Dr (Project 10) to confirm the pipe slope and whether the capacity would be limited.

The 2016 LWMP also recommended that the Village monitor and flush out top-end sewers with low design flows and purchase two flow meters and a portable rain gauge. These are included within the recommended projects list as Projects 18 and 26, respectively.

7.5 EMERGENCY PREPAREDNESS

During the preparation of this master plan, it was noted that there is no available emergency response plan for the storm or sanitary systems. It is recommended that an Emergency Response Plan be developed (Project 15) that considers failures within the storm or sanitary systems. These failures could be the result of natural disasters (flooding, earthquakes, landslides) or infrastructure degradation. The *Village of Harrison Hot Springs Water System Emergency Response Plan* was last updated in January 2025 and could be used as the basis for a more comprehensive Emergency Response Plan that considers the storm and sanitary systems.

7.6 PROJECT PRIORITIES

Projects are rated as either High, Medium, or Low. These designations are defined as follows:

- High: Project addresses an existing serious deficiency or system need. Typical timeline is completion within 5 years.
- Medium: Project addresses growth and/or expected end of economic service life of existing critical asset required for overall system operation. Generic timeline is completion within 5 to 10 years but subject to project specifics.
- Low: Project addresses growth and/or expected end of economic service life of minor assets or improvements to level of service. Generic timeline is completion within 10-20 years but subject to project specifics.

- Conditional: Projects may or may not be required subject to completion of additional work to verify need. No recommended timeline

The conveyance systems along the main sewer trunk line are critical to prevent surcharging at manholes and service connections throughout the entire sewer network. Capacity is limited at various locations between LS3 and LS1, and three projects were classified as "High" along the trunk line to address these limitations. The replacement of the sewer along Cedar Ave (Project 4) is assessed the top priority because it is required to convey flow from almost the entire Village network and is close to an area with recurring sewer connection back-ups. The other two projects include improvements to FM3 (Project 5) and gravity sewer improvements along Hot Springs Rd from 318 Hot Springs Rd (MH113) to Cedar Ave (MH40; Project 6). The monitoring project for HHSR (Project 7) is also assessed as "High" priority because it is an area that is known to have large contribution to inflows to LS1 and the WWTP.

"Medium" priority projects included I&I investigations and reduction programs to limit design flows and prevent the need for expensive sewer replacements throughout the network. Sewers that were identified as having capacity limitations after an assumed reduction to I&I are also classified as "Medium" priority projects.

Other "Medium" priority projects include the Miami River Siphon Inlet Chamber improvements, preparing an emergency response plan, and past recommendations from the 2016 LWMP for improving the documentation and maintenance of sanitary infrastructure.

"Low" priority projects include forcemain replacements that have relatively high velocities, gravity sewer improvements that address capacity limitations when both pumps are active in LS3, and the replacement of the Miami River Siphon.

Improving LS1 forcemain was prioritized as "Conditional". The forcemain condition is variable and was noted as aging with historical leaks by Village staff along the older PVC section (constructed in 1994). Modelling did not identify FM1 as a limit to the network capacity (subject to effectiveness of I&I reduction), but upsizing would be recommended if improvements are constructed. Priority would increase if condition warrants or I&I reduction is not successful.

Upgrading the pumps in LS3 and improving the sewer along McCombs Dr are not recommended.

7.7 PROJECT COMBINATIONS

The following projects could be combined to reduce administration and construction costs and should be reviewed together when selecting projects to complete:

- **Gravity sewer upgrades north of Miami River:** Project 4, Project 6, Project 9, water main looping project (Water Project 1) from Water Master Plan (Water Street Engineering, 2025d).
- **Capacity limitations from LS3 to Walnut Ave:** Project 5, Project 10, Project 20, Project 21

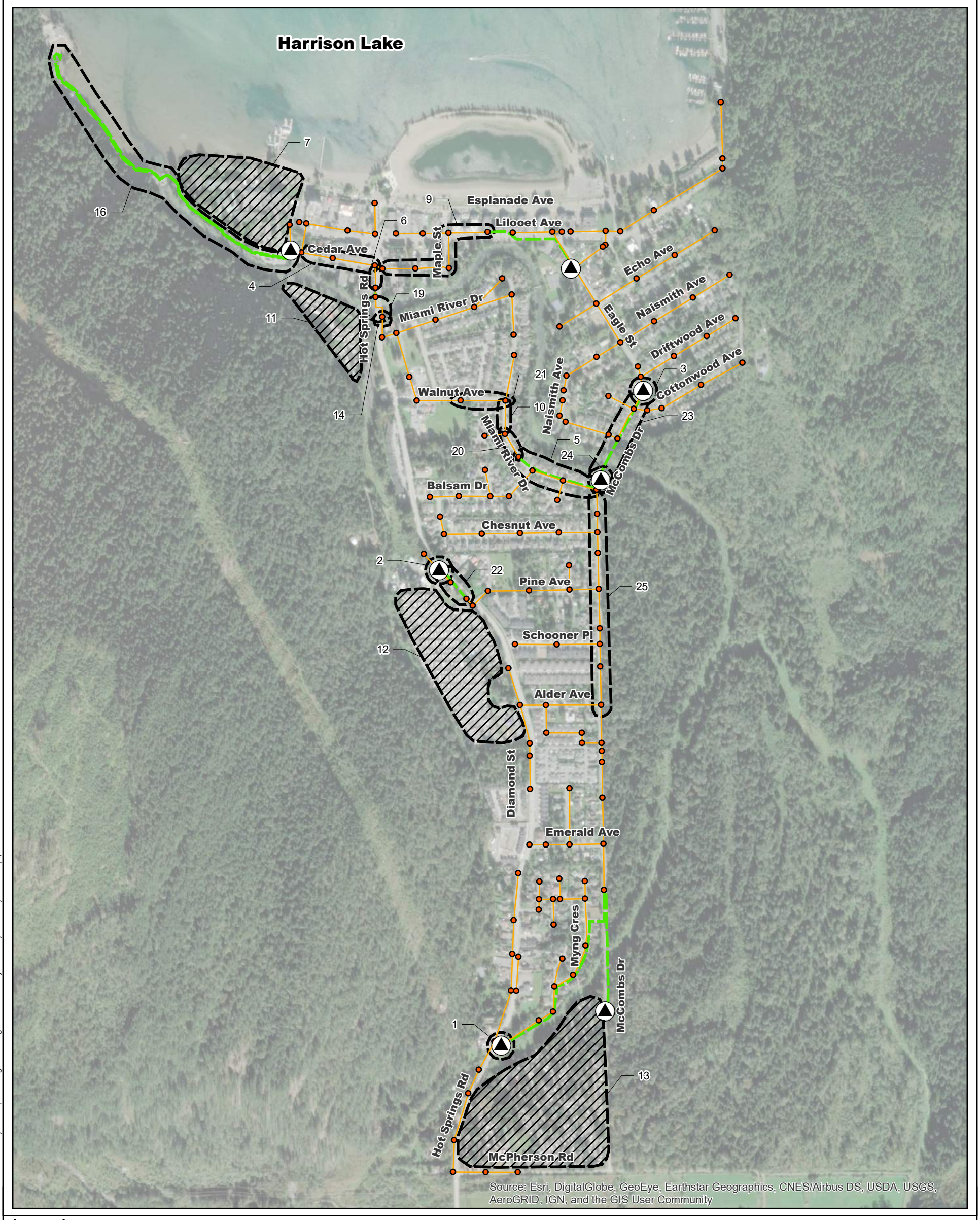
7.8 HYDRAULIC ANALYSIS WITH UPGRADES

The upgraded system was modelled to reflect conditions after implementing "High" and "Medium" priority projects, as well as Project 20. Critical deficiencies including sewer capacity and manhole surcharging are addressed with the implementation of these projects. The remaining discharge deficiencies are shown in Figure 7-2 and include high velocity in two forcemains (FM5 and FM6).

Table 7-1: Capital Project List

Project Number	Description	Deficiency	Action	Additional Notes	Primary Justification Category	DCC Eligible?	Priority
1	LS4 Improvements	New wet well to improve maintenance.	FRP wet well insert	Per existing Wedler design. Planned project.	Asset management / life cycle replacement	No	Planned
2	LS5 Improvements	Pumps at end of service life. Raise concrete wet well to avoid flooding.	Pump replacement and raise wet well	Per existing Wedler design. Planned project.	Asset management / life cycle replacement	No	Planned
3	LS6 Improvements	Pumps at end of service life. New wet well to improve maintenance.	Pump replacement and FRP wet well inset	Per existing Wedler design. Planned project.	Asset management / life cycle replacement	No	Planned
4	Cedar Ave sewer improvements	Capacity exceedance along sewers	Replace 250 mm gravity sewer with 350 mm dia, length 192 m	Risk of surcharging upstream of LS1. Can be constructed concurrently with water main looping project discussed in the Water Master Plan (Water Street Engineering, 2025d).	Address growth hydraulic deficiency	Yes	Very High
5	Forcemain 3 improvements	Capacity exceedance at LS3 and high velocity in FM3	Replace 150 mm forcemain with 250 mm dia, length 209 m	Existing FM constrains LS3 capacity. Original FM (1970s nearing end of service life). Avoids potential SSO at MH25 (upstream of LS3), as well as surcharging in LS3 and LS6, and surrounding gravity sewers. FM3 could be extended to Walnut Ave to address capacity deficienies along Miami River Dr currently noted in Projects 10, 20, and 21.	Address existing hydraulic deficiency	No	High
6	Hot Springs Rd sewer improvements	Capacity exceedance along sewers	Replace 250 mm gravity sewer with 350 mm dia, length 58 m	Risk of surcharging at Miami River Siphon.	Address growth hydraulic deficiency	Yes	High
7	Harrison Hot Springs Resort sewer flow investigation	Significant source of additional base flows and I&I that is not fully characterized	Monitor discharge from HHSR service, directly	High inflows were back calculated from available monitoring data at SS1 and LS1.	Reduce PWWF to maintain system capacity	No	High
8	System-wide I&I reduction program	Existing 5-yr I&I rates are estimated as 50,000 L/ha/day and 65,000 L/ha/day (on gross area basis) for catchment areas SS1 and SS2, respectively.	System wide program to reduced existing I&I rates to achievable levels. Target of 22,000 L/ha/day (on gross area basis) for a 5-yr storm.	Existing I&I rates observed at SS1 and SS2 during flow monitoring and from previous storms show higher than normal I&I rates. Reducing I&I rates needed to convey sanitary flows during significant storms and stay within discharge permit. Avoids significant system wide upgrades.	Reduce PWWF to maintain system capacity	No	Medium
9	Lillooet Ave, Maple St, and Cedar Ave sewer improvements	Capacity exceedance along sewers	Replace 200 mm gravity sewer with 250 mm dia, length 391 m	Risk of surcharging along waterfront properties with LS1 Catchment.	Address growth hydraulic deficiency	Yes	Medium
10	Miami River Dr sewer improvements	Capacity exceedance along sewers	Replace 350 mm gravity sewer with 450 mm dia, length 87 m	Capacity exceedance was identified due to a shallow sewer slope and increased discharge from LS3. Risk of surcharging along Miami River Dr. Capacity requirement could be reduced if FM3 is extended to Walnut Ave (ref Project 5).	Address growth hydraulic deficiency	Yes	Medium
11	Harrison RV Country Club I&I investigation	Potential source of I&I that is not characterized	Monitor discharge from 398 Hot Springs Road service	Details of runoff in Harrison RV Country Club are unknown and could result in high I&I. No known onsite storm sewer system.	Reduce PWWF to maintain system capacity	No	Medium
12	Springs RV Resort I&I investigation	Potential source of I&I that is not characterized	Monitor discharge from Springs RV Resort service (670 Hot Springs Rd)	Details of runoff in Springs RV Resort are unknown and could result in high I&I. No known onsite storm sewer system.	Reduce PWWF to maintain system capacity	No	Medium
13	Harrison Holiday Park I&I investigation	Potential source of I&I that is not characterized	Monitor discharge from HHP (973 Hot Springs Rd) at MH14 on McCombs Dr	Details of runoff in HHP are unknown and could result in high I&I. No known onsite storm sewer system. Area of higher I&I from SS2 monitoring	Reduce PWWF to maintain system capacity	No	Medium
14	Miami River Siphon Inlet Chamber Improvements	Monitoring of levels to verify siphon performance, improvements to trash rack	Instrumentation to notify of flooding, clogging of inlet trash rack.	Improve maintainability of trash rack, settling chamber. Add instrumentation for alarming.	Asset management / life cycle replacement	No	Medium
15	Emergency response plan	No existing response plan for storm or sanitary systems	Prepare updated Emergency Response Plan	Water System Emergency Response Plan was last updated in January 2025 and could be used as a basis for a plan for a more comprehensive Emergency Response Plan.	Emergency preparedness	No	Medium

Project Number	Description	Deficiency	Action	Additional Notes	Primary Justification Category	DCC Eligible?	Priority
16	LS1 Forcemain replacement	Condition of forcemain. Growth (if I&I reduction targets not met).	Replace 200 mm forcemain with 250 mm dia, length 910 m	Forcemain condition is variable and was noted as aging with historical leaks by Village staff along the older PVC section (constructed in 1994). Modelling did not identify FM1 as a limit to the network capacity (subject to effectiveness of I&I reduction), but upsizing would be recommended if improvements are constructed. Priority would increase if condition warrants or I&I reduction is not successful.	Asset management / life cycle replacement	Partial	Conditional
17	Inventory, Survey, and Infrastructure Assessment	Improve documentation of infrastructure	Perform inventory survey compatible with modern GIS and design software.	Recommendation from 2016 LWMP, partially completed. Material information is still lacking.	Asset documentation	No	Medium
18	Inspect and maintain top end / dead end segments	Low flow velocity and capacity exceedances	Periodic inspection by CCTV and flushing at regular intervals	Recommendation from 2016 LWMP, status unknown.	Monitor existing hydraulic deficiency	No	Medium
19	Miami River Siphon Replacement or 3rd pipe	Capacity hydraulically adequate but subject to flooding, undersized compared to FM3 capacity.	Replace existing siphon with 300 mm pipe. Construct new inlet chamber for siphon and extend siphons away from the Miami River.	Capacity OK but marginal. Likely would be HDD construction. Requires further study to determine if required (condition of existing siphon).	Asset management / life cycle replacement	No	Low
20	Miami River Dr sewer improvements	Capacity exceedance along sewers	Replace 350 mm gravity sewer with 450 mm dia, length 70 m	Capacity exceedance after upgrades to FM3 when two pumps active. Capacity requirement could be reduced if FM3 is extended to Walnut Ave (ref Project 5).	Address growth hydraulic deficiency	Yes	Low
21	Walnut Ave sewer improvements	Capacity exceedance along sewers	Replace 350 mm gravity sewer with 450 mm dia, length 117 m	Capacity exceedance after improvements to FM3 when two pumps active and with improvements to Miami River Dr sewer. Capacity requirement could be reduced if FM3 is extended to Walnut Ave (ref Project 5).	Address growth hydraulic deficiency	Yes	Low
22	Forcemain 5 improvements	High velocity in FM5, end of service life	Replace 75 mm forcemain with 150 mm dia, length 106 m	Existing FM is undersized, constricting flows.	Asset management / life cycle replacement	No	Low
23	Forcemain 6 improvements	High velocity in FM6, end of service life	Replace 100 mm forcemain with 150 mm dia, length 214 m	Existing FM is undersized, constricting flows. Alternate alignment to discharge toward LS2 could be considered.	Asset management / life cycle replacement	No	Low
24	Lift Station 3 improvements	Capacity exceedance at LS3	Upgrade pumps in LS3	Risk of surcharging in sanitary sewer MH25, LS3, and LS6. Secondary to FM3 improvements. Not recommended if upstream RDII can be reduced per Project 8.	Not recommended	No	n/a
25	McCombs Drive sewer improvements	Low flow velocity and capacity exceedances	Replace 300 mm forcemain with 375 mm dia, length 148 m	Recommendation from 2016 LWMP, not completed.	Not recommended	Yes	n/a
26	Flow Meter Installation	Limited flow data	Purchase of 2 non-contact area/velocity flow meters plus one portable rain gauge	Recommendation from 2016 LWMP, not completed. Flow monitoring completed as part of this study and additional monitoring recommended through other projects.	Not recommended	No	n/a



Legend

- Sanitary Sewer
- Forcemains
- Lift Stations
- Saniatry Manholes

Sanitary Project Area

- I&I Investigation Project
- Infrastructure Projects

N

0 150 300 450 m

1:10,000

WATER STREET ENGINEERING

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Sanitary Sewer Master Plan

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PROJECT NO. 456.3

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Sanitary Sewer Infrastructure Project Area

Figure 7-1

Document Path: D:\WSE Dropbox\001-Projects\456-Harrison Hot Springs Master Plans\430-GIS\data\Sanitary\ArcMap Working Folder\Figure 7-1 Sanitary Sewer System Project Areas (2).mxd

Harrison Lake
Esplanade Ave
Lilooet Ave
Cedar Ave
Maple St
Hot Springs Rd
Miami River Dr
Echo Ave
Naismith Ave
Eagle St
Driftwood Ave
Cottonwood Ave
Walnut Ave
Naismith Ave
Miami River Dr
McCombs Dr
Balsam Dr
Chesnut Ave
Pine Ave
Schooner Pl
Miami Creek
Alder Ave
Diamond St
Emerald Ave
Myng Cres
McCombs Dr
Hot Springs Rd
McPherson Rd
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

Lift Stations

Manhole Surcharging
- Well Below Crown (>0.1 m Below Crown)

Forcemain Velocity
- Within Normal Velocity Range (0.75 m/s to 2 m/s)
- Below Minimum Velocity (< 0.75 m/s)
- High Velocity (2 m/s to 4 m/s)

Pipe Surcharging
- Under Capacity (<80%)
- Near Capacity (80%-100%)
- Over Capacity (>100%)

N

0 150 300 450 m

1:10,000

WATER STREET ENGINEERING

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Future Sanitary Sewer System Performance with Upgrades

Figure 7-2

Document Path: D:\WSE Dropbox\001-Projects\456-Harrison Hot Springs Master Plans\430-GIS\data\Sanitary\ArcMap Working Folder\Figure 7-2 Future Sanitary Sewer System Performance with Upgrades.mxd

8 CAPITAL WORKS PLAN

Based on the identified deficiencies and the project prioritization outlined in above, a capital works plan has been developed. Recommended projects are listed in order of priority with associated costs in Table 8-1. Detailed projects sheets with cost breakdowns are included in Appendix 3. A non-exhaustive list of potential grant sources for each project is included on each sheet.

Except where noted otherwise, the capital costs for construction projects include an allowance of 20% for design and contract administration and 30% for construction contingency while projects without construction scopes include a 20% contingency.

The cost opinions presented are EGBC/ACEC-BC Class C estimates, based on unit rates from similar projects. They are intended for initial capital project budgeting. The expected accuracy range is between a low of -25% and a high of +40% for the given scope. Costs are to yr-2025, no escalation is included for future completion of the projects.

Table 8-1: Capital Projects

Project Number	Description	Deficiency	Priority	Capital Cost	DCC Eligible?
1	LS4 Improvements	New wet well to improve maintenance.	Planned	$530,000	No
2	LS5 Improvements	Pumps at end of service life. Raise concrete wet well to avoid flooding.	Planned	$60,000	No
3	LS6 Improvements	Pumps at end of service life. New wet well to improve maintenance.	Planned	$390,000	No
4	Cedar Ave sewer improvements	Capacity exceedance along sewers	Very High	$514,000	Yes
5	Forcemain 3 improvements	Capacity exceedance at LS3 and high velocity in FM3	High	$470,000	No
6	Hot Springs Rd sewer improvements	Capacity exceedance along sewers	High	$203,000	Yes
7	Harrison Hot Springs Resort sewer flow investigation	Significant source of additional base flows and I&I that is not fully characterized	High	$18,000	No
8	System-wide I&I reduction program	Existing 5-yr I&I rates are estimated as 50,000 L/ha/day and 65,000 L/ha/day (on gross area basis) for catchment areas SS1 and SS2, respectively.	Medium	$580,000	No
9	Lillooet Ave, Maple St, and Cedar Ave sewer improvements	Capacity exceedance along sewers	Medium	$953,000	Yes
10	Miami River Dr sewer improvements	Capacity exceedance along sewers	Medium	$274,000	Yes
11	Harrison RV Country Club I&I investigation	Potential source of I&I that is not characterized	Medium	$18,000	No
12	Springs RV Resort I&I investigation	Potential source of I&I that is not characterized	Medium	$18,000	No

Project Number	Description	Deficiency	Priority	Capital Cost	DCC Eligible?
13	Harrison Holiday Park I&I investigation	Potential source of I&I that is not characterized	Medium	$18,000	No
14	Miami River Siphon Inlet Chamber Improvements	Monitoring of levels to verify siphon performance, improvements to trash rack	Medium	240,000	No
15	Emergency response plan	No existing response plan for storm or sanitary systems	Medium	$24,000	No
16	LS1 Forcemain replacement	Condition of forcemain. Growth (if I&I reduction targets not met).	Conditional	TBD	Partial
17	Inventory, Survey, and Infrastructure Assessment	Improve documentation of infrastructure	Medium	$60,000	No
18	Inspect and maintain top end / dead end segments	Low flow velocity and capacity exceedances	Medium	$10,000	No
19	Miami River Siphon Replacement or 3rd pipe	Capacity hydraulically adequate but subject to flooding, undersized compared to FM3 capacity.	Low	$999,000	No
20	Miami River Dr sewer improvements	Capacity exceedance along sewers	Low	$227,000	Yes
21	Walnut Ave sewer improvements	Capacity exceedance along sewers	Low	$351,000	Yes
22	Forcemain 5 improvements	High velocity in FM5, end of service life	Low	$199,000	No
23	Forcemain 6 improvements	High velocity in FM6, end of service life	Low	$400,000	No

Notes:
1. Cost of siphon replacement was assumed to be similar magnitude of estimate from 2016 LWMP with additional adjusted for inflation.
2. The cost of improvements to the Miami River Siphon Inlet include an allowance for installation of level or flow meters and additional electrical components.

9 CONCLUSIONS AND RECOMMENDATIONS

9.1 SUMMARY

The background review, load development, and sanitary system modelling revealed the following deficiencies after the completion of planned projects:

- RDII in the Village's sanitary system is relatively high compared to other municipalities within the Lower Mainland with similar infrastructure ages.
- Indirect flows attributed to HHSR indicate high base flows and RDII, that should be addressed.
- Inflows from three RV parks are undocumented and a specific concern for high RDII.
- FM3, FM5, and FM6 experience high velocities.
- LS3 has insufficient capacity for PWWF conditions (limited by FM3).
- Gravity sewers in select locations along the main sewer trunk and near the waterfront area on Lillooet Ave and Cedar Ave have insufficient capacity for PWWF conditions.
- The Miami River Siphon has sufficient capacity for PWWF conditions. However, back-ups in the inlet chamber have been noted as occurring in the past.
- The capital plan is developed on the basis of reducing RDII (several capital projects include tasks to address RDII), if significant RDII reductions cannot be realized additional capacity projects would be required (beyond those recommended).

9.2 RECOMMENDATIONS

Twenty-six projects were identified based on previous reports, planned projects, and the system deficiencies. Three of the projects are not recommended. The remaining 23 projects were given a project priority and high-level capital cost estimate. The total costs of the recommended projects are summarized by project priority in Table 9-1 and project type in Table 9-2. There are four projects with "High" priority:

- Project 4: Cedar Ave sewer improvements
- Project 5: Forcemain 3 improvements
- Project 6: Hot Springs Rd sewer improvements
- Project 7: Harrison Hot Springs Resort sewer flow investigation

Table 9-1: Projects Summary by Priority

Project Priority	Number of Projects	Total Capital Costs
Planned	3	$980,000
High	4	$1,205,000
Medium	11	$2,195,000
Low	5	$2,176,000
Conditional	1	TBD
Total	23	$6,556,000

Table 9-2: Projects Summary by Type

Project Type	Number of Projects	Total Capital Costs
Forcemain improvements	4	$1,069,000 [1]
Lift station improvements	3	$980,000
Gravity sewer improvements	6	$2,522,000
I&I investigations	4	$72,000
I&I reduction	1	$580,000
Siphon improvements	2	$1,239,000
System maintenance and assessment	2	$70,000
Emergency preparedness	1	$24,000
Total	23	$6,556,000

Notes:
1. Total cost of forcemain improvements excludes LS1 forcemain

10 CLOSURE

We trust this report meets your present requirements. Please contact the undersigned with any questions or comments.

WATER STREET ENGINEERING LTD.

Andrew Clow, MASc, PEng
Water Resources Engineer

Neal Whiteside, MASc, PEng
Principal, Senior Municipal Engineer

EGBC permit number 1000830

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ABBREVIATIONS

AC – asbestos cement

BD – base demand (water)

BSF – base sanitary flow

FM – forcemain

GWI – groundwater infiltration

HGL – hydraulic grade line

HHP – Harrison Holiday Park

HHSR – Harrison Hot Springs Resort

ICI – industrial, commercial, and institutional

I&I – inflow and infiltration

LS – lift station

LWMP – Liquid Water Management Plan

MH - manhole

MV – Metro Vancouver

OCP – Official Community Plan

PDWF – peak dry weather flow

PWWF – peak wet weather flow

RDII – rainfall derived inflow and infiltration

SDSB – Subdivision and Development Servicing Bylaw

VC – vitrified clay

Village – Village of Harrison Hot Springs

WWTP – wastewater treatment plant

APPENDIX 1: POPULATION, BASE SANITARY FLOWS, AND BASE WATER DEMANDS MEMORANDUM

Bound separately

APPENDIX 2: FLOW MONITORING DATA ANALYSIS MEMORANDUM

Bound separately

APPENDIX 3: PROJECT DEFINITION SHEETS

Village of Harrison Hot Springs Sanitary Sewer Master Plan
November 2025 Cost Estimate
Project Number 4
Cedar Ave sewer improvements
Priority: High

Project Description: Replace 250 mm gravity sewer along Cedar Ave with 350 mm dia. to increase capacity and reduce risk of
Deficiency: Capacity exceedance along sewers
Additional Notes: Risk of surcharging upstream of LS1. Can be constructed concurrently with water main looping project discussed in the Water Master Plan (Water Street Engineering, 2025d).

Primary Justification: Address growth hydraulic deficiency
DCC Eligible: Yes
Grant Opportunities: Canada Community Building Fund, British

Assumptions: All manholes require replacement

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	350 mm Dia. Sanitary Sewer (2.5-3m)	m	83	$ 1,550.00	$ 128,805
2	350 mm Dia. Sanitary Sewer (2.5-3m)	m	109	$ 1,550.00	$ 168,950
3	1050 mm Dia. Manhole	ea.	3	$ 14,750.00	$ 44,250

Subtotal:		**$ 342,005**
Design / Construction Management / Contingency (%)	**50%**	**$ 171,003**
Total Estimated Cost:		**$ 513,008**

Village of Harrison Hot Springs Sanitary Sewer Master Plan
November 2025 Cost Estimate
Project Number 5
Forcemain 3 improvements
Priority: High

Project Description: Replace 150 mm forcemain along Miami River Dr from LS3 with 250 mm dia. to increase LS3 capacity.
Deficiency: Capacity exceedance at LS3 and high velocity in FM3
Additional Notes: Existing FM constrains LS3 capacity. Original FM (1970s nearing end of service life). Avoids potential SSO at MH25 (upstream of LS3), as well as surcharging in LS3 and LS6, and surrounding gravity sewers. FM3 could be extended to Walnut Ave to address capacity deficiencies along Miami River Dr currently noted in
Primary Justification: Address existing hydraulic deficiency
DCC Eligible: No
Grant Opportunities: Canada Community Building Fund, British Columbia Growing Communties Fund

Assumptions: Manholes and lift station will not be replaced.

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	250 mm Dia. Forcemain	m	209	$ 1,495.00	$ 312,904
			Subtotal:		**$ 312,904**
	Design / Construction Management / Contingency (%)			**50%**	**$ 156,452**
			Total Estimated Cost:		**$ 469,355**

Village of Harrison Hot Springs Sanitary Sewer Master Plan
November 2025 Cost Estimate
Project Number 6
Hot Springs Rd sewer improvements
Priority: High

Project Description: Replace 250 mm sanitary gravity sewer along Hot Springs Rd with 350 mm dia. to increase capacity and reduce risk of surcharging at the Miami River Siphon.

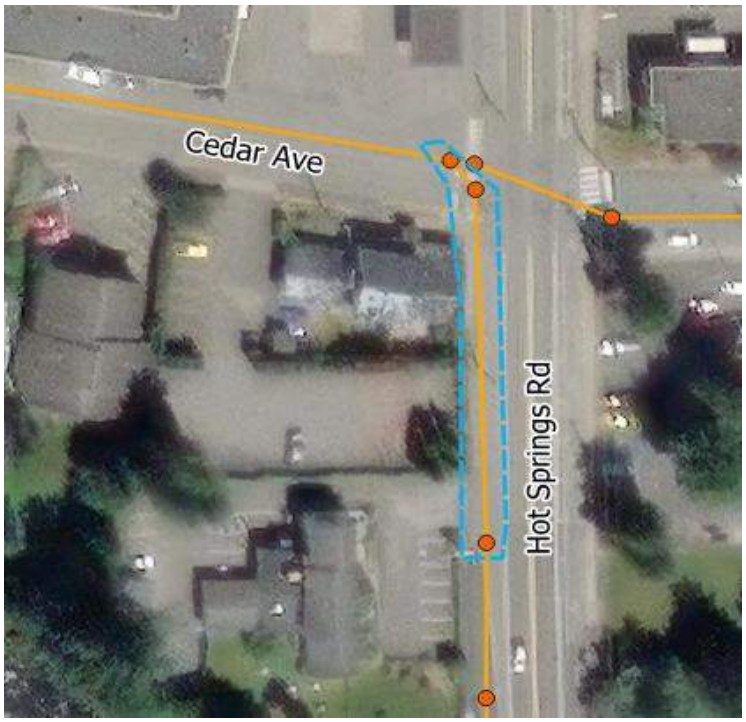
Deficiency: Capacity exceedance along sewers

Additional Notes: Risk of surcharging at Miami River Siphon.

Primary Justification: Address growth hydraulic deficiency

DCC Eligible: Yes

Grant Opportunities: Canada Community Building Fund, British Columbia Growing Communties Fund



Assumptions: All manholes require replacement

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	350 mm Dia. Sanitary Sewer (2.5-3m)	m	55	$ 1,550.00	$ 85,250
2	351 mm Dia. Sanitary Sewer (2.5-3m)	m	3.5	$ 1,550.00	$ 5,425
3	1050 mm Dia. Manhole	ea.	3	$ 14,750.00	$ 44,250
			Subtotal:		**$ 134,925**
	Design / Construction Management / Contingency (%)			**50%**	**$ 67,463**
			Total Estimated Cost:		**$ 202,388**

Village of Harrison Hot Springs Sanitary Sewer Master Plan
November 2025 Cost Estimate
Project Number 7
Harrison Hot Springs Resort sewer flow investigation
Priority: High

Project Description: Directly monitor discharge from Harrison Hot Springs Resort service to fully characterize base flows and I&

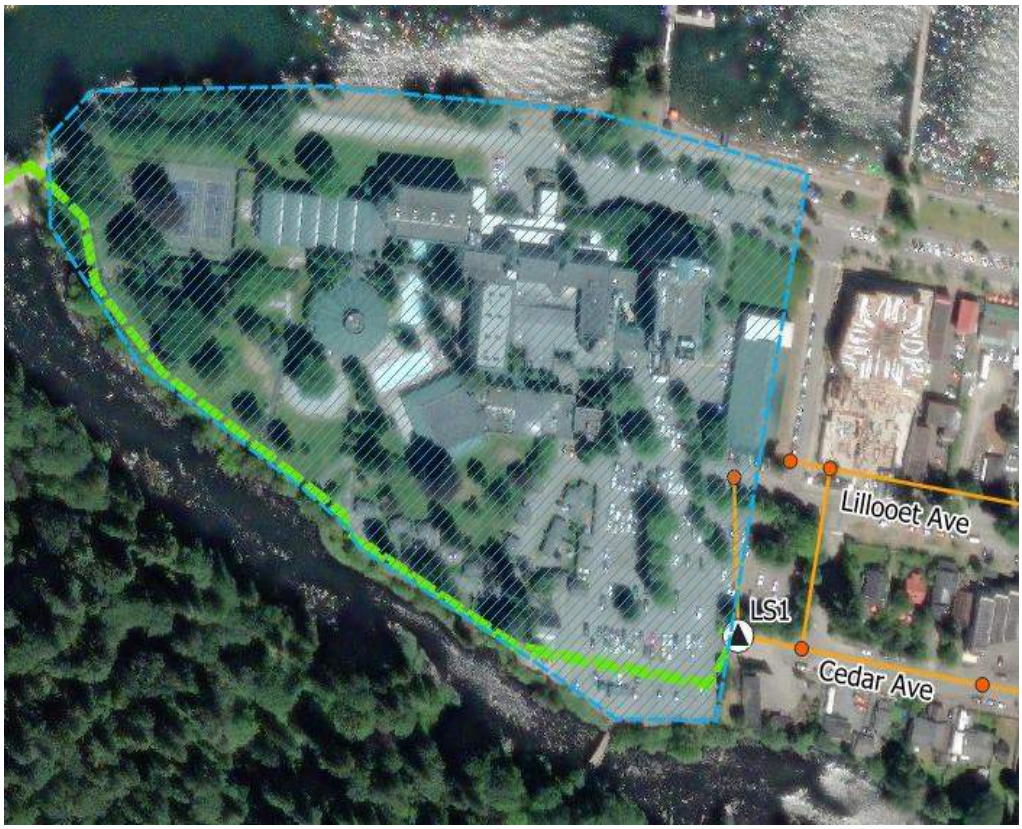
Deficiency: Significant source of additional base flows and I&I that is not fully characterized

Additional Notes: High inflows were back calculated from available monitoring data at SS1 and LS1.

Primary Justification: Reduce PWWF to maintain system capacity

DCC Eligible: No

Grant Opportunities: Canada Community Building Fund, British Columbia Infrastructure Planning Grant Program, Union of BC Municipalities Asset Management Planning Program



Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	Sanitary flow monitoring - 6 months	-	1	$ 15,000.00	$ 15,000
			Subtotal:		**$ 15,000**
			Administration / Installation Contingency:	**20%**	**$ 3,000**
			Total Estimated Cost:		**$ 18,000**

Village of Harrison Hot Springs Sanitary Sewer Master Plan
November 2025 Cost Estimate
Project Number 8
System-wide I&I Reduction Program
Priority: Medium

Project Description: Implement a system wide program to reduce existing I&I rates to achievable levels. Target of 22,000 L/ha/day (on gross area basis) for a 5-year storm. Recommended actions include CCTV of the entire catchment, smoke and dye testing, identifying and eliminating cross connections, using summertime flow monitoring to identify extent and tributary area of cross connections, and investigating storm drainage system improvements to mitigate inflows into the sanitary system. Costs from MV I&I Management template (Archetype E).

Deficiency: Existing 5-yr I&I rates are estimated as 50,000 L/ha/day and 65,000 L/ha/day (on gross area basis) for catchment areas SS1 and SS2, respectively.

Primary Justification: Reduce PWWF to maintain system capacity

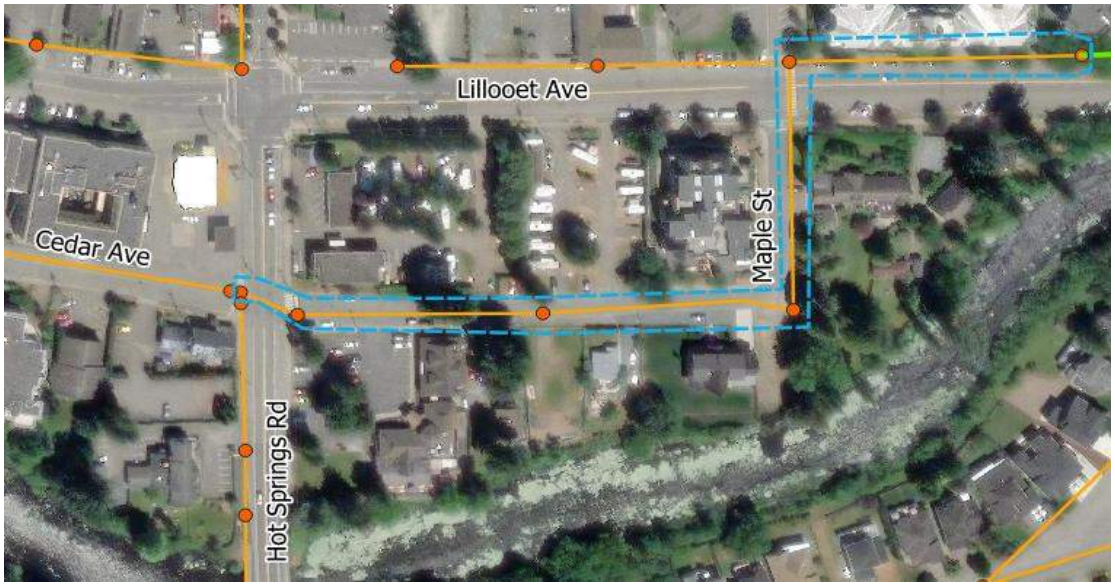
DCC Eligible: No

Grant Opportunities: Canada Community Building Fund, British Columbia Growing Communties Fund

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	Targeted I&I Reduction	m	13600	$ 40.00	$ 544,000
2	Flow monitoring and analysis	-	1	$ 36,000.00	$ 36,000
			Subtotal:		**$ 580,000**
	Administration / Installation Contingency:		**incl.**		**$ -**
			Total Estimated Cost:		**$ 580,000**

Village of Harrison Hot Springs Sanitary Sewer Master Plan
November 2025 Cost Estimate
Project Number 9
Lillooet Ave, Maple St, and Cedar Ave sewer improvements
Priority: Medium

Project Description: Replace 200 mm sanitary gravity sewer along Lillooet Ave, Maple St, and Cedar Ave with 250 mm dia. to increase capacity and reduce risk of surcharging.
Deficiency: Capacity exceedance along sewers
Additional Notes: Risk of surcharging along waterfront properties with LS1 Catchment.
Primary Justification: Address growth hydraulic deficiency
DCC Eligible: Yes
Grant Opportunities Canada Community Building Fund, British Columbia Growing Communties Fund



Assumptions: All manholes require replacement

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	250 mm Dia. Sanitary Sewer (0-2m)	m	102	$ 1,300.00	$ 132,470
2	250 mm Dia. Sanitary Sewer (2-2.5m)	m	92	$ 1,340.00	$ 123,816
3	250 mm Dia. Sanitary Sewer (2.5-3m)	m	87	$ 1,400.00	$ 121,800
4	250 mm Dia. Sanitary Sewer (2.5-3m)	m	86	$ 1,400.00	$ 120,120
5	250 mm Dia. Sanitary Sewer (2.5-3m)	m	21	$ 1,400.00	$ 29,400
6	250 mm Dia. Sanitary Sewer (2.5-3m)	m	3	$ 1,400.00	$ 4,200
7	1050 mm Dia. Manhole	ea.	7	$ 14,750.00	$ 103,250
			Subtotal:		**$ 635,056**
	Design / Construction Management / Contingency (%)			**50%**	**$ 317,528**
			Total Estimated Cost:		**$ 952,584**

Village of Harrison Hot Springs Sanitary Sewer Master Plan
November 2025 Cost Estimate
Project Number 10
Miami River Dr sewer improvements
Priority: Medium

Project Description: Replace 350 mm gravity sewer along Miami River Dr with 450 mm dia. at steeper slope to increase capacity and reduce risk of surcharging. Can be combined with Project 20 and Project 21

Deficiency: Capacity exceedance along sewers

Additional Notes: Capacity exceedance was identified due to a shallow sewer slope and increased discharge from LS3. Risk of surcharging along Miami River Dr. Capacity requirement could be reduced if FM3 is extended to Walnut Ave (ref Project 5).

Primary Justification: Address growth hydraulic deficiency

DCC Eligible: Yes

Grant Opportunities: Canada Community Building Fund, British Columbia Growing Communties Fund

Assumptions: All manholes require replacement.

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	450 mm Dia. Sanitary Sewer (0-2m)	m	87	$ 1,750.00	$ 152,600
2	1050 mm Dia. Manhole	ea.	2	$ 14,750.00	$ 29,500
			Subtotal:		**$ 182,100**
	Design / Construction Management / Contingency (%)			**50%**	**$ 91,050**
			Total Estimated Cost:		**$ 273,150**

Village of Harrison Hot Springs Sanitary Sewer Master Plan
November 2025 Cost Estimate
Project Number 11
Harrison RV Country Club I&I investigation
Priority: Medium

Project Description: Directly monitor discharge from Harrison RV Country Club (398 Hot Springs Rd) service to fully characterize base flows and I&I.

Deficiency: Potential source of I&I that is not characterized

Additional Notes: Details of runoff in Harrison RV Country Club are unknown and could result in high I&I. No known onsite storm sewer system.

Primary Justification: Reduce PWWF to maintain system capacity

DCC Eligible: No

Grant Opportunities: Canada Community Building Fund, British Columbia Infrastructure Planning Grant Program, Union of BC Municipalities Asset Management Planning Program

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	Sanitary flow monitoring - 6 months	-	1	$ 15,000.00	$ 15,000
				Subtotal:	**$ 15,000**
				Administration / Installation Contingency: **20%**	**$ 3,000**
				Total Estimated Cost:	**$ 18,000**

Village of Harrison Hot Springs Sanitary Sewer Master Plan
November 2025 Cost Estimate
Project Number 12
Springs RV Resort I&I investigation
Priority: Medium

Project Description: Directly monitor discharge from Springs RV Resort (670 Hot Springs Rd) service to fully characterize base flows and I&I.

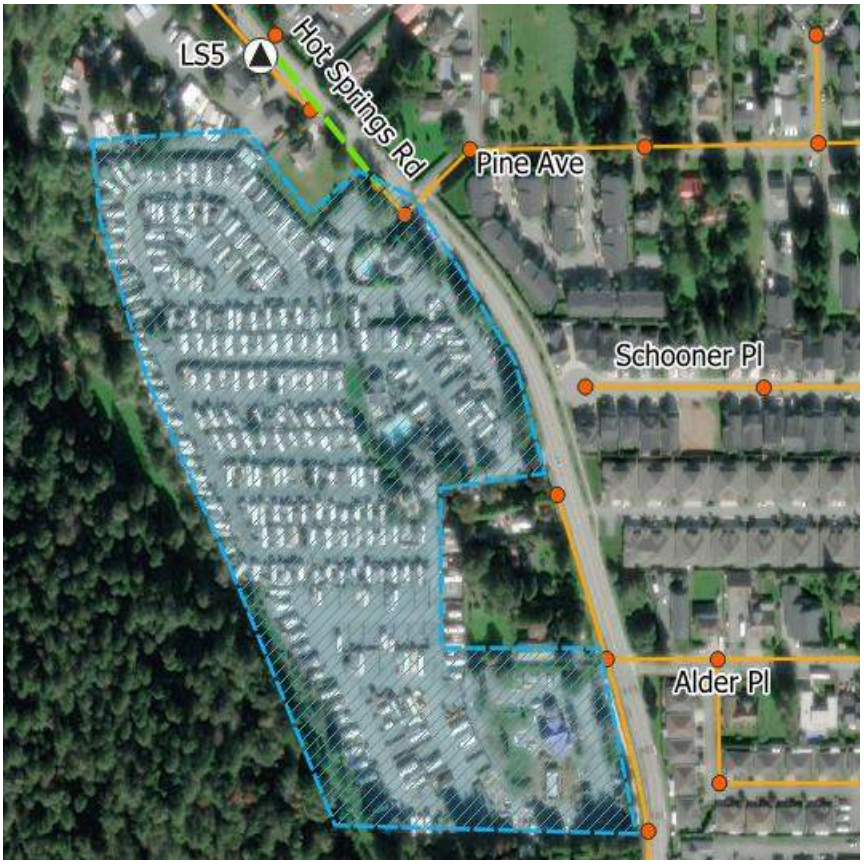
Deficiency: Potential source of I&I that is not characterized

Additional Notes: Details of runoff in Springs RV Resort are unknown and could result in high I&I. No known onsite storm sewer system.

Primary Justification: Reduce PWWF to maintain system capacity

DCC Eligible: No

Grant Opportunities: Canada Community Building Fund, British Columbia Infrastructure Planning Grant Program, Union of BC Municipalities Asset Management Planning Program



Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	Sanitary flow monitoring - 6 months	-	1	$ 15,000.00	$ 15,000
			Subtotal:		**$ 15,000**
			Administration / Installation Contingency:	**20%**	**$ 3,000**
			Total Estimated Cost:		**$ 18,000**

Village of Harrison Hot Springs Sanitary Sewer Master Plan
November 2025 Cost Estimate
Project Number 13
Harrison Holiday Park I&I investigation
Priority: Medium

Project Description: Directly monitor discharge from Harrison Holiday Park (973 Hot Springs Rd) at Manhole 14 on McCombs Dr to fully characterize base flows and I&I.

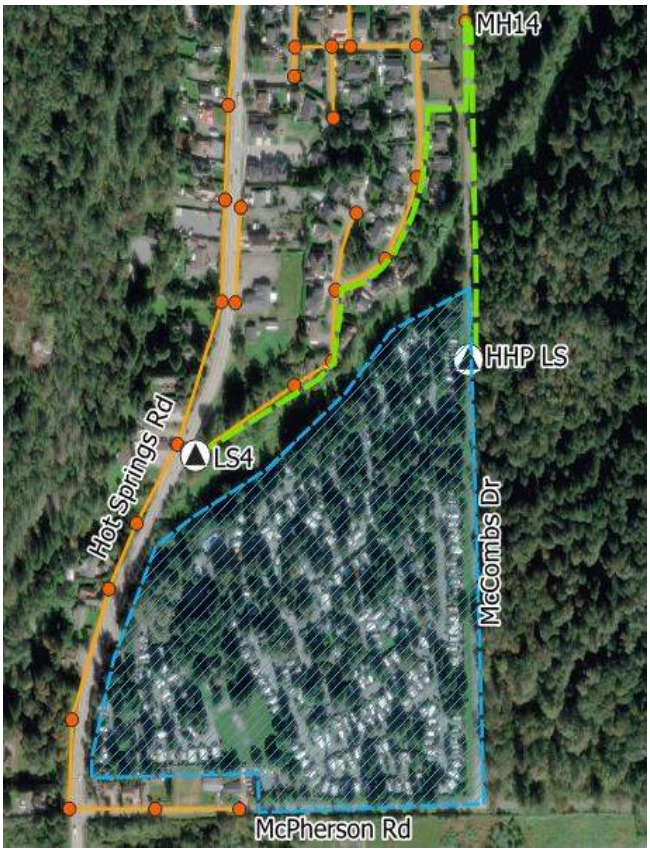
Deficiency: Potential source of I&I that is not characterized

Additional Notes: Details of runoff in HHP are unknown and could result in high I&I. No known onsite storm sewer system. Area of higher I&I from SS2 monitoring

Primary Justification: Reduce PWWF to maintain system capacity

DCC Eligible: No

Grant Opportunities: Canada Community Building Fund, British Columbia Infrastructure Planning Grant Program, Union of BC Municipalities Asset Management Planning Program



Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	Sanitary flow monitoring - 6 months	-	1	$ 15,000.00	$ 15,000
				Subtotal:	**$ 15,000**
				Administration / Installation Contingency:	**20% $ 3,000**
				Total Estimated Cost:	**$ 18,000**

Village of Harrison Hot Springs Sanitary Sewer Master Plan
November 2025 Cost Estimate
Project Number 14
Miami River Siphon Inlet Chamber Improvements
Priority: Medium

Project Description: Install instrumentation to monitor water levels and notify of flooding or clogging of inlet trash rack. Adjustments could be made to trash rack for simpler maintenance.

Deficiency: Monitoring of levels to verify siphon performance, improvements to trash rack

Additional Notes: Improve maintainability of trash rack, settling chamber. Add instrumentation for alarming.

Primary Justification: Asset management / life cycle replacement

DCC Eligible: No

Grant Opportunities: Canada Community Building Fund, British Columbia Growing Communties Fund

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	Instrumentation allowance	-	1	$ 200,000.00	$ 200,000
			Subtotal:		**$ 200,000**
			Administration / Installation Contingency:	**20%**	**$ 40,000**
			Total Estimated Cost:		**$ 240,000**

Village of Harrison Hot Springs Sanitary Sewer Master Plan
November 2025 Cost Estimate
Project Number 15
Emergency response plan
Priority: Medium

Project Description: Prepare more comprehensive Emergency Response Plan to outline responsibilities and actions in the case of an emergency situation impacting the storm or sanitary systems.

Deficiency: No existing response plan for storm or sanitary systems

Additional Notes: Water System Emergency Response Plan was last updated in January 2025 and could be used as a basis for a more comprehensive Emergency Response Plan.

Primary Justification: Emergency preparedness

DCC Eligible: No

Grant Opportunities: Canada Community Building Fund, Disaster Risk Reduction-Climate Adaptation

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	Emergency Response Plan	-	1	$ 20,000.00	$ 20,000
			Subtotal:		**$ 20,000**
			Administration / Installation Contingency:	**20%**	**$ 4,000**
			Total Estimated Cost:		**$ 24,000**

Village of Harrison Hot Springs Sanitary Sewer Master Plan
November 2025 Cost Estimate
Project Number 16
LS1 Forcemain replacement
Priority: Conditional

Project Description: Replace two parallel 200 mm forcemains from LS1 to the WWTP with 250 mm dia. to address pipe deterioration and improve capacity.

Deficiency: Condition of forcemain (leak history), and growth if I&I reduction targets can not be met.

Additional Notes: Forcemain condition is variable and was noted as aging with historical leaks by Village staff along the older PVC section (constructed in 1994). Modelling did not identify FM1 as a limit to the network capacity (subject to effectiveness of I&I reduction), but upsizing would be recommended if improvements are constructed. Priority would increase if condition warrants or I&I reduction is not successful.

Primary Justification: Asset management / life cycle

DCC Eligible: Yes (partial)

Grant Opportunities: Canada Community Building Fund, British Columbia Growing Communties Fund

Item No.	Description	Unit	Estimated Quantity (Total Length)	Estimated Unit Price	Estimated Amount
1	150 mm Dia. Force Main	m	1,820	TBD	
			Total Estimated Cost:		**TBD**

Village of Harrison Hot Springs Sanitary Sewer Master Plan
November 2025 Cost Estimate
Project Number 17
Inventory, Survey, and Infrastructure Assessment
Priority: Medium

Project Description: Perform inventory survey that is compatible with modern GIS and design software. Material information, diameters, and elevations should be included with age of construction where possible.

Deficiency: Improve documentation of infrastructure

Additional Notes: Recommendation from 2016 LWMP, partially completed. Material information is still lacking.

Primary Justification: Asset documentation

DCC Eligible: No

Grant Opportunities: Canada Community Building Fund, British Columbia Infrastructure Planning Grant Program, Union of BC Municipalities Asset Management Planning Program

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	Survey and data processing	-	1	$ 50,000.00	$ 50,000
				Subtotal:	**$ 50,000**
				Administration Contingency: 20%	**$ 10,000**
				Total Estimated Cost:	**$ 60,000**

Village of Harrison Hot Springs Sanitary Sewer Master Plan
November 2025 Cost Estimate
Project Number 18
Inspect and maintain top end / dead end segments
Priority: Medium

Project Description: Periodic inspection by CCTV and flushing at regular intervals at dead-end sewer segments with low velocities.

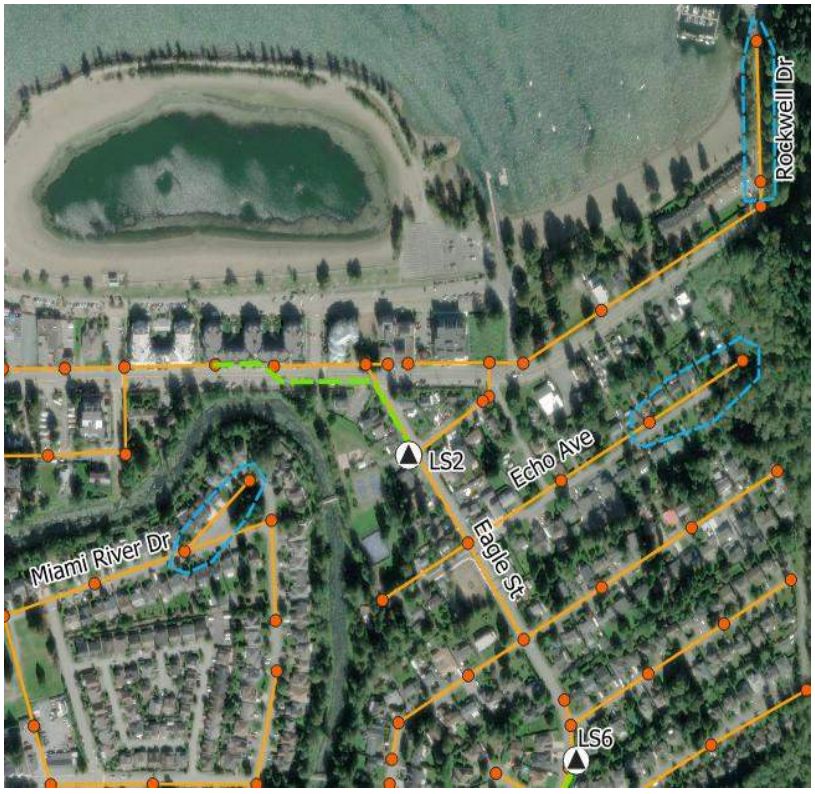
Deficiency: Low flow velocity and capacity exceedances

Additional Notes: Recommendation from 2016 LWMP, status unknown.

Primary Justification: Monitor existing hydraulic deficiency

DCC Eligible: No

Grant Opportunities: n/a



Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	Echo Ave	m	122	$ 10.00	$ 1,220
2	Lakeburg Cres	m	62	$ 10.00	$ 620
3	Miami River Dr	m	104	$ 10.00	$ 1,040
4	Rockwell Dr	m	146	$ 10.00	$ 1,460
5	Flushing	hr	8	$ 400.00	$ 3,200
			Subtotal:		**$ 7,540**
			Administration Contingency:	**20%**	**$ 1,508**
			Total Estimated Cost:		**$ 9,048**

Village of Harrison Hot Springs Sanitary Sewer Master Plan
November 2025 Cost Estimate
Project Number 19
Miami River Siphon Replacement or 3rd pipe
Priority: Low

Project Description: Replace existing Miami River Siphon with 300 mm dia. Pipe. Construct new inlet chamber for the siphon and extend the siphons away from the Miami River.

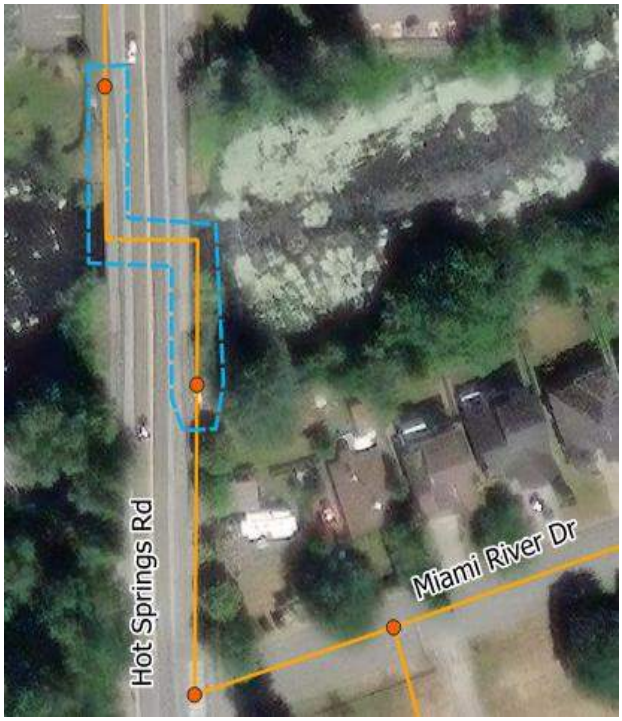
Deficiency: Capacity hydraulically adequate but subject to flooding, undersized compared to FM3 capacity.

Additional Notes: Capacity OK but marginal. Likely would be HDD construction. Requires further study to determine if required (condition of existing siphon).

Primary Justification: Asset management / life cycle replacement

DCC Eligible: No

Grant Opportunities: Canada Community Building Fund, British Columbia Growing Communties Fund



Assumptions: Adjustment for inflation based on ENR Construction Cost Index

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	2016 LWMP Estimate	-	1	$ 497,000.00	$ 497,000
			Subtotal:		**$ 497,000**
	Inflation Adjustment (Dec 2016 index = 10530, Nov 2025 index = 14097)			**34%**	**$ 168,357**
	Design / Construction Management / Contingency (%)			**50%**	**$ 332,678**
			Total Estimated Cost:		**$ 998,035**

Village of Harrison Hot Springs Sanitary Sewer Master Plan
November 2025 Cost Estimate
Project Number 20
Miami River Dr sewer improvements
Priority: Low

Project Description: Replace 350 mm gravity sewer along Miami River Dr with 450 mm dia. to increase capacity and reduce risk of surcharging. Can be combined with Project 10 and Project 21.

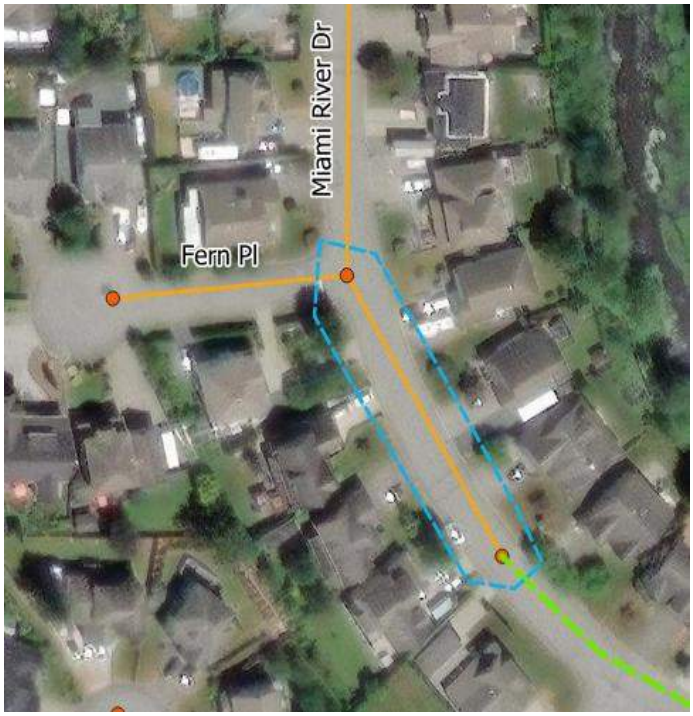
Deficiency: Capacity exceedance along sewers

Additional Notes: Capacity exceedance after upgrades to FM3 when two pumps active. Capacity requirement could be reduced if FM3 is extended to Walnut Ave (ref Project 5).

Primary Justification: Address growth hydraulic deficiency

DCC Eligible: Yes

Grant Opportunities: Canada Community Building Fund, British Columbia Growing Communties Fund



Assumptions: All manholes require replacement.

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	450 mm Dia. Sanitary Sewer (0-2m)	m	70	$ 1,750.00	$ 121,800
2	1050 mm Dia. Manhole	ea.	2	$ 14,750.00	$ 29,500
				Subtotal:	**$ 151,300**
	Design / Construction Management / Contingency (%)			**50%**	**$ 75,650**
				Total Estimated Cost:	**$ 226,950**

Village of Harrison Hot Springs Sanitary Sewer Master Plan
November 2025 Cost Estimate
Project Number 21
Walnut Ave sewer improvements
Priority: Low

Project Description: Replace 350 mm gravity sewer along Walnut Ave with 450 mm dia. to increase capacity and reduce risk of surcharging. Can be combined with Project 10 and Project 20.

Deficiency: Capacity exceedance along sewers

Additional Notes: Capacity exceedance after improvements to FM3 when two pumps active and with improvements to Miami River Dr sewer. Capacity requirement could be reduced if FM3 is extended to Walnut Ave (ref Project 5).

Primary Justification: Address growth hydraulic deficiency

DCC Eligible: Yes

Grant Opportunities: Canada Community Building Fund, British Columbia Growing Communties Fund

Assumptions: All manholes require replacement.

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	450 mm Dia. Sanitary Sewer (0-2m)	m	117	$ 1,750.00	$ 204,050
2	1050 mm Dia. Manhole	ea.	2	$ 14,750.00	$ 29,500
			Subtotal:		**$ 233,550**
	Design / Construction Management / Contingency (%)			**50%**	**$ 116,775**
			Total Estimated Cost:		**$ 350,325**

Village of Harrison Hot Springs Sanitary Sewer Master Plan
November 2025 Cost Estimate
Project Number 22
Forcemain 5 improvements
Priority: Low

Project Description: Replace 75 mm forcemain along Hot Springs Rd from LS5 with 150 mm dia. to reduce flow velocity.

Deficiency: High velocity in FM5, end of service life

Additional Notes: Existing FM is undersized, constricting flows.

Primary Justification: Asset management / life cycle replacement

DCC Eligible: No

Grant Opportunities: Canada Community Building Fund, British Columbia Growing Communties Fund

Assumptions: Manholes and lift station will not be replaced.

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	150 mm Dia. Force Main	m	106	$ 1,245.00	$ 132,468
			Subtotal:		**$ 132,468**
	Design / Construction Management / Contingency (%)			**50%**	**$ 66,234**
			Total Estimated Cost:		**$ 198,702**

Village of Harrison Hot Springs Sanitary Sewer Master Plan
November 2025 Cost Estimate
Project Number 23
Forcemain 6 improvements
Priority: Low

Project Description: Replace 100 mm forcemain along Hot Springs Rd from LS6 with 150 mm dia. to reduce velocity.

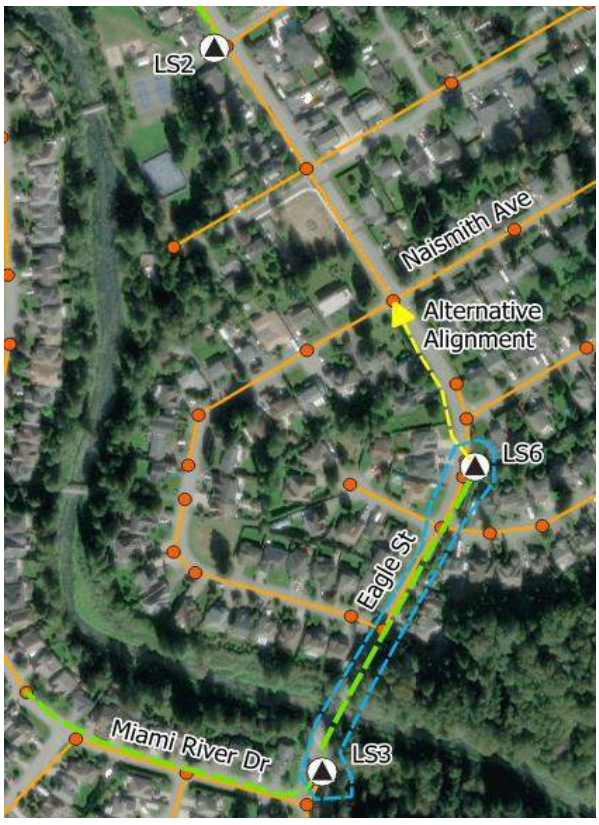
Deficiency: High velocity in FM6, end of service life

Additional Notes: Existing FM is undersized, constricting flows. Alternate alignment to discharge toward LS2 could be considered.

Primary Justification: Asset management / life cycle replacement

DCC Eligible: No

Grant Opportunities: Canada Community Building Fund, British Columbia Growing Communties Fund



Assumptions: Manholes and lift station will not be replaced.

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	150 mm Dia. Force Main	m	214	$ 1,245.00	$ 266,057
			Subtotal:		**$ 266,057**
	Design / Construction Management / Contingency (%)			**50%**	**$ 133,028**
			Total Estimated Cost:		**$ 399,085**

WATER STREET ENGINEERING

TECHNICAL MEMORANDUM			
Subject	Population, Base Sanitary Flows and Base Water Demands		
Project	Village of Harrison Hot Springs Sanitary Sewer and Water Master Plans		
To	Jace Hodgson Village of Harrison Hot Springs	**From**	Jade Sangha, EIT and Neal Whiteside, MASc, PEng
Date	29 Sep 2025	**File ref**	Water Street File # 456.300
Version	C	**Status**	Final

1. INTRODUCTION

1.1. PURPOSE

The Village of Harrison Hot Springs (the Village) has retained Water Street Engineering (Water Street) to complete village-wide sanitary sewer, storm, and water master plans.

This technical memorandum evaluates populations, base sanitary flows and base water demands for use in the sanitary sewer and water master plans. Specifically, this memorandum aims to:

1. Identify current and future village-wide residential populations based on BC Stats and Fraser Valley Regional District (FVRD) data.
2. Assess current and future Industrial, Commercial, and Institutional (ICI) population equivalents, to develop the current and future design population equivalents (sum of residential population and ICI population equivalent).
3. Estimate the (winter base and summer peak) residential populations and ICI population equivalents. connected to the sanitary sewer and water systems.
4. Develop estimated current sanitary sewer base sanitary flow (total and per capita rate), and groundwater infiltration (GWI) based on 2025 flow monitoring.
5. Develop estimates of current water demands (BD, SD, UFW), based on 2023 data.

1.2. BACKGROUND

The VHHS is experiencing population growth and redevelopment, which necessitates a long-term improvement plan to ensure the water and sanitary sewer systems can meet the increasing demands / loads and fire protection requirements.

As noted in the 2015 Water Master Plan, the growth in the village is unique and has not been consistent with the surrounding municipalities. The Village has a developed tourism industry and a significant number of seasonal residents. Estimating the seasonal residents and seasonal commercial population equivalents is important for planning and evaluation of the Village sanitary sewer and water systems.

1.3. PREVIOUS WORK

2016 LIQUID WASTE MANAGEMENT PLAN (CTQ, 2016)

The 2016 Liquid Water Management Plan (LWMP) noted a 2011 Census population of 1,468 ca and an average growth rate (1996 -2011) of 4.2%. A yr-2036 population forecast range of 2,367 to 2,733 ca was developed based

on growth rates. A "full-capacity" population of 4,447 ca was also developed based on current (at the time) land use zoning.

1.4. LIMITATIONS

This technical memorandum must be read with the Statement of Limitations at the end of this document.

2. BASE (WINTER) POPULATION

The BC Stats Population Estimates & Projections for British Columbia (BC Stats, 2024a) and the FVRD regional growth strategy (Fraser Valley Regional District, 2024) were used to assess current and future base (winter) village-wide populations. BC Stats uses the Component/Cohort-Survival method to project populations, which grows the population from the latest base year estimate by forecasting births, deaths and migration. Similarly, the BC Stats Household Estimates & Projections for British Columbia (BC Stats, 2024b) is used to assess current and future dwelling units and per-capita dwelling unit densities. Note that households include occupied dwellings only. The FVRD regional growth strategies presents populations and number of households for 2021 and projections for 2030, 2040 and 2050.

The historical estimates and future projections of populations and household within the Village are shown in Figure 1. Note the future projections provided by BC Stats only include up to the year 2046. The FVRD projections for populations and population per housing unit differ slightly from corresponding BC Stats projections.

For the Master Planning work, 2023 population data from BC Stats was selected to represent existing conditions, as this is consistent with the data available. The Village has selected the 2050 FVRD projections as their preferred option for future growth estimates. These are presented in Table 1.

Figure 1: BC Stats population and household estimates / projections

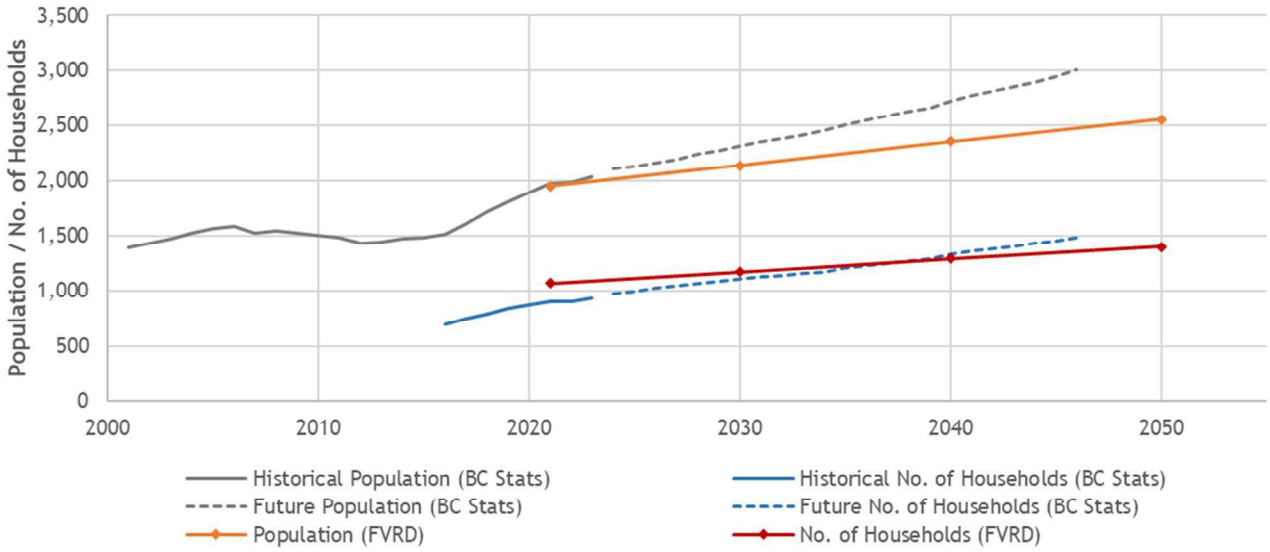


Table 1: Village-wide base (winter) populations

Master Plan Scenario	BC Stats		FVRD	
	Population	No. of Households	Population	No. of Housing Units
2021 for reference*	1,979	897	1,951	1,070
Existing (2023)	2,032	932	-	-
2046 BC Stats*	3,004	1,488	-	-
Future (2050)	-	-	2,553	1,400
* Not considered in master plan modelling, provided for reference only.				

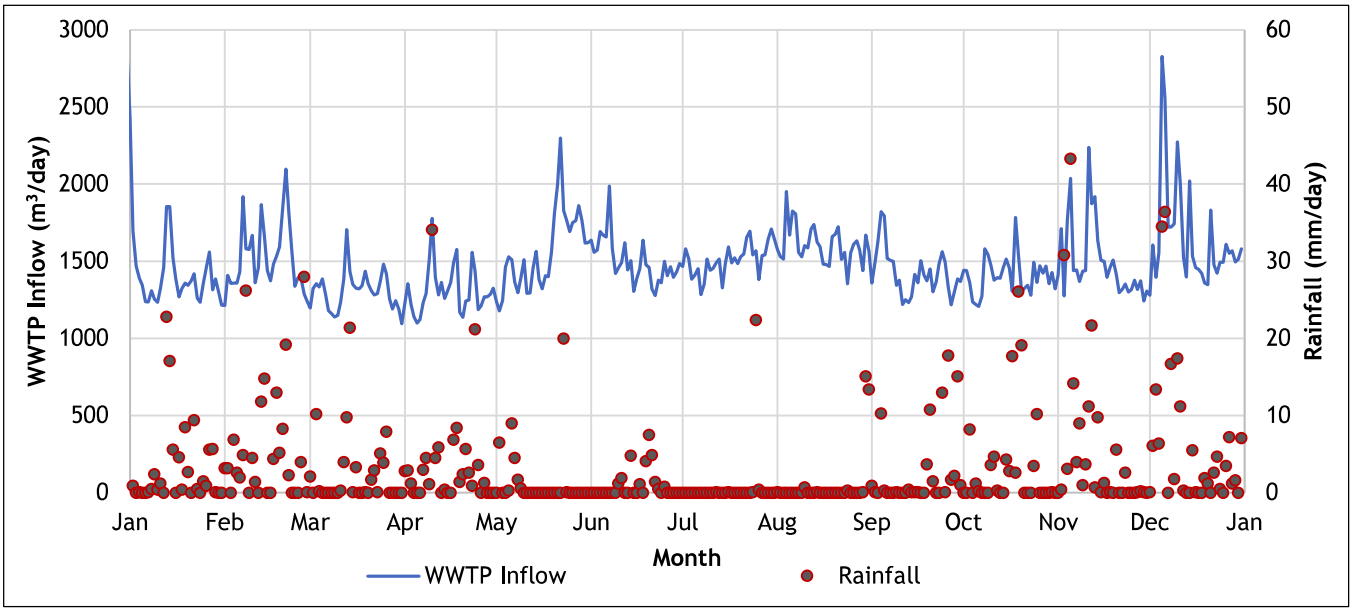
The 2023 BC Stats population projection is used for the existing master plan scenarios; the 2050 FVRD population projection is used for the future master plan scenarios.

3. WWTP & WTP FLOWS

3.1. WWTP EFFLUENT FLOWS

The daily recorded effluent discharge from 2023 is shown in Figure 2. The wastewater treatment plant (WWTP) effluent flows were used to assist in determining base sanitary flows (winter and seasonal component) and in turn establishing the seasonal population.

Figure 2: 2023 WWTP effluent flow



Implicitly included in the WWTP effluent flows would be:

- Some daily fluctuation compared to inflows to the WWTP (due to changes in levels in the WWTP aeration basins),
- Rainfall derived inflow and infiltration (RDII), and
- Sanitary ground water inflows (GWI)

The first two factors were minimized by averaging flows over a number of dry days in the summer and winter periods. It was assumed that the GWI would not vary considerably from summer to winter.

Table 2: 2023 WWTP effluent flow summary

Period	Flow		Dates
	m³/day	L/s	
Average (for reference incl. wet periods)	1479	17.1	1 Jan - 31 Dec
Winter Dry Weather	1185	13.7	5-10, 27-31 Mar, 4-6 Apr
Summer Dry Weather	1617	18.7	26 Jul - 29 Aug
Seasonal Component of DWF	432	5.00	Summer less Winter dry weather flow

Data for 2021 was checked and showed a similar increase in summer dry weather WWTP flows.

3.2. WTP FLOWS

Source flows to the Village are metered at the water treatment plant (WTP), which flows to the Village's tank before supplying the Village. The flows are manually recorded daily, and do not include peak hour consumption. The data for the village is shown in Figure 3 and Table 3.

Figure 3: 2023 WTP discharge

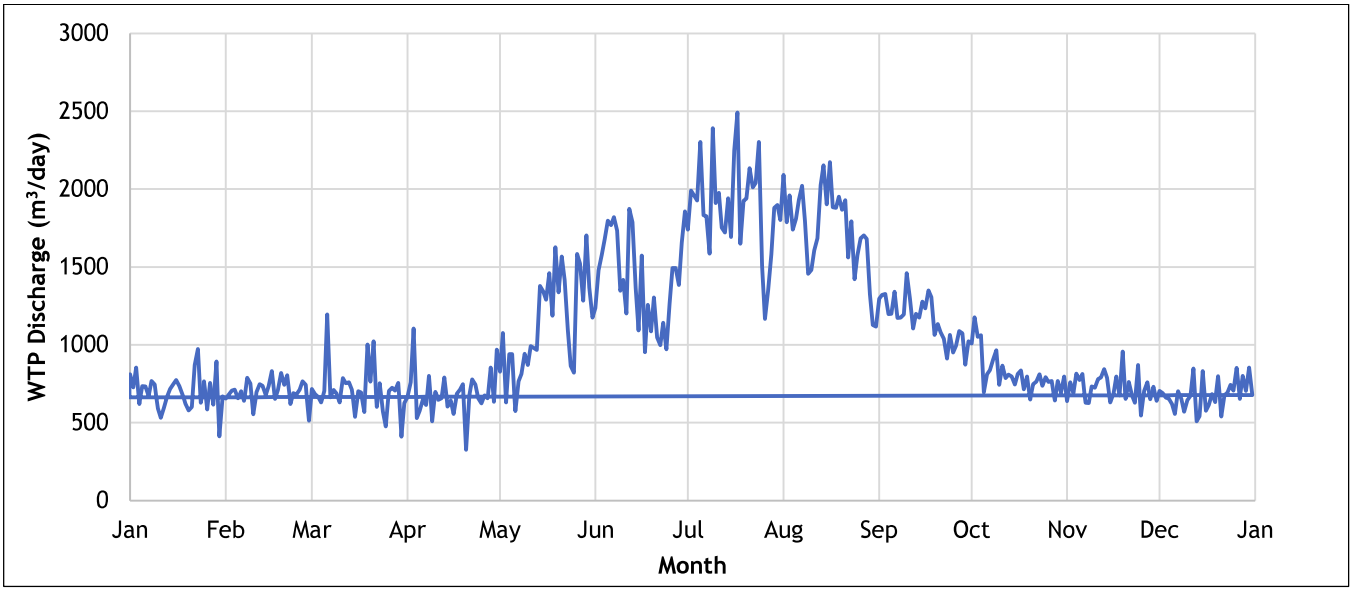


Table 3: 2023 WTP discharge summary

Demand Type	Demand		Dates
	m³/day	L/s	
Average Day (ADD)	1034	12.0	1 Jan - 31 Dec
Base (BD)	703	8.14	1 Jan - 31 Mar (Q1)
Maximum Day (MDD)	2492	28.8	17 Jul
Seasonal (SD)	1789	20.7	Maximum Day less Base demand

It is noted that due to the location of the WTP water meter, there can be significant fluctuations in the daily flow recordings (due to tank level fluctuations). As such, the above measured peak day flow (28.8 L/s) may be higher than the actual system MDD.

3.3. 2025 SANITARY SEWER FLOW MONITORING

Flow monitoring was completed between Jan and Jun 2025 as described in a separate technical memorandum (Water Street Engineering, 2025).

4. SERVICED & METERED PROPERTIES

4.1. SERVICED WATER AND SEWER LOTS

Not all of the Village is serviced by the respective water and sanitary sewer systems. A list of properties connected to the water and sanitary systems was provided by the Village, and mapped to GIS data to determine whether a property is serviced with water and/or sewer, or neither, and number of service connections. BCAA actual use codes were used to assign usage type and dwelling unit counts.

- Un-serviced lots: 175 GIS parcels were identified as un-serviced. These parcels include several large lots and the total area of unserviced parcels is 211.2 ha (63% of total lot area of parcels within Village).
- Lots serviced by **both water and sewer**: 659 lots, 78.4 ha, accounting for 1098 dwelling units, including 622 single-family dwelling units and 13 multi-family units (with a total of 475 water service connections noted). It is noted that many of the multi-family units are understood to be unoccupied in the winter.
- Lots serviced by **sanitary sewer only**: 82 lots, 47.3 ha, accounting for 97 dwelling units. A review of the lots serviced by sanitary but not water indicates that these generally have their own groundwater source (i.e. well(s)).
- Lots serviced by **water only**: 2 lots both indicated as vacant by BCAA actual use code.

Notable properties / exceptions are as follows:

- **Springs RV Resort (SRVR, 640 & 670 Hot Springs Rd.):** The SRVR is connected to both the Village water and sewer systems. HHP is set-up for seasonal RV use. The water system is metered. It is understood that the facility is open year-round.
    - Serviced area (for calculation of sanitary GWI and RDII): 47,464 m^2 / 4.75 ha
    - Metered water use: Winter 15 m^3/day (Q1 2023) and Summer 115 m^3/day (Q3 2023)
    - Outdoor water use allowance (summer typical only, not included in BSF): 9 m^3/day (assumed based on 3,000 m^2 irrigated area at 3 mm/day irrigation rate)
    - Winter and summer BSF water: Assumed equal to metered water consumption less outdoor usage. 15 m^3/day winter, 106 m^3/day summer total.
    - Typical winter and summer occupancy: 12% winter (back calculated from Q1 2023 meter data) and 90% summer (assumed)
    - Total number of RV pads: 288 sites plus additional 82 RV sites being added in 2025 (Phase 3).
    - Occupancy per occupied pad (based on indoor water consumption at 200 L/ca/day): 2.04 ca/site
- **Harrison Holiday Park (HHP, 973 Hot Springs Rd.):** The HHP has its own water supply system (groundwater wells). The sanitary system discharges to MH14 on McCombs Rd. HHP is set-up for seasonal RV use. It is understood that the facility is empty in the winter (except for caretaker occupancy), and open April - October.
    - BSF rate: 388 L/occupied site/ day; 2.04 ca/site at 190 L/ca/day (matching Springs RV rates)
    - Total number of RV pads: 400
    - Typical winter and summer occupancy: 32 % winter (126 sites) and 90% summer (360 sites)
    - Note winter occupancy derived from April calibration data
    - Serviced area (for calculation of sanitary GWI and RDII): 129,447 m^2 / 12.9 ha
    - Winter discharge BSF: 49 m^3/day
    - Summer BSF: 140 m^3/day

- **Harrison Hot Springs Resort (HHSR, 100 Esplanade Ave):** The HHSR has its own water supply but is connected to the sanitary sewer system. The sanitary sewer system is metered but volume measured is only the discharge from the onsite pools.[1] Key information on the HHSR:
    - Serviced area (for calculation of sanitary GWI and RDII): 60,347 m^2 / 6.03 ha
    - Total number of rooms: 342
    - Typical winter and summer occupancy: 30 % winter and 90 % summer (note this is arbitrary)
    - BSF rate: 460 L/occupied room/day; 2 BU x 230 L/BU/day (Province of BC (MFNRO), 2012)
    - Metered discharge (emptying of pools): 15.2 m^3/day (average from 2020 - 2023 meter data)
    - Winter discharge BSF estimate: 47 m^3/day (indoor), 62 m^3/day (total incl. pool) – pre-calibration
    - Summer BSF estimate: 142 m^3/day (indoor), 157 m^3/day (total incl. pool) – pre-calibration
    - Observed April 2025 average dry weather flow (ADWF) of 12.1 L/s (1,045 m^3/day) including 7.3 L/s GWI and 4.8 L/s BSF (see flow monitoring TM)Revised existing summer BSF estimate to match Apr 2025 data.

- **Harrison Hot Springs Public Mineral Pool (HHSMP, 101 Hot Springs Rd):** The HHSMP is not supplied from the Village water system but is connected to the sanitary sewer system. The HHSMP's discharge is metered.
    - Metered discharge (emptying of pools): 103 m^3/day (average from 2022 - 2023 meter data)
    - Assume other uses are not significant.
    - Winter and Summer BSF = 103 m^3/day

- **Harrison RV Country Club (398 Hot Springs Rd):** This site is also not supplied from the Village water system but is connected to the sanitary sewer system. No metering.
    - Estimated 70 RV sites (year-round occupancy assumed)
    - Assumed 2.04 ca/site and 160 L/ca/day, to arrive at 23 m^3/day
    - No future growth assumed.

4.2. WATER SERVICE METER DATA

The Village meters all ICI users and all new multi-family (MF) residential lots connected to the water system. Single-family and older multi-family residential lots are not metered. Meters are read quarterly, and the metered consumption customer data was provided by the Village. Note the exact dates of meter read were not provided (hence the length of billing periods is estimated as 365 /4 days for each period).

Meter data was matched to GIS parcel data, to determine existing metered consumption for each metered lot and assign metered consumption to a use type (ICI or MF residential).

The data provided included 30 active water meters including:

- 21 on ICI (industrial, commercial, institutional) properties
- 9 residential (multi-family) properties (incl. 3 mixed use properties with commercial uses as well)
- A total of 369 dwelling units (most of the estimated 506 MF dwelling units in the Village).

Metered consumption data was used to estimate water demands as follows:

- Base demand (BD): Q1 demand (excluding missing readings).
- Maximum day demand (MDD): Assume metered usage is same as Q3 consumption

[1] 27 Nov 2024 email from VHHS (Tyler Simmonds).

Table 4: 2023 ICI and multi-family metered consumption (L/s)

Use	Quarter				ADD	Winter BD	MDD
	Q1	Q2	Q3	Q4			
ICI	1.36	2.05	3.28	1.62	1.99	1.36	3.28
Residential (Multi-family)	0.54	0.85	1.22	0.59	0.79	0.54	1.22
Total	1.90	2.90	4.50	2.21	2.78	1.90	4.50

In 2023, metered consumption made up 23% of total water delivered by the WTP.

5. EXISTING WATER BALANCE

5.1. WATER BASE DEMANDS

Winter base and summer MDD water demands were derived from the data as follows.

Table 5: 2023 existing water demands

Use	Use Code	Demand (m^3/day)	Source / Unit Rates
Base Demand			
ICI	BD-ICI-M	117	From meter data
Residential MF Metered [1,2]	BD-RES-MF-M	46	From meter data. 280 DU, 232 ca
Residential MF Unmetered[1,2]	BD-RES-MF-UM	29	197 DUo x 0.63 ca/DU x 237 L/ca/day
Residential SF [1,2]	BD-RES-SF	363	622 DU x 2.47 ca/DU x 237 L/ca/day
Unaccounted for Water[3]	BD-UFW	147	125 L/service/day x 1176
Total Base Demand		704	
Seasonal Component (in addition to BD)			
ICI	SD-ICI-M	166	From meter data
Residential MF Metered	SD-RES-MF-M	58	From meter data
Residential MF Unmetered Addl. Indoor Use	SD-RES-MF-UM-I	7	Assume addl. 22 % occupancy
Residential MF Unmetered Outdoor Use	SD-RES-MF-UM-O	91	Same rate as SF lots
Residential SF Addl. Indoor Use[4]	SD-RES-SF-I	80	Assume addl. 22 % occupancy
Residential SF Outdoor Use[5]	SD-RES-SF-O	1390	4.78 L/m^2/day on irrigable area of 50% of lot area up to maximum of 2000 m^2/DU
Total Addl. Seasonal Demand		1791	
Maximum Day Demand		2494	

Notes:
1. 237 L/ca/day represents typical indoor water use rate observed in lower mainland with current mix of indoor water fixture (excl. unusual leakage)
2. Total population of 2032 ca for Harrison; distributed first to SF DU at 2.47 ca/DU; then remainder to MF DU. Note the low population density is expected to be primarily due to seasonal occupancy.
3. UFW estimated from water balance; i.e. total delivered water from source flow data less metered consumption and unmetered estimate.
4. Additional seasonal occupancy allowance of 22% (note 2021 census data indicates 18% of DU are not occupied normally).
5. Outdoor water use rate of 4.78 L/m^2/day is back-calculated from observed seasonal demand after accounting for an allowance for addl. occupancy.

5.2. SANITARY DRY WEATHER FLOWS

Sanitary dry weather flows were developed from the data as follows.

Table 6: Existing sanitary dry weather flows

Use	Use Code	Load (m^3/day)	Source / Unit Rates
ADWF (Winter) – April 2025			
ICI with Water Connection	BSF-ICI	92	80% of ICI water BD
ICI without Water Connection	BSF-ICI-NW	175	Incl. HHP and HHSMP (see section 4)
Residential with Water Connection	BSF-RES	351	Equal to residential water BD
Residential without Water Connection [1]	BSF-RES-NW	45	97 DU x 2.47 ca/DU x 190 L/ca/day
BSF HHSR	BSF-ICI-HHSR	410	From calibration
Groundwater Infiltration (except HHSR)	GWI	211	2,000 L/ha/day (calibrated)
GWI (HHSR)	GWI-HHSR	631	From calibration
Total ADWF (Winter)		1916	

Notes:
1. Residential base sanitary flow rates are 80% of indoor water use rates per calibration.
2. HHSR loads from calibration

Note that the base sanitary flow cannot be directly compared to the water base demand, as there are several properties serviced by the sanitary system but not the water system (these lots have a separate private water supply).

A summer forecast is not produced as the design flow condition (high rainfall and RDII) occurs in the winter season.

5.3. EXISTING POPULATION AND SUMMER (SEASONAL) COMPONENT

Harrison Hot Springs has a significant seasonal population. From the water balance a 22% increase in serviced water population (1834 ca winter to 2237 ca summer) is estimated. Compared to the water system, the sanitary sewer system services an additional 186 ca in the winter (2020 ca total). The total residential sanitary sewer service population in the summer is estimated as 2464 ca.

The above values exclude the additional flows from the SRVR and HHP and additional occupancy at hotels including the HHR.

The above values are substantiated by the increased WTP and WWTP flows that were used in the water and sewer flow balances. The 2023 dry weather flow increase at the WWTP was 36% from 1185 m^3/day in the winter to 1617 m^3/day in the summer.

The existing serviced residential populations are estimated as shown in Table 7.

Table 7: 2023 serviced residential populations

Utility System Serviced	Winter Population (ca)	Summer Population Increase	Summer Population Increase (ca)	Summer Population (ca)
Sanitary	1834	+22%	+403	2237
Water	2020		+444	2464

6. OCP FORECAST

6.1. LAND USE DESIGNATIONS

The future residential population was based on the FVRD population projects (see Section 2). The projected distribution of residential population and ICI growth was developed based on the Village's Official Community Plan (OCP).

The various OCP designations considered are provided in the table below.

Table 8: OCP designations

Abbr.	OCP Designation	Subtype	Residential Uses	Lot Area (ha)
LB	Lakeshore Beach	Park		19
LDR	Low Density Residential	Residential	Single-family, duplex	60
LR	Lakeshore Residential	Residential	Townhomes, row homes	1
MDR	Medium Density Residential	Residential	Townhomes, row homes	4
MTC	Marine Tourist Commercial	ICI		10
PU	Public Use	ICI or Park		75
R	Resources	Vacant		90
TC	Tourist Commercial	ICI		24
VC	Village Centre	Mixed Use	Apartments	6
WC	Waterfront Commercial	Mixed Use	Apartments	25
TC-HDR[1,2]	Tourist Commercial - High Density Residential	Residential	Apartments	2
TC-MDR[1,3]	Tourist Commercial - Medium Density Residential	Residential	Townhomes, row homes	4
TC-SLR[1,4]	Tourist Commercial - Small Lot Residential	Residential	Resort (small lot) residential	1
Total				325

Notes:
1. New categories created for residential properties with the Tourist Commercial (TC) OCP designation.
2. Singular property at 740 Hot Springs Rd (planned apartment development).
3. 628 McCombs Dr, 386 & 388 Pine Ave, and all properties on Schooner Pl.
4. 750 & 798 Hot Springs Rd.

6.2. RESIDENTIAL POPULATION GROWTH

The FVRD projects a Village 2050 residential population of 2,553 ca with 1,400 occupied housing units. This translates to a population increase of +521 ca (or +26%). Assuming a seasonal occupancy of 78% of units being occupied year-round (based on current occupancy), a total of 1,804 total dwelling units in the village are projected (with 404 unoccupied). This translates to +603 new dwelling units.

To distribute these dwelling units spatially amongst the Village, future densities (DU/ha or DU/lot) were set based on a combination of current densities, typical densities in other municipalities, and judgement, such that the total resulted in a net +603 new dwelling units. The actual densities will depend on the ultimate development of the lot.

Residential dwelling units were assigned as either the current number of dwelling units or calculated using the estimated future density, whichever resulted in a greater number of dwelling units for a given property. Constraints to buildable areas were created for larger lots, particularly those fronting Hot Springs Rd, where steep topography to the west limits the total developable area.

Two OCP designations are classified as mixed-use: Village Centre (VC) and Waterfront Commercial (WC). For properties with these OCP designations, future residential usage was considered only for properties that currently have residential usage (including both multi- and single-family uses).

The residential densities and resulting dwelling units for each OCP designation are shown in the table below.

Table: OCP residential dwelling unit projections

Abbr.	Lot Area (ha)	Buildable Area (ha)	Dwelling Unit Density		Dwelling Units (DU)	Dwelling Unit Growth (DU)
			DU/ha	DU/lot		
LDR	60	55	13	-	798	189
LR	1	1	25	-	35	4
MDR	4	4	25	-	110	53
VC	2*	2*	150	-	242	124
WC	2*	2*	150	-	319	79
TC-HDR	2	1	150	-	105	105
TC-MDR	4	4	25	-	107	5
TC-SLR	1	1	-	1	87	52
Total	76	69	-	-	1803	611
Dwelling Unit Decrease on ICI Properties						-9
Net Dwelling Unit Growth						602
* Mixed-use OCP designations; this table only includes those properties identified as residential.						

The future residential population (2,553 ca as per FVRD projections) was distributed using estimated population densities. The population densities were set for each land use category generally based on current densities such that the total population was approximately equal to the FVRD projection of 2,553 ca. Note the population densities used for the future projections are less than existing population density estimates. This trend of declining population density is consistent with the BC Stats projections.

Table 9: OCP residential population projections

Abbr.	Dwelling Units (DU)	Population Density (ca/DU)		Population (ca)		Population Growth (ca)	
		Winter	Summer	Winter	Summer	Winter	Summer
LDR	798	2.16	2.64	1724	2103	296	361
LR	35	1.40	1.71	48	59	25	31
MDR	110	1.40	1.71	154	187	61	74
VC	242	0.53	0.65	128	157	36	44
WC	319	0.53	0.65	169	206	7	9
TC-HDR	105	0.53	0.65	56	68	56	68
TC-MDR	107	1.40	1.71	150	183	25	31
T-SLR	87	1.40	1.71	122	149	36	43
Total	1803	-	-	2553	3112	541	660
Population Decrease on ICI Properties						-22	-27
Net Population Growth						519	633

Note the above tables indicate a dwelling unit and population decrease for some ICI properties. These properties are currently used for single-family dwellings, however their OCP designations indicate they will be used for ICI or be vacant in the future.

6.3. ICI GROWTH

ICI growth is assumed to be consistent with residential growth (i.e. an overall ICI growth of +26% is assumed).

There are some properties which are currently residential but have ICI OCP designations. These properties are as follows:

- Town Centre (TC): 694, 674, 682, 690, and 728 Hot Springs Rd. Assumed to be commercial in the future. Assigned new water and sanitary demands.
- Public Use (PU): 590 Hot Springs Rd and 520 Lillooet Ave. Assumed to be vacant or used as parks in the future, with no water or sanitary demands.
- Resources (R): 480 and 980 Hot Springs Rd. Assumed to be vacant in the future, with no water or sanitary demands.

Additionally, there are some properties that are currently vacant ICI but are assumed to be developed at OCP:

- Town Centre (TC): 720 Hot Springs Rd. Assumed to be commercial in the future. Assigned new water and sanitary demands.
- Village Commercial (VC): 316 Hot Springs Rd, 260 Esplanade Ave, and 260 Cedar Ave. Assumed to be commercial in the future. Assigned new water and sanitary demands.
- Waterfront Commercial (WC): 490 Esplanade Ave, 498 Esplanade Ave, and 511 Lillooet Ave. Assumed to be commercial in the future. Assigned new water and sanitary demands.
- Public Use (PU): 22 lots throughout the Village. Assumed to remain vacant or used as parks in the future, with no water or sanitary demands.

It is assumed that properties with Marine Tourist Commercial (MTC) OCP designation will not be developed / not produce water or sanitary demands at OCP.

6.4. WATER BASE DEMANDS

Projected winter base and summer MDD water demands are summarized in Table 10.

It is assumed that all new residential and ICI properties will be connected to both the water and sanitary systems at OCP, and that currently un-serviced residential properties will become connected. Currently un-serviced ICI properties are assumed to remain un-serviced.

Table 10: OCP water demands

Use	Use Code	Demand (m^3/day)	Source / Unit Rates
Base Demand			
ICI New [1]	OCP-BD-ICI-N	34	2.01 L/m^2/day x 1700 m^2
ICI Existing [2]	OCP-BD-ICI	127	Assume 117% existing demand
Residential [3]	OCP-BD-RES	605	2551 ca x 237 L/ca/day
Unaccounted for Water [3,4]	OCP-BD-UFW	237	125 L/service/day x 1900 services
Total Base Demand		1004	Overall growth of +300 m^3/day (43%)
Seasonal Component (in addition to BD)			
ICI New [5]	OCP-SD-ICI-N	26	1.55 L/m^2/day x 1700 m^2
ICI Existing [2]	OCP-SD-ICI	190	Assume 117% existing demand
Residential Addl. Indoor Use [6]	OCP-SD-RES-I	133	Assume addl. 22 % occupancy

Residential Outdoor Use [3]	OCP-SD-RES-O	1808	4.78 L/m^2/day on irrigable area of 50% of lot area up to maximum of 2000 m^2/DU
Total Addl. Seasonal Demand		2157	Overall growth of +366 m^3/day (20%)
Maximum Day Demand		3161	Overall growth of +657 m^3/day (26%)

Notes:
1. New ICI BD rate of 2.01 L/m^2/day selected based on existing ICI BD.
2. 117% selected to maintain an overall ICI winter BSF growth of 26%. See Table 11.
3. Unit-rate as per existing water balance. See Table 5.
4. Includes existing services plus new services, which consist of currently un-serviced residential properties and all new residential or ICI properties.
5. New ICI SD rate of 1.55 L/m^2/day selected based on existing ICI SD.
6. Additional seasonal occupancy allowance of 22% as per existing water balance.

6.5. SANITARY DRY WEATHER FLOWS

Projected OCP sanitary dry weather flows were developed as follows

- Using unit rates for base sanitary loads (190 L/PE/day, 80% of water BD) and RDII (2000 L/ha/day)
- Note that the forecast assumes that the observed high BSF and GWI loads from HHSR are significantly reduced to design criteria values (460 L/room/day BSF and 2000 L/ha/day for GWI).
- HHP, Springs RV and Harrison RV Country Club full occupancy (as opposed to winter occupancy observed from flow monitoring)

Due to the large impact of the HHSR reduction, OCP flows (for ADWF) are similar to existing (i.e. the increase in loading from other areas can be offset by reductions in HHSR flows).

Table 11: OCP sanitary dry weather flows

Use	Use Code	Demand (m^3/day)	Source / Unit Rates
ADWF (Winter)			
ICI New	OCP-BSF-ICI-N	27	80% of water BD
ICI Existing [1]	OCP-BSF-ICI	93	Assume 117% existing loads + HHSR
ICI Existing (no current water connection)	OCP-BSF-NW	360	HHP, Springs RV, HHMP, Harrison RV Country Club
Residential	OCP-BSF-RES	470	80% of water BD
Groundwater Infiltration	OCP-GWI	228	2,200 L/ha/day (calibrated)
HHSR BSF		157	
HHSR GWI		12	
Total ADWF (Winter)		1347	Overall growth of + m^3/day (%)

Notes:
1. 117% selected to maintain an overall ICI winter BSF growth of 26%
2. HHSR loads reduced from existing observed.

7. CONCLUSIONS AND RECOMMENDATIONS

The recommended water demands for the water master plan are summarized in Table 12, and the sanitary dry weather flows recommended for the sanitary master plan are summarized in Table 13.

Table 12: Water demands summary

Use	Demand (m^3/day)	
	Existing	OCP
Base Demand		
ICI	117	162
Residential	439	605
Unaccounted for Water	147	237
Total Base Demand	704	1004
Seasonal Component (in addition to BD)		
ICI	166	216
Residential	1625	1941
Total Addl. Seasonal Demand	1791	2157
Maximum Day Demand	2494	3161

Table 13: Sanitary dry weather flows summary

Use	Demand (m^3/day)	
	Existing	OCP
ADWF (Winter)		
ICI BSF (water connected)	94	120
ICI BSF (no water connection)	175	360
HHSR BSF	410	157
Residential BSF	396	470
Groundwater Infiltration	211	227
HHSR GWI	631	12
Total ADWF (Winter)	1916	1347

WATER STREET ENGINEERING LTD. *(EGBC permit to practice # 1000830)*

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA W.N. WHITESIDE 29 Sep. 2025

Jade Sangha, EIT
Project Engineer

Neal Whiteside, MASc, PEng
Senior Municipal Engineer

REFERENCES

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ABBREVIATIONS

ADD	Average Day Demand (Water)
ADWF	Average Dry Weather Flow
BD	Base Demand (Water)
BSF	Base Sanitary Flow (Sanitary)
GWI	Ground water Infiltration (Sanitary)
HHP	Harrison Holiday Park
HHSMP	Harrison Hot Springs (Public) Mineral Pool
HHSR	Harrison Hot Springs Resort
FVRD	Fraser Valley Regional District
ICI	Industrial, Commercial, and Institutional
LWMP	Liquid Water Management Plan
MDD	Maximum Day Demand (Water)
MF	Multi-Family
RDII	Rainfall Derived Inflow and Infiltration (Sanitary)
SD	Seasonal (Outdoor) Demand
SF	Single-Family
SRVR	Springs RV Resort
UFW	Unaccounted for Water
Village	Village of Harrison Hot Springs
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant

STATEMENT OF LIMITATIONS

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REVISION HISTORY

Version	Status	Date	Description of Revisions	Author
A	Draft	15 Apr 2025	For client review	JAS / NW
B	Draft	17 Jun 2025	Add OCP forecast, address comments	JAS / NW
C	Final	29 Sep 2025	Updated sanitary flows per flow monitoring	NW

https://wopi.dropbox.com/wopi/files/oid_4011581495825752576/WOPIServiceId_TP_DROPBOX_PLUS/WOPIUserId_680855889/Populations TM vC.docx

WATER STREET ENGINEERING

TECHNICAL MEMORANDUM			
Subject	Flow Monitoring Data Analysis		
Project	Village of Harrison Hot Springs Sanitary Sewer Master Plan		
To	Village of Harrison Hot Springs	**From**	Neal Whiteside, MASc, PEng and Laura Christensen, PEng
Date	29 Sep 2025	**File ref**	Water Street File # 456.303
Version	A	**Status**	Draft

1. INTRODUCTION

1.1. PURPOSE

This technical memorandum assesses the flow monitoring data collected by SFE Global (SFE). The data includes flow monitoring at two gravity manholes (sites SS1 and SS2) as well as data from a rain gauge installed as part of the program. Data was gathered from 23 Jan to 17 Jun 2025 (note SS2 data period was slightly shorter). The data was used to calculate base sanitary flow (BSF), rainfall derived infiltration and inflow (RDII), and groundwater infiltration (GWI) for the two monitored sites.

1.2. ACKNOWLEDGEMENTS

We acknowledge ClimateData.ca for providing the climate information used. ClimateData.ca was created through a collaboration between the Pacific Climate Impacts Consortium (PCIC), Ouranos Inc., the Prairie Climate Centre (PCC), Environment and Climate Change Canada (ECCC), Centre de Recherche Informatique de Montréal (CRIM), and Habitat7.

2. FLOW MONITORING CONFIGURATION

See Attachment 1 from SFE Global for details on the installed flow monitoring equipment.

2.1. RAIN GAUGE: MIAMI RIVER DRIVE AND MCCOMBS DRIVE

A tipping bucket rain gauge was located at Lift Station 3 (LS3). The apparatus was an ISCO interface module with a 506G Rain Gauge. The data was collected in 5-minute intervals and transmitted every 24 hours.

2.2. SANITARY SEWER MONITORING SITE 1: ST ALICE ST AND CEDAR AVE

Sanitary monitoring site 1 (SS1) was installed on the 350 mm outlet of the sanitary manhole at St Alice St and Cedar Ave, just upstream of Lift Station 1 (LS1). This location captures all of the Village of Harrison Hot Springs sewer inflows with the exception of the flow from Harrison Hot Springs Resort (HHSR). The sensor used was a submerged area velocity (AV) sensor. Data was collected in 5-minute intervals and transmitted every 24 hours.

2.3. SANITARY MONITORING SITE 2: 760 MCCOMBS DRIVE

Sanitary monitoring site 2 (SS2) was installed on the 300 mm outlet of MH16 on McCombs Drive. This location is downstream of LS4, and the private lift station servicing the Harrison Holiday Park (HHP).

The sensor used was a submerged AV sensor. Data was collected in 5-minute intervals and transmitted every 24 hours.

2.4. SCADA FOR LIFT STATION 1AND 3

Hourly and daily average flows were downloaded from the Village's SCADA. The data collection started on30 Mar 2025.

3. ANALYSIS

3.1. DATA

The recorded data is summarized for the two sites in Attachment 2. Data presented is hourly average to smooth out variations caused by the of upstream lift station operation.

3.2. CATCHMENT AREA CHARACTERISTICS

Table 1: Catchment Area Characteristics

	SS2	LS3	SS1	LS1	Notes
Gross Area (ha)	42.1	80.5	139.8	145.8	Includes roads and unserviced lots in the catchment.
Sewer Serviced Lot Area	34.2	75.3	105.7	111.7	
Serviced Dwelling Units	110	553	1196	1196	
Res. Population (SF)	271	1095	1701	1701	
Res. Population (MF)	0	69	319	319	
PE (ICI)	7	119	576	576	
PE (All)	278	1163	2596	2596	
Notes: LS1 catchment includes SS1 catchment plus Harrison Hot Springs Resort, HHSR is not assigned any ICI population (separate assignment during calibration)					

3.3. DRY WEATHER FLOWS

The data was analyzed to determine hourly average dry weather flows for the two sites for the period of Jan – Apr 2025, see Attachment 2 graphs. Data was excluded where there had been rainfall in the previous 48 hours. Data for May was excluded to avoid effect of increasing occupancy in shoulder season.

Table 2: Observed Winter Dry Weather Flow Summary (L/s)

	SS2	SS1	Notes
Minimum Night Flow (MNF)	1.83	3.33	@ 03:00 for SS1, 02:00 for SS2
Average Dry Weather Flow (ADWF)	2.67	6.86	
Peak Dry Weather Flow (PDWF)	3.17	10.14	@ 09:00 for SS1, 08:00 for SS2
Notes: SS2 profile indicates significantly more GWI as a proportion of the total flow.			

Note SCADA data was made available starting 30 Mar 2025 for LS1 and LS3. Using this data the following dry weather flows were calculated for April 2025.

Table 3: Observed April Dry Weather Flow Summary (L/s)

	SS2	LS3	SS1	LS1	Notes
Minimum Night Flow (MNF)	1.28	3.74	4.63	13.33	
Average Dry Weather Flow (ADWF)	2.10	5.75	7.82	19.92	
Peak Dry Weather Flow (PDWF)	2.81	7.88	11.47	26.08	
Notes:					

Using the four flow monitors, the system can be divided into four catchments:

- SS2: including the LS4 catchment, HHP and a portion of the gravity sewers feeding LS3.
- LS3 – SS2: including all flows into LS3 less observed flow at SS2, including LS5 and LS6 catchments and direct gravity connections
- SS1 – LS3: including all flows into SS1 (the manhole at Cedar and St Alice) less the LS3 flows including LS2 and local direct gravity connections
- HHSR: including all flows out of LS1 less the flow measured at SS1 (the manhole at Cedar and St Alice), the only connection for this catchment is the HHSR.

To calibrate the model the following adjustments were made to the base data:

- Additional GWI of 7.3 L/s added for the HHSR (due to very high minimum night flow (MNF) at LS1 not present at SS1 site).
- Additional 4.17 L/s of BSF (1900 PE x 190 L/PE/day) also added to HHSR to account for variable flows at LS1.
- Additional 0.55 L/s of BSF (250 PE) applied at HHP to account for higher than expected flows observed at SS2.
- Overall BSF rate set at 80% of base demand (BD) water use rate previously developed (160 L/PE/day for metered connections, 190 L/PE/day for unmetered water connections).
- MNF analysis was used to estimate a groundwater infiltration rate for the remainder of the service area. Assuming minimum night flow usage of 30% of average base sanitary flow (at SS1), the remainder of MNF is assigned as GWI, resulting in a GWI rate of 2000 L/ha/day (ha of serviced lot area).

The resulting calibration is summarized in the following table.

Table 4: Dry Weather Flow Catchment Calibration Summary

	SS2	LS3-SS2	SS1-LS3	HHSR	Notes
Observed Values					
MNF, L/s	1.28	2.45	0.90	8.70	
ADWF, L/s	2.10	3.66	2.06	12.10	
PDWF, L/s	2.81	5.33	4.98	16.30	
Serviced Lot Area (ha)	34.21	41.10	30.38	6.04	
Calibrated Values					
Model GWI, L/s - calibrated	0.79	0.95	0.70	7.30	
Model BSF, L/s - calibrated	1.17	2.22	3.78	4.75	

Model ADWF, L/s - calibrated	1.96	3.17	4.49	12.05	
ADWF Error % (Calibrated/ Observed)-1	-6%	-13%	117%	0%	

The resulting calibration is deemed acceptable with the exception of the SS1 – LS3 catchment. It is believed that the SS1 site may have been underreading. This combined with potential subtraction errors would increase the % inaccuracy for the SS1 -LS3 catchment. The higher model ADWF was left.

3.4. WET WEATHER FLOWS

Lift station 1 and 3 data were not included in the wet weather flow analysis as data was not available for winter storms.

For both temporary flow monitoring sites, the peak observed flow was on the evening of 23 Mar 2025 / morning of 24 Mar 2025.

The RDII component can be developed by subtracting the dry weather component from the data (adjusted for the time of day).

Table 5: 2025 Peak Weather Flow Summary (L/s)

	SS1	SS2	Notes
Peak Wet Weather Flow (PWWF)	58.6	18.9	23:00 23 Mar for SS1, 01:00 24 Mar for SS2
RDII component of PWWF (PWWF - BSF)	53.4	16.6	
Notes: The rainfall observed for the storm averaged 2.97 mm/hr (71 mm for 24 hr from 01:00 23 Mar to 01:00 24 Mar)			

Other minor rainstorms were also analyzed for each site to determine the RDII component and compared to the 24-hour rainfall intensity. It was noted that for both stations the best correlation between rainfall intensity and RDII was found when the average intensity for previous 24-hour period was considered.

The correlation between RDII for the storms observed are shown in Attachment 3.

The best fit correlations were:

- SS1: $Q_{RDII} = 14.1 \times i$ and
- SS2: $Q_{RDII} = 5.58 \times i$

Where discharge, Q is in L/s and rainfall intensity, i is in mm/hr.

It is noted that the peak RDII intensity observed for SS1 on 24 Mar 2025 is an outlier. Based on the observed storm intensity of 2.67 mm/hr, a RDII of 38 L/s would have been expected, compared to the 53 L/s observed. The higher intensity could be attributed to lift station operation over the period.

As developed from Agassiz historical data, the 5-yr, 24-hr rainfall is 3.8 mm/hr and the yr-2050 moderate emission climate change design is 5.5 mm/hr. (PCIC, 2025)

Using the design rainfall intensity of 5.5 mm/hr, the following RDII values are derived from the data.

Table 6: Design RDII rates (from flow monitoring)

Catchment	SS2	SS1	Units
Design RDII Rate based on serviced lot area	77,500	63,400	L/ha/day

Design RDII Rate based on gross catchment area	63,000	48,000	L/ha/day
Design RDII	31	78	L/s

4. CONCLUSIONS

The following data from the flow monitoring will be used for modelling:

- BSF rate 160 L/PE/day for metered and 190 L/PE/day for unmetered (BSF/BD ratio of 80%)
- Global GWI rate of 2000 L/ha/day will be applied to serviced lot areas.
- GWI load of 7.3 L/s will be applied at HHSR
- Additional BSF loads of 0.55 L/s and 4.17 L/s will be applied at HHP and HHSR, respectively.
- Design existing RDII rate of 63,400 L/ha/day of serviced area will be applied to the system, except for SS2 catchment where a higher rate of 77,500 L/ha/day will be applied.

WATER STREET ENGINEERING LTD.

Neal Whiteside, MASc, PEng
Sr Municipal Engineer

Laura Christensen
Project Manager

EGBC permit to practice number 1000830

ATTACHMENTS

Attachment 1: Flow Monitoring Site Details (from SFE Global)

Attachment 2: Sanitary Sewer Flow Monitoring Graphs

Attachment 3: RDII Analysis

REFERENCES

CTQ Consultants Ltd. (Dec 2016). *Liquid Waste Management Plan*. Village of Harrison Hot Springs.

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ABBREVIATIONS

ADWF – Average Dry Weather Flow
AV – area velocity
BD – Base Demand (Water)
BSF – Base Sanitary Flow
CRIM – Centre de Recherche Informatique de Montréal
ECCC – Environment and Climate Change Canada
GWI – Groundwater Infiltration
HHP – Harrison Holiday Park
HHSR – Harrison Hot Springs Resort
ICI – Industrial, Commercial, and Institutional
LS – Lift Station
MNF – Minimum Night Flow
PCC – Prairie Climate Centre
PCIC – Pacific Climate Impacts Consortium
PDWF – Peak Dry Weather Flow
PWWF – Peak Wet Weather Flow
RDII – rainfall derived infiltration and inflow
SS – Sanitary monitoring site

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REVISION HISTORY

Version	Status	Date	Description of Revisions	Author
A	Draft	29 Sep 2025	Original	NW

https://wopi.dropbox.com/wopi/files/oid_4011581495531058944/WOPIServiceId_TP_DROPBOX_PLUS/WOPIUserId_680855889/Flow Monitoring Data Analysis.docx

Site Details Sheet

CLIENT MONITORING #: 506G
NAME: Harrison Hot Springs Flow Monitoring
SFE PROJECT #: 506G
SFE SITE #: 506G Rain Gauge

Project Specific Information

Client Name:	Water Street Engineering	
End User Name:	Village of Harrison Hot Springs	
Project Name:	Sanitary and Storm Master Plan	
Client Contact:	Neal Whiteside	
Field Contact:	Jace Hogdson	
SFE PM Contact:	Glenn Cumyn	Sam Cumyn
Site Maintenance:	as required	

Site Location Information

Client Site Name/ #:	506G	
Street Address:	Miami River Dr & McCombs Dr	
City, Province:	Harrison Hot Springs, BC	
GPS (North - West):	49.29665	-121.777416
Landmarks:	Pump Station	
Traffic Control Req's:	No Traffic	
Additional Information:	Inside locked pump station.	

Site Equipment

Installation Date:	January 24, 2025	
Removal Date:	May 24, 2025	
Meter Make & Model:	ISCO Interface Module	
Meter ID - #1:	506G Rain Gauge	
Meter ID - #2:	N/A	
Wireless ID #:	506G Rain Gauge	
Cellular #:	N/A	
Level / Velocity Type:	n/a	n/a
Sensor Mounting:	other	
Primary Device:	Rain Gauge	
Logging Rate / Call out:	5 minute	24hr

Site Profile

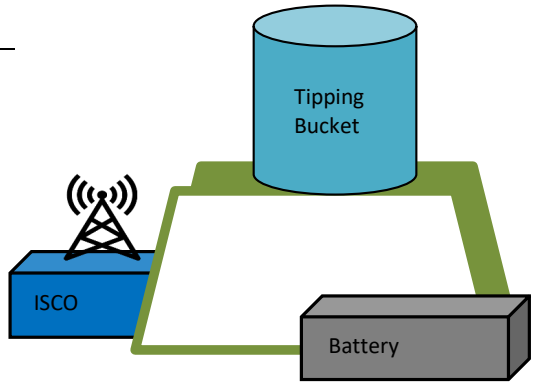
Overall Site Condition:	Good	
Access:	Other	
Invert Distance (cm):	N/A	
Overall Pipe Condition:		
Per Tip (mm):	#1:	0.25
	#2	N/A
Sensor (x)	#3:	N/A
	#4:	N/A
Additional Information:	N/A	

all setup by SFE, located in city pump station

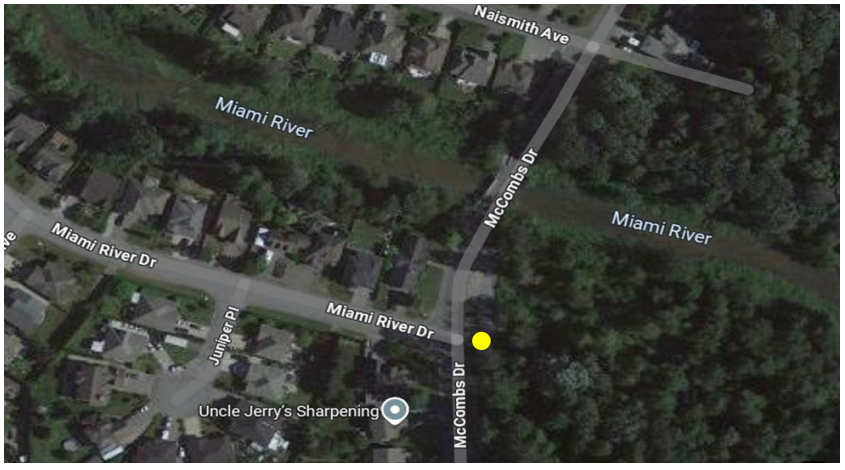
Site Set up

Sensor in Pipe #: 0.25mm Per Tip

Sensor Placement: Leveled Ground



Map



N

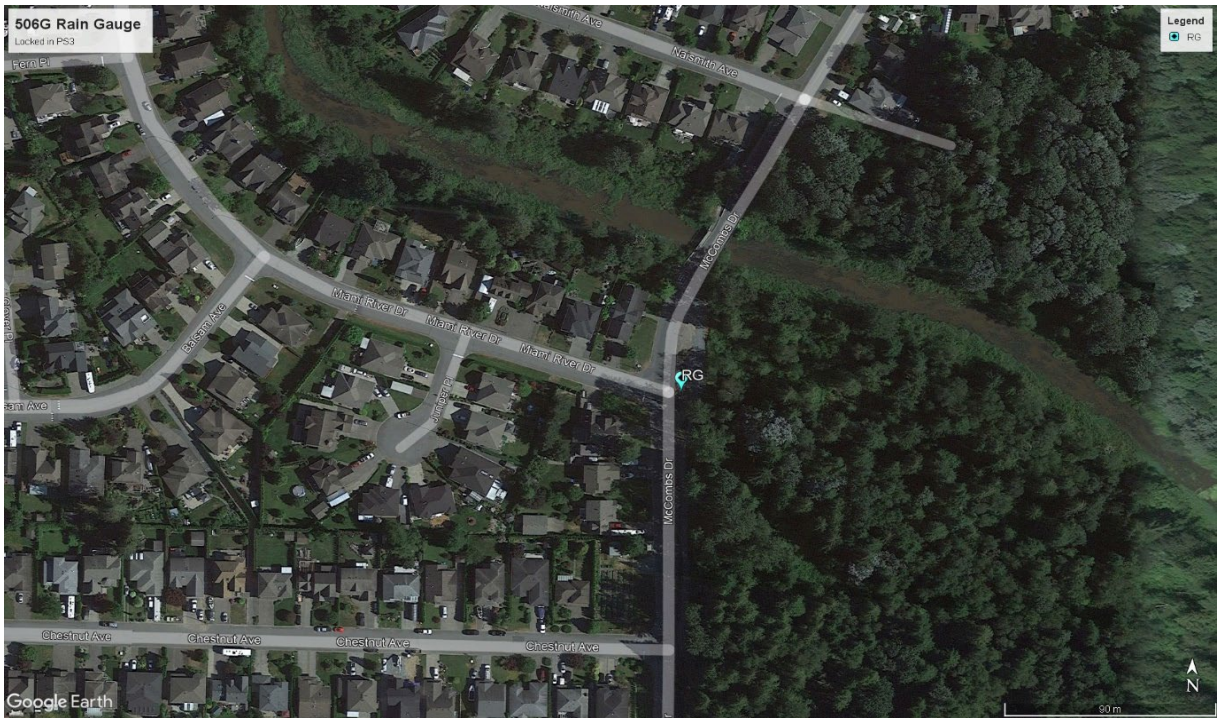
Site Pictures

CLIENT MONITORING #: 506G
NAME: Harrison Hot Springs Flow Monitoring

SFE PROJECT #: 506G
SFE SITE #: 506G Rain Gauge

Photo: Streetview Map

Map - Aerial



Site Pictures

CLIENT MONITORING #:	**506G**	**SFE PROJECT #:**	**506G**
NAME:	**Harrison Hot Springs Flow Monitoring**	**SFE SITE #:**	**506G Rain Gauge**

Site Details Sheet

CLIENT MONITORING #:	**506G**	**SFE PROJECT #:**	**506G**
NAME:	**Harrison Hot Springs Sanitary Flow Monitoring**	**SFE SITE #:**	**Sani Site 1**

Project Specific Information

Client Name:	Water Street Engineering
End User Name:	Harrison Hot Springs
Project Name:	Temporary Flow Monitoring
Client Contact:	Neal Whiteside
Field Contact:	Jace Hogdson
SFE PM Contact:	Sam Cumyn
Site Maintenance:	as required

Site Location Information

Client Site Name/ #:	N/A	
Street Address:	Cedar Ave & St. Alice St	
City, Province:	Harrison Hot Springs, BC	
GPS (North - West):	49.302187	-121.788143
Landmarks:	N/A	
Traffic Control Req's:	Local Traffic	
Additional Information:	N/A	
Sewer Type:	Sanitary	

Site Equipment

Installation Date:	January 23, 2025	
Removal Date:	May 23, 2025	
Meter Make & Model:	ISCO 2150	
Meter ID - #1:	506G Sani Site 1	
Meter ID - #2:	506G Sani Site 1	
Wireless ID #:	506G Sani Site 1	
Cellular #:	SFEBC	
Level / Velocity Type:	Submerged	AV Sensor
Sensor Mounting:	Compression	
Primary Device:	Area Velocity	
Logging Rate / Call out:	5 minute	24hr

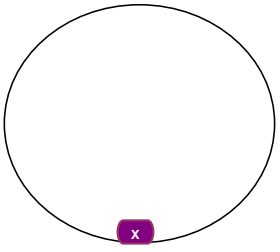
Site Profile

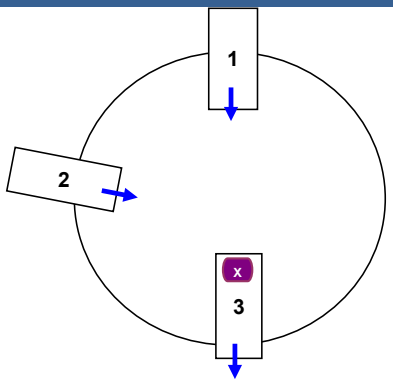
Overall Site Condition:	Good	
Access:	Road	
Invert Distance (cm):	210	
Overall Pipe Condition:	Good	
Pipe Size (mm): #1:	350	
#2	250	
Sensor (x) #3:	x ~~250~~ 350	
#4:	N/A	
Additional Information:	Sensor downstream.	

Site Set up

Sensor in Pipe #: #3 350mm outlet

Sensor Placement: Bottom Center





Map

Site Pictures

CLIENT MONITORING #: 506G
NAME: Harrison Hot Springs Sanitary Flow Monitoring
SFE PROJECT #: 506G
SFE SITE #: Sani Site 1

Photo: Streetview Map

Photo: Sewer Map N/A

Site Pictures

CLIENT MONITORING #: 506G
NAME: ırrison Hot Springs Sanitary Flow Monitorir

SFE PROJECT #: 506G
SFE SITE #: Sani Site 1

Photo: Surrounding Area

Photo: Inside MH prior to installation

Photo: Inside MH after installation

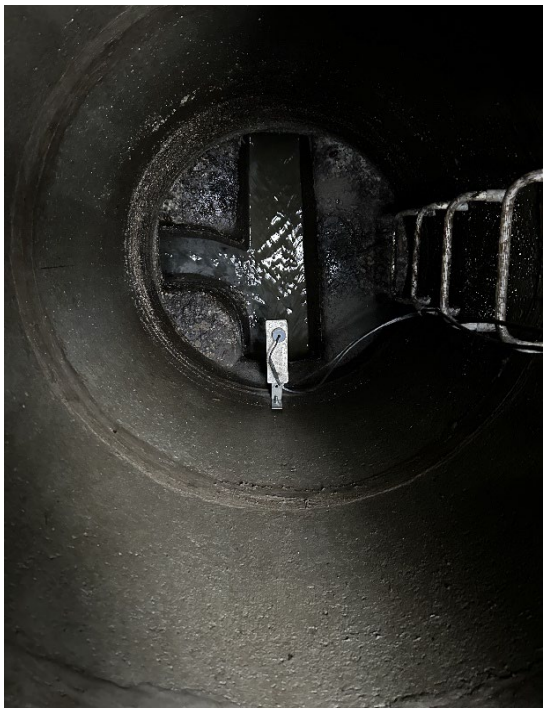
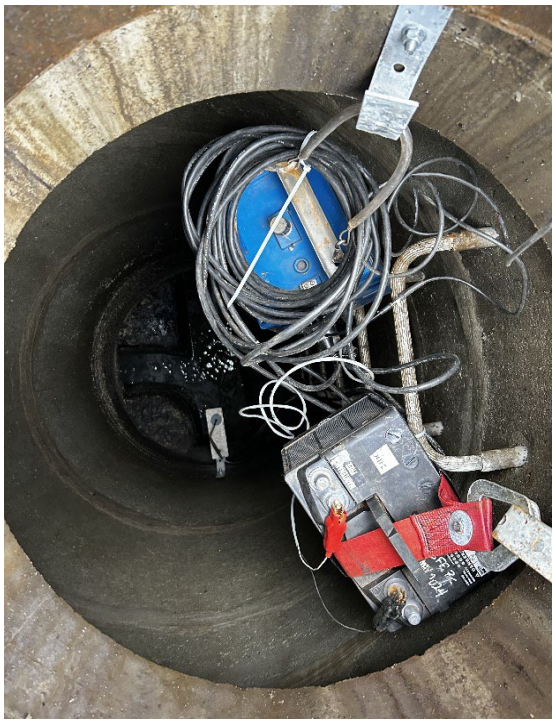


Photo: MH with equipment & battery



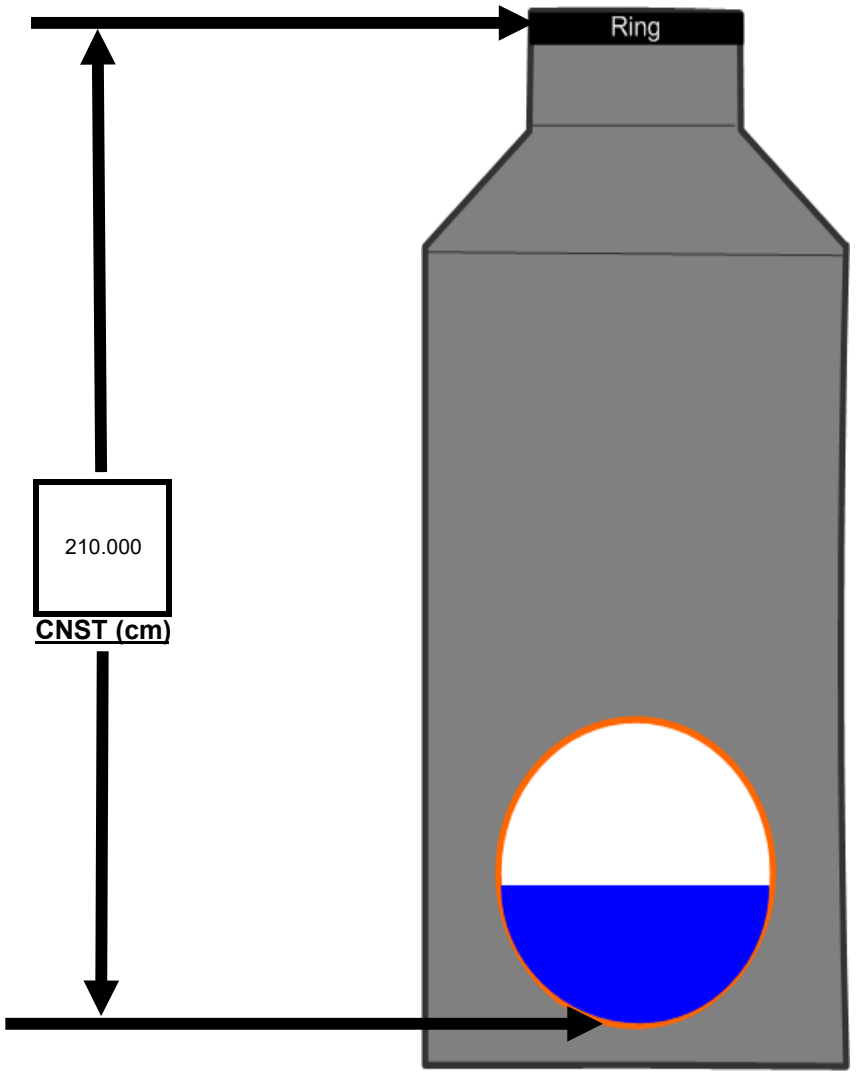
Install Sheet

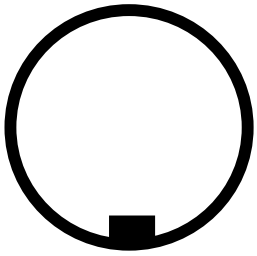
CLIENT FLOW MONITORING #: 506G
NAME: arrison Hot Springs Sanitary Flow Monitorin

SFE PROJECT #: 506G
SFE SITE #: Sani Site 1
Technician 1: Sam Cumyn
Technician 2: Sachin Ahlwat
Technician 3:

Meter Depth vs. Field Depth Calibration / Verification

Reading Number	Date (m/d/yyyy)	Time (hh:mm)	Field Meas (cm)	Meter Depth (cm)	Comments (Zero Meter Level before Installation)
Initial	1-23-2025	13:35	18.2	18.2	Installed AV sensor & US Velocity Reading (m/s): 0.248
1		(PST)	18.2	18.0	Level Offset +2000mm for AV. 506G Sani Site 1
2			18.2	18.2	US no offset.
3			18.2	18.2	Pipe Diameter (mm) = 350mm outlet
Average			18.2	18.1	Installed sensor downstream. Surcharge evidence.





Sensor Location

Site Details Sheet

CLIENT MONITORING #:	**506G**	**SFE PROJECT #:**	**506G**
NAME:	**Harrison Hot Springs Sanitary Flow Monitoring**	**SFE SITE #:**	**Sani Site 2**

Project Specific Information

Client Name:	Water Street Engineering
End User Name:	Harrison Hot Springs
Project Name:	Sanitary Sewer Master Plan
Client Contact:	Neal Whiteside
Field Contact:	Jace Hogdson
SFE PM Contact:	Sam Cumyn
Site Maintenance:	as required

Site Location Information

Client Site Name/ #:	MH16	
Street Address:	760 McCombs Dr.	
City, Province:	Harrison Hot Springs, BC	
GPS (North - West):	49.290230	-121.777550
Landmarks:	N/A	
Traffic Control Req's:	Full Traffic TMP req.	
Additional Information:	N/A	
Sewer Type:	Sanitary	

Site Equipment

Installation Date:	February 4, 2025	
Removal Date:	May 4, 2025	
Meter Make & Model:	ISCO 2150	
Meter ID - #1:	506G Sani Site 2	
Meter ID - #2:	506G Sani Site 2	
Wireless ID #:	506G Sani Site 2	
Cellular #:	SFEBC	
Level / Velocity Type:	Submerged	AV Sensor
Sensor Mounting:	Compression	
Primary Device:	Area Velocity	
Logging Rate / Call out:	5 minute	24hr

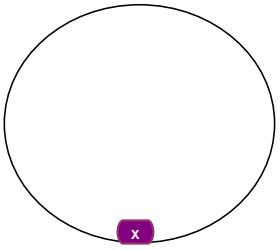
Site Profile

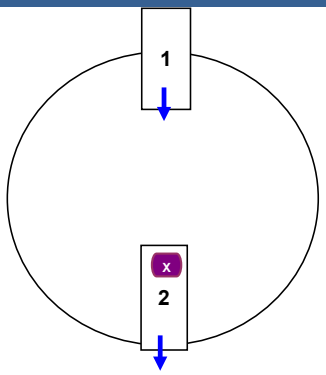
Overall Site Condition:		Good	
Access:		Road	
Invert Distance (cm):		120	
Overall Pipe Condition:		Good	
Pipe Size (mm):	#1:		300
	#2	x	300
Sensor (x)	#3:		N/A
	#4:		N/A
Additional Information:		Sensor downstream.	

Site Set up

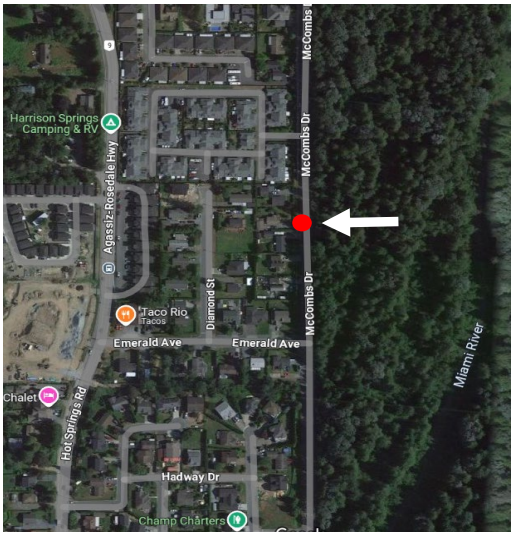
Sensor in Pipe #: #2 300mm outlet

Sensor Placement: Bottom Center





Map

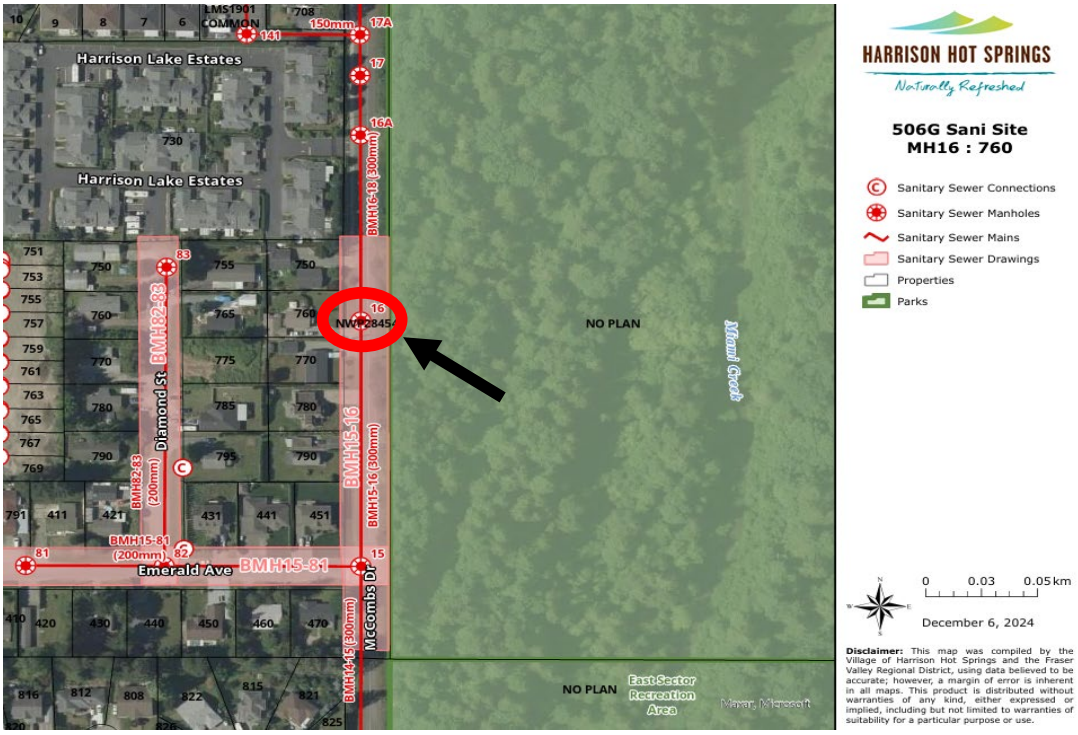


Site Pictures

CLIENT MONITORING #:	**506G**	**SFE PROJECT #:**	**506G**
NAME:	**Harrison Hot Springs Sanitary Flow Monitoring**	**SFE SITE #:**	**Sani Site 2**

Photo: Streetview Map

Photo: Sewer Map



Site Pictures

CLIENT MONITORING #: 506G
NAME: Harrison Hot Springs Sanitary Flow Monitoring
SFE PROJECT #: 506G
SFE SITE #: Sani Site 2

Photo: Surrounding Area

Photo: Inside MH prior to installation

Photo: Inside MH after installation

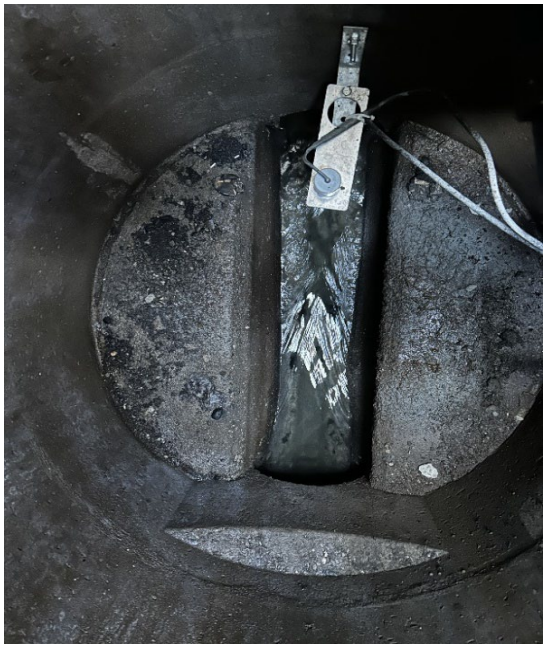


Photo: MH with equipment & battery

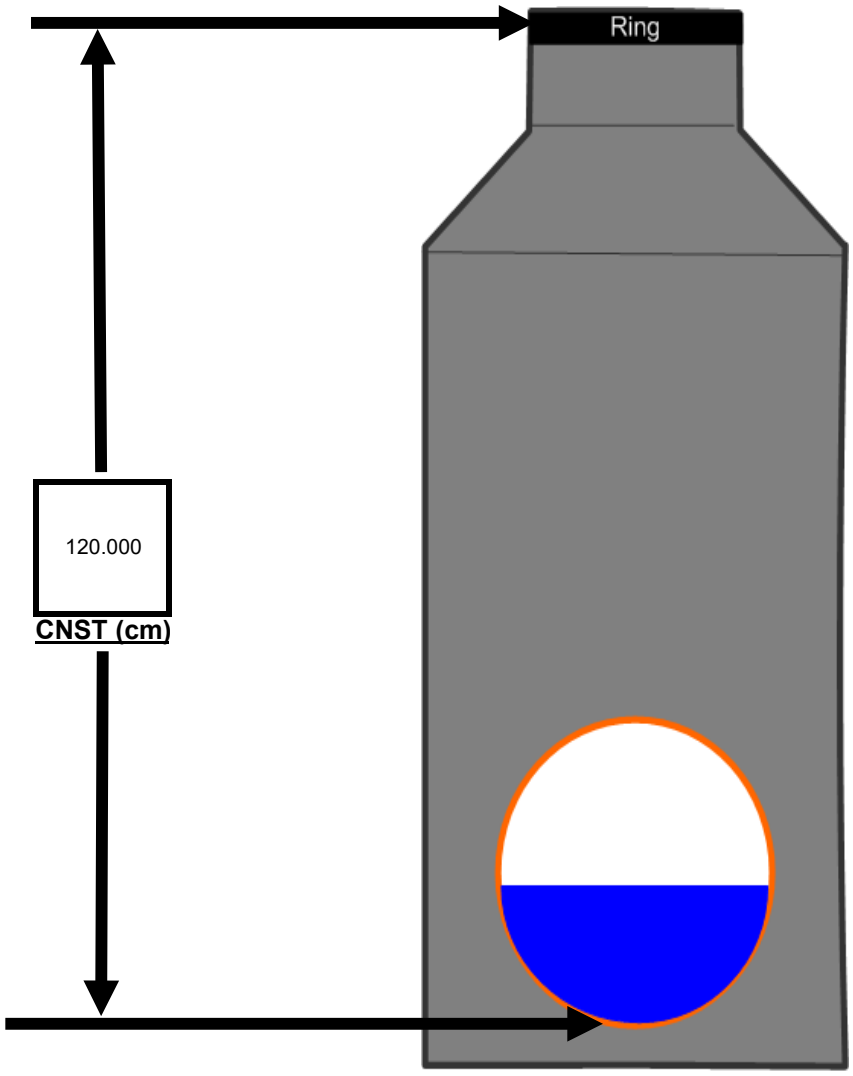
Install Sheet

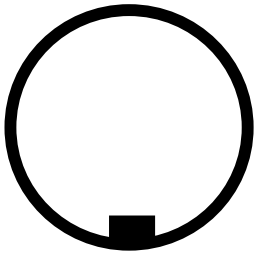
CLIENT FLOW MONITORING #: 506G
NAME: Harrison Hot Springs Sanitary Flow Monitoring

SFE PROJECT #: 506G
SFE SITE #: Sani Site 2
Technician 1: Sam Cumyn
Technician 2: Sachin Ahlwat
Technician 3:

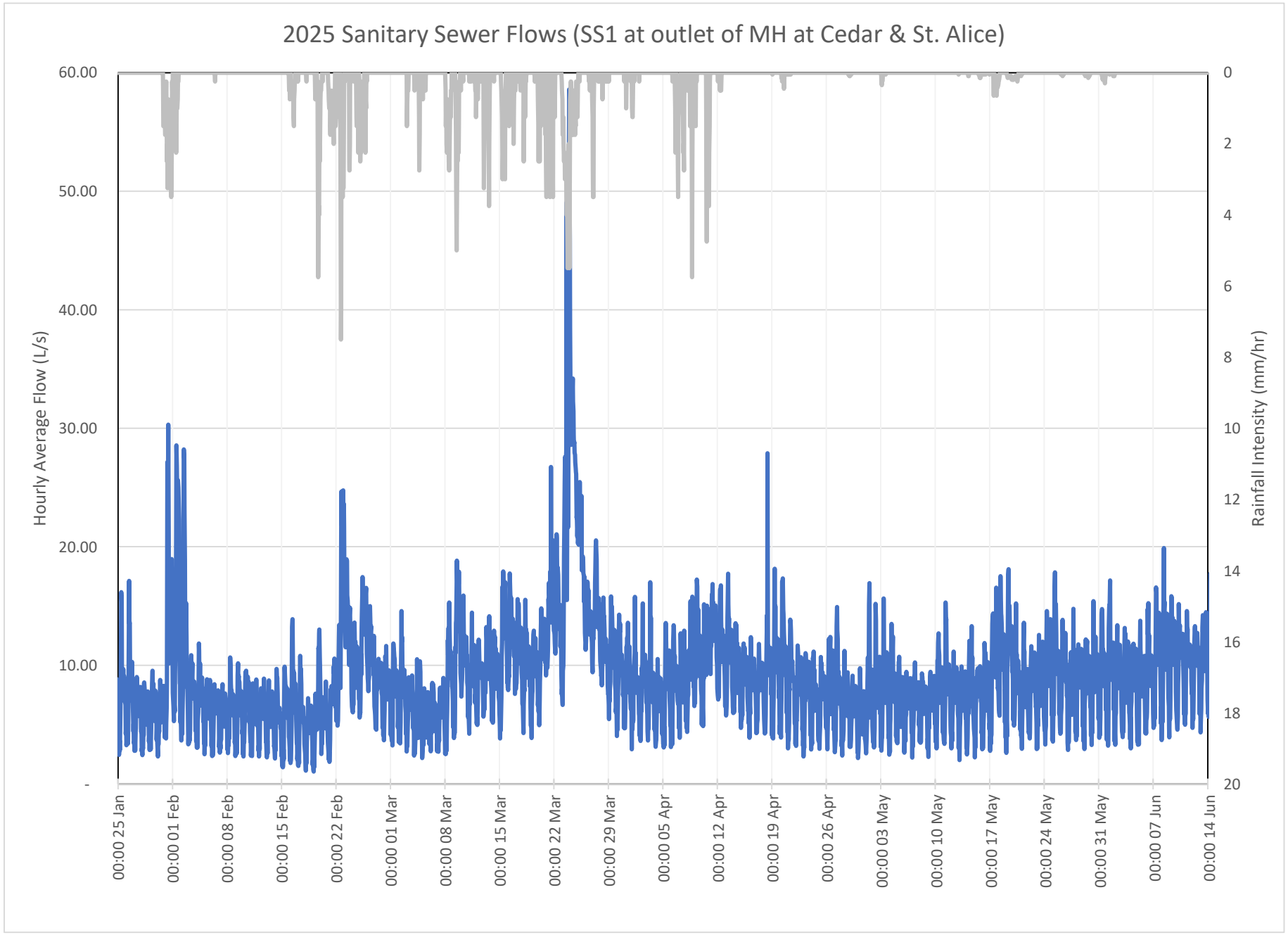
Meter Depth vs. Field Depth Calibration / Verification

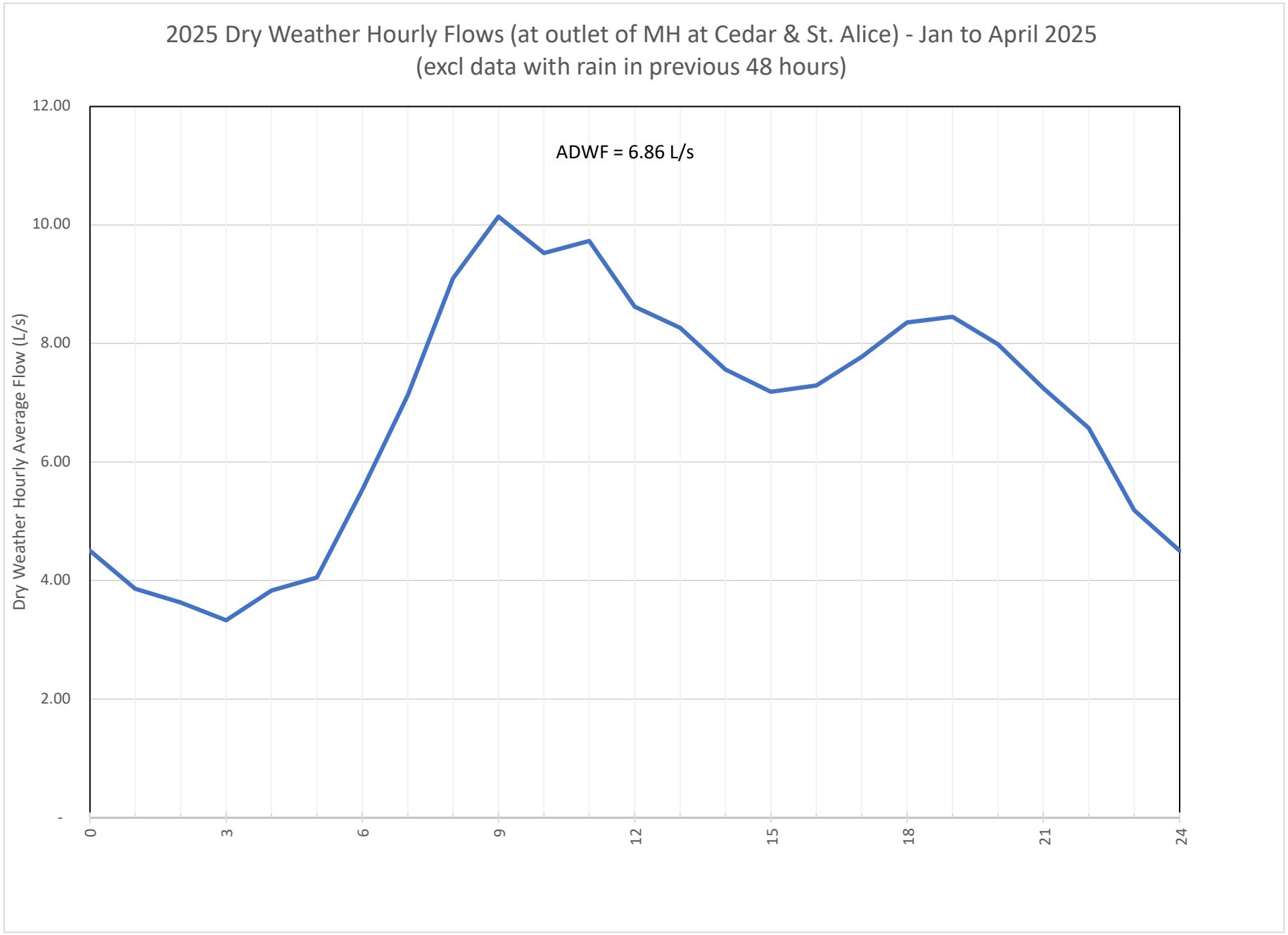
Reading Number	Date (m/d/yyyy)	Time (hh:mm)	Field Meas (cm)	Meter Depth (cm)	Comments (Zero Meter Level before Installation)
Initial	2-4-2025	11:10	3.0	3.0	Installed AV sensor & US Velocity Reading (m/s): 0.080
1		(PST)	3.0	3.0	Level Offset +2000mm for AV. 506G Sani Site 2
2			3.0	3.0	US no offset.
3			3.0	3.0	Pipe Diameter (mm) = 300mm outlet
Average			3.0	3.0	Installed sensor downstream.

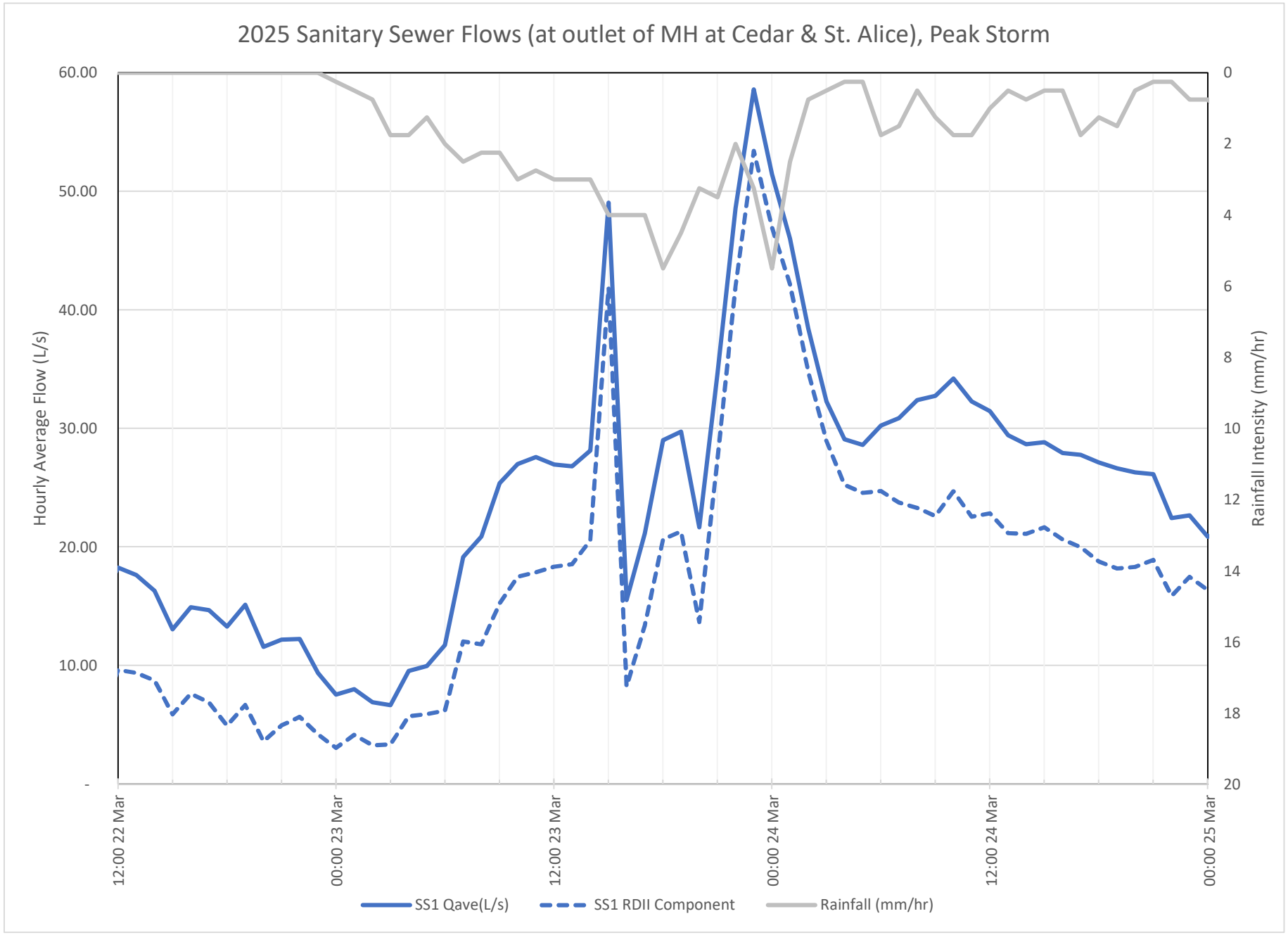


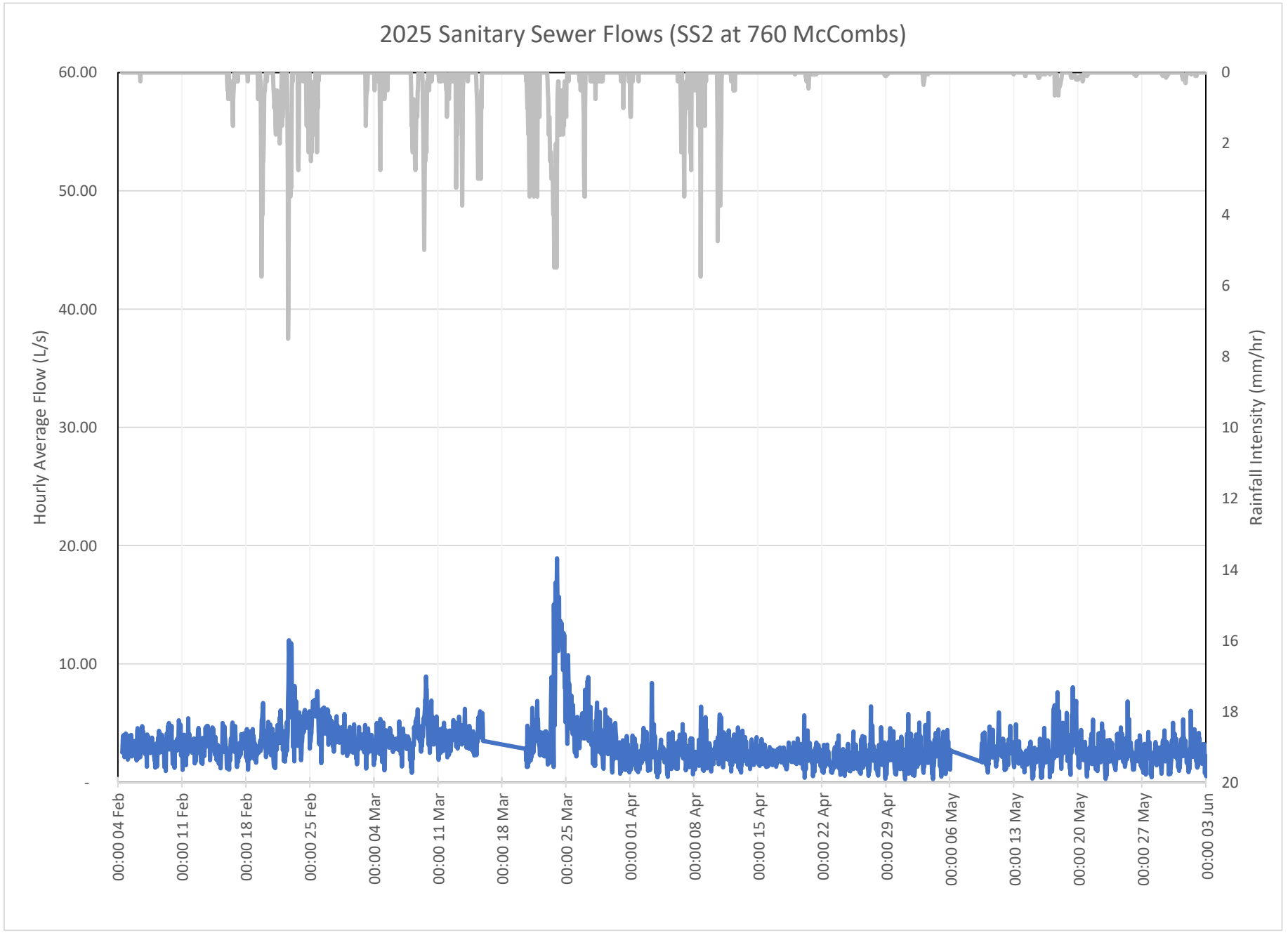


Sensor Location


2025 Sanitary Sewer Flows (SS1 at outlet of MH at Cedar & St. Alice)
Hourly Average Flow (L/s)
Rainfall Intensity (mm/hr)
60.00
50.00
40.00
30.00
20.00
10.00
-
0
2
4
6
8
10
12
14
16
18
20
00:00 25 Jan
00:00 01 Feb
00:00 08 Feb
00:00 15 Feb
00:00 22 Feb
00:00 01 Mar
00:00 08 Mar
00:00 15 Mar
00:00 22 Mar
00:00 29 Mar
00:00 05 Apr
00:00 12 Apr
00:00 19 Apr
00:00 26 Apr
00:00 03 May
00:00 10 May
00:00 17 May
00:00 24 May
00:00 31 May
00:00 07 Jun
00:00 14 Jun


2025 Dry Weather Hourly Flows (at outlet of MH at Cedar & St. Alice) - Jan to April 2025
(excl data with rain in previous 48 hours)
ADWF = 6.86 L/s
Dry Weather Hourly Average Flow (L/s)
12.00
10.00
8.00
6.00
4.00
2.00
-
0
3
6
9
12
15
18
21
24


2025 Sanitary Sewer Flows (at outlet of MH at Cedar & St. Alice), Peak Storm
Hourly Average Flow (L/s)
Rainfall Intensity (mm/hr)
60.00
50.00
40.00
30.00
20.00
10.00
-
0
2
4
6
8
10
12
14
16
18
20
12:00 22 Mar
00:00 23 Mar
12:00 23 Mar
00:00 24 Mar
12:00 24 Mar
00:00 25 Mar
SS1 Qave(L/s)
SS1 RDII Component
Rainfall (mm/hr)


2025 Sanitary Sewer Flows (SS2 at 760 McCombs)
Hourly Average Flow (L/s)
Rainfall Intensity (mm/hr)
60.00
50.00
40.00
30.00
20.00
10.00
-
0
2
4
6
8
10
12
14
16
18
20
00:00 04 Feb
00:00 11 Feb
00:00 18 Feb
00:00 25 Feb
00:00 04 Mar
00:00 11 Mar
00:00 18 Mar
00:00 25 Mar
00:00 01 Apr
00:00 08 Apr
00:00 15 Apr
00:00 22 Apr
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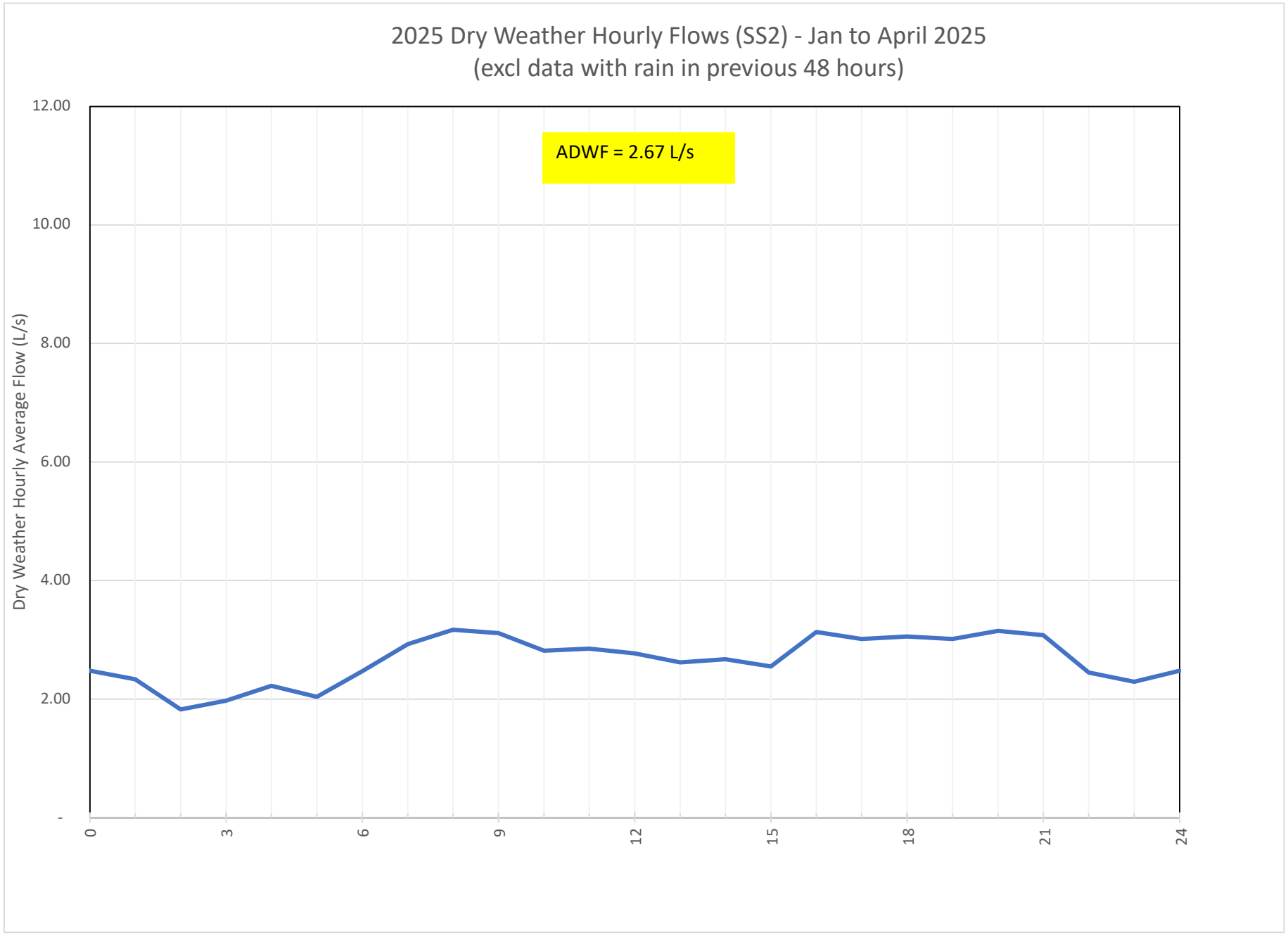
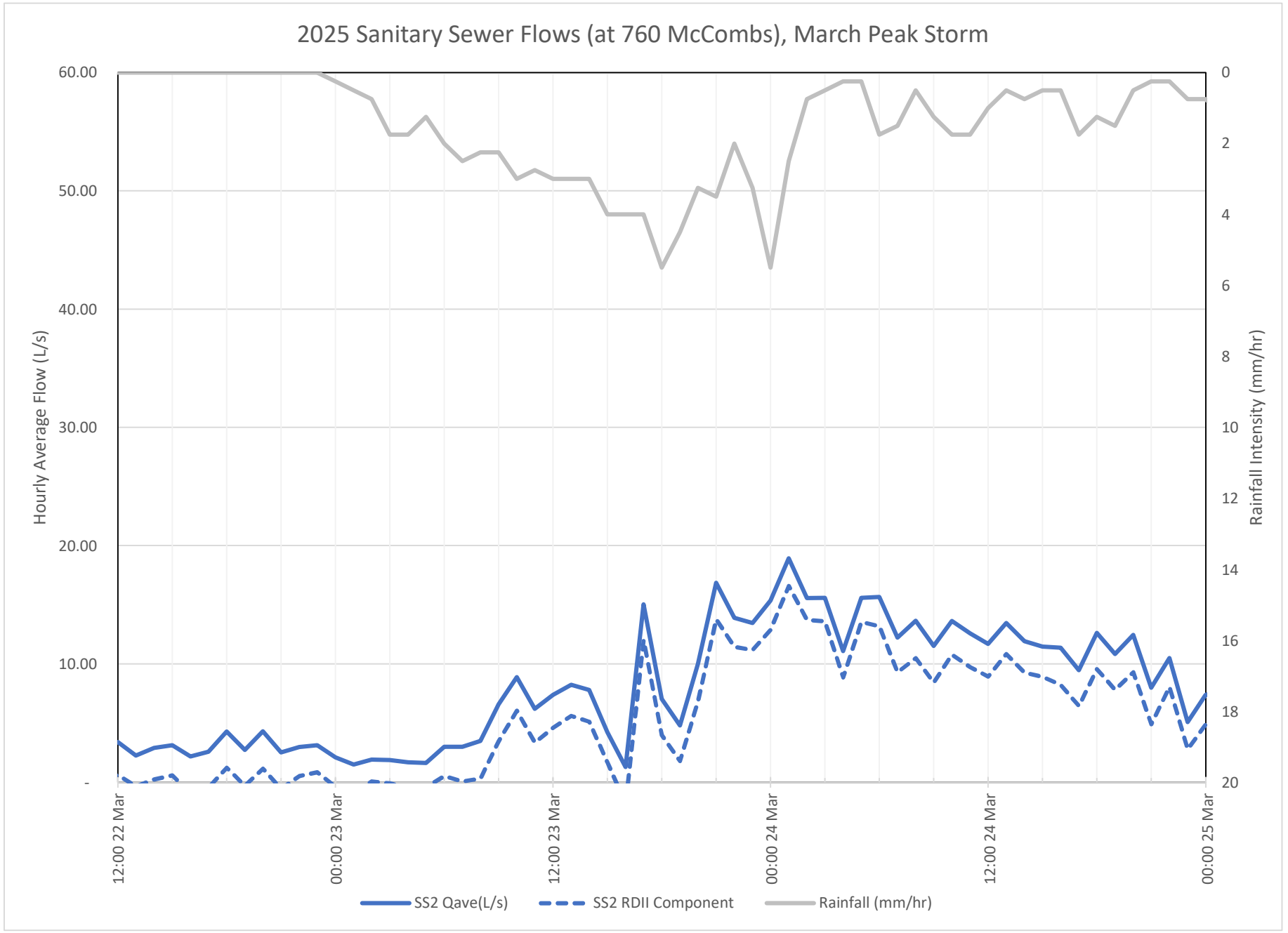
00:00 06 May
00:00 13 May
00:00 20 May
00:00 27 May
00:00 03 Jun


2025 Dry Weather Hourly Flows (SS2) - Jan to April 2025
(excl data with rain in previous 48 hours)
ADWF = 2.67 L/s
Dry Weather Hourly Average Flow (L/s)
12.00
10.00
8.00
6.00
4.00
2.00
-
0
3
6
9
12
15
18
21
24


2025 Sanitary Sewer Flows (at 760 McCombs), March Peak Storm
Hourly Average Flow (L/s)
Rainfall Intensity (mm/hr)
60.00
50.00
40.00
30.00
20.00
10.00
-
0
2
4
6
8
10
12
14
16
18
20
12:00 22 Mar
00:00 23 Mar
12:00 23 Mar
00:00 24 Mar
12:00 24 Mar
00:00 25 Mar
SS2 Qave(L/s)
SS2 RDII Component
Rainfall (mm/hr)

Water Street Engineering Ltd.
Project Title: Sanitary Sewer Master Plan - Flow Monitoring Data Analysis
Project #: 456
Purpose: *Summarizes the I&I values for observed storms*

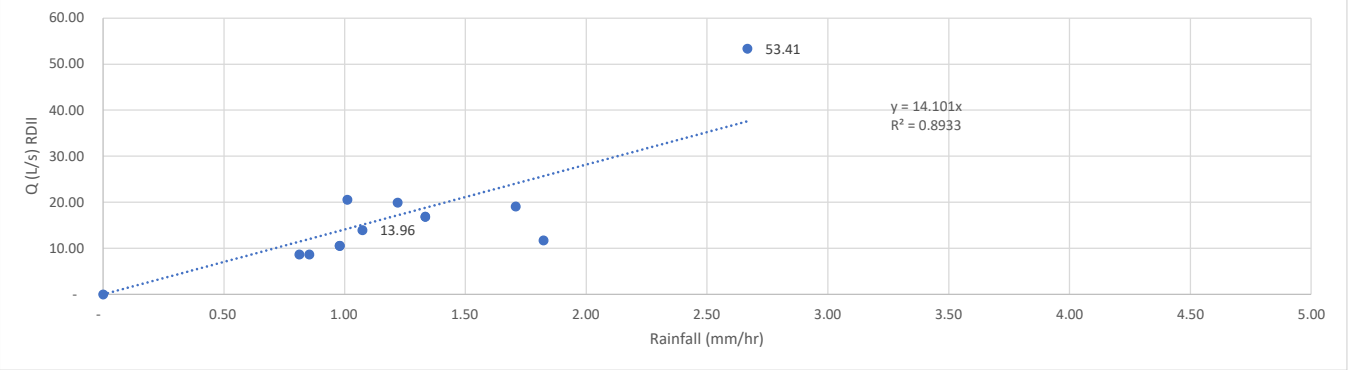
RDII Events recorded at SS1 — Rainfall Intensity (average over duration, in mm/hr)

Storm #	Date	r-1hr	r-2hr	r-4hr	r-6hr	r-12hr	r-24hr	I&I Peak Q-RDII (L/s)	Notes
0		-	-	-	-	-	-	-	
1	2025-01-31 11:00	0.75	1.13	1.88	1.92	1.52	1.01	20.58	
2	2025-01-31 21:00	2.50	3.00	2.44	2.54	2.10	1.82	11.72	
3	2025-02-01 12:00	2.00	2.13	1.13	0.79	0.42	1.22	19.93	
4	2025-02-22 17:00	2.25	4.50	4.81	3.38	1.73	1.33	16.89	
5	2025-02-22 17:00	2.25	4.50	4.81	3.38	1.73	1.33	16.89	
6	2025-02-23 0:00	1.75	2.50	2.44	2.54	3.06	1.71	19.11	
7	2025-03-09 13:00	4.00	4.50	3.50	2.54	1.27	0.98	10.57	
8	2025-03-09 13:00	4.00	4.50	3.50	2.54	1.27	0.98	10.57	
9	2025-03-15 18:00	0.50	1.75	1.25	1.13	1.56	0.81	8.66	
10	2025-03-16 8:00	-	0.25	0.50	0.38	0.23	0.85	8.65	
11	2025-03-21 22:00	0.75	2.13	1.56	1.54	1.35	1.07	13.96	
12	2025-03-23 23:00	3.25	2.63	3.00	3.67	3.58	2.67	53.41	

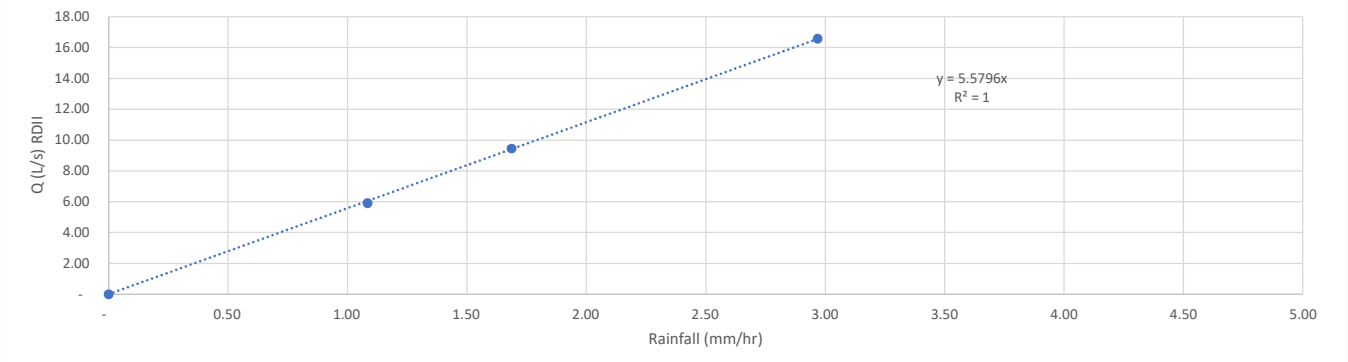
RDII Events recorded at SS2 — Rainfall Intensity (average over duration, in mm/hr)

Storm #	Date	r-1hr	r-2hr	r-4hr	r-6hr	r-12hr	r-24hr	I&I Peak Q-RDII (L/s)	Notes
0		-	-	-	-	-	-	-	
4	2025-02-22 23:00	3.25	2.25	2.81	2.46	2.92	1.69	9.45	
7	2025-03-09 17:00	1.75	1.88	2.13	2.92	1.98	1.08	5.92	
12	2025-03-24 1:00	2.50	4.00	3.31	3.33	3.75	2.97	16.59	

SS1 RDII vs average 24-hr rainfall intensity



SS2 RDII vs average 24-hr rainfall intensity



Notes: The I&I values indicate best correlation between rainfall and RDII for 24hr storm, indicating RDII is slow infiltration dominated.

https://wopi.dropbox.com/wopi/files/oid_401158149539179392O/WOPIServiceId_TP_DROPBOX_PLUS/WOPIUserId_-/[Flow Monitoring Data v2.xlsx]I&I Summary

WATER STREET ENGINEERING

Storm Sewer Master Plan

Village of Harrison Hot Springs

04 Dec 2025

Document Information

Project	Village of Harrison Hot Springs Storm Sewer Master Plan		
Report Title	Storm Sewer Master Plan		
Authors	David Marshall, PEng, Neal Whiteside, MASc, PEng		
Date	04 Dec 2025	Reference	Water Street File # 456.300.2
Version	0	Status	Issued for Council Review

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Permit to Practice

EGBC permit number 1000830.

Revision History

Version	Status	Date	Description of Revisions	Author
A	Draft	03 Oct 2025	Draft document	DM
B	Draft	14 Nov 2025	Updates for missing sections, refinements to align with updated analysis and address Village comments	DM
C	Draft	24 Nov 2025	Updates per Village comments and additional review, minor refinements.	DM
0	Issued for Council Review	04 Dec 2025	Updates per Village comments, minor refinements	DM

https://wopi.dropbox.com/wopi/files/oid_401158149314028467 2/WOPIServiceId_TP_DROPBOX_PLUS/WOPIUserId_1020286355/Storm Master Plan.docx

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APPENDICES

APPENDIX 1: PROJECT DEFINITION SHEETS

EXECUTIVE SUMMARY

Water Street Engineering Ltd. (Water Street) was retained by the Village of Harrison Hot Springs (the Village) to prepare a Storm Sewer Master Plan. The purpose of this plan is to assess the performance of the existing storm sewer system, identify current and future deficiencies, and establish a prioritized capital works program to support sustainable growth and stormwater management within the Village.

This plan builds on the 2016 Liquid Waste Management Plan (LWMP) and associated Autodesk Storm and Sanitary Analysis model. To update the storm sewer model, the previous model was imported into PCSWMM and updated to incorporate record drawings from recent developments, new survey data, and observed field conditions. The hydraulic network was expanded to include Miami Creek (more commonly known as Miami River) and key open-channel ditches to represent complete flow connectivity to Harrison Lake. Subcatchments were re-delineated using 2016 LiDAR data, and imperviousness was reassessed using 2023 aerial imagery and current zoning. Infiltration and other hydrologic parameters were assigned based on provincial soil classifications and established literature values.

Model calibration and validation were completed using flow monitoring data collected at three representative sites between February and June 2025. Calibration results demonstrated agreement between observed and modelled flows, confirming that the updated model provides a reliable basis for evaluating infrastructure capacity and informing design decisions.

Deficiency analysis was completed for existing and future (Year 2050) design storm scenarios. This analysis indicated many storm sewers do not meet the Village's current design criteria. However, the drainage system is still able to convey the design flows under surcharged conditions with minimal surface flooding. The most significant deficiencies noted were:

- The Miami River Dike Pump Station has observed inlet capacity concerns.
- The model indicates significant potential for surface flooding along Bear Ave.
- There is no drainage system on the east portion of Echo Ave, which is prone to flooding.
- McPherson Rd ditch is subject to backwater conditions from beaver activity west of Hot Springs Rd.
- There is limited water quality treatment within the Village, with approximately 29% of developed drainage areas discharging to Miami River or a tributary without any documented water quality treatment.

Based on the background review, input from Village staff, and the storm sewer model work, a capital works plan was developed. The Village is currently confirming access rights for storm sewers that were identified to be crossing private property.

There is one recommended "High" priority project; assessing the Miami River Dike Pump Station and outlet works to Harrison Lake based on observed capacity issues. The pump station function is critical to the performance of the storm sewer system. It is understood that this assessment is ongoing.

There are six recommended "Medium" priority projects:

1. Implementation of a surface flooding field verification program to confirm modelled capacity issues.
2. Implementation of a stormwater quality monitoring program to prioritize areas for treatment projects.
3. Completion of a storm sewer condition assessment to identify pipes that are at risk of failure.
4. Sewer upgrades to resolve capacity deficiencies along Bear Ave.
5. Installation of a new storm sewer on Echo Ave and restore outfall function for the Mount St system to address reported drainage issues.
6. Resolution of backwater conditions and inflow issues along McPherson Rd and McCombs Dr, including elimination of an inappropriate drainage connections from the East Sector Recreation Area.

There are two recommended "Low" priority projects:

1. Realignment of the storm sewer from Lillooet Ave that crosses private property at 565 Lillooet Ave.
2. Addition of a Hope Pl storm sewer to reduce local inflow and infiltration issues with the sanitary sewer.

In addition to the recommended projects, 18 conditional projects have been identified to resolve capacity deficiencies where the risk of damaging surface flooding is low based on model results. Six of the conditional projects have been identified for monitoring to verify any surface flooding during significant storm events. Potential triggers for the conditional projects include field verification of surface flooding issues, identification of water quality issues, and condition assessment data that indicates pipes are at risk of failure. An overview of the estimated costs for the identified projects is provided as follows:

Table 1: Projects Summary by Priority

Project Priority	Number of Projects	Total Capital Costs
High	1	$30,000
Medium	6	$1,146,000[1]
Low	2	$799,000
Conditional - Monitor	6	$4,792,000
Conditional - Assess	12	$5,654,000
Total		$12,421,000
Notes: [1]Excludes estimated cost of $50,000/yr for stormwater quality monitoring program.		

The identified capital projects are not triggered by growth. They are required to resolve existing system limitations and increased rainfall intensity associated with climate change. As such, they are not eligible for Development Cost Charge funding. The projects are recommended to reduce flood risk, improve stormwater quality, and enhance environmental protection or asset condition information and thus align with the objectives of provincial and federal grant programs that focus on disaster risk reduction, climate adaptation, and sustainable water infrastructure.

In addition to the identified capital projects, the following recommendations are made regarding urban drainage concerns:

1. Confirm access rights for storm pipes crossing 114 Cedar Ave, 830 Ramona Pl, 861 and 875 Myng Cr.
2. The Village's Subdivision and Development Servicing Bylaw should be updated to require consideration of climate change impacts.
3. An updated Emergency Response Plan should be developed that considers hazards from urban drainage and flooding. A project to provide a Drainage/Sewer Emergency Response Plan is identified in the Sanitary Sewer Master Plan (Water Street Engineering Ltd., 2025).

Overall, the updated modelling work, deficiency assessment, and capital works plan provides the Village with a clear framework for stormwater infrastructure investment and policy decisions. Implementation of the recommended improvements will reduce flooding risk, enhance water quality, and align the Village's infrastructure planning with its 2022 *Subdivision and Development Servicing Bylaw* and future climate-adaptation objectives.

1 INTRODUCTION

1.1 PURPOSE

Water Street Engineering Ltd. (Water Street) was retained by the Village of Harrison Hot Springs (the Village) to provide engineering services for the development of the Village's Storm Sewer Master Plan. The purpose of this Storm Sewer Master Plan is to create an updated plan for stormwater infrastructure improvements to meet future demands and resolve existing deficiencies. An overview of the storm sewer infrastructure is provided on Figure 1-1 attached.

1.2 SCOPE

The scope of the Storm Sewer Master Plan includes:

- Review of relevant background reports
- Updated assessment of stormwater infrastructure deficiencies based on updated modelling of existing condition with current rainfall data
- Updated assessment of future condition stormwater infrastructure requirements
- Recommendations for flow reduction and flow management
- Recommendations for infrastructure improvements to meet future demands
- Class D cost estimates for recommended improvements
- Prioritized recommendations for infrastructure improvements

1.3 PREVIOUS STUDIES

The storm system was previously assessed for the 2016 Liquid Waste Management Plan (LWMP) (CTQ Consultants Ltd., 2016). The 2016 LWMP built on a 2008 Storm Water Drainage Requirements Study completed by Civic Consultants (2008). The 2008 study included a Drainage Features Survey by Eaton Land Surveyors Ltd.

1.4 LIMITATIONS

This report is based on information received from the Village. It must be read with the Statement of Limitations at the beginning of this document.

The following data limitations affect the accuracy of the model and calculated results:

- **Assumption that Miami River and Harrison Lake water levels do not cause backwater conditions that could limit storm sewer performance. This assumption is further detailed in later sections of the report.**
- Potential inaccuracies and/or missing information from the GIS shapefiles and record drawings provided to update the model. This includes missing information on pipe materials and age of install for many sewers.
- Limited flow monitoring data was used for calibration. Flow monitoring at three strategic locations from Feb to Jun 2025 was used to calibrate the entire model as detailed in this report.
- Limitations on forecasting impacts of future development on stormwater runoff.
- Limitations on forecasting climate change impacts on rainfall.
- Limitations on available catch basin information such that inlet capacity was not modelled (full utilization of the sewer capacity was assumed).

Legend

Drainage Elements

- Creek System
- Ditch
- Storm Sewer
- Storages
- Outfalls
- Manholes, Storm Junctions

N

0 150 300 450 m

1:10,000

WATER STREET ENGINEERING

EGBC Permit to Practice #1000830

Storm Sewer Master Plan

PREPARED FOR

Village of Harrison Hot Springs

PROJECT NO. 456.2

DATE 04 DEC 2025

REVISION 0

Storm Infrastructure Overview

Figure 1-1

Document Path: D:\WSE Dropbox\001-Projects\456-Harrison Hot Springs Master Plans\430-GIS\data\MD_Storm Infrastructure\ArcMap Working Folder\Storm Infrastructure Overview.mxd

1.5 ACKNOWLEDGEMENTS

The project development, leadership, and review of interim deliverables was accomplished with the assistance of the following individuals.

- Village of Harrison Hot Springs
  - Director of Operations
  - Utilities Supervisor
  - Public Works Supervisor
- SFE Global (flow monitoring program)
  - Glenn Cumyn
  - Nicole Moen
  - Sam Cumyn
- Wedler Engineering
  - Jonathan Funk, PEng; Principal

In addition to the authors, the Water Street Engineering team included: Andrew Clow, PEng; Laura Christensen, PEng, Connor Dickson, EIT; and Jade Sangha, EIT.

We acknowledge ClimateData.ca for providing the climate information used. ClimateData.ca was created through a collaboration between the Pacific Climate Impacts Consortium (PCIC), Ouranos Inc., the Prairie Climate Centre (PCC), Environment and Climate Change Canada (ECCC), Centre de Recherche Informatique de Montréal (CRIM), and Habitat7.

2 EXISTING SYSTEM BACKGROUND

The existing storm sewer system primarily discharges to Miami Creek (more commonly known as Miami River) upstream of Harrison Lake. Drainage is conveyed to Miami River via a system of storm sewers, ditches, and culverts that has several discharge points distributed along the length of the creek.

2.1 EXISTING STORM SYSTEM MODEL

An Autodesk Storm and Sanitary Analysis storm system model was developed by CTQ Consultants Ltd. (CTQ) for the Village during the preparation of the 2016 LWMP. The existing model included a total catchment area of 105 ha. Areas where runoff flowed directly into Miami River, or a natural tributary, were not modelled. The model did not include leads from catch basins or stormwater management infrastructure in private developments. Downstream boundary conditions for pipe outlets were set to free flow conditions. Deficiencies that were identified during the 2016 review included pipes with reverse grades, undersized pipes, and lack of water quality treatment. This is further described in the following section.

2.2 EXISTING DEFICIENCIES (FROM 2016 LWMP)

The 2016 LWMP identified several deficiencies in the existing storm system. The 2016 deficiencies are summarized in Table 2-1.

Table 2-1: Existing Condition Deficiencies from 2016 LWMP

2016 ID	Location	Deficiency	Status
1, 8	Cedar Ave west of Hot Springs Rd	Negative slope, undersized pipe	No deficiency. Misidentified flow direction.
2	Maple St north of Lillooet Ave	No slope	Unresolved
3	Angus Estates	ROW registration on private properties	Location of new storm sewer. IFC Drawings indicate a ROW.
4	Various ditches	Ditch alterations by property owners	Unknown
5	Discharge locations	Treatment required	Select areas have treatment
6	Driftwood Ave	Clogged manhole	Unknown. Assumed to be resolved.
7	Pine Avenue	Vitrified clay pipe	Resolved. Upgraded in 2018.
9	Lillooet Ave west of Chehalis St	Undersized pipe	Modelled incorrectly. Resolved through record drawing.
10, 11	Lillooet Ave near Spruce St	Rock pits with no overflow	Resolved through new storm system for 470 Esplanade Ave
12	Echo Ave	Undersized pipe	Resolved. Updated survey confirmed adequate.
13	Hadway Dr	Undersized pipe	Unresolved
14, 15	Myng Cres	Undersized outfalls	Unresolved

2016 ID	Location	Deficiency	Status
16	Hot Springs Rd	Inadequate drainage system	The inadequate stormwater management system on Hot Springs Road (Highway 9), identified as deficiency 16 in the LWMP, is under the jurisdiction of the Ministry of Transportation and Transit (MOTT). Improvements to provide a proper drainage system are ongoing (autumn 2025) and will address drainage south of 750 Hot Springs Road.
17	McPherson Rd	Collapsed pipe section	Submerged due to backwater condition during site visit
18	McCombs Dr & McPherson Rd	Standing water / collapsed pipe	Unresolved. Negligible slope and backwater condition.
19	McCombs Dr	Collapsed pipe section	Resolved as part of 2019 Lift Station 3 upgrades

More generally, the LWMP noted there are significant areas that lack a storm sewer system and do not have adequate drainage. In some of these areas, storm services have been connected to the sanitary sewer system which impacts the conveyance and treatment capacity of the sanitary sewer system and the wastewater treatment plant (WWTP).

2.3 POTENTIAL DEFICIENCIES NOTED IN 2024 FIELD VISIT

Beyond deficiencies identified in the LWMP, the following additional deficiencies were identified during a Nov 2024 site visit by Water Street (David Marshall and Neal Whiteside) and through conversations with Village staff:

- There are conveyance capacity limitations with the box culvert that connects Miami River to the Harrison Lake pump intake (at the Miami River Dike Pump Station).
- There is no drainage system for the section of Echo Ave (east of Eagle St) leading to Mount St drainage system.
- Water ponds at Lillooet Ave near Eagle St. It is understood that regrading as part of ongoing paving work (autumn 2025) may resolve this issue.
- A catch basin on McCombs Dr (approximately 100 m north of McPherson Rd) is elevated and should be levelled or lowered to improve drainage capture.
- There is inflow to the McCombs Dr storm sewer from the East Sector Recreation Area. This area should be draining away from the Village's storm sewer system.
- There was a significant backwater condition in the McPherson Rd ditch extending upstream of the Hot Springs Rd culvert crossing.
- Considerable surface runoff from 872 Hot Springs Rd drains to 880 Hot Springs Rd. The homeowners at 880 Hot Springs Rd have built an onsite storm detention pond and pump the stormwater out to the highway. It is understood that a new storm connection has been added to this property as part of drainage upgrades along Hot Springs Rd.

2.4 RECENT DEVELOPMENTS

Subsequent to the development of the 2016 LWMP, the following developments have occurred:

- Harrison Lake View
- 470 Esplanade Ave (Oasis at Harrison Lake)
- Pine Ave Subdivision
- 750 Hot Springs Rd
- 775 Hot Springs Rd
- 798 Hot Springs Rd

The following infrastructure improvements have also occurred:

- Pine Ave, Emerald Ave, and Myng Cr Neighbourhood Upgrades
- Lift Station 3 drainage improvements

Additionally, the following infrastructure improvements are in the process of being constructed or have been constructed in 2025:

- Hot Springs Rd (Highway 9) drainage improvements (from north of Emerald Ave south to Miami River)
- McCombs Dr drainage improvements (from Hot Springs Rd south of Emerald Ave to the McCombs Dr ditch and Miami River)

3 EXISTING CONDITION MODEL UPDATES

3.1 SOFTWARE SELECTION

The existing storm system model from the 2016 LWMP was developed in Autodesk Storm and Sanitary Analysis. To update the 2016 model, the model was exported in EPA SWMM format for modelling in PCSWMM. PCSWMM was selected for its compatibility with the original model format, proven performance and regulatory acceptance in urban drainage modelling, dual drainage network capabilities, and its stand-alone GIS engine that enables efficient model updates and results analysis.

3.2 MODEL SETUP

EPA SWMM software allows for the selection of a range of simulation options to characterize flow and runoff. The following modelling methodologies have been selected for the updated PCSWMM model:

- Routing method: Dynamic Wave
    - This is the same methodology as used in the 2016 model and is typically used for urban storm networks. The dynamic wave method allows for more complex system hydraulics, such as backwater effects and surcharging, to be modelled.
- Infiltration method: Green-Ampt
    - Green-Ampt was selected over Horton (used in the 2016 model) because its physically based approach offers more accurate infiltration estimates for event-based urban runoff modelling than Horton's empirical method which requires more field data and responds less effectively to varying rainfall intensity.

3.3 HYDRAULIC NETWORK UPDATES

As a starting point for the model updates, the hydraulic network was verified and updated with infrastructure from recent developments. The existing model lacked documentation on data sources, which limited confidence in reliability. Therefore, data for the existing junctions and conduits in the model was cross-checked with available record or design drawings and available survey information. For each junction and conduit, information about the asset type, condition, dimensions, data sources, and assumptions were recorded. Through this process, several inaccuracies in the 2016 modelling were identified and corrected. Significant changes included addition of the Mount St drainage infrastructure and the Harrisburgh and Emerald Gate Estates development drainage infrastructure. For the recent developments listed in Section 2.3, the associated infrastructure was also added to the model.

To improve model connectivity and comprehensiveness, open channel ditches and Miami River were added to the hydraulic network. Miami River was modelled in PCSWMM as a series of conduits between the outlet nodes from the storm sewer network. The Miami River channel geometry was derived from a Digital Elevation Model (DEM) available from the Forests, Lands, and Natural Resource Operations and Rural Development, GeoBC project NDMP 2016 which included LiDAR data acquisition between June and September 2016. The data indicates that that water level at the downstream limit of Miami River was approximately 10.5 m when the LiDAR was collected. The Miami River channel inverts and slopes were assigned based on survey points collected at mid-channel from select bridge crossings.

After finalizing the base hydraulics for the model, a dual drainage system was added to the storm sewer conduits to convey major system flows that exceed the capacity of the storm sewer. The dual drainage system is a simplified representation of the roadway above the storm sewer. The model assumes that all surface runoff enters the storm sewer network and overflows into the dual drainage network if the pipe capacity is exceeded. This assumption does not account for potential inlet capacity restrictions that would limit the effectiveness of the storm sewers (assumes the collection system has higher capacity than the storm sewer).

Following the model updates, the total number of nodes was increased from 175 in the 2016 model to 261 in the updated model and the total number of conduits was increased from 161 to 256 (not including the overland drainage system above the pipes). By adding Miami River to the model, the number of outfalls

was decreased. The ultimate outfalls for the updated model are Harrison Lake, the undeveloped area west of the Village that connects to the Miami Slough, and the west end of the ditch on McPherson Rd.

3.4 HYDRAULIC NETWORK PARAMETERIZATION

Roughness coefficients are used to quantify the major energy losses due to friction along the drainage network. For the updated model, a Manning's roughness coefficient of 0.013 was assigned to all concrete and PVC pipes[1], 0.024 was assigned to corrugated metal pipes, 0.05 was assigned to roadway ditches and Miami River. The assigned Manning's roughness coefficients were selected based on typical published values and are similar to the Village's *Subdivision and Development Servicing Bylaw No. 1179* (Village of Harrison Hot Springs, 2022).

Loss coefficients are applied at manhole directional changes, culvert inlets, and culvert or storm sewer outlets to account for minor losses in the system. An entrance loss coefficient of 0.50 has been assigned to culvert inlets and an exit loss coefficient of 1.00 has been assigned to culvert or storm sewer outlets based on typical published values. Losses due to directional changes at manholes have been assigned based on design guidance in the Mile High Flood District's 2024 *Urban Storm Drainage Criteria Manual: Volume 1 – Management, Hydrology, and Hydraulics* as summarized in Table 3-1. It is generally assumed that manholes do not have benching (higher losses are assumed).

Table 3-1: Manhole Bend Loss Coefficients (Mile High Flood District, 2024)

Angle in Degree	Loss Coefficient (No Benching)	Loss Coefficient (With Benching)
0 - 5	0.05	0.05
5 - 22.5	0.13	0.10
22.5 - 30	0.20	0.15
30 - 45	0.38	0.28
45 - 60	0.63	0.48
60 - 70	0.85	0.63
70 - 80	1.08	0.82
80 +	1.32	1.01

3.5 SUBCATCHMENT DELINEATION

The subcatchments in the 2016 model were generally delineated based on property boundaries. Upon closer inspection of subcatchments and the private development stormwater management plans, various inaccuracies in the subcatchment delineation were identified. To take advantage of improved topographic data and to address issues in the 2016 model, an updated subcatchment delineation was completed using PCSWMM's delineation tool and the DEM from 2016 LiDAR data. Delineating catchments in urban areas is more difficult because of the surface features and underground infrastructure that impact overland flow directions. To limit inaccuracies from automated delineation, the following process was used.

1. PCSWMM's watershed delineation tool was used to define catchment boundaries for outlets to creeks or ditches based on the DEM from 2016 LiDAR.
2. Catchments that did not contribute to the Village's storm infrastructure were generally eliminated from the model.
3. The major catchment boundaries (delineated to outlets to creeks or ditches) were verified with reference to the previous delineation, topographic data, record drawings, and lot parcel data.

[1] 2016 LWMP used n=0.011, typical textbook values for materials, are PVC 0.009-0.010, AC 0.010-0.011, Concrete 0.011 - 0.013, CMP 0.022 - 0.030.

4. Major catchments were manually subdivided into minor subcatchments for each manhole or other drainage node based on the previous delineation, topographic data, record drawings, and lot parcel data.

With the updated delineation, the total modelled subcatchment area in the developed area was slightly increased from 105 ha to 111 ha. Based on refined modelling of the sewer and ditch systems in the northwest portion of the model (Mount St) and the southern portion of the model (McPherson Rd), 119 ha of external subcatchments were added to the model.

3.6 SUBCATCHMENT PARAMETERIZATION

In the 2016 LWMP model, the imperviousness for each subcatchment was characterized based on land use as presented in Table 3-2. In some cases, an area-weighted value was used where subcatchments had multiple land use types. The 2016 model assumed that all impervious area and all pervious area was routed directly to the catchment outlet with no subarea routing (i.e. no impervious area drains across any grassed area before connecting to the storm sewer).

Table 3-2: Land Use Impervious Coefficients (CTQ Consultants Ltd., 2016)

Land Use	% Impervious
Commercial / Industrial	80
Multi Family	60
Subdivision	40
Natural Environment	2

To improve the assigned imperviousness values, 2023 aerial imagery was used to determine more appropriate values for imperviousness and subarea routing. Similar to the methodology for the 2016 LWMP, the Zoning land use was used as a basis for assigning imperviousness values. The Zoning land use was converted into an imperviousness shapefile with the base impervious values summarized in Table 3-2. A percent routed field was added to the shapefile to represent the percentage of impervious area that is routed over pervious areas before contributing to the storm sewer system. Based on input from the Village, it was assumed that most roof drainage in older areas of the Village had a direct connection to the storm sewer. After assigning base imperviousness and percent routed values to the shapefile, it was overlaid on the 2023 aerial imagery to assess the appropriateness of the assigned values. Spot checks of areas with consistent land use were completed to calculate actual imperviousness values based on area measurements of the impervious and pervious areas within a sample area. Appropriate percent routed values were assigned based on engineering judgement of the aerial imagery. Recognizing that many buildings in the Village have roof leaders directly connected to the sewer system, the percentage of impervious area routed to pervious surfaces was generally assumed to be low. Detailed review showed that several residential areas were developed at a higher imperviousness than the base land use assumptions. After finalizing the imperviousness and percent routed shapefile, this shapefile was used to apply area-weighted imperviousness and percent routed parameters to each subcatchment.

For the pervious area, the infiltration characteristics were assigned based on soil information. A soils shapefile was sourced from the BC Soil Information Finder Tool (Provincial Soils Working Group, BC Ministry of Environment and Climate Change Strategy and Ministry of Agriculture, 2018). The information relevant to the study area is from the 1962 *Soil Map of Chilliwack Area* (Comar, 1962). The soils shapefile included several shapes that encompass the study area. Appropriate Suction Head, Hydraulic Conductivity, and Initial Deficit values were assigned according to the values summarized in Table 3-3. The soils shapefile was then used to apply area-weighted infiltration parameters to each subcatchment.

Table 3-3: Green-Ampt Infiltration Parameters (Rawls, 1982)

Soil Texture Class	Hydraulic Conductivity (mm/hr)	Suction Head (mm)	Initial Deficit
Sand	120.34	49.02	0.413
Loamy Sand	29.97	60.96	0.39
Sandy Loam	10.92	109.98	0.368
Loam	3.3	88.9	0.347
Silt Loam	6.6	169.93	0.366
Sandy Clay Loam	1.52	219.96	0.262
Clay Loam	1.02	210.06	0.277
Silty Clay Loam	1.02	270	0.261
Sandy Clay	0.51	240.03	0.209
Silty Clay	0.51	290.07	0.228
Clay	0.25	320.04	0.21

The flow length and slope for each subcatchment was assigned based on the DEM from 2016 LiDAR by drawing flow paths for each subcatchment. Other hydrologic parameters were assigned based on typical published values as summarized in Table 3-4.

Table 3-4: Miscellaneous Hydrologic Parameters

Parameter	Value
Manning's roughness coefficient - impervious	0.018
Manning's roughness coefficient - lawns	0.15
Manning's roughness coefficient - fields	0.20
Manning's roughness coefficient - brush	0.40
Depression storage - impervious	2 mm
Depression storage - pervious	5 mm
Impervious Area with no depression storage	25%

3.7 STORMWATER CONTROLS

Currently the Village does not have any regional stormwater controls. Based on the proximity of Miami River to the storm sewer system, the contributing drainage areas to the storm sewer upstream of Miami River are generally modest. There is limited information about lot level stormwater controls, and it is generally assumed that there are no runoff controls. Stormwater controls that were added to the model based on available information include:

- The underground storage tank for the Oasis at Harrison Lake condo development (470 Esplanade Ave) was modelled with a storage node and outlet orifices.
- The soak away trenches for the private developments at 750, 775, and 798 Hot Springs Road were modelled as infiltration trench LIDs based on information from the record drawings.
- Storage nodes representing rock pits (dry wells) were maintained from the 2016 LWMP model for the drainage areas along Hot Springs Road. The storage nodes for the dry wells on Lillooet Rd

near 470 Esplanade Ave were removed based on servicing drawings for the Oasis at Harrison Lake condo development.

3.8 BOUNDARY CONDITIONS

Most of the storm sewer network in the Village directs water to Miami River which flows north and discharges to Harrison Lake. Miami River typically outlets to Harrison Lake by gravity via two box culverts. During high lake levels, flood gates on the box culverts close and Miami River is pumped over the Harrison Lake Dike into the lake.

The Miami River Dike Pump Station Replacement project was completed in 2016 to replace the aging pump station and improve flood construction. The upgraded station has twin screw pumps that each have a design capacity of 3.0 m^3/s (with 3 m of head) to meet hydraulic objectives through a range of flow and lake level scenarios. The second pump provides redundancy and additional emergency capacity.

As outlined in the 2014 *Miami Creek Pump Station Hydrologic Assessment* (Northwest Hydraulic Consultants Ltd., 2014), a maximum water elevation of 12.0 m was targeted for the 200-year design event (joint probability of flow and lake level) based on the surveyed top of banks and key elevations for local infrastructure. A flood elevation of 12.0 m would result in some flooding of Harrison Hot Springs Resort. When the gates are closed and the box culverts are not functioning, the single pump capacity can keep the water elevation below 12.0 m for a 10-year summer flood event and two pumps can keep the water elevation below 12.0 m for a 20-year summer flood event. A pumping capacity exceeding 10 m^3/s is required to safely convey flows associated with larger Miami River flood events, such as the 100-year summer flow or the 10-year winter flow.

To assess the storm sewer system, minimal backwater impacts from Harrison Lake and Miami River are assumed. Based on information presented in the *Miami Creek Pump Station Hydrologic Assessment*, the lake level was set to a typical value for October through April (9.5 m) and Miami River was set to convey a modest peak flow representative of a 10-year summer storm or a modest winter storm (6.3 m^3/s). See Section 6.6 for discussion of performance with higher backwater levels.

It is noted that there is potential for boundary conditions to have a significant impact on the storm system. During the Nov 2024 site visit, the Miami River level was at 9.9 m and the pumps were set to turn on at 11.0 m and turn off at 10.8 m. It is reasonable to expect Miami River levels to be above 11.0 m at the lake with higher water levels expected further upstream. Recent monitoring at Harrison Lake (Environment Canada, Oct 2025) indicates maximum yearly values of:

- 2021: 12.27 m (2 Jul 2021)
- 2022: 12.09 m (5 Jul 2022)
- 2023: 12.00 m (22 May 2023)
- 2024: 11.13 m (2 Feb 2024)

While extreme maximum values typically occur during the freshet period (late May to early July), a peak winter value of 12.04 m was recently recorded on 16 Nov 2021.

The Miami River Dike Pump Station is essential for the storm system to function effectively when the Harrison Lake water level is high.

4 MODEL CALIBRATION AND VALIDATION

4.1 MONITORING

To improve confidence in the existing conditions model that will be used to assess the storm sewer infrastructure, a monitoring program was completed to allow for model calibration and validation. The Village's drainage system is composed of several small storm sewer networks that outlet to Miami River at different locations. This makes it challenging to select monitoring locations that encompass large areas of the Village. Several candidate sites were reviewed before selecting three representative locations for the monitoring program. A rain gauge was installed at one of the monitoring sites. The monitoring began in late February and continued through early June. The selected monitoring locations are summarized in Table 4-1. The base imperviousness represents the pre-calibrated values based on the methodology described in Section 3.6.

Table 4-1: Selected Monitoring Locations

Site	Model ID	Location	Drainage Area (ha)	Base Imperviousness (%)
1	J074	Manhole east of Lift Station 3 along McCombs Dr	20.78	35%
2	J021	Miami River outfall west of Hot Springs Rd	6.49	89%
3	J058	Miami River outfall east of Walnut Ave	7.55	45%

Storm Site 1 includes a significant undeveloped area east of McCombs Drive. This undeveloped area is 7.78 ha and is largely forested. The developed area is 13 ha with ~55% impervious area. The other sites have more uniform development characteristics.

As shown in Figure 4-1, during the monitoring period, the Harrison Lake levels (Environment Canada, Oct 2025) were within normal range (between 8.5 and 10.0 m), hence storm sewers were not backwatered.

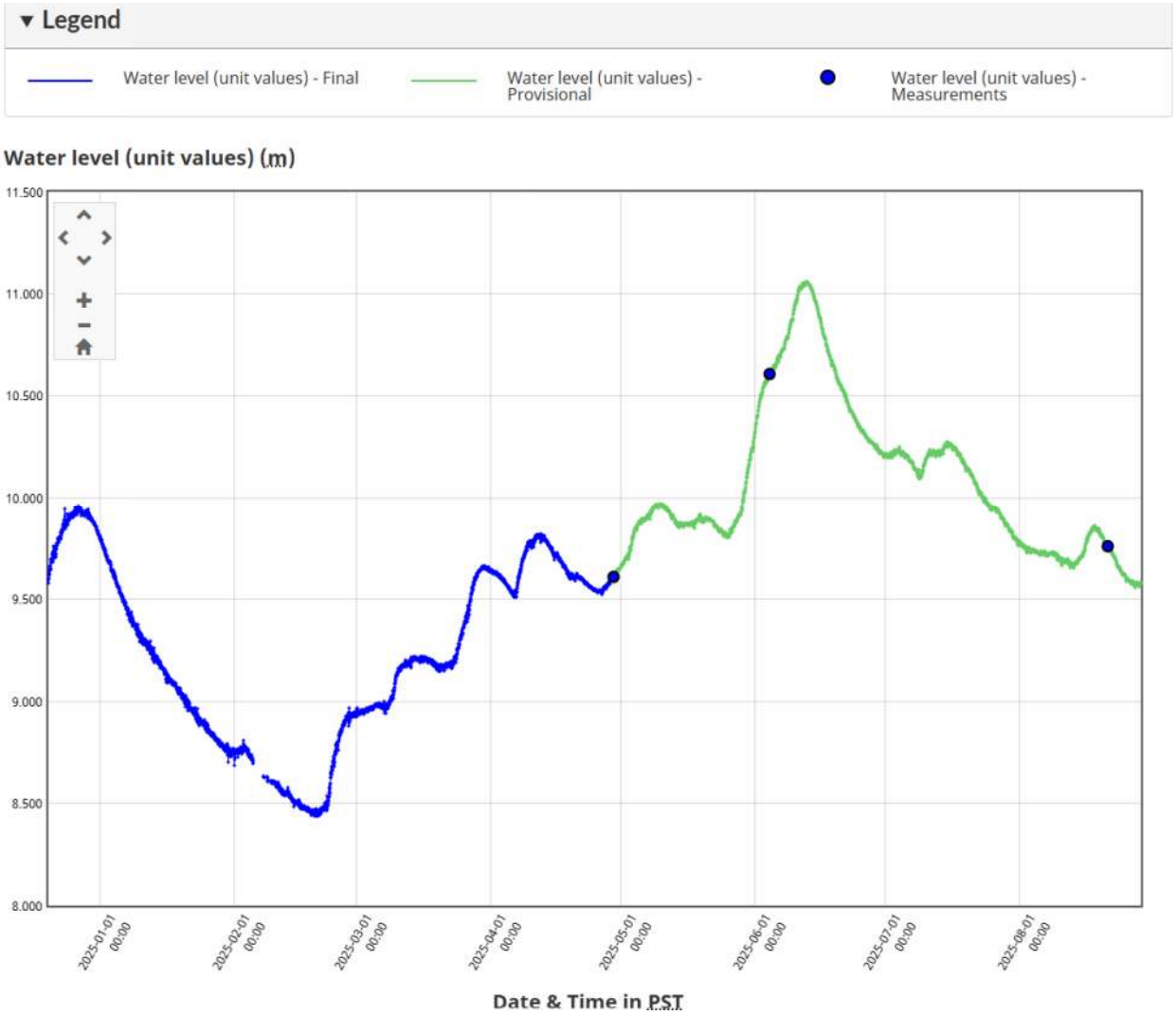


Figure 4-1: 2025 Real-Time Hydrometric Data Graph for Harrison Lake Near Harrison Hot Springs - 08MG012 (Environment Canada, Oct 2025)

4.2 CALIBRATION COMPARISON

The February 2025 model results for Harrison Hot Springs overpredicted storm sewer flows relative to observed data. Although temperatures remained near or above freezing and no snow accumulation was recorded, soil conditions were likely dry following a cold start to the month. These antecedent conditions likely reduced effective runoff. In contrast, model performance improved significantly in March when rainfall events were larger, more frequent, and coincided with saturated ground conditions, suggesting the model is well-calibrated for wet-season response but may overpredict runoff for dry or transitional periods.

Based on the discrepancy in results, March was used as the targeted calibration period, when higher runoff was observed. During the calibration period, five significant events were examined. As summarized in Table 4-2 below, no extreme rainfall events occurred during the calibration period, but each of the calibration events is substantial (typically 25% - 50% of 2-year return period volumes).

Table 4-2: Calibration Events

Event	Duration	Volume percentage of 2-year return period volume		
		Peak hour	Peak 6 hours	Peak 24 hours
1	March 8 at 03:00 – March 9 at 20:00	~40%	~50%	~40%
2	March 12 at 23:25 – March 13 at 20:00	~30%	~30%	~25%
3	March 19 at 23:15 – March 21 at 02:30	~30%	~25%	~30%
4	March 21 at 11:10 – March 21 at 23:00	~30%	~25%	~30%
5	March 23 at 00:30 – March 25 at 02:00	~50%	~60%	~85%

The calibration process used several PCSWMM tools, including the sensitivity analysis module, graphical hydrograph comparisons, and automated error statistics reporting. Sensitivity analysis results helped identify which input parameters had the greatest influence on peak inflows at each monitored node. Through this analysis, imperviousness, routing of impervious area to pervious surfaces, and subcatchment length were consistently ranked as the most impactful parameters across the sites.

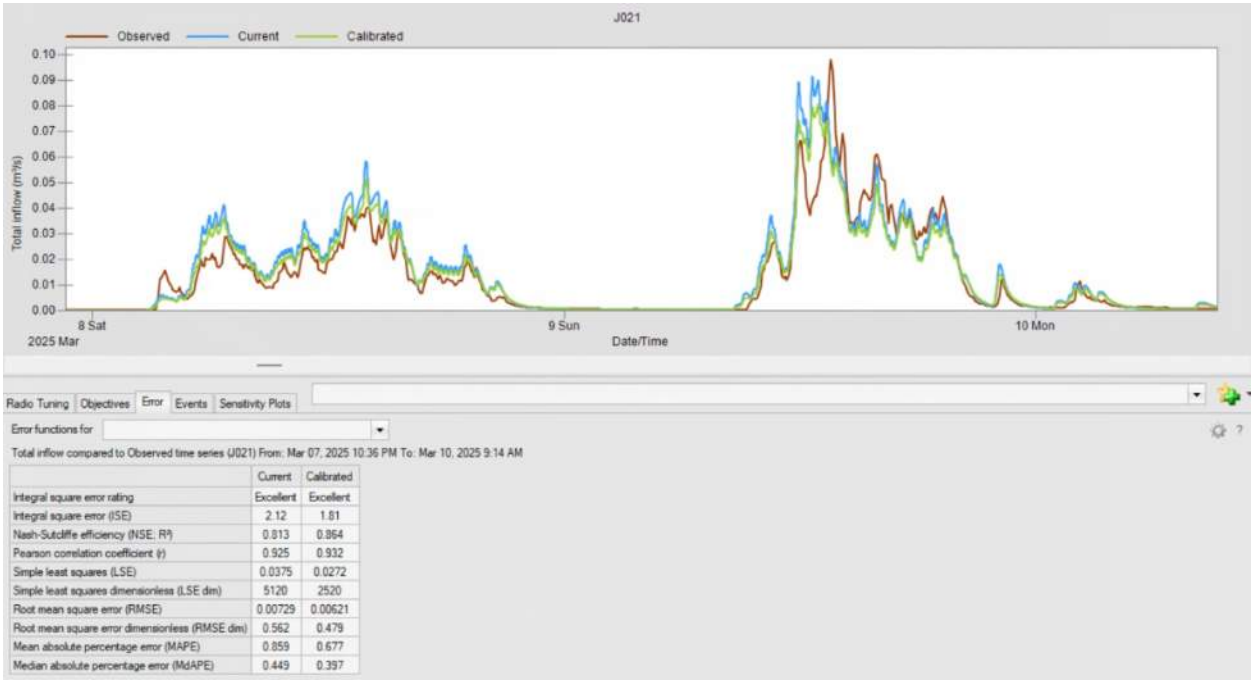
After determining parameter sensitivity, PCSWMM's event-based calibration interface was used to isolate the calibration events and visualize the impact of parameter changes. Calibration performance was assessed using a range of statistical metrics available in PCSWMM, including Nash–Sutcliffe Efficiency (NSE), Integral Square Error (ISE), and Pearson correlation coefficient (r). Peak flow magnitude and timing were assessed manually. For the base condition, most events achieved "very good" to "excellent" agreement with observed data according to the calculated ISE value, with modelled peak timing and shape closely aligning with the monitored hydrograph. However, opportunities for improvements were identified.

For Storm Site 1, which captures drainage from conventional single-family lots, higher density townhouse lots, and undeveloped area south of Miami River Drive, the monitoring results indicated that peak flows were over predicted. The calibration results for Event #1 are shown in Figure 4-2 below (note that the time series with the label "Current" is the uncalibrated flow hydrograph). To better match the monitored flow data, the impervious values were re-evaluated and reduced based on area-specific measurements from the 2023 aerial imagery. The routing of impervious area to pervious surfaces was also significantly increased. These changes notably improved the event-specific error metrics across the calibration events.

	Current	Calibrated
Integral square error rating	Very good	Excellent
Integral square error (ISE)	3.45	1.39
Nash-Sutcliffe efficiency (NSE; R^2)	-0.434	0.769
Pearson correlation coefficient (r)	0.951	0.95
Simple least squares (LSE)	0.083	0.0134
Simple least squares dimensionless (LSE dim)	340	219
Root mean square error (RMSE)	0.0116	0.00466
Root mean square error dimensionless (RMSE dim)	0.855	0.343
Mean absolute percentage error (MAPE)	0.667	0.469
Median absolute percentage error (MdAPE)	0.703	0.337

Figure 4-2: Storm Site 1 Calibration for Event #1

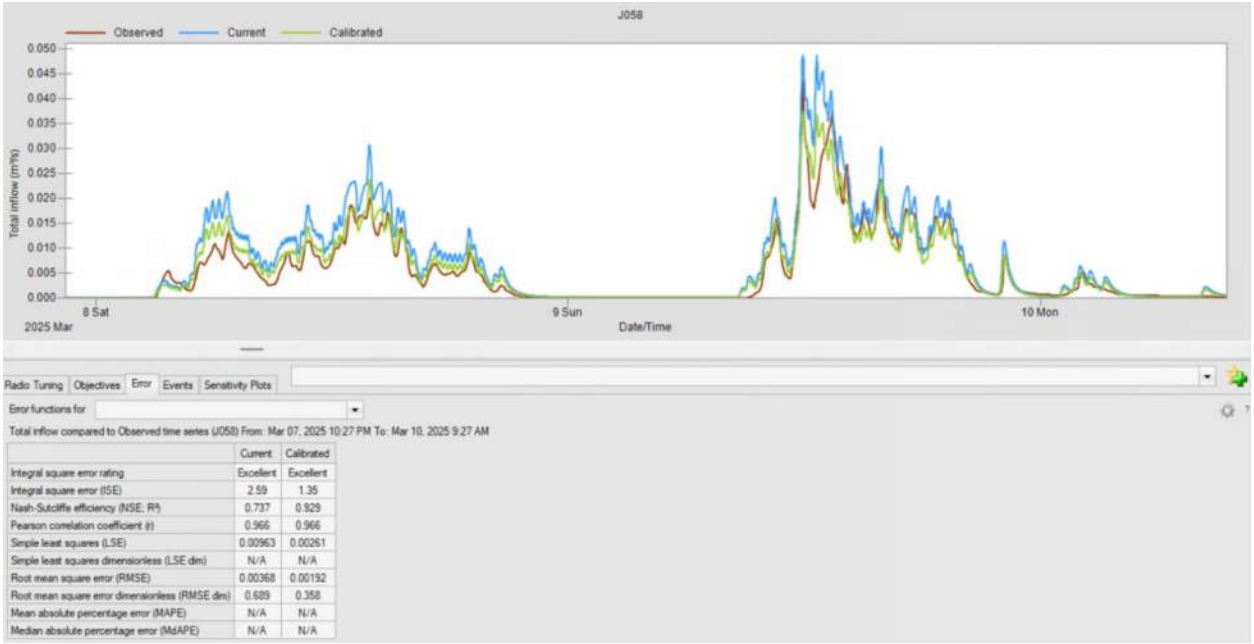
For Storm Site 2, which captures the highly impervious commercial drainage area in the northwest corner of the Village, the monitoring results indicated that peak flows were slightly over predicted. To better match the monitored flow data, the drainage area was modified to add 10% routing of impervious area to pervious surfaces (from an initial value of 0%). These changes yielded modest improvements to event-specific metrics, which were already good. The calibration results for Event #1 are shown in Figure 4-3 below.



	Current	Calibrated
Integral square error rating	Excellent	Excellent
Integral square error (ISE)	2.12	1.81
Nash-Sutcliffe efficiency (NSE; R^2)	0.813	0.864
Pearson correlation coefficient (r)	0.925	0.932
Simple least squares (LSE)	0.0375	0.0272
Simple least squares dimensionless (LSE dim)	5120	2520
Root mean square error (RMSE)	0.00729	0.00621
Root mean square error dimensionless (RMSE dim)	0.562	0.479
Mean absolute percentage error (MAPE)	0.859	0.677
Median absolute percentage error (MdAPE)	0.449	0.397

Figure 4-3: Storm Site 2 Calibration for Event #1

For Storm Site 3, which captures drainage from conventional single-family lots and Harrison Hot Springs Elementary School, the monitoring results indicated that peak flows were slightly over predicted. The calibration results for Event #1 are shown in Figure 4-4 below. To better match the monitored flow data, the impervious values were slightly reduced and routing of impervious area to pervious surfaces was modestly increased (from a typical value of 10% to 20%). Similar to Storm Site 2, these changes resulted in modest improvements to the event-specific error metrics.



	Current	Calibrated
Integral square error rating	Excellent	Excellent
Integral square error (ISE)	2.59	1.35
Nash-Sutcliffe efficiency (NSE; R^2)	0.737	0.929
Pearson correlation coefficient (r)	0.966	0.966
Simple least squares (LSE)	0.00963	0.00261
Simple least squares dimensionless (LSE dim)	N/A	N/A
Root mean square error (RMSE)	0.00368	0.00192
Root mean square error dimensionless (RMSE dim)	0.689	0.358
Mean absolute percentage error (MAPE)	N/A	N/A
Median absolute percentage error (MdAPE)	N/A	N/A

Figure 4-4: Storm Site 3 Calibration for Event #1

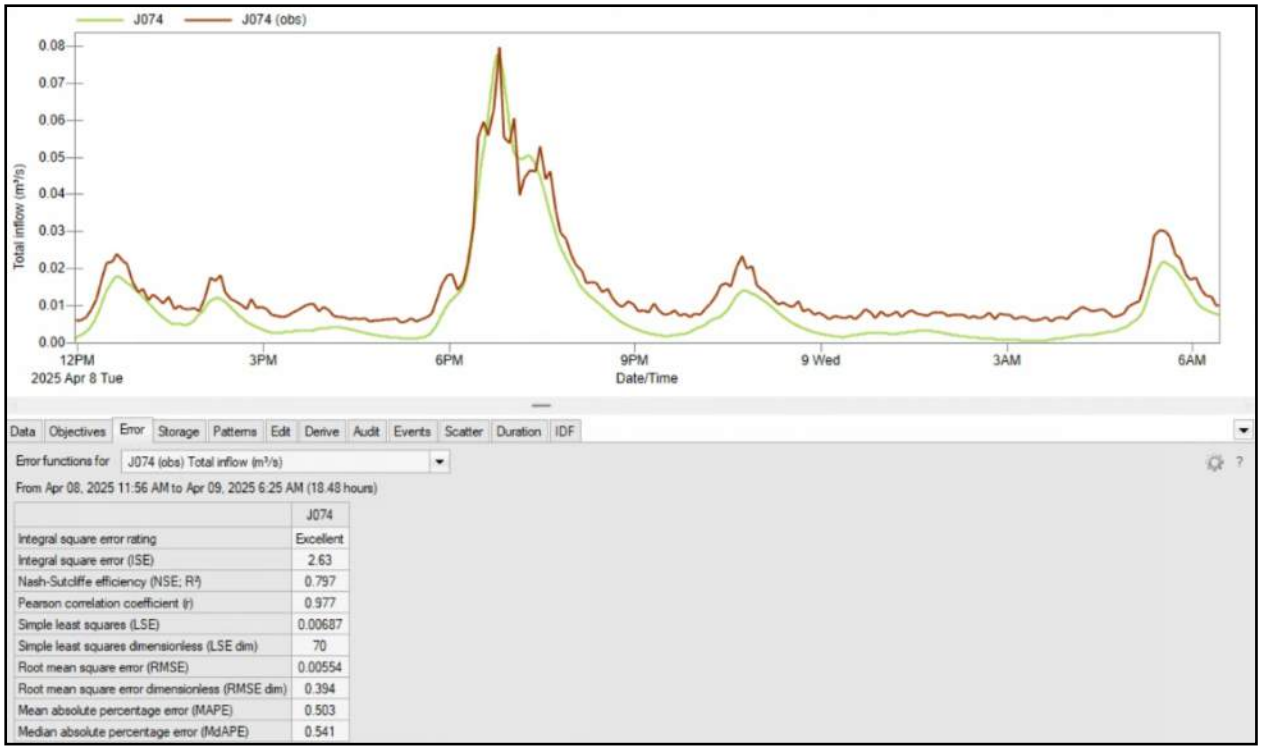
4.3 VALIDATION

After completing the calibration model adjustments, results of calibration were validated for significant rainfall events from April through June. During this period, five significant events were examined. Similar to the calibration events, the validation events were significant, but not extreme rainfall events. The validation events are summarized in Table 4-3.

Table 4-3: Validation Events

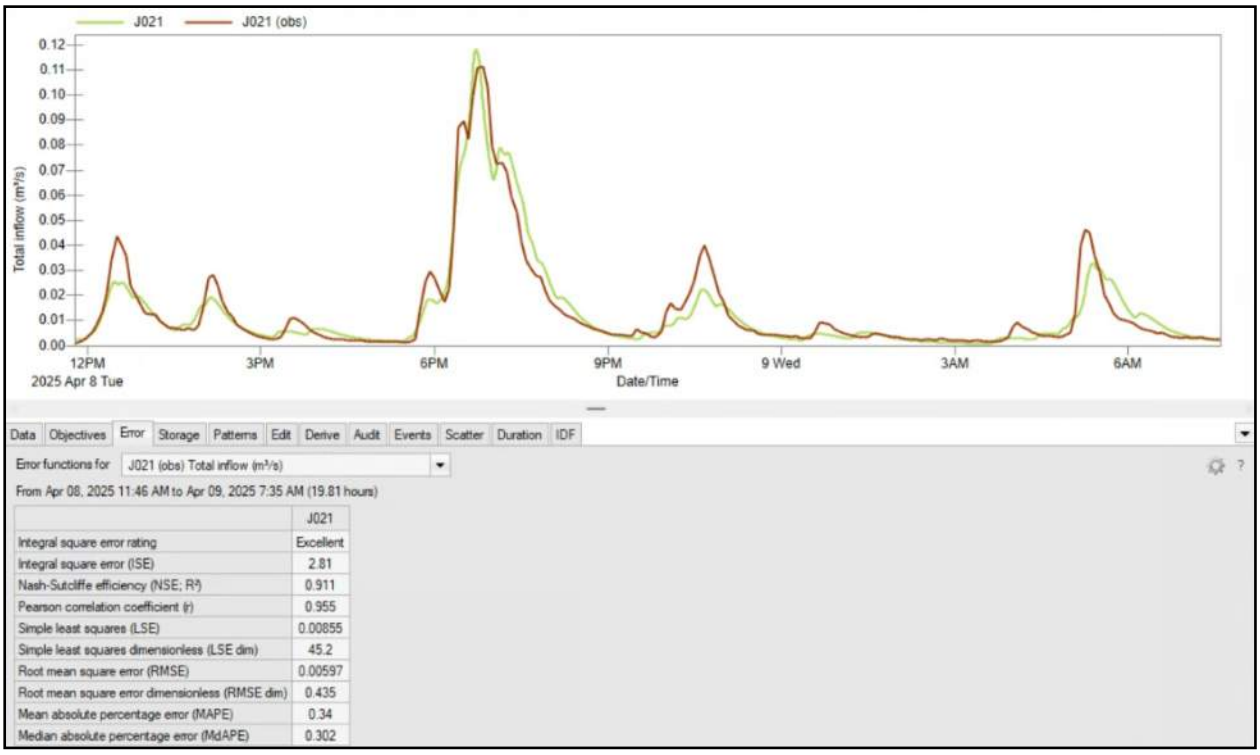
Event	Duration	Volume percentage of 2-year return period volume		
		Peak hour	Peak 6 hours	Peak 24 hours
1	April 6 at 13:50 - April 7 at 07:00	~30%	~30%	~20%
2	April 7 at 14:00 - April 7 at 18:40	~25%	~25%	~20%
3	April 8 at 11:30 -April 9 at 06:30	~50%	~30%	~20%
4	April 10 at 14:00 - April 11 at 01:30	~40%	~40%	~30%
5	May 17 at 11:10 - May 18 at 06:50	~30%	~30%	~40%

As with the calibration, performance was assessed using PCSWMM's statistical metrics. For the validation events the ISE values showed "very good" to "excellent" alignment between the modelled data and the observed data. The only outlier was Event #5. For this event, the monitored flow data exhibited sharper peaks relative to the distributed rainfall pattern. Because the sharper peaks are not reflected in the recorded rainfall data, this alignment issue does not reflect a need for further model calibration. Overall, based on the validation results, the parameter adjustments completed for the calibration were confirmed to be appropriate. The monitored versus observed flow data for Validation Event #3 for the monitoring sites are shown in the figures below.



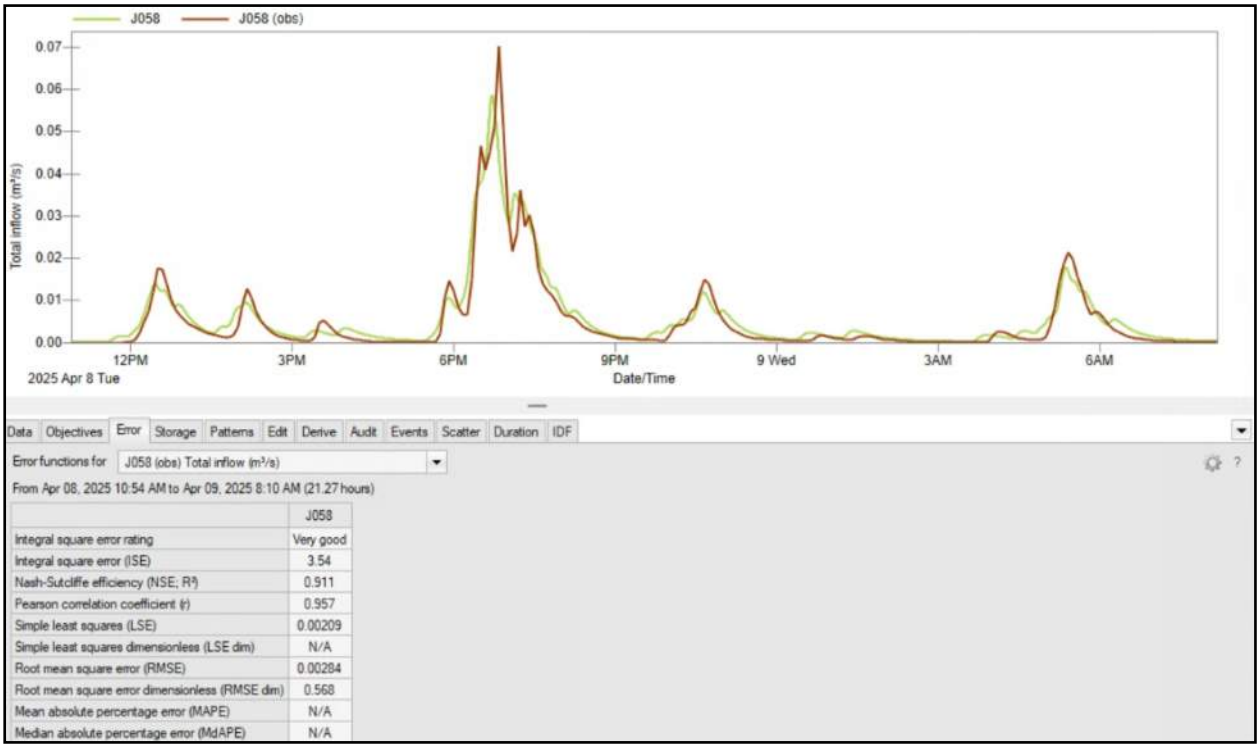
	J074
Integral square error rating	Excellent
Integral square error (ISE)	2.63
Nash-Sutcliffe efficiency (NSE; R^2)	0.797
Pearson correlation coefficient (r)	0.977
Simple least squares (LSE)	0.00687
Simple least squares dimensionless (LSE dim)	70
Root mean square error (RMSE)	0.00554
Root mean square error dimensionless (RMSE dim)	0.394
Mean absolute percentage error (MAPE)	0.503
Median absolute percentage error (MdAPE)	0.541

Figure 4-5: Storm Site 1 Validation for Event #3



	J021
Integral square error rating	Excellent
Integral square error (ISE)	2.81
Nash-Sutcliffe efficiency (NSE; R^2)	0.911
Pearson correlation coefficient (r)	0.955
Simple least squares (LSE)	0.00855
Simple least squares dimensionless (LSE dim)	45.2
Root mean square error (RMSE)	0.00597
Root mean square error dimensionless (RMSE dim)	0.435
Mean absolute percentage error (MAPE)	0.34
Median absolute percentage error (MdAPE)	0.302

Figure 4-6: Storm Site 2 Validation for Event #3



	J058
Integral square error rating	Very good
Integral square error (ISE)	3.54
Nash-Sutcliffe efficiency (NSE; R^2)	0.911
Pearson correlation coefficient (r)	0.957
Simple least squares (LSE)	0.00209
Simple least squares dimensionless (LSE dim)	N/A
Root mean square error (RMSE)	0.00284
Root mean square error dimensionless (RMSE dim)	0.568
Mean absolute percentage error (MAPE)	N/A
Median absolute percentage error (MdAPE)	N/A

Figure 4-7: Storm Site 3 Validation for Event #3

4.4 CALIBRATION ADJUSTMENTS

Following confirmation of calibration and validation results for the monitored catchments, the imperviousness and routing parameter shapefile was reviewed to determine whether adjustments were appropriate beyond the monitored catchments.

The calibration for Storm Site 1 and Storm Site 3 indicated that the imperviousness shapes for the associated residential areas were measured slightly large during initial parameterization. The calibration results across all sites indicated that the conservative assumptions for impervious areas routed to pervious surfaces (typically 10%) were overly conservative. These insights were used to inform a detailed review of the imperviousness and routing parameter shapefile. Based on the calibration results, increasing the impervious to pervious routing by 10% was considered reasonable for most areas and this increase was applied broadly.

Storm Site 1 indicated a larger increase could be appropriate, but this would be area specific and would require further monitoring to justify in other areas. Select refinements were also applied to impervious values where detailed visual review indicated this was appropriate. The changes to impervious percentages are area-specific and the adjustments for Storm Site 1 and Storm Site 3 are not necessarily indicative of changes that should be applied to all catchments. Therefore, refinements were only made where there was adequate evidence for an adjustment. After updating the imperviousness and routing parameter shapefile, the existing conditions model is considered calibrated and validated and is suitable for identifying system deficiencies to inform future infrastructure planning and design.

5 DESIGN CRITERIA

The following section summarizes relevant design criteria for assessment of the storm sewer system from the Village's *Subdivision and Development Servicing Bylaw No. 1179* (Village of Harrison Hot Springs, 2022).

5.1 SITE REQUIREMENTS

The Village requires on-site stormwater systems to include provisions for retention, conveyance, and flood risk management. Development proposals are to provide quantity control through capture and detention of runoff and quality control to treat runoff from impervious areas. Performance targets include:

- Capture and management of the first 30 mm of daily rainfall through infiltration, evapotranspiration, storage, or reuse
- Conveyance of the first 60 mm of rainfall per day (up to the 10-year event) through the drainage system, with detention as necessary to maintain pre-development release rates
- Safe conveyance of major rainfall events up to the 100-year return period

The extent to which these controls have been implemented in the Village is unknown. The performance targets are provided for reference, but it is generally assumed that most existing developments do not meet the on-site stormwater control performance targets.

5.2 WATER QUALITY

For stormwater quality treatment, all flow up to 50% of the 2-year (1-hour duration) post-development flow is to be routed through a water quality treatment facility to remove suspended solids and floatables. Facility options include green infrastructure such as biofiltration swales, detention facilities such as constructed wetlands, and mechanical devices such as oil and grit separators. Specific to the evaluation of existing condition deficiencies, storm sewer outlets with no documented water quality treatment will be identified.

5.3 MINOR SYSTEM

The minor system is the infrastructure associated with the collection, conveyance and treatment of minor (frequently occurring) rainfall events. The minor system is to be designed to prevent flooding and property damage and to limit public inconvenience caused by rainfall events with a return period equal to or more frequent than the 10-year event. Specific to evaluation of deficiencies in the minor system, the model will be used to evaluate:

- Areas with no minor system for drainage
- Surcharging of storm mains for the 10-year storm
- Storm mains that do not have a minimum diameter of 250 mm
- Storm mains that do not have a minimum velocity of 0.6 m/s flowing full and storm mains where the maximum velocity exceeds 3 m/s
- Storm mains that do not meet the Village's minimum grading specifications based on pipe diameter

Additional criteria are specified for ditch dimensions, erosion protection, inlet capacity, and urban roadway flooding limits. This is outside the scope of the model assessment as there is inadequate information on ditch dimensions and inlet capacities. Roadway flooding will be assessed as part of the major system.

5.4 MAJOR SYSTEM

The major system is the infrastructure associated with the collection, conveyance and treatment of major (infrequent) rainfall events. The major system is comprised of surface flood paths, swales, channels, watercourses, roadways, walkways, pathways, and flow control facilities. The major system is to be designed to protect the public and prevent significant property damage caused by rainfall events with a

return period equal to or more frequent than the 100-year event. Requirements for on-site control of the major system are specified, but most developed areas do not have on-site control because the development occurred prior to the Village's 2022 *Subdivision and Development Servicing Bylaw No. 1179*.

Specific to evaluation of deficiencies in the major system, the model will be used to evaluate:

- Performance of existing flow control facilities
- Flooding depths within the dual drainage system (urban roadway flooding)
    - Particular attention will be devoted to sags or low points to evaluate whether there is a safe overland outlet flow route.

An additional criterion is specified for the maximum hydraulic grade line to be kept below minimum building elevations. This is outside the scope of the current modelling as the dual drainage system only allows for a simplified understanding of major system flow depths.

Major system watercourse crossings in the Village include the Miami River bridge crossings and the Hot Springs Rd crossing for the ditch on the south side of McPherson Rd. The Miami River bridge crossings are outside the scope of this analysis. The Hot Springs Rd culvert crossing was also not modelled. During the site visit, it was noted that water levels in the McPherson Rd ditch were very high. It is understood this is related to backwater conditions from beaver activity. Based on site observations, there is potential that the Hot Springs Rd crossing would not have capacity to convey major storm event flows without overtopping due to the severe backwater condition.

5.5 DESIGN STORM SCENARIOS

Design storms were developed for the model using the latest Environment Canada intensity-duration-frequency (IDF) data for Agassiz, BC. Historic and climate adjusted rainfall data is available from ClimateData.ca. The historic data was used to develop existing condition design storms. Climate projected data is also provided for specific time horizons and emissions scenarios. The 2022 *Design Guidelines* from the Master Municipal Construction Documents (MMCD) Association generally recommends that new infrastructure is designed for Year 2050 projections with moderate emissions. The MMCD guidelines recommend that high-risk infrastructure is designed for Year 2100 projections.

An analysis of IDF data from the Agassiz climate station indicates that long duration storms are most similar to an SCS Type 1A distribution. This is consistent with guidance about the likely geographic distribution of storm types in BC (Millar, 2017). For short and medium duration storms, Water Street completed a comprehensive review of municipal guidelines of nearby municipalities to determine appropriate distributions. This review showed that the 30% AES BC Coast distribution storm is most appropriate for short-duration storms (0 – 2 hours) and the 50% AES BC Coast distribution is most appropriate for medium-duration storms (6 – 12 hours). For a comprehensive assessment of the Village's storm infrastructure, a 1-hour storm with a 30% AES BC Coast distribution, a 6-hour storm with a 50% AES BC Coast distribution, and a 24-hour storm with an SCS Type 1A distribution were selected for evaluation. The AES BC Coast distributions were sourced from the City of Mission's Engineering Department. The rainfall volumes were determined based on the historic IDF data and Year 2050 with moderate emissions data for the Agassiz climate station and are presented in Table 5-1.

Table 5-1: Selected Design Storms

Storm Duration (hr)	Historic IDF (mm)		Year 2050 Agassiz IDF (mm)	
	10-year event	100-year event	10-year event	100-year event
1	19.3	22.0	28.8	32.0
6	43.6	48.6	56.1	60.0
24	103.3	115.2	139.5	156

6 GENERAL DEFICIENCIES

6.1 MIAMI RIVER OUTFALL

During the site visit, the Miami River Dike Pump Station was reviewed. This station drains the Miami River to Harrison Lake during high lake levels. It was noted that there have been issues with the culvert inlet capacity to the pump station. The pump station is an important component of the drainage system that allows the creek to outlet to the lake even when there are high lake levels. NHC is currently doing an assessment of the pump station and associated infrastructure to confirm that the pump station is meeting the needs of the Village. The function of the pump station is critical to the performance of the storm sewer system as further discussed in Section 6.6.

In addition to potential issues at the pump station, the creek immediately upstream of the pump station is exposed to high ground from Mount Agassiz to the southwest. A rock fall or landslide in this area has potential to block the Miami River outlet to the lake and potentially leading to flooding. This hazard has not been assessed as part of this study.

6.2 NO DRAINAGE SYSTEM

In the northeast portion of the Village, Echo Ave and Naismith Ave have no documented drainage system to the Mount St storm sewer or the downstream ditch outlet to Miami River. The Village noted there have been drainage issues on Echo Ave due to inadequate drainage infrastructure and poor grading. A field review in Oct 2025 confirmed there is no drainage system on Echo Ave and that Naismith Ave has a ditch and culvert system. Where the ditch on Naismith Ave has been filled, some catch basins and drainage pipes were identified. The Naismith Ave system is not documented, and the level of service has not been modelled.

Similarly, Hot Springs Rd north of Alder Ave to Miami River does not have a documented drainage system. The Miami Slough is the primary outlet to Miami River for this area and runs parallel to Hot Springs Rd on the west side of the road. The east side of the road has intermittent dry wells. Based on input from the Village, it is understood that there are issues with stormwater inflows to the sanitary sewer along Hot Springs Rd. Resolving the inflow and infiltration (I&I) issues for the sanitary sewer system may require drainage improvements along Hot Springs Rd. This issue is further described in the Village's Sanitary Sewer Master Plan (Water Street Engineering Ltd., 2025).

6.3 MUNICIPAL INFRASTRUCTURE ON PRIVATE PROPERTY

During the Oct 2025 field investigation, it was confirmed that a municipal sewer from Lillooet Ave likely crosses under the 565 Lillooet Ave building to outlet to Harrison Lake in Rendall Park. As this sewer is on private property, it is desirable to re-route the drainage. Additional areas where municipal infrastructure crosses private property include:

- 114 Cedar Ave
- 830 Ramona Pl
- 861 and 875 Myng Cr

For these areas, property access rights should be confirmed.

6.4 PIPE GEOMETRY DEFICIENCIES

The review of pipe geometry revealed deficiencies throughout the entire network. These deficiencies are shown on Figure 6-1.

Legend

Drainage Elements

- Creek System
- Ditch
- No Drainage System
- Outfalls
- Storages
- Manholes
- Municipal Infrastruture On Private Property

Pipe Deficiency

- No Deficiency
- Min Slope Deficiency (varies based on dia.)
- Min Diameter Deficiency (<250 mm dia.)

N

0 150 300 450 m

1:10,000

WATER STREET ENGINEERING

EGBC Permit to Practice #1000830

Storm Sewer Master Plan

PREPARED FOR

Village of Harrison Hot Springs

PROJECT NO. 456.2

DATE 04 DEC 2025

REVISION 0

Storm Infrastructure General Deficiencies

Figure 6-1

Document Path: D:\WSE Dropbox\001-Projects\456-Harrison Hot Springs Master Plans\430-GIS\data\MD_Storm Infrastructure\ArcMap Working Folder\Minor System Deficiencies\Storm General Minor System Deficiencies.mxd

MINIMUM GRADING

26 storm mains were identified with slopes less than the Village's minimum grading specifications. Areas with a concentration of storm mains with slopes less than design criteria include the lakefront area along Esplanade Ave; the central residential area along Pine Ave, Schooner Pl, and Alder Ave; along Eagle St and McCombs drive near Miami River; and the southern extents of the Village near McPherson Rd.

The topography throughout the Village is relatively flat and it is not uncommon for gravity drained storm mains to have flatter sections to achieve the required pipe length when little elevation relief is available. Capital upgrades for these pipes are only recommended if capacity deficiencies were also present.

MINIMUM DIAMETER LESS THAN 250 MM

23 storm pipes were identified to have an inner diameter less 250 mm. These pipes are primarily located in the Angus Estates areas, at the southern extent of the Village on McPherson Rd, and near the north end of the Village on Poplar St and Esplanade Ave. Upsizing for pipes that do not meet minimum diameter requirements should be based on capacity deficiencies.

FLOW VELOCITIES

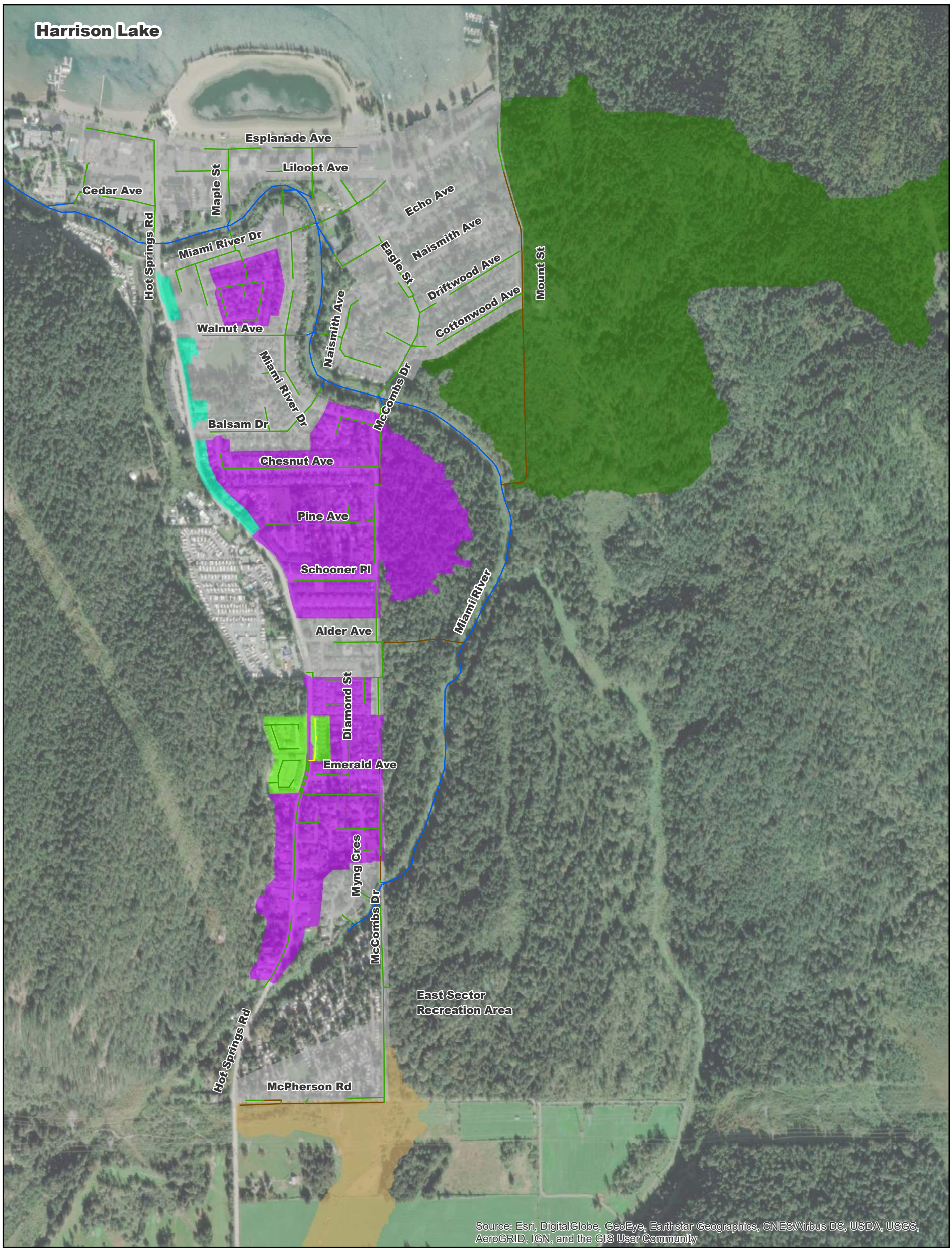
No velocities exceeding 3.0 m/s were identified during design storm runs. When velocities exceed 3.0 m/s and supercritical flow occurs, provisions for structural stability and durability are required. Storm mains that were identified with velocities lower than 0.6 m/s had low velocities due to backwater conditions and not the pipe gradient. All storm mains that meet the Village's minimum grading also meet the minimum velocity requirements when unimpeded and flowing full.

6.5 WATER QUALITY DEFICIENCIES

Through review of the available record drawings, five oil grit separator units were identified. Additionally, there are several dry wells throughout the Village and three recent developments have soak away trenches. To achieve a high-level understanding of quality concerns, drainage areas have been categorized based on the type of runoff that is expected from the drainage area and the type of quality control that is provided. The performance of the quality controls has not been assessed. The results of this analysis are summarized in Table 6-1 and are shown on Figure 6-2.

Table 6-1: Water Quality Treatment Overview

Treatment	Area (ha)	Percent of Total Area Assessed
Drains to OGS	41.66	18%
Drains to Soakaway Trench	2.52	1%
Drains to Dry Well	2.07	1%
Agricultural Area	37.07	16%
Undeveloped Forested Area	79.62	35%
Developed Area, No Known Treatment	66.82	29%



Legend

Subcatchments

- Undeveloped
- Drains to Soakaway Trench
- Drains to Dry Well
- Agricultural
- No Known Treatment
- Drains to OGS

Drainage Elements

- Storm Sewer
- Creek System
- Ditch
- Soakaway Trench Sewer

N

0 150 300 450 m

1:10,000

WATER STREET ENGINEERING

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Storm Sewer Master Plan

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Storm Water Quality Treatment

Figure 6-2

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6.6 BOUNDARY CONDITION DEFICIENCIES

In the 2014 *Miami Creek Pump Station Hydrologic Assessment* (Northwest Hydraulic Consultants Ltd., 2014), the maximum water level during the 200-year design event was recommended to be no greater than 12.0 m based on the surveyed top of banks and local infrastructure. This recommendation was not based on a detailed infrastructure assessment, and a significant amount of drainage infrastructure is below the 12.0 m target (connections to Miami River are as low as 9.57 m). Figure 6-3 shows manholes, outfalls, and conduits (storm sewers) that would be submerged at a water level of 12.0 m. This figure provides some context on areas of potential backwatering concern.

It is understood that NHC is currently completing a study of the pump station that considers joint probability of high lake levels and high creek flows. It is a potential concern that the pump station's operating level (when the pumps turn on) are set to an elevation of 11.0 m when many of the storm sewer outfalls to Miami River are below 10.5 m. In conjunction with NHC's ongoing pump station assessment, the potential to reduce the operating level should be assessed. This will increase the reliability of the storm sewer system during high lake levels. The simplified assessment of the storm sewer system assumes there is no backwater condition from the lake/creek.

For future storm system improvements that outlet to Miami River, a higher backwater level should be considered during detailed design. This should be informed by the updated assessment of the Miami River Dike Pump Station. It may be advisable to raise the storm sewer system where feasible to reduce sensitivity to high creek levels.

Legend

Drainage Elements
- Creek System
- Ditch
- Storages

Outfall Rim Elevation
- Rim Above 12 m
- Rim Below 12 m

Manhole Crown Elevation
- Crown Above 12 m
- Crown Below 12 m

Conduit Crown Elevation
- Conduit Crown Above 12 m
- Conduit Crown Below 12 m

N

0 150 300 450 m

1:10,000

WATER STREET ENGINEERING

EGBC Permit to Practice #1000830

Storm Sewer Master Plan

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Storm Infrastructure Below 12.0 m Flood Level

Figure 6-3

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7 EXISTING CONDITION ASSESSMENT

7.1 MINOR SYSTEM (STORM SEWER) DEFICIENCIES

A summary of deficiencies for insufficient flow capacity in the existing storm sewers during the current 10-year storm peak flows is provided in Table 7-1 and the deficiencies are shown on Figure 7-1.

Table 7-1: Existing Condition Minor System Deficiencies

Capacity Deficiency	Pipe IDs	Area	Surcharge Severity	Cause
1	C024, C025, C026	Esplanade Ave and Hot Springs Rd	Significant, surface flooding, insufficient overland flow route	Combination of insufficient slope and insufficient pipe size
2	C037, C038, C135	Esplanade Ave and Maple St	Significant, below ground level	Combination of insufficient slope and insufficient pipe size
3	C044, C138	Esplanade Ave and Chehalis St	Significant, below ground level	Combination of insufficient slope and insufficient pipe size
4	C055, C056	Bear Ave	Significant, surface flooding, insufficient overland flow route	Combination of insufficient slope and insufficient pipe size
5	C063	Naismith Ave outlet	Significant, below ground level	Insufficient pipe size
6	C084, C086, C087, C088, C163	Eagle St approaching Miami River	Significant, surface flooding, insufficient overland flow route	Combination of insufficient slope and insufficient pipe size
7	C028, C030	Miami River Dr outlet near Poplar St	Significant, below ground level	Combination of insufficient slope and insufficient pipe size
8	C060	Walnut Ave	Significant, below ground level	Insufficient pipe size
9	C069, C070	Balsam Ave	Significant, below ground level	Insufficient pipe size
10	C156, C157, C158	Chestnut Ave	Significant, below ground level	Insufficient pipe size
11	C074, C075, C079, C081, C082	Pine Ave and McCombs Dr approaching Miami River	Significant, surface flooding, insufficient overland flow route	Combination of insufficient slope and insufficient pipe size
12	C176, C177, C197, C198, C199, C200	Alder Ave, Schooner Pl and along McCombs Dr	Significant, below ground level	Combination of insufficient slope and insufficient pipe size
13	C191, C192	Diamond St	Significant, below ground level	Insufficient pipe size
14	C189	McCombs Dr near Emerald Ave	Minor, below ground level	Insufficient pipe size
15	C184, C205	Hadway Dr	Significant, surface flooding, insufficient overland flow route	Combination of insufficient slope and insufficient pipe size
16	C117, C122	Myng Cr	Significant, below ground level	Insufficient pipe size

17	C231, C232, C235, C237	South portion of McCombs Dr, McPherson Rd	Significant, approaching ground level	Combination of insufficient slope, insufficient pipe size, and backwater condition at McPherson Rd ditch.

In addition to the deficiencies described in the table above, the following deficiencies were identified for the private infrastructure that was modelled.

- C180, C181, C182, C202, and C204 are private pipes that are part of the Harrison Lake Estates development and have modest surcharging.
- C209 is a private pipe part of the 750 Hot Springs Rd development and has modest surcharging.
- C254 is a private pipe part of the 798 Hot Springs Rd development and has modest surcharging.

7.2 MAJOR SYSTEM PERFORMANCE

For the current 100-year storm peak flows, most storm sewers have capacity to convey the flow with surcharging that remains below the manhole rim elevations. Only 26 conduits show surcharging above ground level. For overland flow, a typical street cross-section was modelled to convey flow. Only 6 locations were simulated to have water depths greater than 0.10 m. Only Bear Ave has overland flow greater than 50 L/s.

Legend

Drainage Elements
- Creek System
- Ditch
- Outfalls
- Storages
- Deficiency Area

Manhole Surcharging
- Well Below Crown (>0.1 m below crown)
- Near Crown (within 0.1 m below crown)
- Minor Surcharge (<0.1 m above crown)
- Significant Surcharge (>0.1 m above crown)

Capacity
- Under Capacity (<85%)
- Near Capacity (85-100%)
- Minor Surcharge (100-115%)
- Siginificant Surcharge (>115%)

N

0 150 300 450 m

1:10,000

WATER STREET ENGINEERING

EGBC Permit to Practice #1000830

Storm Sewer Master Plan

PREPARED FOR

Village of Harrison Hot Springs

PROJECT NO. 456.2

DATE 04 DEC 2025

REVISION 0

Current 10-Year Storm Minor System Deficiencies

Figure 7-1

Document Path: D:\WSE Dropbox\001-Projects\456-Harrison Hot Springs Master Plans\430-GIS\data\MD_Storm Infrastructure\ArcMap Working Folder\Minor System Deficiencies\Existing Storm Minor System Deficiencies_v2.mxd

8 FUTURE CONDITION ASSESSMENT

To account for future development and densification, the Village's *Official Community Plan Bylaw No. 1184* (Village of Harrison Hot Springs, 2022) land use was evaluated to determine where increases in impervious coverage should be considered. The MMCD's 2022 *Design Guidelines* were used as a reference for imperviousness associated with different land uses. In general, for areas that already had an imperviousness greater than the design numbers provided in the MMCD's design guidelines, the imperviousness was maintained. Areas with lower imperviousness were adjusted to match the design guideline values.

Based on input from the Village, it is understood that there is a potential development area just north of the East Sector Recreation Area. This area is east of the Miami River bridge connecting McCombs Dr and Eagle St. This area naturally drains to Miami River without contributing to Village infrastructure. Future development of this area should discharge directly to Miami River suitable quantity and quality controls to prevent deleterious impacts on the watercourse. Development of this area is considered unlikely and has not been assessed for this Storm Sewer Master Plan.

8.1 MINOR SYSTEM (STORM SEWER) DEFICIENCIES

A summary of deficiencies for insufficient flow capacity in the existing storm sewers during the year 2050 10-year storm peak flows under future conditions is provided in Table 8-1 and the deficiencies are shown on Figure 8-1.

Table 8-1: Future Condition Minor System Deficiencies

Capacity Deficiency	Pipe IDs	Area	Surcharge Severity	Cause
1	C023, C024, C025, C026	Esplanade Ave and Hot Springs Rd	Significant, surface flooding, insufficient overland flow route	Combination of insufficient slope and insufficient pipe size
2	C037, C038, C135	Esplanade Ave and Maple St	Significant, surface flooding, insufficient overland flow route	Combination of insufficient slope and insufficient pipe size
3	C044, C138	Esplanade Ave and Chehalis St	Significant, below ground level	Combination of insufficient slope and insufficient pipe size
4	C055, C056	Bear Ave	Significant, surface flooding, insufficient overland flow route	Combination of insufficient slope and insufficient pipe size
5	C063, C151	Naismith Ave outlet	Significant, surface flooding, insufficient overland flow route	Insufficient pipe size
6	C084, C085, C086, C087, C088, C163, C165, C166	Eagle St approaching Miami River	Significant, surface flooding, insufficient overland flow route	Combination of insufficient slope and insufficient pipe size
7	C028, C030	Miami River Dr outlet near Poplar St	Significant, below ground level	Combination of insufficient slope and insufficient pipe size
8	C060	Walnut Ave	Significant, below ground level	Insufficient pipe size
9	C069, C070	Balsam Ave	Significant, below ground level	Insufficient pipe size

10	C156, C157, C158	Chestnut Ave	Significant, below ground level	Insufficient pipe size
11	C074, C075, C079, C080, C081, C082, C161	Pine Ave and McCombs Dr approaching Miami River	Significant, surface flooding, insufficient overland flow route	Combination of insufficient slope and insufficient pipe size
12	C175, C176, C177, C197, C198, C199, C200	Alder Ave, Schooner Pl and along McCombs Dr	Significant, below ground level	Combination of insufficient slope and insufficient pipe size
13	C191, C192, C206	Diamond St	Significant, approaching ground level	Insufficient pipe size
14	C187, C189	McCombs Dr near Emerald Ave	Significant, approaching ground level	Insufficient pipe size
15	C184, C205	Hadway Dr	Significant, surface flooding	Combination of insufficient slope and insufficient pipe size
16	C117, C122	Myng Cr	Significant, below ground level	Insufficient pipe size
17	C231, C232, C235, C237	South portion of McCombs Dr, McPherson Rd	Significant, approaching ground level	Combination of insufficient slope, insufficient pipe size, and backwater condition at McPherson Rd ditch.
18	C047, C048	Echo Ave outlet	Significant, below ground level	Insufficient pipe size

In addition to the deficiencies described in the table above, the following deficiencies were identified for the private infrastructure that was modelled.

- C180, C181, C182, C202, and C204 are private pipes that are part of the Harrison Lake Estates development and have modest surcharging.
- C209 is a private pipe part of the 750 Hot Springs Rd development and has modest surcharging.
- C254 is a private pipe part of the 798 Hot Springs Rd development and has modest surcharging.

8.2 MAJOR SYSTEM PERFORMANCE

For the 2050 100-year storm peak flows overland flow increases to 61 conduits that show surcharging above ground level. 15 locations show water depths greater than 0.10 m. 8 locations have flows greater than 50 L/s and are distributed along Bear Ave, Pine Ave, Hadway Dr, and Esplanade Ave approaching Hot Springs Rd.

Harrison Lake

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17

Cedar Ave
Maple St
Lilooet Ave
Echo Ave
Naismith Ave
Eagle St
Driftwood Ave
Mount St
Cottonwood Ave
Walnut Ave
McCombs Dr
Balsam Dr
Chesnut Ave
Pine Ave
Schooner Pl
Alder Ave
Miami River
Diamond St
Emerald Ave
Myng Cres
East Sector
Recreation Area
Hot Springs Rd
McPherson Rd
Hot Springs Rd

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

Drainage Elements
- Creek System
- Ditch
- Outfalls
- Storages
- Deficiency Area

Manhole Surcharging
- Well Below Crown (>0.1m below crown)
- Near Crown (within 0.1m below crown)
- Minor Surcharge (<0.1m above crown)
- Significant Surcharge (>0.1 m above crown)

Pipe Surcharging
- Under Capacity (<85%)
- Near Capacity (85-100%)
- Minor Surcharge (100-115%)
- Significant Surcharge (>115%)

N

0 150 300 450 m

1:10,000

WATER STREET ENGINEERING

EGBC Permit to Practice #1000830

Storm Sewer Master Plan

PREPARED FOR

Village of Harrison Hot Springs

PROJECT NO. 456.2

DATE 04 DEC 2025

REVISION 0

Future 10-Year Storm Minor System Deficiencies

Figure 8-1

Document Path: D:\WSE Dropbox\001-Projects\456-Harrison Hot Springs Master Plans\430-GIS\data\MD_Storm Infrastructure\ArcMap Working Folder\Minor System Deficiencies\Future Storm Minor System Deficiencies.mxd

9 PROJECT IDENTIFICATION AND PRIORITIZATION

Following deficiency identification, a complete project list was developed and analyzed to determine project priorities. Projects are rated as either High, Medium, Low or Conditional. These designations are defined as follows:

- High: Project addresses an existing significant deficiency or system need with broad impacts. Typical timeline is completion within 5 years.
- Medium: Project addresses an existing significant deficiency or system need with localized impact or addresses information gaps to identify deficiencies that could have localized impacts. Generic timeline is completion within 5 to 10 years but subject to project specifics.
- Low: Project addresses an existing minor deficiency or system need with localized impact. Generic timeline is completion within 10 to 20 years but subject to project specifics.
- Conditional: Projects may or may not be required subject to completion of additional work to verify need. No recommended timeline.

9.1 GENERAL CONSIDERATIONS

Regarding the drainage design criteria, the Village's 2022 update to the Subdivision and Development Servicing Bylaw is a significant improvement that will reduce the impact of future development. Notably, the design criteria now require stormwater quality treatment, which is absent or undocumented in many areas of the Village. Currently the Village's Subdivision and Development Servicing Bylaw does not provide criteria related to climate change, which is expected to increase the intensity of extreme storms. This could be resolved by referencing the MMCD's 2022 *Design Guidelines* for climate change impact considerations.

In reviewing the Village's storm sewer system, the capacity requirements to provide safe conveyance to Miami River are generally modest (provided Miami River levels are controlled to be below 9.5 m at Harrison Lake). Based on the well distributed outfalls along Miami River, drainage areas are small. Preliminary sizing for the year 2050 10-year storm peak flows and increased imperviousness with no on-site stormwater control indicates that the largest required sewer size is 900 mm dia. and only 967 m of the 11,641 m of storm sewer needs to be larger than 600 mm dia. For this type of system, centralized detention has limited benefit in reducing sewer size requirements. Further, the Village is close to the outlet for the Miami River watershed such that efficient drainage to Miami River is preferable for peak flow timing. Therefore, no centralized storage detention facilities are recommended. For flow reduction, the Village's existing requirements for on-site stormwater control are considered adequate. The requirements will generally improve conditions where there is re-development since much of the Village was developed before these criteria were implemented.

In reviewing major system flows, several areas within the Village do not have positive drainage to Miami River and significant flood depths could occur with overland flow. Therefore, reliable performance from the storm sewer is critical. In most of these areas, the model shows that the major flows can be conveyed via the storm sewer with only minimal surcharging on the road if the storm sewer capacity is fully utilized. However, the storm sewer conveyance is dependent on sufficient inlet capacity and a free-flowing outfall. Inlet capacity was not within the scope of this analysis and high backwater levels were not considered. Further review of inlet capacity and potential backwater conditions may be warranted where the storm sewer is providing conveyance for major system flows.

In reviewing hazards associated with urban drainage and flooding, it is noted that it is important for the Village to have an Updated Emergency Response plan. A non-comprehensive list of hazards that have been identified through the preparation of this Storm Sewer Master Plan is provided as follows:

1. Hazards associated with Harrison Lake include a landslide induced wave, elevated lake levels associated with local precipitation and Harrison River backwater, and dike failures.
2. Hazards associated with Miami River include high water levels from high creek flows, blockages from landslides or debris inflows, and insufficient outlet capacity to the lake at the pump station.
3. Hazards associated with storm sewer failures include significant surface ponding and flooding.

For areas where municipal infrastructure crosses private property and no alternative routing is proposed, an internal assessment project has been identified to confirm access rights for maintenance. This assessment is ongoing for 114 Cedar Ave, 830 Ramona Pl, and 861 and 875 Myng Cr and is considered a low concern.

9.2 PROJECT PRIORITIZATION

HIGH PRIORITY

The Miami River outfall to Harrison Lake was not part of the storm sewer analysis, however an adequate outlet is critical to the function of the storm sewer infrastructure. It is understood that debris clogging at the pump station is a primary concern. To confirm the reliability of this outlet, an assessment of the Miami River Dike Pump Station is currently being completed by NHC. This ongoing project is most critical to overall flooding concerns and has been assessed as "High" priority (Project #1). As part of the NHC assessment, the potential to lower the operating water level at the pump station should be reviewed as this will improve storm sewer system performance. After reviewing the potential to lower the operating water level at the pump station, further analysis of the storm sewer system is recommended to confirm flooding concerns associated with the storm sewer system during high backwater conditions.

MEDIUM PRIORITY

For all storm sewer projects with capacity deficiencies, model results indicate that the potential flood damage is low based on the modest surface flooding. To verify potential surface flooding concerns, a surface flooding field verification program is recommended as a "Medium" priority project to confirm capacity issues (Project #2). Priority areas for field verification have been identified based on model results.

Based on available information, there are several areas of the Village that do not have any known water quality treatment. To confirm water quality concerns and determine prioritization of future water quality improvement projects, a water quality monitoring program is recommended as a "Medium" priority project (Project #3). It is understood that the Miami River Streamkeepers currently monitor the Miami River at 3 locations on a quarterly basis. It is recommended to collaborate with the Miami River Streamkeepers to expand the quality monitoring. Results from the water quality monitoring could impact project prioritization.

To understand the risk of failure for the existing sewer system, a condition assessment of the storm sewer system is recommended as a "Medium" priority project (Project #4). The modelling assumes that the storm sewer system is functioning according to the as-built condition. Identifying condition issues that could lead to pipe failure could dramatically impact project prioritization.

Storm sewer projects have been ranked according to their impact on surface flooding. In general, surface flooding is modest with only one area (Bear Ave) where the model indicates flooding will be significantly greater than 0.3 m for the 2050 100-year event. The Bear Ave sewer improvement is the only project that has been given a priority of "Medium" based on the model results (Project #5).

Two projects have been given a priority of "Medium" based on information from the Village and site observations of existing issues. The first project (Project #6) is to add a storm sewer on Echo Ave to the Mount St sewer to eliminate the reported drainage issues in this area. During an Oct 2025 field visit to assess this area, it was observed that the outlet to the Mount St sewer was almost entirely buried. Based on this observation, a ditch cleanout and outfall improvements at the Mount St sewer outlet are also recommended as part of this project. The second project (Project #7) is to eliminate the backwater impact from beaver damming downstream of McPherson Rd that compromises the performance of upstream drainage infrastructure and has potential to result in flooding of Hot Springs Rd. As it is presumed that the damming is on District of Kent property, a portion of this work may need to be a collaborative project with the District of Kent. Contributing to this backwater area is drainage from the East Sector Recreation Area that drains south on McCombs Dr and west to the McPherson Rd ditch and Miami River. Topographically, this drainage area should be draining northeast to Miami River rather than contributing

to the existing issues along the McPherson Rd ditch. Eliminating the East Sector Recreation Area drainage contribution to McCombs Dr is a second component of this "Medium" priority project.

LOW PRIORITY

The final recommended projects are based on input from Village staff and field investigation work. One project is to eliminate a municipal storm sewer on private property that crosses under 565 Lillooet Ave (Marina Beach). The Oct 2025 field investigation confirmed that this sewer likely crosses under the 565 Lillooet Ave building to outlet to Harrison Lake in Rendall Park. As this sewer is on private property, it is desirable to re-route the drainage to the Mount St sewer, which is on municipal land. No drainage issues have been identified for this area, so this project is recommended as "Low" priority subject to confirmation of any condition issues. The other recommended project is to improve drainage conditions at the Angus Estates development to reduce I&I issues with the sanitary sewer. This project will be informed by the I&I reduction program recommended for the Sanitary Sewer Master Plan (Water Street Engineering Ltd., 2025). The initial recommendation is to provide a storm sewer on Hope Pl and redirect stormwater from the dry well on Myng Cr that is likely to contribute to local I&I issues. This project is recommended as "Low" priority and could be refined or expanded based on investigations completed for the I&I reduction program.

CONDITIONAL PRIORITY

In addition to the recommended projects, conditional projects were defined for areas that have identified deficiencies associated with low flooding risks.

Where sewer capacities are deficient and some surface flooding is expected during the 10-year event, the projects were given a priority of "Conditional – Monitor." These projects are not currently monitored but should be included in the surface flooding field verification program and could be assigned as "Low" priority or higher if field observations confirm surface flooding occurs during significant rain events. The risk of surface flooding informs the ranking of the "Conditional – Monitor" projects. The priority of these projects could also be increased if the condition assessment indicates the sewers are damaged and need to be replaced.

Where sewer capacities are deficient and no surface flooding is expected during the 10-year event, the projects have been given a priority of "Conditional – Assess". The priority of these projects could be increased if the condition assessment indicates the sewers are damaged and need to be replaced. The risk of surface flooding informs the ranking of the "Conditional – Assess" projects. Higher ranked "Conditional – Assess" projects could be included in the surface flooding field verification program.

All conditional projects should be considered where there are cost efficiencies of implementing with other projects in the Village.

Of note, there are sewers in the Village that are below minimum slope and below minimum diameter but have not been identified for replacement as the capacity impact is marginal.

SUMMARY

All recommended and conditional projects are summarized in Table 9-1. An overview of the projects is provided on Figure 9-1 and additional details for each project are included in Appendix 1. For the current ranking, the potential to provide water quality treatment to areas that do not have any documented treatment has been used as a differentiator between projects that have equivalent or similar impacts on surface flooding.

Table 9-1: Capital Project List

Project Number	Description	Deficiency	Surface Flooding (10-Year)	Surface Flooding (100-Year)	Water Quality Impact	Additional Notes	Priority
1	Assess Miami River Dike Pump Station	Confirm resilience to blockages at culvert inlet, adequate inlet capacity to the pumps, adequate pump capacity for storm system function	Extensive	Extensive	N/A	Risk of widespread flooding issues if Miami River cannot be pumped to Harrison Lake during high water levels.	High
2	Surface flooding field verification program	Potential surface flooding	To be confirmed	To be confirmed	N/A	Recommended field verification of areas with identified capacity constraints.	Medium
3	Stormwater quality monitoring program	Untreated stormwater flows	N/A	N/A	High	Recommended water quality monitoring during rainfall events to confirm areas to prioritize for stormwater treatment.	Medium
4	Storm sewer condition assessment	Unknown	Not quantified	Not quantified	N/A	Recommended to assess condition of sewers older than 20 years (or undocumented age) to identify risks.	Medium
5	Bear Ave sewer improvements	Significant, 10-year event surface flooding, insufficient overland flow route	2 manholes (existing and future), >0.3 m depth	5 manholes (2 existing +3 future)	3.74 ha Area	Confirm recent paving eliminated ponding issue at Lillooet Ave and Eagle St intersection. Maximum surface flooding for future 100-year storm simulated at >0.5 m depth and 0.240 m^3/s flow.	Medium
6	New sewer for Echo Ave approaching Mount St, outfall improvements	No drainage system connecting to Mount St and buried outlet. Drainage issues noted by Village.	Not quantified	Not quantified	2.00 ha Area	The severity of this issue is not quantified. Maximum surface flooding for future 100-year storm is 0.105 m^3/s.	Medium
7	General improvements for south McCombs Dr, McPherson Rd	Backwater condition from beaver dam on McPherson Rd ditch, unnecessary drainage connection to McCombs Dr	Not quantified	Not quantified	N/A	East Sector Recreation Area should not be flowing to McCombs Dr. Significant backwater on McPherson Rd due to beaver damming downstream of Hot Springs Rd culvert crossing needs to be resolved.	Medium
8	Eliminate private property sewer (565 Lillooet Ave)	Sewer crosses under a building on private property	None	None	3.59 ha Area	Private sewer to be eliminated by connecting Lillooet Ave sewer to Mount St and upgrading capacity.	Low
9	Angus Estates drainage improvements	Excessive I&I in sanitary sewer	Not quantified	Not quantified	0.89 ha Area	Improvements to be informed by I&I reduction program. Add storm sewer on Hope Pl with outlet to Miami River.	Low
10	Esplanade Ave and Hot Springs Rd sewer improvements	Significant, 10-year event surface flooding, insufficient overland flow route	1 manhole (existing and future)	2 manholes (1 existing +1 future)	6.49 ha Area	Maximum surface flooding for future 100-year storm simulated at 0.28 m depth and 0.098 m^3/s flow	Conditional – Monitor
11	Pine Ave and McCombs Dr sewer improvements	Significant, 10-year event surface flooding, insufficient overland flow route	1 manhole (existing and future)	5 manholes (1 existing +4 future)	Already treated	Maximum surface flooding for future 100-year storm simulated at 0.31 m depth and 0.133 m^3/s flow	Conditional – Monitor
12	Hadway Dr sewer improvements	Significant, 10-year event surface flooding, insufficient overland flow route	1 manhole (existing and future)	3 manholes (existing and future)	Already treated	Maximum surface flooding for future 100-year storm simulated at 0.17 m depth and 0.063 m^3/s flow	Conditional – Monitor
13	Eagle St sewer improvements	Significant, 10-year event surface flooding, insufficient overland flow route	4 manholes (future only)	7 manholes (2 existing +5 future)	3.96 ha Area	Maximum surface flooding for future 100-year storm simulated at 0.26 m depth and 0.028 m^3/s flow	Conditional – Monitor
14	Naismith Ave outlet sewer improvements	Significant, 10-year event surface flooding, insufficient overland flow route	1 manhole (future only)	2 manholes (existing and future)	3.02 ha Area	Maximum surface flooding for future 100-year storm simulated at 0.13 m depth and 0.019 m^3/s flow	Conditional – Monitor
15	Esplanade Ave and Maple St sewer improvements	Significant, 10-year event surface flooding, insufficient overland flow route	3 manholes (future only)	5 manholes (4 existing +1 future)	2.50 ha Area	Maximum surface flooding for future 100-year storm simulated at 0.19 m depth and 0.042 m^3/s flow	Conditional – Monitor
16	South portion of McCombs Dr, McPherson Rd sewer improvements	Significant, 10-year event approaching ground level	None	5 manholes (2 existing +3 future)	6.09 ha Area	CB on McCombs Dr should be lowered to improve drainage capture. Collapsed pipes noted in 2016 LWMP (to be confirmed). Maximum surface flooding for future 100-year storm simulated at 0.06 m depth and 0.007 m^3/s flow.	Conditional – Assess
17	Alder Ave, Schooner Pl and along McCombs Dr sewer improvements	Significant, 10-year event below ground level, insufficient overland flow route	None	2 manholes (existing and future)	3.52 ha Area	Maximum surface flooding for future 100-year storm simulated at 0.09 m depth and 0.012 m^3/s flow	Conditional – Assess

18	Myng Cr sewer improvements	Significant, 10-year event below ground level	None	2 manholes (existing and future)	1.57 ha Area	Maximum surface flooding for future 100-year storm simulated at 0.03 m depth and 0.022 m^3/s flow	Conditional – Assess
19	Diamond St sewer improvements	Significant, 10-year event approaching ground level	None	3 manholes (2 existing +1 future)	Already treated	Maximum surface flooding for future 100-year storm simulated at 0.17 m depth and 0.021 m^3/s flow	Conditional – Assess
20	McCombs Dr near Emerald Av sewer improvements	Significant, 10-year event approaching ground level	None	1 manhole (existing and future)	Already treated	Maximum surface flooding for future 100-year storm simulated at 0.05 m depth and 0.011 m^3/s flow	Conditional – Assess
21	Walnut Ave sewer improvements	Significant, 10-year event below ground level, insufficient overland flow route	None	2 manholes (future only)	7.55 ha Area	Maximum surface flooding for future 100-year storm simulated at 0.04 m depth and 0.014 m^3/s flow	Conditional – Assess
22	Echo Ave outlet sewer improvements	Significant, 10-year event below ground level	None	4 manholes (future only)	4.06 ha Area	Maximum surface flooding for future 100-year storm simulated at 0.07 m depth and 0.007 m^3/s flow	Conditional – Assess
23	Balsam Ave sewer improvements	Significant, 10-year event below ground level, insufficient overland flow route	None	2 manholes (future only)	3.41 ha Area	Maximum surface flooding for future 100-year storm simulated at 0.07 m depth, no flow	Conditional – Assess
24	Esplanade Ave and Chehalis St sewer improvements	Significant, 10-year event below ground level, insufficient overland flow route	None	None	2.67 ha Area	No surface flooding, just sewer surcharging below ground level	Conditional – Assess
25	Miami River Dr outlet near Poplar St sewer improvements	Significant, 10-year event below ground level, insufficient overland flow route	None	5 manholes (future only)	1.96 ha Area	Maximum surface flooding for future 100-year storm simulated at 0.05 m depth and 0.007 m^3/s flow	Conditional – Assess
26	Chestnut Ave sewer improvements	Significant, 10-year event below ground level, insufficient overland flow route	None	2 manholes (future only)	Already treated	Maximum surface flooding for future 100-year storm simulated at 0.11 m depth, no flow	Conditional – Assess
27	Various water quality improvements	Untreated areas where not addressed through other projects	None	None	6 outlets 8.49 ha Area	Largely residential areas with exception of Alice St outlet	Conditional – Assess

Legend

Drainage Elements
- Creek System
- Ditch
- Proposed Outfall Upgrade
- Outfalls
- Storages

Capital work project area
- High
- Medium
- Low
- Conditional - Monitor
- Conditional - Assess

Manholes
- Existing Manhole
- Proposed MH/OGS Upgade
- Proposed Manhole Upgrade
- Inlets

Storm Sewer
- Existing Storm Sewer
- Proposed Storm Sewer Upgrade
- To Be Abandoned

N

0 150 300 450 m

1:10,000

WATER STREET ENGINEERING

EGBC Permit to Practice #1000830

Storm Sewer Master Plan

PREPARED FOR

Village of Harrison Hot Springs

PROJECT NO. 456.2

DATE 04 DEC 2025

REVISION 0

Capital Works Projects

Figure 9-1

Document Path: D:\WSE Dropbox\001-Projects\456-Harrison Hot Springs Master Plans\430-GIS\data\MD_Storm Infrastructure\ArcMap Working Folder\Capital Works Projects_v2.mxd

10 CAPITAL WORKS PLAN

Based on the identified deficiencies and ranking outlined above, a capital works plan has been developed. All proposed projects are based on capacity improvements to meet future development conditions with climate change (2050). The sizing difference between existing development conditions with current storms is marginal. No allowance for additional on-site storage has been made. The unit pricing for sewer replacement is inclusive of removals and restoration.

None of the recommended drainage upgrades are driven by growth. Therefore, they are not eligible for Development Cost Charges (DCCs) because they are not specifically required to service new development. The upgrades are required to resolve deficiencies that are attributed to existing system limitations and increased rainfall intensity associated with climate change. Climate change has a larger influence on future peak flows than incremental increases in imperviousness. As the recommended drainage upgrades are recommended to reduce flood risk, improve stormwater quality, and enhance environmental protection or asset condition information, they align with the objectives of provincial and federal grant programs that focus on disaster risk reduction, climate adaptation, and sustainable water infrastructure. Therefore, these projects are expected to be good candidates for external grants.

The capital costs for construction projects include an allowance of 20% for design and contract administration and 30% for construction contingency. Projects without construction scopes include a 20% contingency. The cost opinions presented are EGBC/ACEC-BC Class C estimates, based on unit rates from similar projects. They are intended for initial capital project budgeting. The expected accuracy range is between a low of -25% and a high of +40% for the given scope. Costs are to yr-2025 and no escalation is included for future completion of the projects.

The capital works plan is divided into recommended projects and conditional projects in Table 10-1 and Table 10-2 below. The total cost of the recommended projects is estimated at $1,975,000 excluding an annual cost for a stormwater quality monitoring program (estimated at $50,000/year). The total cost of the conditional projects is estimated at $10,446,000.

Project numbers 1, 2, 3, and 4 are projects related to further assessment of the drainage system to confirm deficiencies. The pump station assessment has the broadest impact on system performance and has been given a “High” priority. The pump station assessment is ongoing and may require some refinement to address recommendations within this report. The “Medium” priority assessment projects are not associated with known deficiencies and have been ranked in order of implementation cost (lower cost assessment projects are higher priority). Though the sewer condition assessment (Project #4) is the lowest ranked assessment project, it could notably impact project priorities if significant condition deficiencies are identified. Therefore, this project should occur at the earliest feasibility dependent on available funding.

Table 10-1: Recommended Capital Projects with Cost Opinions

Project Number	Description	Deficiency	Priority	Capital Cost
1	Assess Miami River Dike Pump Station	Confirm resilience to blockages at culvert inlet, adequate inlet capacity to the pumps, adequate pump capacity for storm system function	High	$30,000
2	Surface flooding field verification program	Potential surface flooding	Medium	n/a (operating cost)
3	Stormwater quality monitoring program	Untreated stormwater flows	Medium	n/a (operating cost)[1]
4	Storm sewer condition assessment	Unknown	Medium	$90,000

5	Bear Ave sewer improvements	Significant, 10-year event surface flooding, insufficient overland flow route	Medium	$450,000
6	New sewer for Echo Ave approaching Mount St	No drainage system connecting to Mount St and buried outlet to ditch. Drainage issues noted by Village.	Medium	$381,000
7	General improvements for south McCombs Dr, McPherson Rd	Backwater condition from beaver dam on McPherson Rd ditch, unnecessary drainage connection to McCombs Dr.	Medium	$225,000
8	Eliminate private property sewer (565 Lillooet Ave)	Sewer crosses under a building on private property	Low	$419,000
9	Angus Estates drainage improvements (Hope Pl sewer)	Excessive I&I in sanitary sewer	Low	$380,000
Total				$1,975,000
Notes: [1]Project #3 is estimated at $50,000 per year for a stormwater quality monitoring program based on 4 samples per year and 5 – 10 sampling locations. This cost is excluded from the total cost as the duration will be determined based on results.				

Table 10-2: Conditional Capital Projects

Project Number	Description	Deficiency	Priority	Capital Cost
10	Esplanade Ave and Hot Springs Rd sewer improvements	Significant, 10-year event surface flooding, insufficient overland flow route	Conditional - Monitor	$1,242,000
11	Pine Ave and McCombs Dr sewer improvements	Significant, 10-year event surface flooding, insufficient overland flow route	Conditional - Monitor	$1,115,000
12	Hadway Dr sewer improvements	Significant, 10-year event surface flooding, insufficient overland flow route	Conditional - Monitor	$306,000
13	Eagle St sewer improvements	Significant, 10-year event surface flooding, insufficient overland flow route	Conditional - Monitor	$1,017,000
14	Naismith Ave outlet sewer improvements	Significant, 10-year event surface flooding, insufficient overland flow route	Conditional - Monitor	$421,000
15	Esplanade Ave and Maple St sewer improvements	Significant, 10-year event surface flooding, insufficient overland flow route	Conditional - Monitor	$691,000
16	South portion of McCombs Dr, McPherson Rd sewer improvements	Significant, 10-year event approaching ground level	Conditional - Assess	$931,000
17	Alder Ave, Schooner Pl and along McCombs Dr sewer improvements	Significant, 10-year event below ground level, insufficient overland flow route	Conditional - Assess	$1,342,000

18	Myng Cr sewer improvements	Significant, 10-year event below ground level	Conditional - Assess	$164,000
19	Diamond St sewer improvements	Significant, 10-year event approaching ground level	Conditional - Assess	$593,000
20	McCombs Dr near Emerald Av sewer improvements	Significant, 10-year event approaching ground level	Conditional - Assess	$122,000
21	Walnut Ave sewer improvements	Significant, 10-year event below ground level, insufficient overland flow route	Conditional - Assess	$289,000
22	Echo Ave outlet sewer improvements	Significant, 10-year event below ground level	Conditional - Assess	$172,000
23	Balsam Ave sewer improvements	Significant, 10-year event below ground level, insufficient overland flow route	Conditional - Assess	$417,000
24	Esplanade Ave and Chehalis St sewer improvements	Significant, 10-year event below ground level, insufficient overland flow route	Conditional - Assess	$591,000
25	Miami River Dr outlet near Poplar St sewer improvements	Significant, 10-year event below ground level, insufficient overland flow route	Conditional - Assess	$199,000
26	Chestnut Ave sewer improvements	Significant, 10-year event below ground level, insufficient overland flow route	Conditional - Assess	$429,000
27	Various water quality improvements	Untreated areas where not addressed through other projects	Conditional - Assess	$405,000
Total				$10,446,000

11 CONCLUSIONS AND RECOMMENDATIONS

11.1 SUMMARY

The background review and storm sewer system modelling revealed that there are extensive storm sewer deficiencies based on the Village's existing design criteria. However, most deficient sewers have adequate capacity for the design flows with surcharging that remains below ground level. A high-level summary of the deficiencies is provided as follows:

- Potential access issues for storm sewer crossing private property
- Potential capacity and/or function issues at the Miami River Dike Pump Station could result in backwater conditions that limit storm sewer performance due to elevated water levels in Miami River
- Widespread areas with capacity issues, where surface flooding should be confirmed
- Widespread areas with no documented water quality treatment and inadequate information on the extent of water quality issues
- Inadequate information about the condition of the existing storm sewers
- Significant capacity issues along Bear Ave with high probability of surface flooding
- No drainage system on Echo Ave and documented drainage issues
- Backwater conditions along McPherson Rd due to beaver activity and an inappropriate drainage connection from the East Sector Recreation Area
- Municipal sewer crossing underneath building at 565 Lillooet Ave (private property)
- Inadequate drainage system on Hope Pl that is presumed to contribute to local I&I issues
- 18 additional areas with sewer systems that do not meet the Village's design criteria for pipe geometry, capacity, or water quality treatment where model results indicate the potential damage is low

11.2 RECOMMENDATIONS

Twenty-seven capital projects were identified based on the background review and storm sewer modelling. Nine of the projects are recommended. The 18 remaining projects have been identified as conditional because there is low risk of damage due to surface flooding. Where some surface flooding is expected for the 10-year storm, the project is classified as "Conditional – Monitor." Otherwise, the project is classified as "Conditional – Assess."

Assessment of the Miami River Dike Pump Station is the only project that has been identified as "High" priority based on the significant impact of the pump station on backwater conditions for the storm sewer system.

Three monitoring and/or assessment projects have been recommended as "Medium" priority. These projects will provide a better understanding of surface flooding risk, water quality issues, and condition issues that could result in pipe failures.

Three storm infrastructure improvement projects are recommended as "Medium" priority based on the existing surface flooding risk.

Two storm infrastructure improvement projects are recommended as "Low" priority based on private property access issues and potential contributions to sanitary sewer deficiencies.

A summary of total capital costs is provided in Table 11-1. It is recommended to initiate the monitoring and assessment projects in the near term. To improve understanding of risks that could result in flood damage, the surface flooding field verification program should be initiated immediately. Completion of a CCTV assessment to understand condition concerns and refine the capital works project prioritization is recommended to occur at the earliest feasibility based on available funding.

Table 11-1: Projects Summary by Priority

Project Priority	Number of Projects	Total Capital Costs
High	1	$30,000
Medium	6	$1,146,000[1]
Low	2	$799,000
Conditional - Monitor	6	$4,792,000
Conditional - Assess	12	$5,654,000
Total		$12,421,000
Notes: [1]Excludes estimated cost of $50,000/yr for stormwater quality monitoring program.		

In addition to the identified capital projects, the following recommendations are made regarding urban drainage concerns:

1. Confirm access rights for storm pipes crossing 114 Cedar Ave, 830 Ramona Pl, 861 and 875 Myng Cr.
2. The Village's Subdivision and Development Servicing Bylaw should be updated to require consideration of climate change impacts.
3. An updated Emergency Response Plan should be developed that considers hazards from urban drainage and flooding. A project to provide a Drainage/Sewer Emergency Response Plan is identified in the Sanitary Sewer Master Plan (Water Street Engineering Ltd., 2025).

12 CLOSURE

We trust this report meets your present requirements. Please contact the undersigned with any questions or comments.

WATER STREET ENGINEERING LTD.

David Marshall, PEng
Senior Water Resources Engineer

Neal Whiteside, MASC, PEng
Principal, Senior Municipal Engineer

EGBC permit number 1000830

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ABBREVIATIONS

CTQ – CTQ Consultants Ltd.

DCC – Development Cost Charge

DEM – digital elevation model

I&I – inflow and infiltration

IDF – intensity-duration-frequency

ISE – integral square error

LWMP – Liquid Water Management Plan

MH – maintenance hole

MMCD – Master Municipal Construction Documents

MOTT – Ministry of Transportation and Transit

NSE – Nash–Sutcliffe efficiency

NHC – Northwest Hydraulic Consultants Ltd.

OGS – Oil and Grit Separator

VHHS – Village of Harrison Hot Springs

Village – Village of Harrison Hot Springs

WWTP – wastewater treatment plant

DEFINITIONS

Minor System – The minor system is the infrastructure associated with the collection, conveyance and treatment of minor (frequently occurring) rainfall events. The minor system is to be designed to prevent flooding and property damage and to limit public inconvenience caused by rainfall events with a return period equal to or more frequent than the 10-year event.

Major System – The major system is the infrastructure associated with the collection, conveyance and treatment of major (infrequent) rainfall events. The major system is comprised of surface flood paths, swales, channels, watercourses, roadways, walkways, pathways, and flow control facilities. The major system is to be designed to protect the public and prevent significant property damage caused by rainfall events with a return period equal to or more frequent than the 100-year event.

APPENDIX 1: PROJECT DEFINITION SHEETS

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 1
Assess Pump Station
Priority: High

Project Description: Assess Miami River inlet to Harrison Lake pumps to confirm resilience to blockages at culvert inlet, adequate capacity of the pumps, and potential to lower operating water level at the pumps to improve storm sewer performace. Update analysis of storm sewer performance considering potential backwater condition within Miami River.

Deficiency: Resilience to culvert blockages, adequate inlet capacity to the pumps, storm sewer performance during backwater condition.

Additional Notes: Risk of widespread flooding issues if Miami River cannot be pumped to Harrison Lake during high water levels.

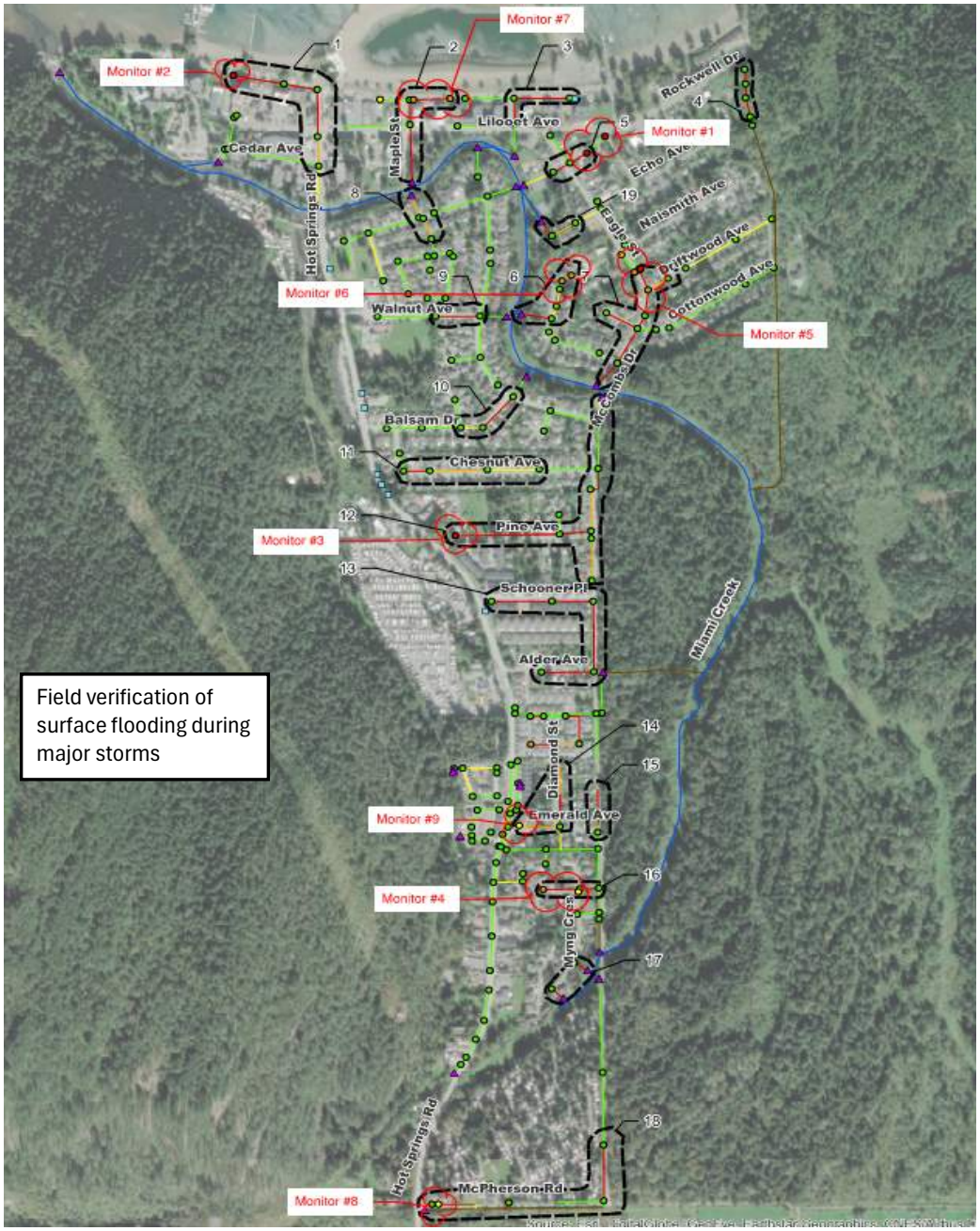
Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	Assessment	LS	1	$ 25,000.00	$ 25,000
			Subtotal:		**$ 25,000**
			Administration Contingency (%)	**20%**	**$ 5,000**
			Total Estimated Cost:		**$ 30,000**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 2
Surface Flooding Field Verification Program
Priority: Medium

Project Description: Field verification program to verify surface flooding in vulnerable locations during major storms.

Deficiency: Potential surface flooding.

Additional Notes: Recommended field verification of surface flooding in areas with identified capacity constraints.



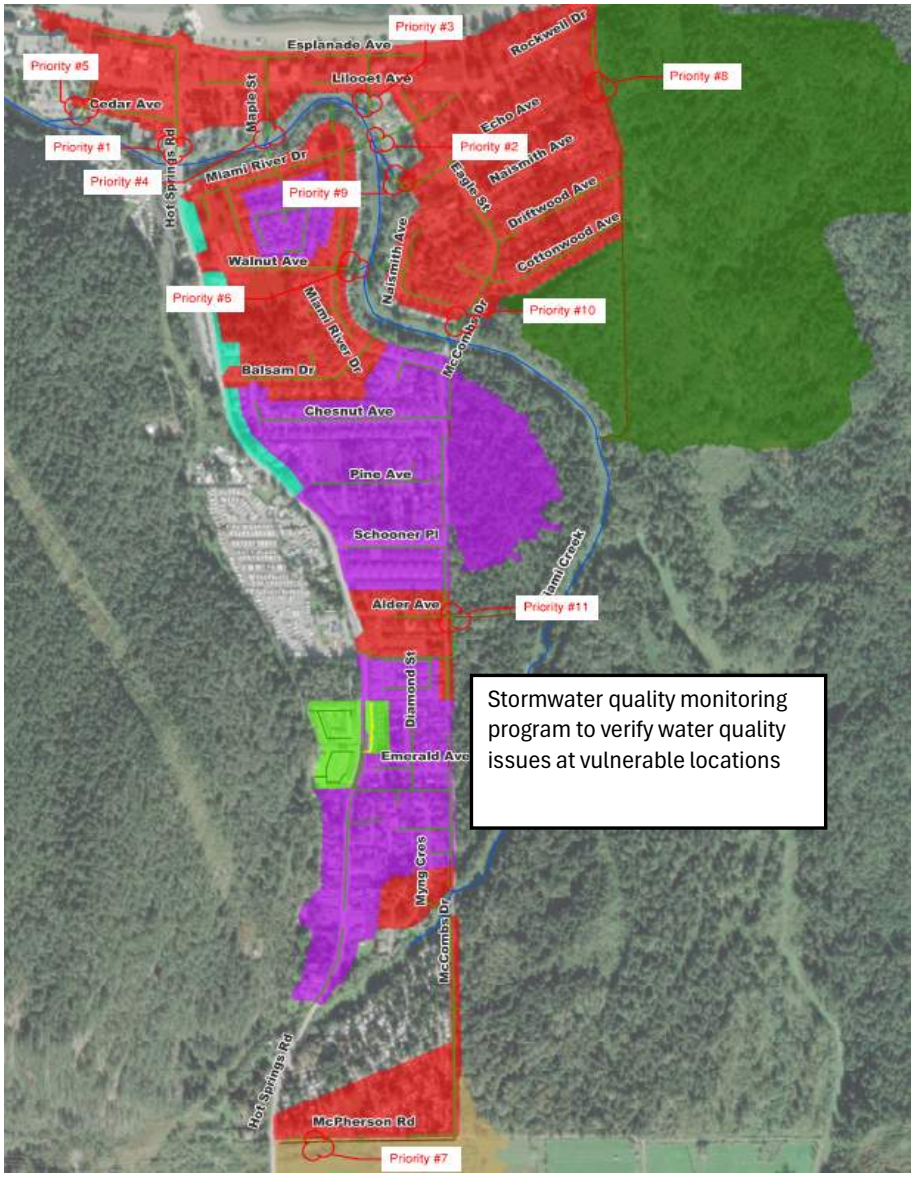
Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	Field reviews	LS	1	$ -	$ -
			Total Estimated Cost:		**$ -**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 3
Stormwater Quality Monitoring Program
Priority: Medium

Project Description: Monitoring program to verify water quality issues in vulnerable locations during discharges. Assume 2 samples during dry seasons and 2 samples during wet season. Assume 5 - 10 sampling locations.

Deficiency: Untreated stormwater flows with potential for negative environmental impact.

Additional Notes: Recommended water quality monitoring during rainfall events to confirm areas to prioritize for stormwater treatment.



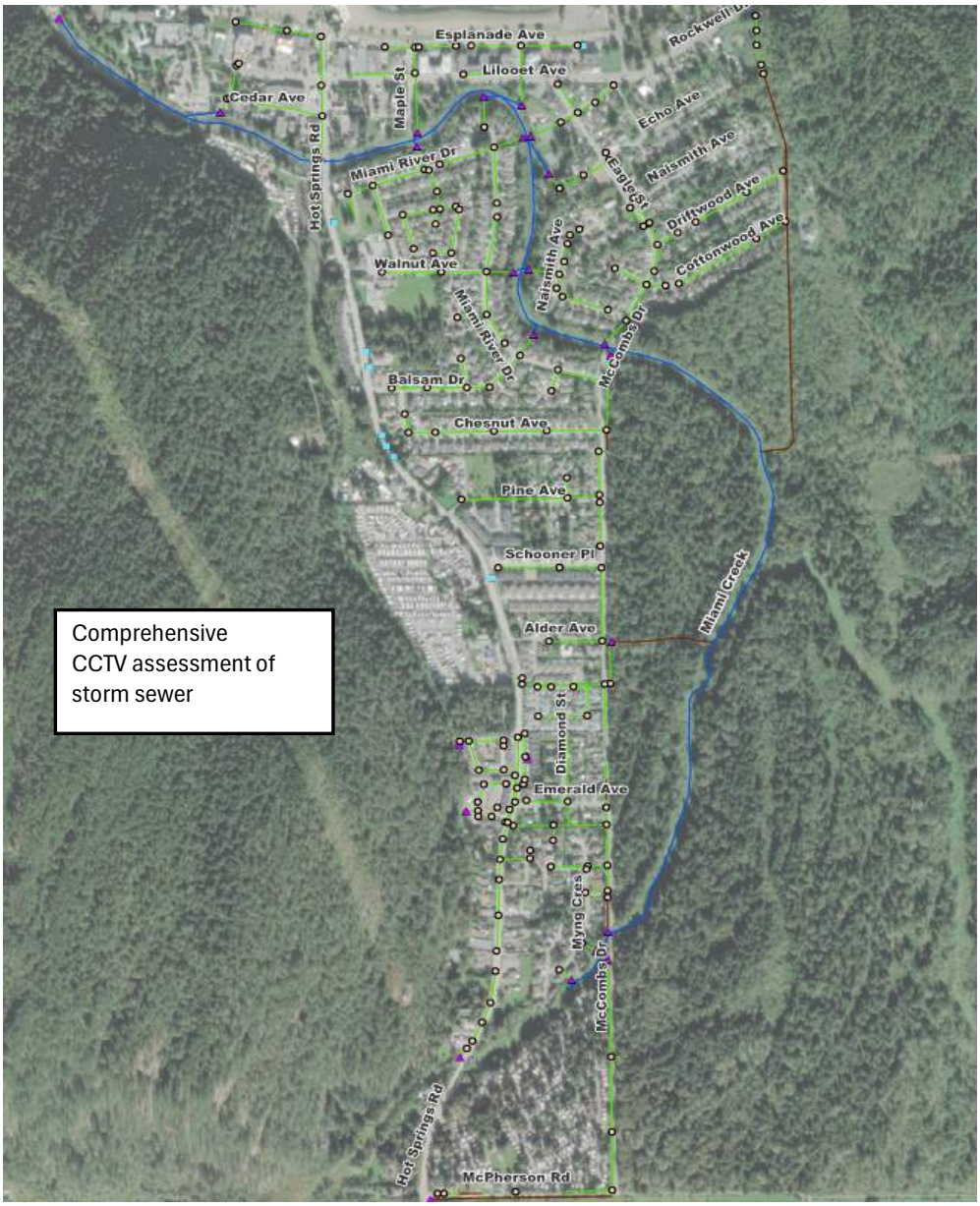
Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	Monitoring program	per annum	1	$ 41,667.00	$ 41,667
			Subtotal:		**$ 41,667**
			Administration Contingency (%)	**20%**	**$ 8,333**
			Total Estimated Cost:		**$ 50,000**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 4
Storm Sewer Condition Assessment
Priority: Medium

Project Description: Comprehensive CCTV assessment of storm sewer system to identify condition issues.

Deficiency: Potentially unknown condition deficiencies.

Additional Notes: Recommended to assess condition of sewers older than 20 years (or undocumented age) to identify risks.



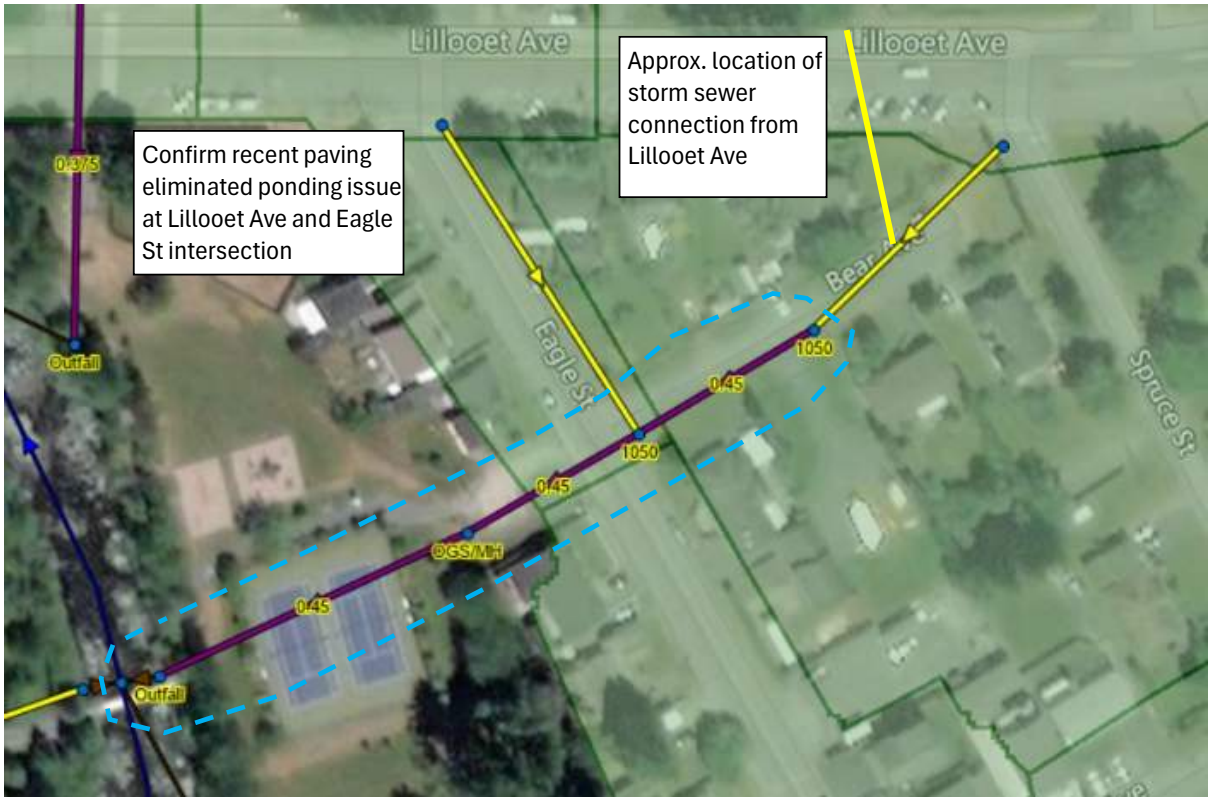
Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	CCTV Assessment	LS	1	$ 70,000.00	$ 70,000
2	Updated capital works plan	LS	1	$ 5,000.00	$ 5,000
			Subtotal:		**$ 75,000**
			Administration Contingency (%)	**20%**	**$ 15,000**
			Total Estimated Cost:		**$ 90,000**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 5
Bear Ave Sewer Improvements
Priority: Medium

Project Description: Upgrade 153m of existing storm main along Bear Ave to provide flow capacity for year 2050 10-year storm event assuming increased imperviousness. Add water quality improvement, outfall protection.

Deficiency: Significantly below design criteria capacity, 10-year event surface flooding, insufficient overland flow route.

Additional Notes: Maximum surface flooding for future 100-year storm is simulated at >0.5 m depth and 0.240 m^3/s flow.



Assumptions: All manholes and catch basins require replacement, assume approximately 2 catch basins per 100 m of sewer.

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	450mm Dia. Storm Sewer	m	70	$ 1,330.00	$ 93,221
2	450mm Dia. Storm Sewer	m	41	$ 1,330.00	$ 54,301
3	450mm Dia. Storm Sewer	m	42	$ 1,330.00	$ 56,016
4	1050mm Dia. Manhole	ea.	2	$ 13,000.00	$ 26,000
5	OGS / Manhole	ea.	1	$ 45,000.00	$ 45,000
6	Catchbasins	ea.	4	$ 4,600.00	$ 18,400
7	Outfall	ea.	1	$ 7,000.00	$ 7,000
			Subtotal:		**$ 299,938**
	Design / Construction Management / Contingency (%)			**50%**	**$ 149,969**
			Total Estimated Cost:		**$ 449,907**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 6
New Sewer for Echo Ave Approaching Mount St and Outfall Improvements
Priority: Medium

Project Description: Add 122m of new storm main along Echo Ave to resolve lack of drainage system and clean out ditch outlet from Mount St sewer, which is currently buried. Provide capacity for year 2050 10-year storm event assuming increased imperviousness. Add water quality improvement.

Deficiency: No drainage system connecting to Mount St and buried outlet. Drainage issues noted by Village.

Additional Notes: The severity of this issue is not quantified. Maximum surface flooding for future 100-year storm is 0.105 m^3/s.

Assumptions: Assume approximately 2 catch basins per 100 m of sewer.

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	300mm Dia. Storm Sewer	m	78	$ 1,140.00	$ 89,007
2	300mm Dia. Storm Sewer	m	44	$ 1,140.00	$ 50,137
3	1050mm Dia. Manhole	ea.	2	$ 13,000.00	$ 26,000
4	OGS / Manhole	ea.	1	$ 45,000.00	$ 45,000
5	Catchbasins	ea.	4	$ 4,600.00	$ 18,400
6	Ditch Maintenance	LS	1	$ 25,000.00	$ 25,000
			Subtotal:		**$ 253,544**
	Design / Construction Management / Contingency (%)			**50%**	**$ 126,772**
			Total Estimated Cost:		**$ 380,316**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 7
General Improvements for South McCombs Dr, McPherson Rd
Priority: Medium

Project Description: Resolve backwater condition on McPherson Rd from beaver dam, ditch upgrades and water quality upgrades along McPherson Rd ditch, eliminate drainage connection from East Sector Recreation Area to McCombs Dr.

Deficiency: Backwater condition from beaver dam on McPherson Rd ditch, unnecessary drainage connection to McCombs Dr.

Additional Notes: East Sector Recreation Area should not be flowing to McCombs Dr. Significant backwater on McPherson Rd due to beaver damming downstream of Hot Springs Rd culvert crossing needs to be resolved.

Assumptions: Balance of maintenance work and modest measures to discourage downstream beaver activity. Modest ditch improvements to reduce pollutant conveyance. Modest improvements to provide outflow to East Sector Recreation Area.

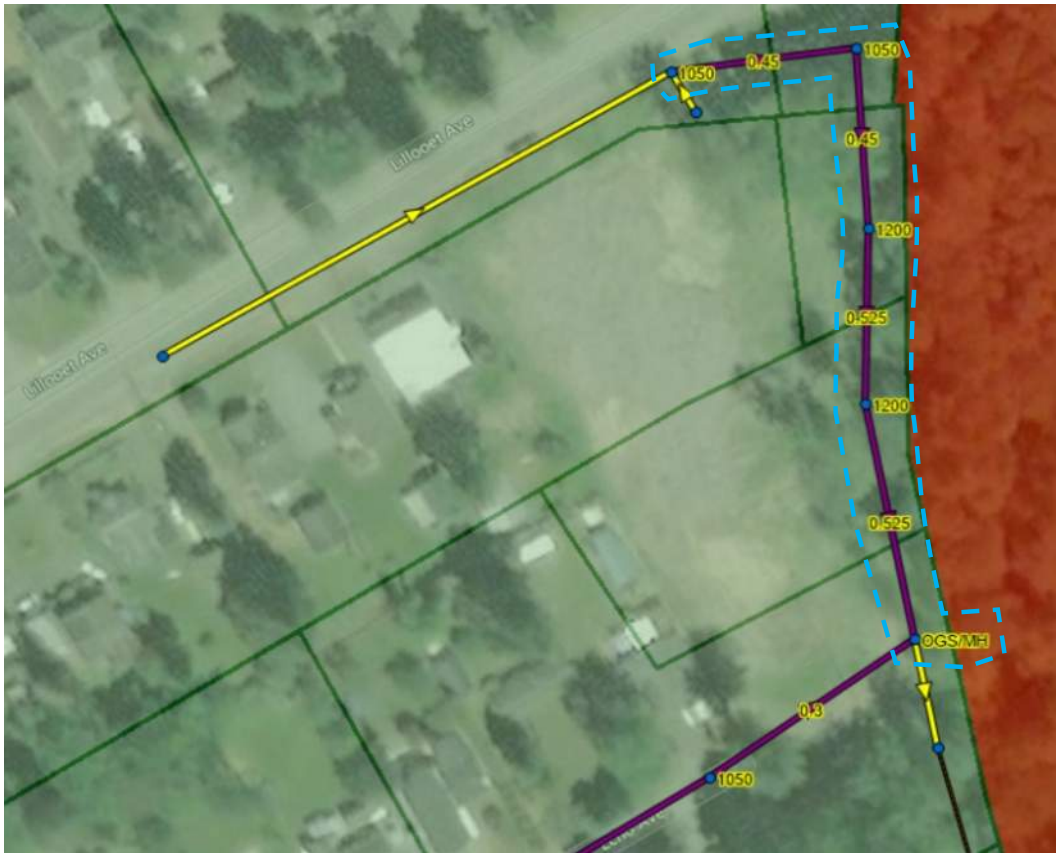
Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	Resolve Beaver Dam Backwater Condition	LS	1	$ 50,000.00	$ 50,000
2	Water Quality Upgrades, Ditch Maintenance	LS	1	$ 80,000.00	$ 80,000
3	Eliminate Drainage Connection	LS	1	$ 20,000.00	$ 20,000
			Subtotal:		**$ 150,000**
			Design / Construction Management / Contingency (%)	**50%**	**$ 75,000**
			Total Estimated Cost:		**$ 225,000**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 8
Eliminate Private Property Sewer (565 Lillooet Ave)
Priority: Low

Project Description: Add 33m of new storm main from Lillooet Ave to eliminate crossing through 565 Lillooet Ave. Upgrade 108m of existing storm main along Mount St to accommodate and provide flow capacity for year 2050 10-year storm event assuming increased imperviousness. Water quality improvements and downstream improvements part of Project 6.

Deficiency: Sewer crosses under a building on private property

Additional Notes: Private sewer to be eliminated by connecting Lillooet Ave sewer to Mount St and upgrading capacity.



Assumptions: All manholes and catch basins require replacement, assume approximately 2 catch basins per 100 m of sewer.

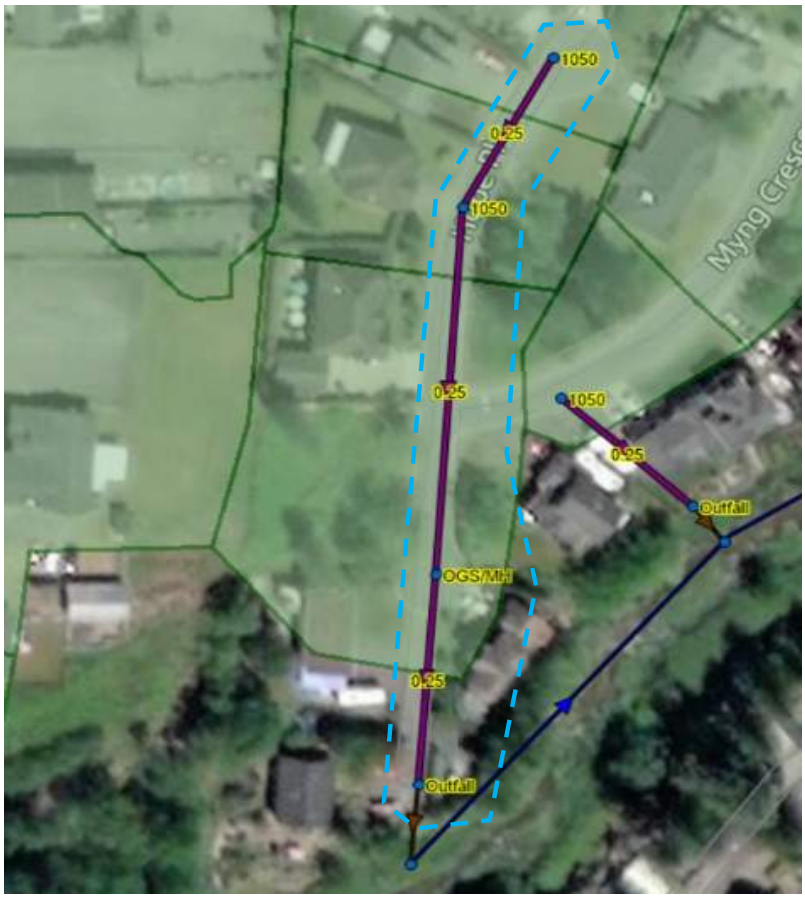
Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	450mm Dia. Storm Sewer	m	33	$ 1,330.00	$ 43,765
2	450mm Dia. Storm Sewer	m	33	$ 1,330.00	$ 43,692
3	525mm Dia. Storm Sewer	m	32	$ 1,575.00	$ 50,375
4	525mm Dia. Storm Sewer	m	44	$ 1,575.00	$ 68,769
5	1050mm Dia. Manhole	ea.	2	$ 13,000.00	$ 26,000
6	1200mm Dia. Manhole	ea.	2	$ 14,000.00	$ 28,000
7	Catchbasins	ea.	4	$ 4,600.00	$ 18,400
			Subtotal:		**$ 279,001**
	Design / Construction Management / Contingency (%)			**50%**	**$ 139,500**
			Total Estimated Cost:		**$ 418,501**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 9
Angus Estates Drainage Improvements
Priority: Low

Project Description: Add 149m of new storm main along Hope Pl to resolve lack of drainage system and reduce local I&I. Provide capacity for year 2050 10-year storm event assuming increased imperviousness. Add water quality improvement.

Deficiency: Excessive I&I in sanitary sewer.

Additional Notes: Improvements to be informed by I&I reduction program. Add storm sewer on Hope Pl with outlet to Miami Creek.



Assumptions: Assume approximately 2 catch basins per 100 m of sewer.

Item No.	Ref No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	250	250mm Dia. Storm Sewer	m	34	$ 1,050.00	$ 35,681
2	250	250mm Dia. Storm Sewer	m	73	$ 1,050.00	$ 76,759
3	250	250mm Dia. Storm Sewer	m	42	$ 1,050.00	$ 43,880
4	1050	1050mm Dia. Manhole	ea.	2	$ 13,000.00	$ 26,000
5	2400	OGS / Manhole	ea.	1	$ 45,000.00	$ 45,000
6	1000	Catchbasins	ea.	4	$ 4,600.00	$ 18,400
7	3000	Outfall	ea.	1	$ 7,000.00	$ 7,000
				Subtotal:		**$ 252,720**
				Design / Construction Management / Contingency (%)	**50%**	**$ 126,360**
				Total Estimated Cost:		**$ 379,080**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 10
Esplanade Ave and Hot Springs Rd Sewer Improvements
Priority: Conditional - Monitor

Project Description: Upgrade 442m of existing storm main along Esplanade Ave and Hot Springs Rd to provide flow capacity for year 2050 10-year storm event assuming increased imperviousness. Add water quality improvement, outfall protection.

Deficiency: Significantly below design criteria capacity, 10-year event surface flooding, insufficient overland flow route.

Additional Notes: Maximum surface flooding for future 100-year storm simulated at 0.28 m depth and 0.098 m^3/s flow.

Assumptions: All manholes and catch basins require replacement, assume approximately 2 catch basins per 100 m of sewer.

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	450mm Dia. Storm Sewer	m	109	$ 1,330.00	$ 144,570
2	450mm Dia. Storm Sewer	m	72	$ 1,330.00	$ 95,152
3	525mm Dia. Storm Sewer	m	107	$ 1,575.00	$ 167,819
4	675mm Dia. Storm Sewer	m	67	$ 1,760.00	$ 117,374
5	675mm Dia. Storm Sewer	m	88	$ 1,760.00	$ 155,596
6	1050mm Dia. Manhole	ea.	2	$ 13,000.00	$ 26,000
7	1200mm Dia. Manhole	ea.	2	$ 14,000.00	$ 28,000
8	OGS / Manhole	ea.	1	$ 45,000.00	$ 45,000
9	Catchbasins	ea.	9	$ 4,600.00	$ 41,400
10	Outfall	ea.	1	$ 7,000.00	$ 7,000
			Subtotal:		**$ 827,912**
	Design / Construction Management / Contingency (%)			**50%**	**$ 413,956**
			Total Estimated Cost:		**$ 1,241,868**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 11
Pine Ave and McCombs Dr Sewer Improvements
Priority: Conditional - Monitor

Project Description: Upgrade 400m of existing storm main along Pine Ave and McCombs Dr to provide flow capacity for year 2050 10-year storm event assuming increased imperviousness. Add outfall protection.

Deficiency: Significantly below design criteria capacity, 10-year event surface flooding, insufficient overland flow route.

Additional Notes: Maximum surface flooding for future 100-year storm simulated at 0.31 m depth and 0.133 m^3/s flow.

Assumptions: All manholes and catch basins require replacement, assume approximately 2 catch basins per 100 m of sewer.

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	525mm Dia. Storm Sewer	m	110	$ 1,575.00	$ 173,223
2	525mm Dia. Storm Sewer	m	110	$ 1,575.00	$ 173,223
3	525mm Dia. Storm Sewer	m	67	$ 1,575.00	$ 105,746
4	525mm Dia. Storm Sewer	m	95	$ 1,575.00	$ 149,790
5	525mm Dia. Storm Sewer	m	17	$ 1,575.00	$ 27,542
6	1200mm Dia. Manhole	ea.	5	$ 14,000.00	$ 70,000
7	Catchbasins	ea.	8	$ 4,600.00	$ 36,800
8	Outfall	ea.	1	$ 7,000.00	$ 7,000
			Subtotal:		**$ 743,324**
	Design / Construction Management / Contingency (%)			**50%**	**$ 371,662**
			Total Estimated Cost:		**$ 1,114,987**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 12
Hadway Dr Sewer Improvements
Priority: Conditional - Monitor

Project Description: Upgrade 125m of existing storm main along Hadway Dr to provide flow capacity for year 2050 10-year storm event assuming increased imperviousness.

Deficiency: Significantly below design criteria capacity, 10-year event surface flooding, insufficient overland flow route.

Additional Notes: Maximum surface flooding for future 100-year storm simulated at 0.17 m depth and 0.063 m^3/s flow.

Assumptions: All manholes and catch basins require replacement, assume approximately 2 catch basins per 100 m of sewer.

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	250mm Dia. Storm Sewer	m	7	$ 1,050.00	$ 7,749
2	300mm Dia. Storm Sewer	m	77	$ 1,140.00	$ 87,649
3	300mm Dia. Storm Sewer	m	40	$ 1,140.00	$ 46,112
4	1050mm Dia. Manhole	ea.	3	$ 13,000.00	$ 39,000
5	Storm Sewer Tie-In	ea.	1	$ 5,000.00	$ 5,000
6	Catchbasins	ea.	4	$ 4,600.00	$ 18,400
			Subtotal:		**$ 203,910**
	Design / Construction Management / Contingency (%)			**50%**	**$ 101,955**
			Total Estimated Cost:		**$ 305,865**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 13
Eagle St Sewer Improvements
Priority: Conditional - Monitor

Project Description: Upgrade 373m of existing storm main along Eagle St approaching Miami Creek to provide flow capacity for year 2050 10-year storm event assuming increased imperviousness. Add water quality improvement, outfall protection.

Deficiency: Significantly below design criteria capacity, 10-year climate change event surface flooding, insufficient overland flow route.

Additional Notes: Maximum surface flooding for future 100-year storm simulated at 0.26 m depth and 0.028 m^3/s flow**.**

Assumptions: All manholes and catch basins require replacement, assume approximately 2 catch basins per 100 m of sewer.

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	300mm Dia. Storm Sewer	m	49	$ 1,140.00	$ 55,804
2	375mm Dia. Storm Sewer	m	75	$ 1,180.00	$ 88,137
3	450mm Dia. Storm Sewer	m	33	$ 1,330.00	$ 44,164
4	450mm Dia. Storm Sewer	m	59	$ 1,330.00	$ 77,910
5	525mm Dia. Storm Sewer	m	90	$ 1,575.00	$ 141,199
6	600mm Dia. Storm Sewer	m	67	$ 1,720.00	$ 115,986
7	1050mm Dia. Manhole	ea.	4	$ 13,000.00	$ 52,000
8	1200mm Dia. Manhole	ea.	1	$ 14,000.00	$ 14,000
9	OGS / Manhole	ea.	1	$ 45,000.00	$ 45,000
10	Catchbasins	ea.	8	$ 4,600.00	$ 36,800
11	Outfall	ea.	1	$ 7,000.00	$ 7,000
			Subtotal:		**$ 678,000**
	Design / Construction Management / Contingency (%)			**50%**	**$ 339,000**
			Total Estimated Cost:		**$ 1,017,000**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 14
Naismith Ave Outlet Sewer Improvements
Priority: Conditional - Monitor

Project Description: Upgrade 134m of existing storm main along Naismith Ave to provide flow capacity for year 2050 10-year storm event assuming increased imperviousness. Add water quality improvement, outfall protection.

Deficiency: Significantly below design criteria capacity, 10-year climate change event surface flooding, insufficient overland flow route.

Additional Notes: Maximum surface flooding for future 100-year storm simulated at 0.13 m depth and 0.019 m^3/s flow.

Assumptions: All manholes and catch basins require replacement, assume approximately 2 catch basins per 100 m of sewer.

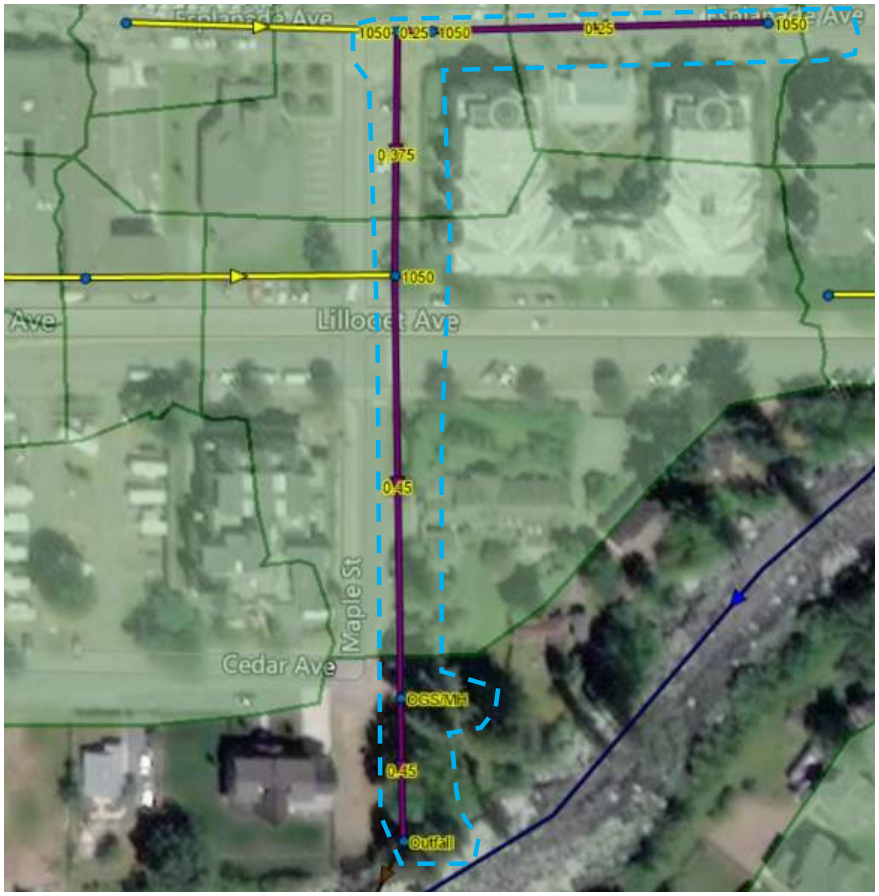
Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	375mm Dia. Storm Sewer	m	39	$ 1,180.00	$ 46,231
2	375mm Dia. Storm Sewer	m	30	$ 1,180.00	$ 35,087
3	525mm Dia. Storm Sewer	m	65	$ 1,575.00	$ 102,608
4	1050mm Dia. Manhole	ea.	2	$ 13,000.00	$ 26,000
5	OGS / Manhole	ea.	1	$ 45,000.00	$ 45,000
6	Catchbasins	ea.	4	$ 4,600.00	$ 18,400
7	Outfall	ea.	1	$ 7,000.00	$ 7,000
			Subtotal:		**$ 280,327**
	Design / Construction Management / Contingency (%)			**50%**	**$ 140,163**
			Total Estimated Cost:		**$ 420,490**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 15
Esplanade Ave and Maple St Sewer Improvements
Priority: Conditional - Monitor

Project Description: Upgrade 271m of existing storm main along Esplanade Ave and Maple St to provide flow capacity for year 2050 10-year storm event assuming increased imperviousness. Add water quality improvement, outfall protection.

Deficiency: Significantly below design criteria capacity, 10-year climate change event surface flooding, insufficient overland flow route.

Additional Notes: Maximum surface flooding for future 100-year storm simulated at 0.19 m depth and 0.042 m^3/s flow.



Assumptions: All manholes and catch basins require replacement, assume approximately 2 catch basins per 100 m of sewer.

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	250mm Dia. Storm Sewer	m	78	$ 1,050.00	$ 81,378
2	250mm Dia. Storm Sewer	m	8	$ 1,050.00	$ 8,378
3	375mm Dia. Storm Sewer	m	56	$ 1,180.00	$ 65,787
4	450mm Dia. Storm Sewer	m	130	$ 1,330.00	$ 173,142
5	1050mm Dia. Manhole	ea.	4	$ 13,000.00	$ 52,000
6	OGS / Manhole	ea.	1	$ 45,000.00	$ 45,000
7	Catchbasins	ea.	6	$ 4,600.00	$ 27,600
8	Outfall	ea.	1	$ 7,000.00	$ 7,000
			Subtotal:		**$ 460,286**
			Design / Construction Management / Contingency (%)	**50%**	**$ 230,143**
			Total Estimated Cost:		**$ 690,428**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 16
South Portion of McCombs Dr, McPherson Rd Sewer Improvements
Priority: Conditional - Assess

Project Description: Upgrade 361m of existing storm main along McPherson Rd and McCombs Dr to provide flow capacity for year 2050 10-year storm event assuming increased imperviousness. Add outfall protection. Water quality improvements and ditch improvements part of Project 7.

Deficiency: Significantly below design criteria capacity, 10-year event approaching ground level.

Additional Notes: CB on McCombs Dr should be lowered to improve drainage capture. Collapsed pipes noted in 2016 LWMP (to be confirmed). Maximum surface flooding for future 100-year storm simulated at 0.06 m depth and 0.007 m^3/s flow.

Assumptions: All manholes and catch basins require replacement, assume approximately 2 catch basins per 100 m of sewer.

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	250mm Dia. Storm Sewer	m	14	$ 1,050.00	$ 14,654
2	250mm Dia. Storm Sewer	m	30	$ 1,050.00	$ 31,530
3	2500mm Dia. Culvert	m	12	$ 860.00	$ 10,096
4	300mm Dia. Storm Sewer	m	89	$ 1,140.00	$ 101,002
5	375mm Dia. Storm Sewer	m	75	$ 1,180.00	$ 88,115
6	375mm Dia. Storm Sewer	m	15	$ 1,180.00	$ 17,378
7	525mm Dia. Storm Sewer	m	127	$ 1,575.00	$ 199,959
8	1050mm Dia. Manhole	ea.	5	$ 13,000.00	$ 65,000
9	1200mm Dia. Manhole	ea.	2	$ 14,000.00	$ 28,000
10	Catchbasins	ea.	8	$ 4,600.00	$ 36,800
11	Intake	ea.	1	$ 7,000.00	$ 7,000
12	Outfall	ea.	3	$ 7,000.00	$ 21,000
			Subtotal:		**$ 620,534**
	Design / Construction Management / Contingency (%)			**50%**	**$ 310,267**
			Total Estimated Cost:		**$ 930,802**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 17
Alder Ave, Schooner Pl and Along McCombs Dr Sewer Improvements
Priority: Conditional - Assess

Project Description: Upgrade 512m of existing storm main along Alder Ave, Schooner Pl, and McCombs Dr to provide flow capacity for year 2050 10-year storm event assuming increased imperviousness. Add water quality improvement, outfall protection.

Deficiency: Significantly below design criteria capacity, 10-year event below ground level, insufficient overland flow route.

Additional Notes: Maximum surface flooding for future 100-year storm simulated at 0.09 m depth and 0.012 m^3/s flow.

Assumptions: All manholes and catch basins require replacement, assume approximately 2 catch basins per 100 m of sewer.

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	375mm Dia. Storm Sewer	m	15	$ 1,180.00	$ 17,819
2	375mm Dia. Storm Sewer	m	6	$ 1,180.00	$ 6,554
3	375mm Dia. Storm Sewer	m	128	$ 1,180.00	$ 151,044
4	450mm Dia. Storm Sewer	m	96	$ 1,330.00	$ 127,639
5	450mm Dia. Storm Sewer	m	69	$ 1,330.00	$ 91,198
6	450mm Dia. Storm Sewer	m	87	$ 1,330.00	$ 115,307
7	600mm Dia. Storm Sewer	m	93	$ 1,720.00	$ 159,380
8	600mm Dia. Storm Sewer	m	15	$ 1,720.00	$ 26,326
9	900mm Dia. Storm Sewer	m	4	$ 2,100.00	$ 7,797
10	1050mm Dia. Manhole	ea.	5	$ 13,000.00	$ 65,000
11	1200mm Dia. Manhole	ea.	2	$ 14,000.00	$ 28,000
12	OGS / Manhole	ea.	1	$ 45,000.00	$ 45,000
13	Catchbasins	ea.	10	$ 4,600.00	$ 46,000
14	Outfall	ea.	1	$ 7,000.00	$ 7,000
			Subtotal:		**$ 894,064**
	Design / Construction Management / Contingency (%)			**50%**	**$ 447,032**
			Total Estimated Cost:		**$ 1,341,096**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 18
Myng Cr Sewer Improvements
Priority: Conditional - Assess

Project Description: Upgrade 63m of existing storm main along Myng Cr to provide flow capacity for year 2050 10-year storm event assuming increased imperviousness. Add outfall protection.

Deficiency: Significantly below design criteria capacity, 10-year event below ground level.

Additional Notes: Maximum surface flooding for future 100-year storm simulated at 0.03 m depth and 0.022 m^3/s flow.

Assumptions: All manholes require replacement.

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	250mm Dia. Storm Sewer	m	31	$ 1,050.00	$ 32,563
2	300mm Dia. Storm Sewer	m	32	$ 1,140.00	$ 36,316
3	1050mm Dia. Manhole	ea.	2	$ 13,000.00	$ 26,000
4	Outfall	ea.	2	$ 7,000.00	$ 14,000
			Subtotal:		**$ 108,878**
	Design / Construction Management / Contingency (%)			**50%**	**$ 54,439**
			Total Estimated Cost:		**$ 163,318**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 19
Diamond St Sewer Improvements
Priority: Conditional - Assess

Project Description: Upgrade 274m of existing storm main along Diamond St and Emerald Ave to provide flow capacity for year 2050 10-year storm event assuming increased imperviousness.

Deficiency: Significantly below design criteria capacity, 10-year event approaching ground level.

Additional Notes: Maximum surface flooding for future 100-year storm simulated at 0.17 m depth and 0.021 m^3/s flow.

Assumptions: All manholes and catch basins require replacement, assume approximately 2 catch basins per 100 m of sewer.

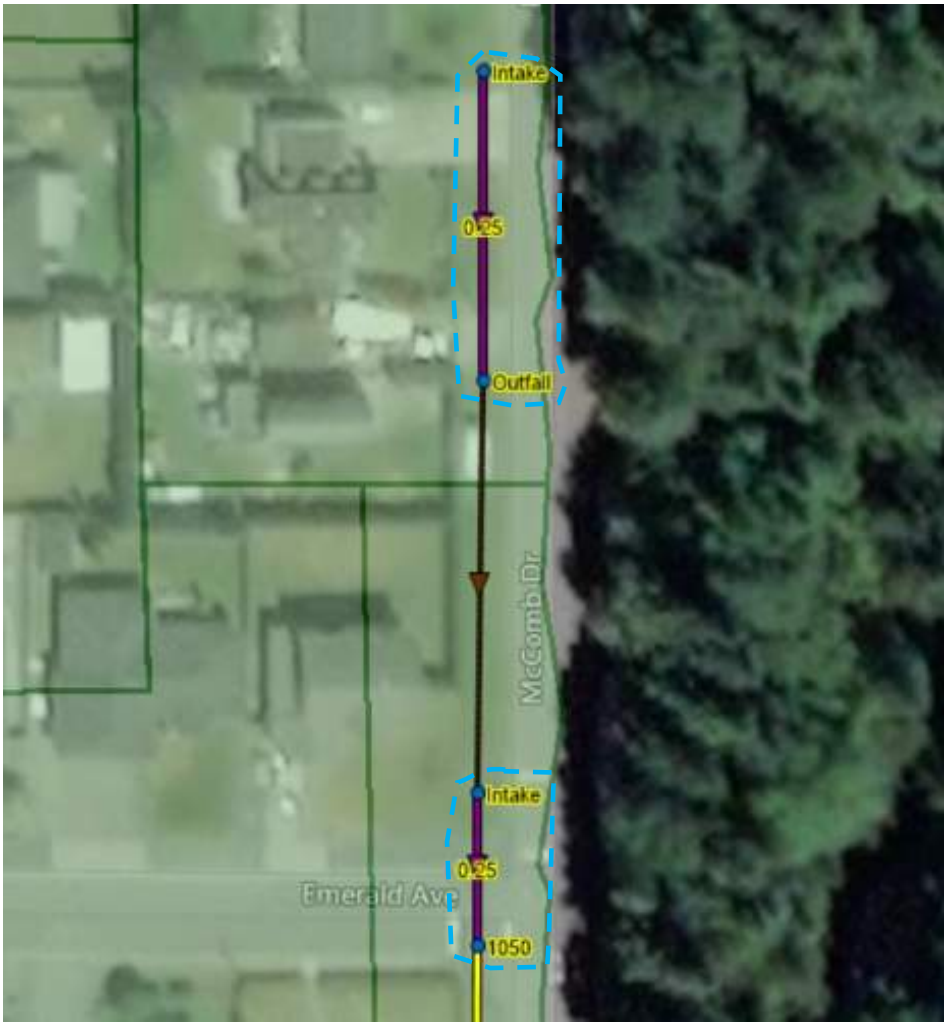
Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	250mm Dia. Storm Sewer	m	86	$ 1,050.00	$ 90,186
2	300mm Dia. Storm Sewer	m	62	$ 1,140.00	$ 70,338
3	375mm Dia. Storm Sewer	m	51	$ 1,180.00	$ 60,614
4	375mm Dia. Storm Sewer	m	76	$ 1,180.00	$ 89,090
5	1050mm Dia. Manhole	ea.	4	$ 13,000.00	$ 52,000
6	Storm Sewer Tie-In	ea.	1	$ 5,000.00	$ 5,000
7	Catchbasins	ea.	6	$ 4,600.00	$ 27,600
			Subtotal:		**$ 394,828**
	Design / Construction Management / Contingency (%)			**50%**	**$ 197,414**
			Total Estimated Cost:		**$ 592,242**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 20
McCombs Dr Near Emerald Ave Sewer Improvements
Priority: Conditional - Assess

Project Description: Upgrade 51m of existing storm main or culvert along McCombs Dr to provide flow capacity for year 2050 10-year storm event.

Deficiency: Significantly below design criteria capacity, 10-year event approaching ground level.

Additional Notes: Maximum surface flooding for future 100-year storm simulated at 0.05 m depth and 0.011 m^3/s flow.



Assumptions: All manholes require replacement.

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	250mm Dia. Culvert	m	34	$ 860.00	$ 29,537
2	250mm Dia. Sewer	m	17	$ 1,050.00	$ 17,538
3	1050mm Dia. Manhole	ea.	1	$ 13,000.00	$ 13,000
4	Intake	ea.	2	$ 7,000.00	$ 14,000
5	Outfall	ea.	1	$ 7,000.00	$ 7,000
			Subtotal:		**$ 81,075**
	Design / Construction Management / Contingency (%)			**50%**	**$ 40,537**
			Total Estimated Cost:		**$ 121,612**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 21
Walnut Ave Sewer Improvements
Priority: Conditional - Assess

Project Description: Upgrade 94m of existing storm main along Walnut Ave to provide flow capacity for year 2050 10-year storm event assuming increased imperviousness. Add water quality treatment.

Deficiency: Significantly below design criteria capacity, 10-year event below ground level, insufficient overland flow route.

Additional Notes: Maximum surface flooding for future 100-year storm simulated at 0.04 m depth and 0.014 m^3/s flow.

Assumptions: All manholes and catch basins require replacement, assume approximately 2 catch basins per 100 m of sewer.

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	450mm Dia. Storm Sewer	m	94	$ 1,330.00	$ 124,992
2	1050mm Dia. Manhole	ea.	1	$ 13,000.00	$ 13,000
3	OGS / Manhole	ea.	1	$ 45,000.00	$ 45,000
4	Catchbasins	ea.	2	$ 4,600.00	$ 9,200
			Subtotal:		**$ 192,192**
	Design / Construction Management / Contingency (%)			**50%**	**$ 96,096**
			Total Estimated Cost:		**$ 288,288**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 22
Echo Ave Outlet Sewer Improvements
Priority: Conditional - Assess

Project Description: Upgrade 40m of existing storm main along Echo Ave to provide flow capacity for year 2050 10-year storm event assuming increased imperviousness. Add water quality improvement, outfall protection.

Deficiency: Significantly below design criteria capacity, 10-year event below ground level.

Additional Notes: Maximum surface flooding for future 100-year storm simulated at 0.07 m depth and 0.007 m^3/s flow.

Assumptions: All manholes and catch basins require replacement, assume approximately 2 catch basins per 100 m of sewer.

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	450mm Dia. Storm Sewer	m	40	$ 1,330.00	$ 53,010
2	OGS / Manhole	ea.	1	$ 45,000.00	$ 45,000
3	Catchbasins	ea.	2	$ 4,600.00	$ 9,200
4	Outfall	ea.	1	$ 7,000.00	$ 7,000
			Subtotal:		**$ 114,210**
	Design / Construction Management / Contingency (%)			**50%**	**$ 57,105**
			Total Estimated Cost:		**$ 171,315**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 23
Balsam Ave Sewer Improvements
Priority: Conditional - Assess

Project Description: Upgrade 141m of existing storm main along Balsam Ave to provide flow capacity for year 2050 10-year storm event assuming increased imperviousness. Add water quality treatment.

Deficiency: Significantly below design criteria capacity, 10-year event below ground level, insufficient overland flow route.

Additional Notes: Maximum surface flooding for future 100-year storm simulated at 0.07 m depth and no flow.

Assumptions: All manholes and catch basins require replacement, assume approximately 2 catch basins per 100 m of sewer.

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	450mm Dia. Storm Sewer	m	95	$ 1,330.00	$ 125,991
2	450mm Dia. Storm Sewer	m	47	$ 1,330.00	$ 62,068
3	1050mm Dia. Manhole	ea.	2	$ 13,000.00	$ 26,000
4	OGS / Manhole	ea.	1	$ 45,000.00	$ 45,000
5	Catchbasins	ea.	4	$ 4,600.00	$ 18,400
			Subtotal:		**$ 277,459**
	Design / Construction Management / Contingency (%)			**50%**	**$ 138,730**
			Total Estimated Cost:		**$ 416,189**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 24
Esplanade Ave and Chehalis St Sewer Improvements
Priority: Conditional - Assess

Project Description: Upgrade 248m of existing storm main along Esplanade Ave and Chehalis St to provide flow capacity for year 2050 10-year storm event assuming increased imperviousness. Add water quality improvement, outfall protection.

Deficiency: Significantly below design criteria capacity, 10-year event below ground level, insufficient overland flow route.

Additional Notes: No surface flooding, just sewer surcharging below ground level.

Assumptions: All manholes and catch basins require replacement, assume approximately 2 catch basins per 100 m of sewer.

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	375mm Dia. Storm Sewer	m	118	$ 1,180.00	$ 138,967
2	375mm Dia. Storm Sewer	m	55	$ 1,180.00	$ 65,119
3	375mm Dia. Storm Sewer	m	75	$ 1,180.00	$ 88,282
4	1050mm Dia. Manhole	ea.	2	$ 13,000.00	$ 26,000
5	OGS / Manhole	ea.	1	$ 45,000.00	$ 45,000
6	Catchbasins	ea.	5	$ 4,600.00	$ 23,000
7	Outfall	ea.	1	$ 7,000.00	$ 7,000
			Subtotal:		**$ 393,369**
	Design / Construction Management / Contingency (%)			**50%**	**$ 196,684**
			Total Estimated Cost:		**$ 590,053**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 25
Miami River Dr Outlet Near Poplar St Sewer Improvements
Priority: Conditional - Assess

Project Description: Upgrade 53m of existing storm main from Miami Creek Dr to Miami Creek near Poplar St to provide flow capacity for year 2050 10-year storm event assuming increased imperviousness. Add water quality improvement, outfall protection.

Deficiency: Significantly below design criteria capacity, 10-year event below ground level, insufficient overland flow route.

Additional Notes: Maximum surface flooding for future 100-year storm simulated at 0.05 m depth and 0.007 m^3/s flow.

Assumptions: All manholes and catch basins require replacement, assume approximately 2 catch basins per 100 m of sewer.

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	450mm Dia. Storm Sewer	m	53	$ 1,330.00	$ 71,039
2	OGS / Manhole	ea.	1	$ 45,000.00	$ 45,000
3	Catchbasins	ea.	2	$ 4,600.00	$ 9,200
4	Outfall	ea.	1	$ 7,000.00	$ 7,000
			Subtotal:		**$ 132,239**
	Design / Construction Management / Contingency (%)			**50%**	**$ 66,120**
			Total Estimated Cost:		**$ 198,359**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 26
Chestnut Ave Sewer Improvements
Priority: Conditional - Assess

Project Description: Upgrade 177m of existing storm main along Chestnut Ave to provide flow capacity for year 2050 10-year storm event assuming increased imperviousness.

Deficiency: Significantly below design criteria capacity, 10-year event below ground level, insufficient overland flow route.

Additional Notes: Maximum surface flooding for future 100-year storm simulated at 0.28 m depth and 0.098 m^3/s flow

Assumptions: All manholes and catch basins require replacement, assume approximately 2 catch basins per 100 m of sewer.

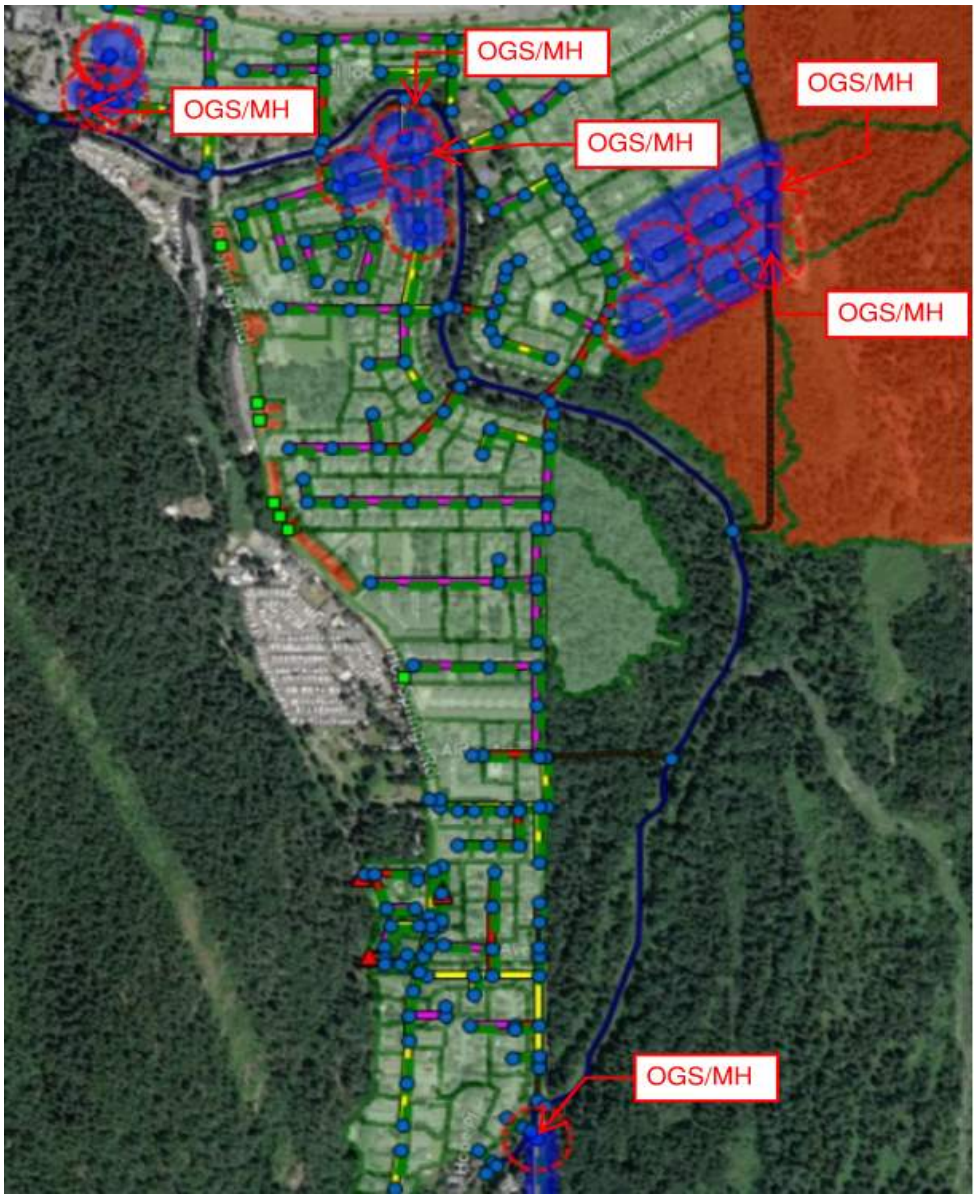
Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	375mm Dia. Storm Sewer	m	55	$ 1,180.00	$ 65,084
2	450mm Dia. Storm Sewer	m	122	$ 1,330.00	$ 162,297
3	1050mm Dia. Manhole	ea.	2	$ 13,000.00	$ 26,000
4	1200mm Dia. Manhole	ea.	1	$ 14,000.00	$ 14,000
5	Catchbasins	ea.	4	$ 4,600.00	$ 18,400
			Subtotal:		**$ 285,781**
			Design / Construction Management / Contingency (%)	**50%**	**$ 142,891**
			Total Estimated Cost:		**$ 428,672**

Village of Harrison Hot Springs Storm Sewer Master Plan
November 2025 Cost Estimate
Project Number 27
Various Water Quality Improvements
Priority: Conditional - Assess

Project Description: Upgrade various outlets to provide water quality improvements.

Deficiency: Untreated areas where not addressed through other projects.

Additional Notes: Largely residential areas with low priority based on expected pollutant load. Exception is Alice St area.



Assumptions: OGS / Manhole provided at each outlet without water quality treatment.

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	OGS / Manhole	ea.	6	$ 45,000.00	$ 270,000
			Subtotal:		**$ 270,000**
			Design / Construction Management / Contingency (%)	**50%**	**$ 135,000**
			Total Estimated Cost:		**$ 405,000**

Water Master Plan

Village of Harrison Hot Springs

04 Dec 2025

Document Information

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Report Title	Water Master Plan		
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Permit to Practice

EGBC permit number 1000830.

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APPENDIX 1: POPULATION, BASE SANITARY FLOWS, AND BASE WATER DEMANDS MEMORANDUM
APPENDIX 2: HYDRANT FLOW TESTING RESULTS MEMORANDUM
APPENDIX 3: PROJECT DEFINITION SHEETS

EXECUTIVE SUMMARY

Water Street Engineering Ltd. (Water Street) was retained by the Village of Harrison Hot Springs (the Village) to update the Village's Water Master Plan. The objectives of the plan are to:

- Identify existing and future deficiencies in the water system, and
- Develop a plan of upgrades to address deficiencies.

The previous Village-wide water master plan was completed in 2015 by CTQ (CTQ Consultants, 2015). As part of the Master Plan, a Village-wide water model was created. Since the 2015 study, key upgrades include new and upsized distribution piping and upsizing of the Harrison Reservoir feeder and supply mains.

Existing demands were developed using source flow, population, and meter data. The Village's Official Community Plan (OCP) was used to develop a population and water demand assessment and forecast. For detailed information on demand development, refer to the Population, Base Sanitary Flows, and Base Water Demands Memorandum (Water Street Engineering, 2025a).

A model calibration was completed using results from hydrant testing. For information on the test results, refer to the Hydrant Flow Testing Results Memorandum (Water Street Engineering, 2025b).

Two water system conditions were evaluated:

- The **Existing Condition** reflects the existing water distribution network with existing demands.
- The **OCP Condition** reflects the existing water distribution network with OCP demands.

Each system condition was evaluated under two scenarios:

1. **Peak hour demand** (PHD) at 7 AM, to assess for system pressures and velocities.
2. **Maximum day demand with fire flow** (MDD + FF), to assess for available fire flows.

Following modelling and deficiency analysis, nine (9) projects were identified, which generally include:

- Addressing insufficient fire protection,
- Improving water quality,
- Adding utility connections,
- Demand management, and
- Operational improvements.

From the nine identified projects, two were classified as high priority. High priority projects are those that addresses an existing significant deficiency or system need with broad impacts . These include the Cedar Ave Water Main Looping (Project 1) and Lillooet and Echo Ave Water Main Looping (Project 2),

Five medium priority projects were identified, which address significant deficiencies or system need with localized impact. These include the Naismith Ave and Mount St Water Main Looping (Project 3), Water Hydrants (Project 4), McCombs Dr Water Main Looping (Project 5), Universal Metering Study (Project 6), and GIS System Update (Project 7).

Two low priority projects were identified, the Lillooet and Bear Ave Water Main Looping (Project 8) and Echo Ave and Eagle St Water main Looping (Project 9). Both projects are to provide sufficient fire flows for growth, to protect future (OCP) developments.

From the nine identified projects, three have been noted to be currently planned: Cedar Ave Water Main Looping (Project 1, High Priority), Lillooet and Echo Ave Water Main Looping (Project 2, High Priority), and McComb Water Main Looping (Project 5, Medium Priority).

High-level cost estimates were prepared for each recommended project. The total costs of projects summarised by priority is as follows:

- High priority (2 projects): $1,273,000
- Medium priority (5 projects): $2,712,000
- Low priority (2 projects): $84,000

Other, non-capital, recommendations have also been identified, including:

- Fire protection reviews,
- Water quality monitoring and flushing,
- Demand management,
- Operational changes, and
- Further investigations.

1 INTRODUCTION

1.1 PURPOSE

Water Street Engineering Ltd. (Water Street) was retained by the Village of Harrison Hot Springs (the Village) to provide engineering services for the development of the Village's Water Master Plan.

1.2 SCOPE

The scope of the Water Master Plan includes:

- Review of relevant background reports
- Hydrant flow testing and model calibration
- Existing and future demand development and required fire flow assignment
- Updated assessment of water infrastructure deficiencies based on updated modelling of existing condition
- Updated assessment of future condition water infrastructure requirements
- Recommendations for demand management
- Recommendations for infrastructure improvements to meet existing and future demands
- Class D cost estimates for recommended improvements
- Prioritized recommendations for infrastructure improvements based on risk and asset management

1.3 PREVIOUS WORK

A Village-wide Water Master Plan was created in 2015 by CTQ (CTQ Consultants, 2015). As part of the Master Plan, a Village-wide water model was created in WaterGEMS.

1.4 LIMITATIONS

The following data limitations affect the accuracy of the model and calculated results:

- Potential inaccuracies and/or missing information from the GIS shapefiles and record drawings provided to update the model
- Inherent uncertainty in OCP forecasts (i.e. dwelling unit counts and population loading forecasts for residential and ICI lots)
- Fire flow requirements based on the Village's design criteria
- Variation in head loss characteristics in the piping in the model
- Status of isolation valves (e.g. missing closed valves in the model)
- Boundary conditions
- Limitations on forecasting of expected / design water use rates

The project scope does not include evaluation of the Village's Water Treatment Plant or raw water supply. At the time this report was developed, a Water Treatment Plant (WTP) Master Plan was being completed by McElhanney (McElhanney, 2025). The WTP Master Plan provides capital projects for the lake intake and VFD, reservoir, and raw water intake.

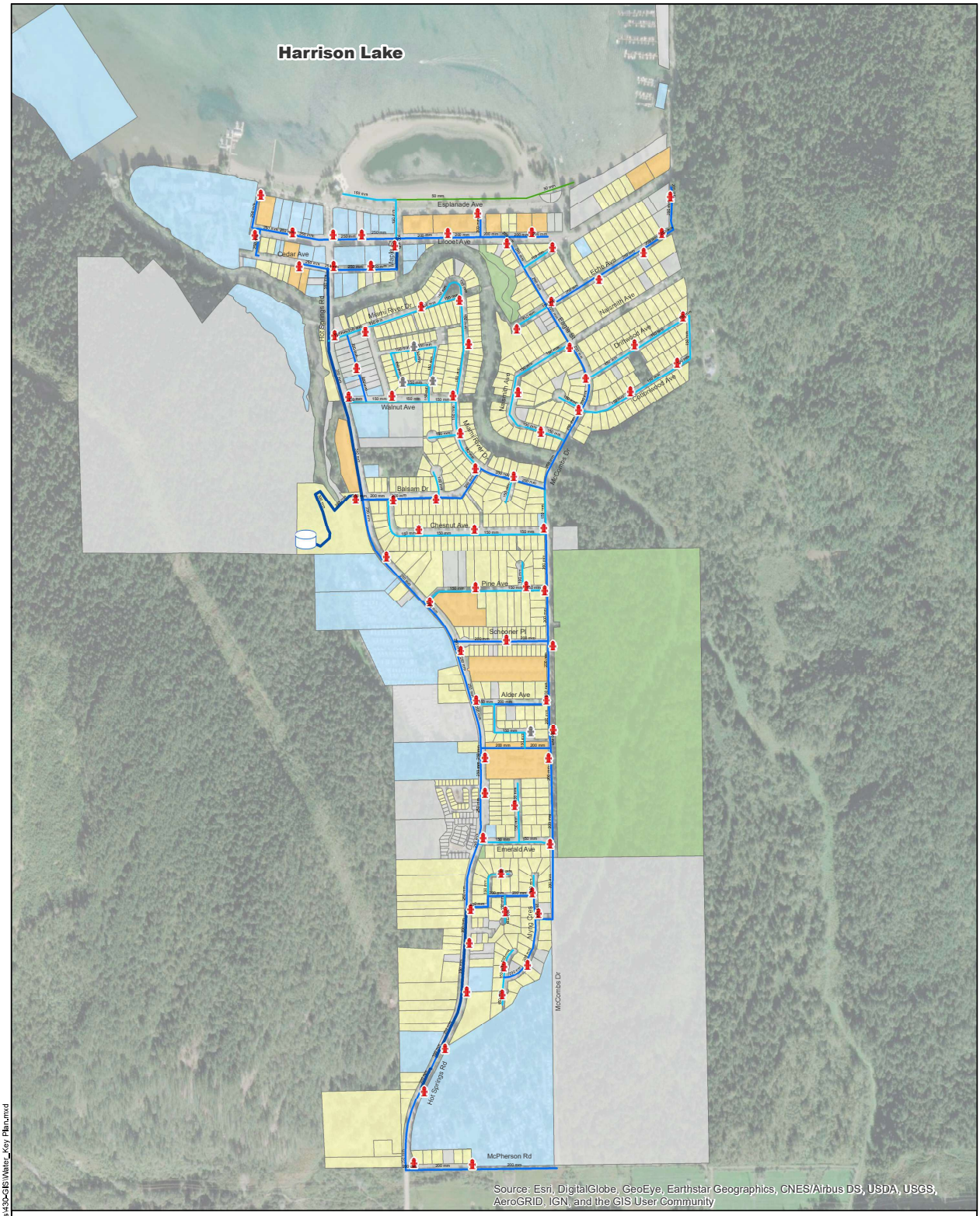
1.5 ACKNOWLEDGEMENTS

The project development, leadership, and review of interim deliverables was accomplished with the assistance of the following individuals.

- Village of Harrison Hot Springs
  - Director of Operations
  - Utilities Supervisor
  - Public Works Supervisor
- SFE Global (flow monitoring program)
  - Glenn Cumyn

    - Nicole Moen
    - Sam Cumyn
- Wedler Engineering
    - Jonathan Funk, PEng; Principal

In addition to the authors, the Water Street Engineering team included: Neal Whiteside, PEng, Laura Christensen, PEng; and Jade Sangha, EIT.



Legend

- Reservoir
- Hydrant
- Hydrant - Private

Water Main Diameter (mm)

- 50
- 100 - 150
- 200 - 250
- 300 - 350

Existing Land Use

- Park
- Single-family Residential
- Multi-family Residential
- ICI
- Vacant

N

0 150 300 450 m

1:10,000

WATER STREET ENGINEERING

EGBC Permit to Practice #1000830

Water Master Plan

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Village of Harrison Hot Springs

PROJECT NO. 456.1

DATE 04 Dec 2025

REVISION 0

Key Plan

Figure 1-1

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2 EXISTING SYSTEM BACKGROUND

2.1 EXISTING INFRASTRUCTURE

The Village's existing water system consists of 15 km of distribution pipes ranging from 50 mm to 350 mm diameter in a single, gravity fed, pressure zone. The pipe material is primarily PVC with some small portions of ductile iron.

WATER SUPPLY

The system is supplied from Harrison Lake via a 350 mm intake line extending one kilometer north into the lake. The Beach Pumps (three 40 HP pumps, VFD-controlled) convey raw water to the treatment plant, which uses membrane ultrafiltration and chlorination. The treated water is pumped from the treatment plant with two 40 HP pumps lift to the reservoir. Review of the raw water pumps and the treatment plant is outside the scope of this Master Plan but is included in the Water Treatment Plant (WTP) Master Plan, which is currently being developed by McElhanney (McElhanney, 2025).

RESERVOIR

The water storage reservoir is 2,778 m^3 in volume[1]. The steel tank was constructed in 2009 to replace a concrete reservoir. The top water level is 74.7 m with an invert elevation of 64.81 m. Currently the reservoir is operated between 95 to 99% full (normal operating range, pump start / stop setpoints).

A Rockfall Hazard Mitigation report was completed by GeoWest Engineering in 2023 (GeoWest Engineering, 2023) and provided geotechnical recommendations for mitigation of rockfall hazards at the reservoir site. This project has not yet been completed. Capital works to address the rockfall hazards are included in the separate WTP Master Plan.

The 2021 Reservoir Inspection Report recommended a maintenance and action plan for the reservoir (Greatario Services, 2021). Considerations of these items and general reservoir condition are included in the separate WTP Master Plan.

Resiliency is also a concern; the existing reservoir is the only treated water reservoir in the community. If it were out of service, the WTP would need to provide treated water continuously on-demand (rather than current batch operation). As well without the reservoir, the fire storage volume and fire flows would be compromised. Potential mitigation measures include a second reservoir, additional WTP capacity (pumping capacity, chlorine dosing) to provide emergency fire flows, and/or emergency operating measures. These are also discussed in the WTP Master Plan.

2.2 EXISTING DEMANDS

Existing demands were analyzed, and the results are summarized in a technical memorandum, "Population, Base Sanitary Flows and Base Water Demands" by Water Street Engineering, dated 29 Sep 2025, provided in Appendix 1. The existing village-wide BD is 704 m^3/day (8.1 L/s) and MDD is 2494 m^3/day (28.9 L/s). The existing demands are further broken down in Section 3.4.

The Village's water demands are unique and increase significantly during the summer months due to seasonal residents and tourists. There is high uncertainty in the population projections; population growth has not followed that of the surrounding Fraser Valley area.

Most water users are billed at a flat rate. While water meters are being installed on all new residential properties, only a small number of multifamily and commercial customers are billed at a volumetric rate. The lack of water use data limits the determination of effective demand management strategies to decrease water use.

[1] Reservoir IFC drawings indicate 2,678 m^3 capacity (Dayton & Knight, 2009), while the 2021 Reservoir Inspection Report shows a name plate capacity of 2,778.5 m^3, or 234,000 gal (Greatario Services, 2021).

2.3 2025 WATER SYSTEM EMERGENCY RESPONSE PLAN

The Village has an Emergency Response Plan in place for their water system (Village of Harrison Hot Springs, 2025), which outlines response plans in the event of:

- Contamination of water source
- Loss of water source (reservoir, supply line)
- Broken water main
- Power failure
- Pump failure
- Chlorination system failure
- Backflow or back siphonage
- Coliform bacteria in distribution system
- Alternative bulk water supply usage
- Water treatment membrane bypass
- Flood conditions

2.4 2015 CAPITAL PLAN AND DEFICIENCIES

The 2015 Water Master Plan (WMP) (CTQ Consultants, 2015) identified several deficiencies and capital projects, summarised in Table 2-1.

Table 2-1: Projects and Deficiencies from 2015 Capital Plan

Project	Purpose / Description	Status
Above Ground Supply/Distribution	Repair/replace above ground piping section	Complete
Hot Springs Road 'A'	Provide fire flow for existing development. Upgrade 375 m of watermain to meet commercial fire flow requirements	Complete
Hot Springs Road 'B'	Provide fire flow for future development. Upgrade 125 m of watermain to meet commercial fire flow requirements	Complete; 33m of pipe under Miami River has not yet been upgraded (upgrade of this section is not required, sufficient fire flows available)
Village Center Loop	Provide service and hydrant protection to properties on wells. Add 250 mm of watermain to Lillooet/Cedar.	Incomplete; upgrade has been partially constructed but looping not yet completed.
Lakeshore Residential	Provide service and hydrant protection to properties on wells. Add 605 m of watermain to Lillooet (east) and Bear.	Incomplete; upgrade has been partially constructed but looping not yet completed.
Naismith and Mount	Provide service and hydrant protection to properties on wells. Add 595 m of watermain to Naismith and Mount.	Incomplete
Emerald and Diamond	Provide service and hydrant protection to properties on wells. Add 350 m of watermain to Emerald and Diamond.	Complete
Angus Estates	Provide service and hydrant protection to properties on wells. Add 875 m of watermain to Angus Estates subdivision.	Complete
Pine and Lakberg	Provide service and hydrant protection to properties on wells. Add 490 m of watermain to Pine and Lakberg.	Complete

Project	Purpose / Description	Status
Marine Tourism 'A' and 'B'	Provide service and hydrant protection to properties on well, fire flow for future development. Add 610 m of watermain to Rockwell.	Incomplete; it is assumed this area will remain unserviced.
Water Services	Connect all existing fronted properties. Add 57 service connections.	Incomplete; 31 fronted residential properties remain on wells/unserviced.
Water Hydrants	Add hydrants to existing fronted properties. Add 5 hydrants.	Incomplete; 5 identified hydrants have not yet been added to the system.
Tee Replacement	Replace damaged tee at Cedar & Hot Springs	Incomplete
Water Treatment Capacity Increase	Add Capacity to WTP as demand increases	Complete
Universal Metering	Meter all existing (2014) serviced properties	Incomplete; majority of single-family residential properties remain unmetered.
System Flushing	Clean debris from system. Improve system performance by flushing and/or pigging 15 km of pipe.	Complete; village currently flushes twice a year.
Sampling Pedestals	Construct compliant sampling locations. Install 6-10 Heath Canada compliant sampling locations.	Complete; yard hydrants added instead.

3 WATER MODEL UPDATE

3.1 MODEL IMPORT

The Village provided the village-wide model in Oct 2024 in an EPANET format, which was exported from the model from the 2015 Water Master Plan. Modelling for the 2025 Water Master Plan was completed in Bentley's WaterCAD version 24.00.03.22.

3.2 GENERAL UPDATES

New piping installed since 2015 was added to the model (total 3.1 km in length), where record drawings were provided by the Village, including:

- New water main installation on Pine Ave and Lakberg Cres.
- New water main installation on Emerald Ave and Diamond St.
- New water main installation on Myng Cres, Ramona Pl, Hadaway Dr, Angus Pl, and Hope Pl.
- New water main installation on Schooner Place.
- New water main installation on St Alice St N and St Alice St S.
- New water main installation on Bear Ave.
- New water main installation on Lillooet Ave, between Eagle St and Bear Ave.
- Water main upgrade on Hot Springs Ave, from Ramona Pl to south of the Miami River.
- Water main upgrade to main feeding out of the Harrison Reservoir. Note the Harrison Reservoir supply line has also been upgraded, but this is not reflected in the model (as the reservoir is modelled as the boundary condition, see the following section).

The elevations of all nodes within the model were updated based on 2016 DEM obtained from LidarBC.

3.3 BOUNDARY CONDITIONS

The modelled boundary is the Village's water storage reservoir (2678 m^3 steel reservoir, located at 590 Hot Springs Rd). The Harrison Lake intake, raw water pump station, and forcemain are not modelled.

Table 3-1: Boundary Conditions

Source	HGL	Notes
Harrison Reservoir	73.71 m	Assumed 90% full (record drawings indicate 64.81 m tank invert elevation, 74.7 m TWL).

3.4 DEMANDS

Existing demands were developed using source flow, population, and meter data. Unit rates derived from the existing demands were used together with the Village-wide Official Community Plan (OCP) to develop a population and water demand assessment and forecast for the Village. Future demands were calculated using an OCP growth estimate. For detailed information on demand development, refer to the Population, Base Sanitary Flows, and Base Water Demands Memorandum (Water Street Engineering, 2025a) provided as Appendix 1. OCP land uses are shown in Figure 3-1.

The resulting demands used for the master plan are shown in Table 3-2. This considers an existing serviced residential population of 2032 ca and an OCP serviced residential population of 2551 ca. Note the projected OCP demands assessed assume the Harrison Hot Springs Resort and Spa will not be connected to the system at OCP.

Table 3-2: Existing and Future Demands Summary

Use	Demand (m^3/day)	
	Existing	OCP
Base Demand (BD)		
ICI	117	162
Residential	439	605
Unaccounted for Water (UFW)	147	237
Total Base Demand (BD)	704	1004
Seasonal Demand (SD, in addition to BD)		
ICI	166	216
Residential	1625	1941
Total Addl. Seasonal Demand (SD)	1791	2157
Maximum Day Demand (MDD) (BD + SD)	**2494**	**3161**

The methodology for demand assignment in the model was as follows:

1. Demands were calculated per lot according to the methodology above / in Appendix 1
2. Each lot was assigned a model junction in close proximity. Junctions lying on supply mains were excluded from this process.
3. Demands are summed per demand category on assigned nodes.

The demand categories used to allocate demands in the model are shown in Table 3-3.

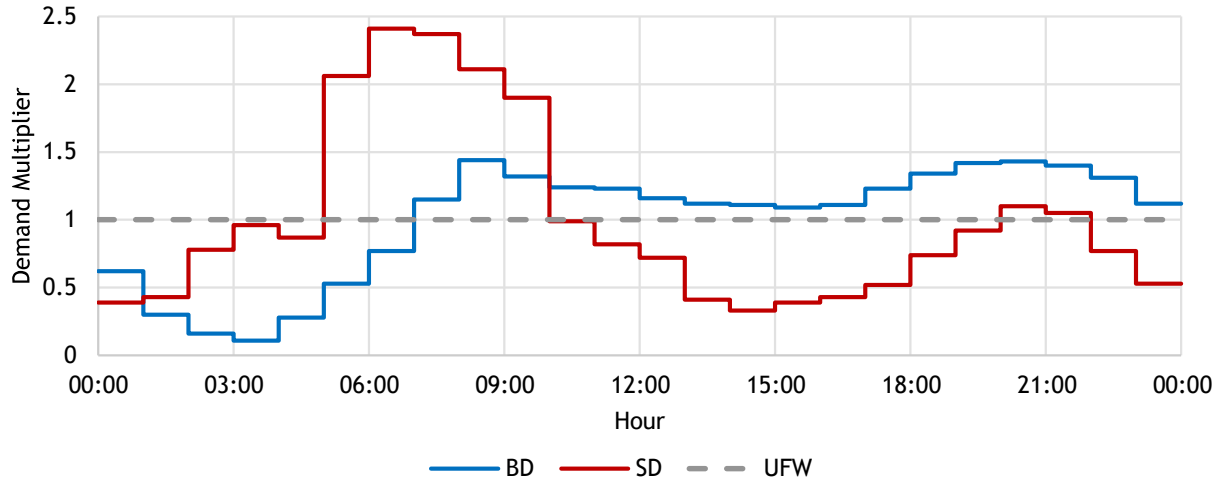
Table 3-3: Water Demand Categories

Model Scenario	Demand Pattern in Model	Description
Existing	BD-ICI	Base demand, ICI
	BD-RES-MF-M	Base demand, residential multi-family, metered
	BD-RES-MF-UM	Base demand, residential multi-family. un-metered
	BD-RES-SF	Base demand, residential single-family
	UFW	Unaccounted-for-water
	SD-ICI	Seasonal demand, ICI
	SD-RES-MF-M	Seasonal demand, residential multi-family, metered
	SD-RES-MF-UM-I	Seasonal demand, residential multi-family, un-metered, indoor
	SD-RES-MF-UM-O	Seasonal demand, residential multi-family, un-metered, outdoor
	SD-RES-SF-I	Seasonal demand, residential single-family, indoor
	SD-RES-SF-O	Seasonal demand, residential single-family, outdoor
OCP	OCP-BD-ICI	Base demand, ICI
	OCP-BD-ICI-N	Base demand, ICI, new properties

Model Scenario	Demand Pattern in Model	Description
	OCP-BD-RES	Base demand, residential
	OCP-UFW	Unaccounted-for-water
	OCP-SD-ICI	Seasonal demand, ICI
	OCP-SD-ICI-N	Seasonal demand, ICI, new properties
	OCP-SD-RES-I	Seasonal demand, residential, indoor
	OCP-SD-RES-O	Seasonal demand, residential, outdoor

The following diurnal pattern was input into the model; however, all analyses were completed using steady state analysis.

Table 3-4: Diurnal Demand Patterns



3.5 REQUIRED FIRE FLOWS

The required fire flows are assignment based on each parcel's OCP designation and the Village's Subdivision and Development Servicing Bylaw No. 1779 (Village of Harrison Hot Springs, 2022), which sets fire flow requirements according to various building types. The minimum required fire flows are as listed in Table 3-5.

The maximum required fire flow considered is 150 L/s, used for lots with multi-family and ICI OCP designations. A detailed Fire Underwriter's Survey (FUS) assessment was not in the scope of this study. The Village may choose to further review fire flow requirements for current buildings (using FUS guide as a standard) to review the adequacy of the 150 L/s requirement.

Table 3-5: Required Fire Flow by OCP Designation

Abbr.	OCP Designation	Required Fire Flow (L/s)	Notes
LB	Lakeshore Beach	n/a	No hydrants
LDR	Low Density Residential	60	Residential; single-family, duplex
LR	Lakeshore Residential	150	Residential; townhomes, row homes

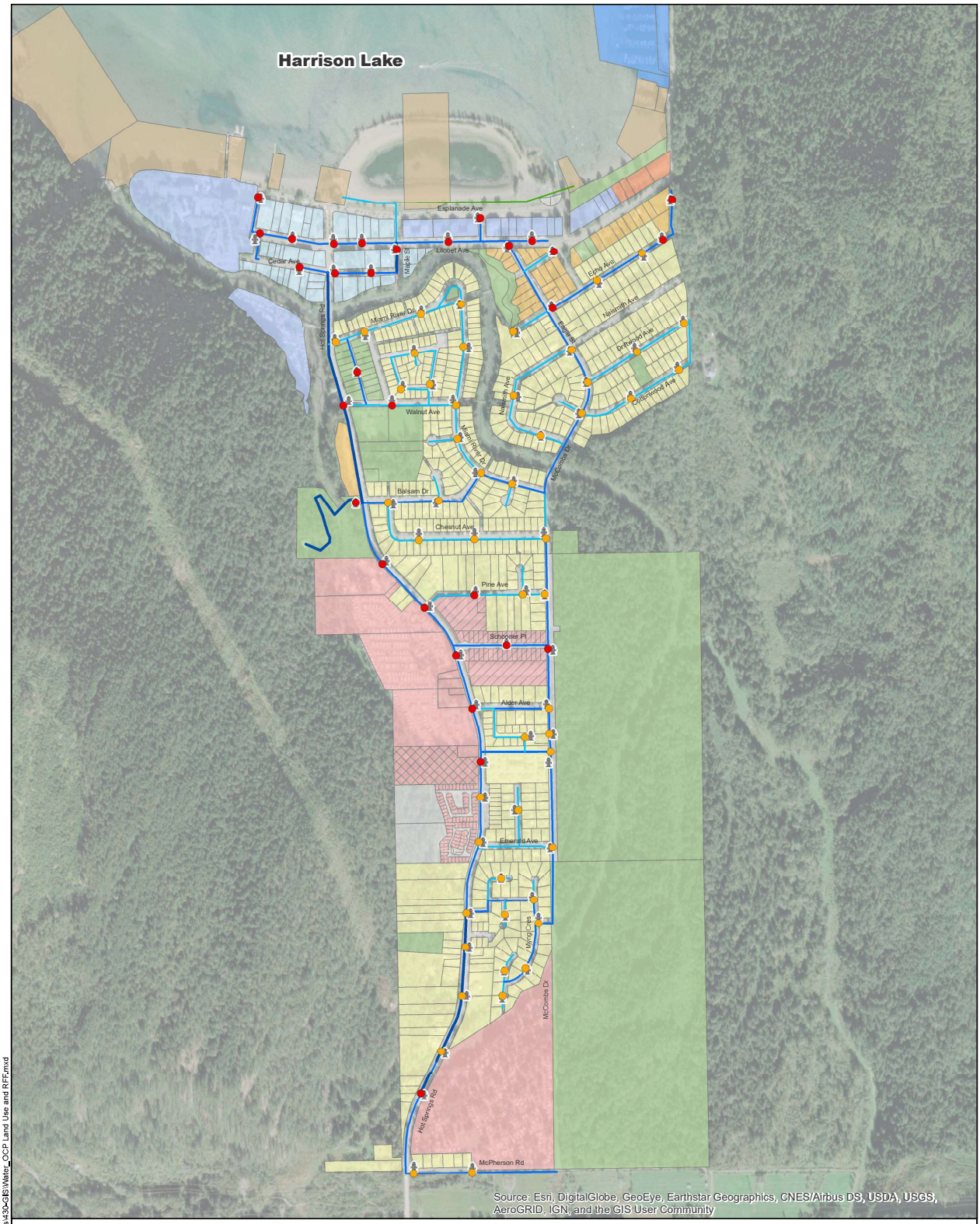
Abbr.	OCP Designation	Required Fire Flow (L/s)	Notes
MDR	Medium Density Residential	150	Residential; townhomes, row homes
MTC	Marine Tourist Commercial	n/a	Unserviced ICI
PU	Public Use	150	ICI or park. No fire flow requirement considered for parks without buildings/structures.
TC	Tourist Commercial	150	ICI
VC	Village Centre	150	Mixed use; apartments, commercial
WC	Waterfront Commercial	150	Mixed use; apartments, commercial
TC-HDR[1,2]	Tourist Commercial - High Density Residential	150	Residential; apartments
TC-MDR[1,3]	Tourist Commercial - Medium Density Residential	150	Residential; townhomes, row homes
TC-SLR[1,4]	Tourist Commercial - Small Lot Residential	60	Residential; resort (small lot) residential

Notes:
1. New categories created for residential properties with the Tourist Commercial (TC) OCP designation.
2. Singular property at 740 Hot Springs Rd (planned apartment development).
3. 628 McCombs Dr, 386 & 388 Pine Ave, and all properties on Schooner Pl.
4. 750 & 798 Hot Springs Rd.

The methodology for required fire flows was as follows:

1. Required fire flows were calculated per lot according to Table 3-5.
2. Required fire flow are assigned to each model junction with a connected hydrant, equal to the maximum required fire flow of all adjacent lots.

The required fire flows by junction are shown in Figure 3-1.



Legend

Hydrants

Required Fire Flow (L/s)
- 60
- 150

Water Main Diameter (mm)
- 50
- 100 - 150
- 200 - 250
- 300 - 350

OCP Land Use
- Lakeshore Beach
- Public Use
- Low Density Residential
- Medium Density Residential
- Lakeshore Residential
- Village Commercial
- Waterfront Commercial
- Marine Tourist Commercial
- Town Centre
- Town Centre - High Density Residential
- Town Centre - Medium Density Residential
- Town Centre -Small Lot Residential
- Vacant

0 150 300 450 m

1:10,000

WATER STREET ENGINEERING

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Water Master Plan

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Village of Harrison Hot Springs

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DATE 04 Dec 2025

REVISION 0

OCP Land Use and Required Fire Flows

Figure 3-1

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4 MODEL CALIBRATION

Hydrant testing was completed by SFE Global, with direction from Water Street and assistance from the City (for valve operation and recording of information from City SCADA). The test results are detailed in the Hydrant Flow Testing Results Memorandum (Water Street Engineering, 2025b), provided as Appendix 2.

Two types of hydrant testing were completed within the Village.

1. Three system flow tests were performed, used to verify system operation.
2. Three C-factor tests were performed, used to calibrate the C-factors for the model pipes.

For the three C-factor tests, Hazen-Williams C-factors were calculated, which are in the range of 142-166 for PVC pipes. Note that the previous water model from the 2015 Water Master Plan used a C-factor of 130. To better approximate both the system flow test results and the calculated C-factors, all PVC pipes in the model have been adjusted to a C-factor of 140. The modelled C-factors are shown in Table 4-1.

Table 4-1: Modelled C-Factors

Pipe Material	Modelled Hazen-Williams C-Factor
PVC	140
Ductile Iron	130

5 DESIGN CRITERIA

The design criteria used to review the system at peak hour demand (PHD) and at maximum day demand with fire flow (MDD+FF) are described under this section, based on the Village's Subdivision and Development Servicing Bylaw No. 1779 (Village of Harrison Hot Springs, 2022) and the MMCD Design Guidelines (MMCD, 2022).

5.1 PRESSURE

From the Village's Servicing Bylaw:

- Maximum static pressure: 830 kPa (120 psi)
- Minimum static pressure: 275 kPa (40 psi)
- Minimum pressure at PHD: 275 kPa (40 psi)
- Minimum pressure at MDD+FF: 140 kPa (20 psi)

5.2 VELOCITY

From the Village's Servicing Bylaw:

- Maximum velocity for pump supply, reservoirs, and trunk mains: 2.0 m/s (note this is not considered for the MDD+FF analysis)
- Maximum velocity for distribution lines at PHD: 2.0 m/s
- Maximum velocity for distribution lines at MDD+FF: 4.0 m/s

5.3 PIPE SIZING

From the Village's Servicing Bylaw (used for sizing of new mains only):

- Distribution mains: minimum 200 mm
- Fire hydrant connections: minimum 150 mm
- Service connections: minimum 19 mm
- Looped distribution mains in residential subdivisions: minimum 150 mm (providing fire flow and all other hydraulic requirements can be met)

5.4 RESERVOIR STORAGE

From the MMCD Design Guidelines:

- A: Fire Storage (from Fire Underwriters Survey Guide)
- B: Equalization Storage (25% of MDD)
- C: Emergency Storage (25% of A+B)

The storage volume required is the sum of A, B, and C.

6 EXISTING CONDITIONS HYDRAULIC ANALYSIS

6.1 PRESSURES, VELOCITIES, AND FIRE FLOWS

The following scenarios were developed to assess existing hydraulic deficiencies in the water system:

1. Existing peak hour demand (at 7 AM)
2. Existing MDD + FF

There were no deficiencies identified in the peak hour demand scenario (Figure 6-1). Pressures in the system range from 82.7 psi to 87.9 psi. This is expected as the system is relatively flat with a single pressure zone. The modelled pressures are within the acceptable design criteria range. All PHD modelled velocities are below the required 2.0 m/s requirement.

Existing MDD+FF was modelled, and the results are presented in Figure 6-2. The available fire flow was compared to the required fire flow under OCP, as existing required fire flows were not set. The following deficiencies were noted and/or dismissed.

Table 6-1: Existing Fire Flow Deficiencies

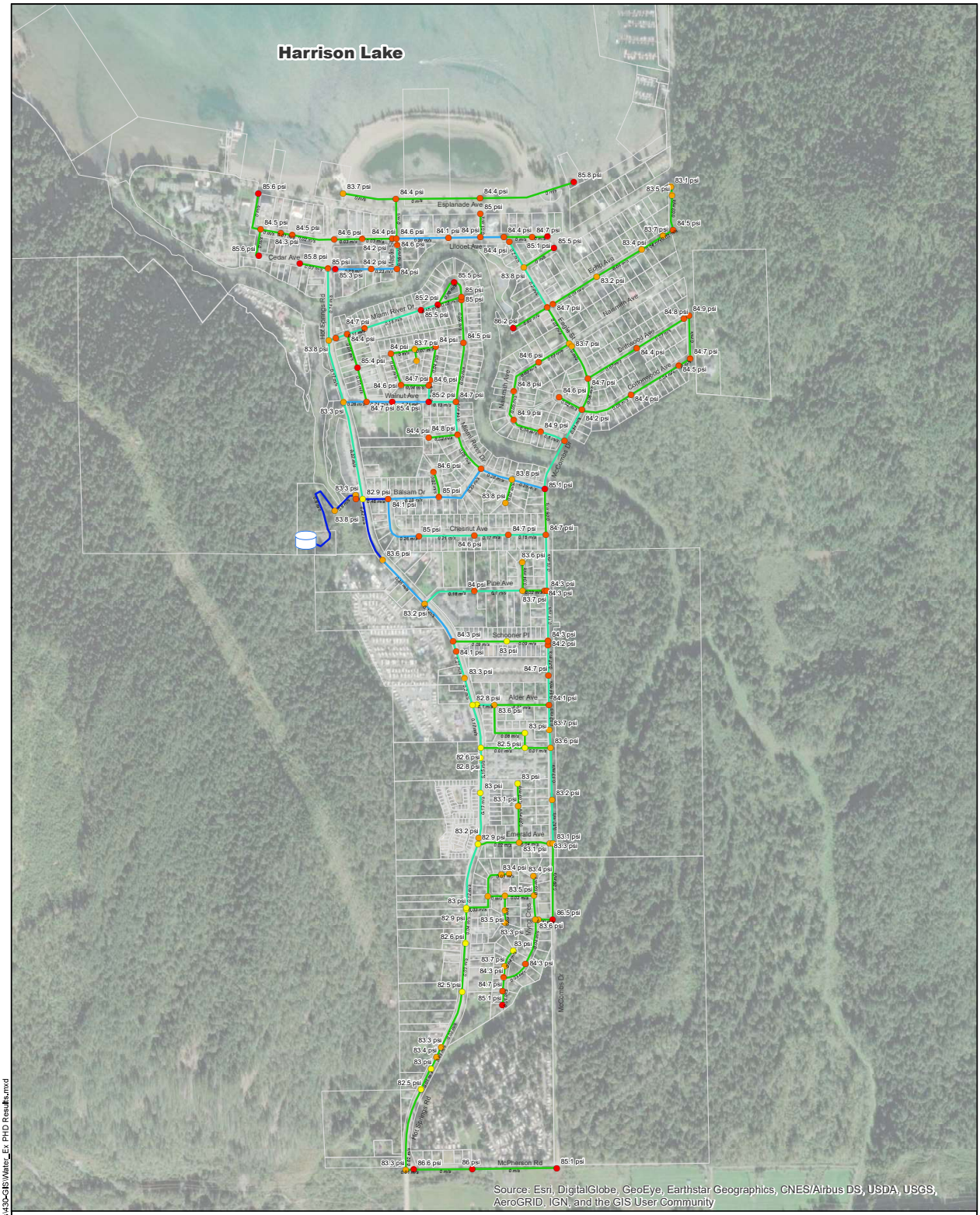
Location	Notes	Action
Lillooet Ave, west of Maple St, and St Alice St	125 L/s AFF calculated, which does not meet the 150 L/s RFF, driven by the existing multi-family and commercial developments in the area.	Looping and/or upsizing required
Lillooet Ave, east of Eagle St	126 L/s AFF calculated, which does not meet the 150 L/s RFF, driven by the existing multi-family developments (450 and 470 Esplanade Ave).	Looping and/or upsizing required
Chehalis St	126 L/s AFF calculated, which does not meet the 150 L/s RFF driven by the existing multi-family developments (378 and 410 Lillooet Ave). These lots may also be serviced by the hydrants on Lillooet Ave (>150 L/s AFF).	Review fire protection for noted properties
Bear Ave	71 L/s AFF calculated, which is sufficient for the existing single-family homes on Bear Ave (60 L/s RFF). However, this hydrant may also be used to service the church at 514 Lillooet Ave (150 L/s RFF).	Review fire protection for noted properties
Echo Ave	69 L/s AFF calculated, which is sufficient for the existing single-family homes on Echo Ave (60 L/s RFF). However, the hydrant at the end of Echo Ave, near Lillooet Ave and Rockwell Dr, could be used to service the multi-family developments on Lillooet Ave (i.e. 595 Lillooet Ave, 150 L/s RFF).	Review fire protection for noted properties
Walnut Ave at Poplar St	109 L/s AFF calculated, which does not meet the 150 L/s RFF driven by the elementary school. This lot may also be serviced by hydrants on the west side of the school on Hot Spring Rd (>150 L/s AFF).	Review fire protection for noted properties
Pine Ave	129 L/s AFF calculated, which does not meet the 150 L/s RFF driven by the existing multifamily development at 386 Pine Ave. This lot may also be serviced by hydrants on the west side of the development on Hot Spring Rd (>150 L/s AFF).	Review fire protection for noted properties

6.2 RESERVOIR STORAGE

The reservoir has adequate capacity with existing demands, as shown in the table below.

Table 6-2: Existing Reservoir Storage

Description	Value	Units	Notes
A: Fire Storage			
Required Fire Flow	150	L/s	Per Section 3.5
Duration	2	hours	Per FUS
Fire Storage	1080	m^3	Required Fire Flow × Duration
B: Balancing Storage			
MDD	2494	m^3/day	Per Section 3.4
Balancing Storage	624	m^3	25% of MDD
C: Emergency Storage			
Emergency Storage	426	m^3	25% of A + B
Total Volume Required	2129	m^3	
Existing Reservoir Capacity	2778	m^3	
Reservoir Spare Capacity	+649	m^3	



Legend

- Reservoir
- Parcels

Peak Hour Demand Pressure (psi)

- <83
- 83-84
- 84-85
- >85

Peak Hour Demand Velocity (m/s)

- <0.10
- 0.10 - 0.22
- 0.23 - 0.40
- >0.41

N

0 150 300 450 m

1:10,000

WATER STREET ENGINEERING

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Water Master Plan

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DATE 04 Dec 2025

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Existing Peak Hour Demand Results

Figure 6-1

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Legend

- Parcels
- Reservoir
- Fire Flow Deficiency (Available Fire Flow < Required Fire Flow)

Water Main Diameter(mm)

- 50
- 100 - 150
- 200 - 250
- 300 - 350

Available Fire Flow (L/s)

- < 70
- 70 - 100
- 100 - 150
- 150 - 200
- > 200

Note: Lables show Avaliable Fire Flow / Required Fire Flow

N

0 150 300 450 m

1:10,000

Water Master Plan

PREPARED FOR

Village of Harrison Hot Springs

PROJECT NO. 456.1

DATE 04 Dec 2025

REVISION 0

Existing MDD + FF Results

Figure 6-2

WATER STREET ENGINEERING

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7 OCP CONDITION HYDRAULIC ANALYSIS

7.1 PRESSURES, VELOCITIES, AND FIRE FLOWS

The following scenarios were developed to assess existing hydraulic deficiencies in the water system:

1. Future peak hour demand (at 7 AM)
2. Future MDD + FF

Future demands were developed as described in Section 3.4.

The peak hour pressures and available fire flows are presented in Figure 7-1 and Figure 7-2, respectively. Similar to the existing system, there were no deficiencies identified in the peak hour demand scenario. Pressures in the system range from 82 psi to 87.6 psi, which are within the acceptable design criteria range. All PHD modelled velocities are below the required 2.0 m/s requirement.

The available fire flow was compared to the required fire flow under OCP land use. The following deficiencies were noted.

Table 7-1: OCP Fire Flow Deficiencies

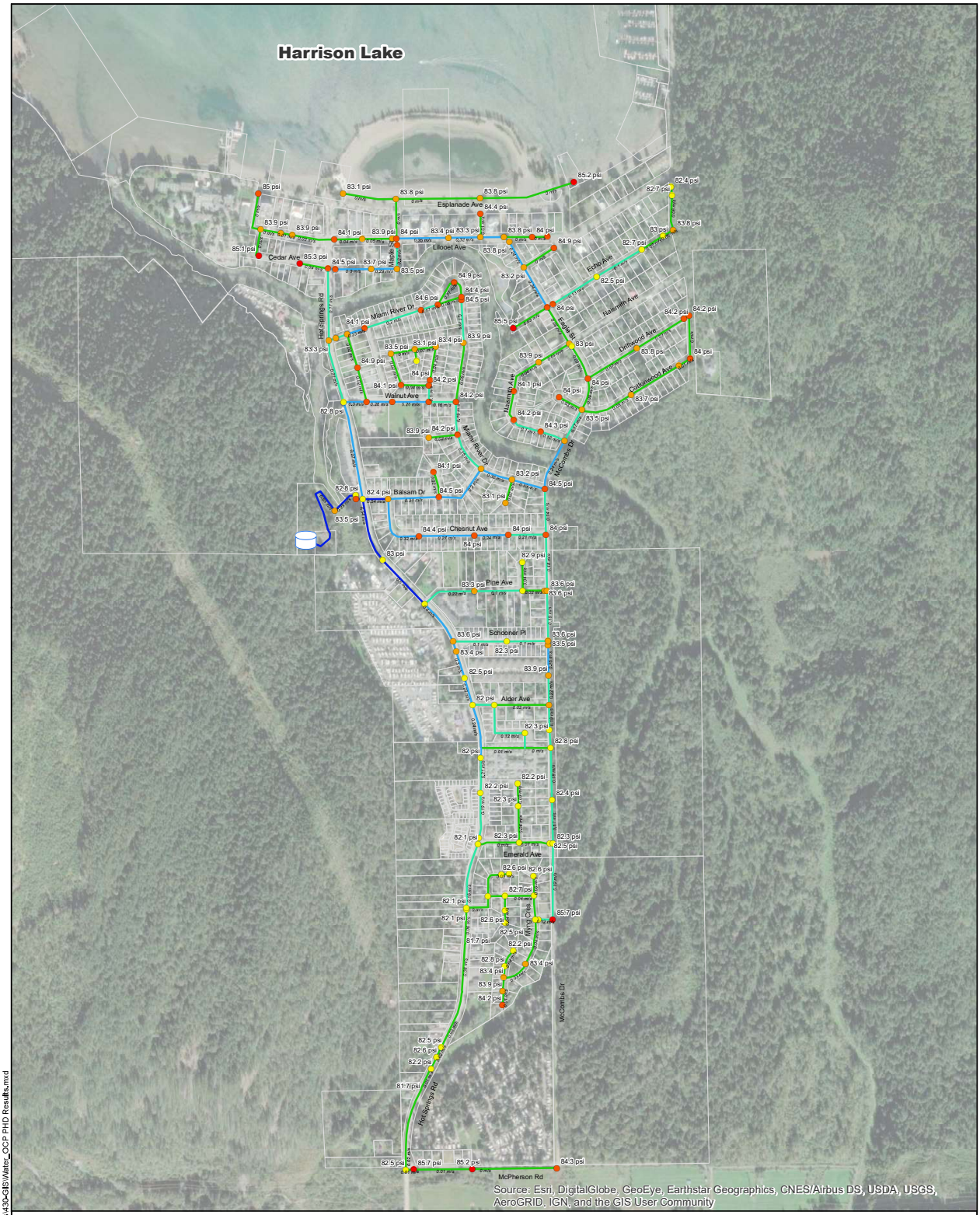
Location	Description	Action
Lillooet Ave, west of Maple St, and St Alice St	124 L/s AFF calculated, which does not meet the 150 L/s RFF. This is an existing deficiency.	Looping and/or upsizing required
Lillooet Ave, east of Eagle St	126 L/s AFF calculated, which does not meet the 150 L/s RFF. This is an existing deficiency.	Looping and/or upsizing required
Chehalis St	126 L/s AFF calculated, which does not meet the 150 L/s RFF driven by the existing multi-family developments (378 and 410 Lillooet Ave). These lots may also be serviced by the hydrants on Lillooet Ave (>150 L/s AFF).	Review fire protection for noted properties
Bear Ave	71 L/s AFF calculated, which does not meet the 150 L/s RFF for lots on Bear Ave with multi-family OCP designations.	Looping and/or upsizing required
Echo Ave	68 L/s AFF calculated, which does not meet the 150 L/s RFF for lots on Echo Ave with multi-family OCP designations.	Looping and/or upsizing required
Walnut Ave at Poplar St	109 L/s AFF calculated, which does not meet the 150 L/s RFF driven by the existing elementary school. This lot may also be serviced by hydrants on the west side of the school on Hot Spring Rd (>150 L/s AFF).	Review fire protection for noted properties
Pine Ave	129 L/s AFF calculated, which does not meet the 150 L/s RFF driven by the existing multifamily development at 386 Pine Ave. This lot may also be serviced by hydrants on the west side of the development on Hot Spring Rd (>150 L/s AFF).	Review fire protection for noted properties

7.2 RESERVOIR STORAGE

The reservoir has adequate capacity with OCP demands, as shown in the table below.

Table 7-2: OCP Reservoir Storage

Description	Value	Units	Notes
A: Fire Storage			
Required Fire Flow	150	L/s	Per Section 3.5
Duration	2	hours	Per FUS
Fire Storage	1080	m^3	Required Fire Flow × Duration
B: Balancing Storage			
MDD	3161	m^3/day	Per Section 3.4
Balancing Storage	790	m^3	25% of MDD
C: Emergency Storage			
Emergency Storage	468	m^3	25% of A + B
Total Volume Required	2338	m^3	
Existing Reservoir Capacity	2778	m^3	
Reservoir Spare Capacity	+440	m^3	



Legend

Reservoir

Parcels

Peak Hour Demand Pressure (psi)

- <83
- 83-84
- 84-85
- >85

Peak Hour Demand Velocity (m/s)

- <0.10
- 0.10 - 0.22
- 0.23 - 0.40
- >0.41

N

0 150 300 450 m

1:10,000

WATER STREET ENGINEERING

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Water Master Plan

PREPARED FOR

Village of Harrison Hot Springs

PROJECT NO. 456.1

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REVISION 0

OCP Peak Hour Demand Results

Figure 7-1

Document Path: D:\WSE Dropbox\001-Projects\456-Harrison Hot Springs Master Plans\430-GIS\Water_OCP PHD Results.mxd

Legend

- Parcels
- Reservoir
- Fire Flow Deficiency (Available Fire Flow < Required Fire Flow)

Available Fire Flow (L/s)

- < 70
- 70 - 100
- 100 - 150
- 150 - 200
- > 200

Water Main Diameter(mm)

- 50
- 100 - 150
- 200 - 250
- 300 - 350

Note: Lables show Avaliable Fire Flow / Required Fire Flow

N

0 150 300 450 m

1:10,000

WATER STREET ENGINEERING

EGBC Permit to Practice #1000830

Water Master Plan	PROJECT NO. 456.1
PREPARED FOR **Village of Harrison Hot Springs**	DATE 2025
	REVISION 0
OCP MDD + FF Results	**Figure 7-2**

Document Path: D:\WSE Dropbox\001-Projects\456-Harrison Hot Springs Master Plans\430-GIS\Water_OCP MDD+FF Results.mxd

8 WATER QUALITY CONSIDERATIONS

System dead-ends (un-looped water mains) pose a risk of low chlorine residuals. Noted dead-ends in the system include:

- Echo Ave: This has been identified as a fire flow deficiency.
- Lillooet Ave, east of Maple St: This has also been identified as a fire flow deficiency.
- McPherson Rd: This is one of the farthest points from the reservoir and has minimal demand. Looping along McCombs Dr would improve water quality.

Water quality monitoring and regular flushing, if required, should be undertaken until these projects are completed.

The Village has indicated, and has been confirmed by SCADA, that the reservoir is currently operated between 95% and 99% full. Increasing the reservoir cycle volume is recommended to improve mixing of the reservoir for water quality. The Village should consider modifying the reservoir operation to increase cycling and turnover for water quality. The reservoir should maintain a minimum storage of 2,129 m^3 for balancing, fire, and emergency storage (80% of the total storage volume of 2678 m^3 per Table 6-2). Based on this the tank fill (pump start) setpoint should be lowered to 80%, to provide 20% storage. Reservoir cycle volumes should be fine tuned based on operational experience and monitored chlorine residuals.

9 DEMAND MANAGEMENT

As population in the Village increases, the impact on the water system can be reduced by implementing demand management practices. The Village adopted a Municipal Water Conservation Plan in 2018 (Village of Harrison Hot Springs, 2018) that includes the following measurements:

- Public education & awareness
- Water use restrictions from June 1 to September 30
- Requirement to install water meters on all new residential construction or new connections to the water system
    - Residential properties, either metered or unmetered, are billed on a flat rate
    - Commercial properties are currently already metered and billed on a volumetric basis

In addition to the existing water conservation plan, the following projects or initiatives should be considered:

- Complete a study to assess the costs and benefits of universal metering through proactive installation of water meters on existing residential properties. Grant funding may be accessed for the cost of the study and subsequent capital costs of implementation.
- Offer residential customers the opportunity to switch to volumetric billing. A rate review would be required to set a rate that would incentivise switching to volumetric billing but maintain sufficient cost recovery.
- Recent SCADA upgrades have improved the data collection at various points in the water system. These upgrades should be leveraged through improved data analysis, such as monitoring for leakage.
- Additional water use restrictions from June 1 to September 30. This may include further restricting days residents can irrigate to one or two weekdays per week (current restriction allow irrigation one weekday and one weekend day).

10 PROJECT IDENTIFICATION AND PRIORITIZATION

The proposed project list is presented in Table 10-1 with locations shown on Figure 10-1. Individual project definition sheets are included in Appendix 3. The projects generally include:

- Addressing insufficient fire protection,
- Improving water quality,
- Adding utility connections,
- Demand management, and
- Operational improvements.

The proposed projects are further discussed below.

10.1 FIRE FLOW IMPROVEMENTS - EXISTING

The hydrants on Lillooet Ave, west of Maple St, and St Alice St do not provide sufficient fire flow for the existing multi-family and commercial developments. Looping along Cedar Ave (Project 1) is recommended to both increase available fire flows at these hydrants and provide servicing and hydrant protection to the residential properties on Cedar Ave that currently lack them. There are plans to complete this project at the same time as sewer improvements on Cedar Ave (Sewer Project 4 in the Sanitary Sewer Master Plan).

Similarly, the hydrants on Lillooet Ave, east of Eagle St, do not provide sufficient fire flow for the existing multi-family developments here. Properties on Lillooet Ave, east of Spruce St, are also currently unserviced and without hydrant protection. Looping along Lillooet Ave, connecting with the Echo Ave water main (Project 2), is recommended to address both deficiencies. This project is currently planned, to be completed when a new multi-family development is constructed adjacent to Rendal Park (at Lillooet Ave and Spruce St).

The single-family homes on Naismith Ave are currently unserviced and without hydrant protection. Looping along Naismith Ave and Mount St (Project 3) is recommended to provide servicing and hydrant protection to these properties.

The 2015 WMP noted that the existing hydrant distribution does not meet FUS linear spacing and coverage guidelines. Five additional hydrants are recommended on the existing system (Project 4).

10.2 FIRE FLOW IMPROVEMENTS - GROWTH

The Lillooet and Bear Ave water main looping (Project 8) is proposed to increase available fire flows on the eastern end of Bear Ave, should multi-family developments be constructed in the future. Similarly, the Echo Ave and Eagle St water main upgrade (Project 9) is proposed to increase available fire flows at this intersection, should multi-family developments be constructed here.

10.3 WATER QUALITY IMPROVEMENTS

Potential water quality concerns for the dead-ends at Lillooet Ave, east of Maple St, and at Echo Ave are addressed by fire protection Project 1 and Project 2, respectively.

Other potential water quality issues are noted on McPherson Rd, a dead-end and one of the farther points from the reservoir. Looping of the watermain along McCombs Dr (Project 5), between McPherson Rd and Hadway Dr, is recommended to improve water quality for this section of water main. This project is currently planned.

10.4 DEMAND MANAGEMENT

The 2015 WMP recommended that the Village implements universal metering. It is noted that the majority of multi-family and ICI properties within the Village are now metered, however most single-

family homes currently remain un-metered. It is recommended that the Village completes a study to assess the costs and benefits of implementing universal metering (Project 6).

10.5 OPERATIONAL

Inaccuracies and/or missing data are noted in the Village's GIS system. An update of the GIS system data (Project 7) is recommended, which may involve the collection and review of record drawings, and surveying where required.

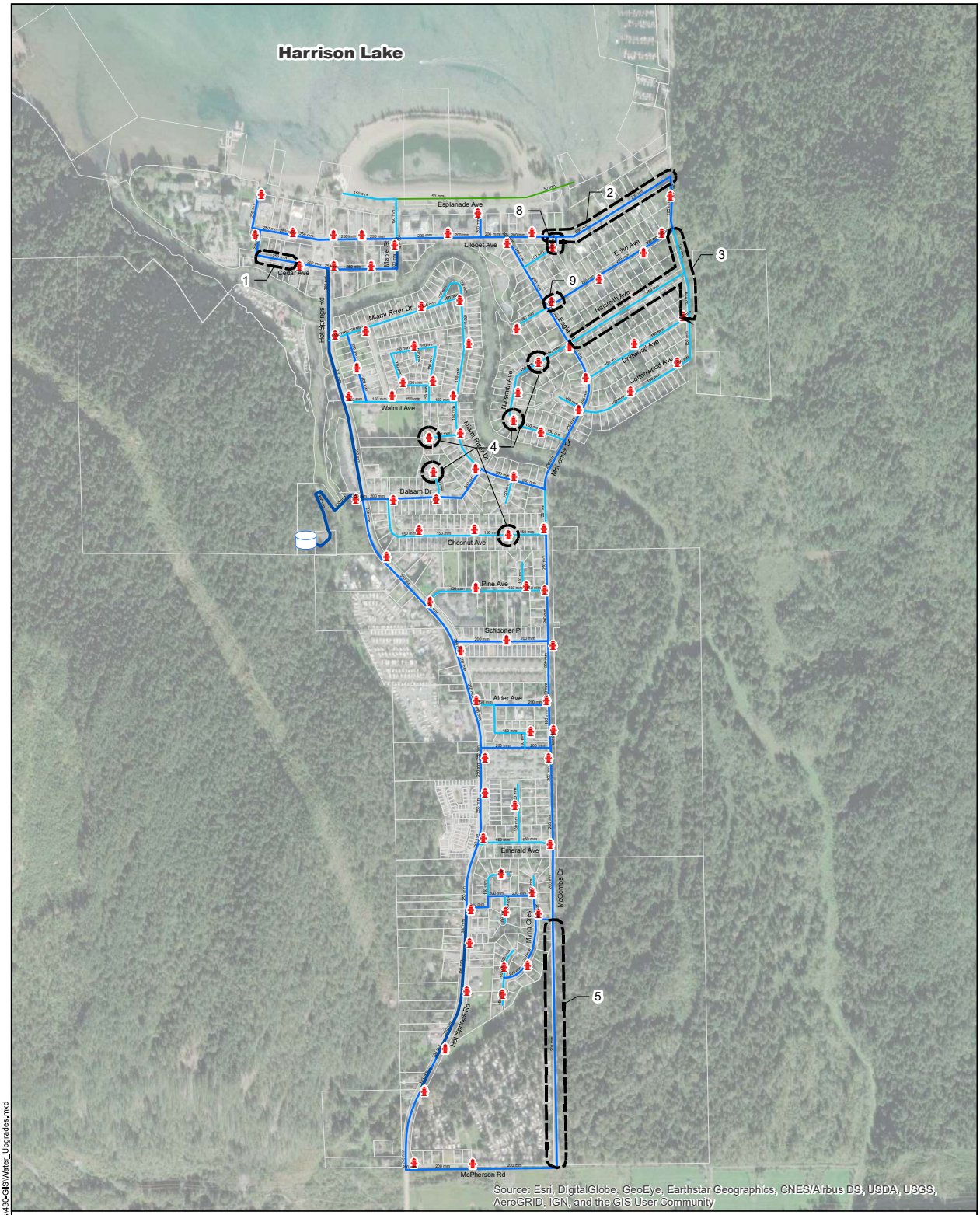
10.6 PROJECT PRIORITIES

Projects are rates as either High, Medium, Low or Conditional. These designations are defined as follows:

- **High**: Project addresses an existing significant deficiency or system need with broad impacts. Projects that address significant fire protection deficiencies are also included in this category. Typical timeline is completion within 5 years.
- **Medium**: Project addresses significant deficiency or system need with localized impact or addresses information gaps to identify deficiencies that could have localized impacts. Generic timeline is completion within 5 to 10 years but subject to project specifics.
- **Low**: Project addresses minor deficiency or system need with localized impact. Projects related to growth are also included in this category. Generic timeline is completion within 10 to 20 years but subject to project specifics.

Table 10-1: Capital Projects - Prioritization

Project Number	Description	Deficiency	Action	Primary Justification Category	Timeline	Priority
1	Cedar Ave Water Main Looping	Unserviced properties without hydrant protection, inadequate fire flows to protect existing developments, and water quality concerns due to dead-end	Construct 127 m of 250 mm diameter water main	Fire protection	Existing	High (Planned)
2	Lillooet and Echo Ave Water Main Looping	Unserviced properties without hydrant protection, inadequate fire flows to protect existing developments, and water quality concerns due to dead-end	Construct 445 m of 200 mm diameter water main	Fire protection	Existing	High (Planned)
3	Naismith Ave and Mount St Water Main Looping	Unserviced properties without hydrant protection	Construct 590 m of 150 mm diameter water main	Fire protection	Existing	Medium
4	Water Hydrants	Properties with water main frontage that have insufficient hydrant protection	Install 5 new hydrants	Fire protection	Existing	Medium
5	McCombs Dr Water Main Looping	Water quality concerns due to dead-end	Construct 650 m of 200 mm diameter water main	Water quality	Existing	Medium (Planned)
6	Universal Metering Study	Unmetered properties	Complete a study to assess costs/benefits of universal metering	Demand management	Existing	Medium
7	GIS System Data Update	Inaccuracies and/or missing data in Village GIS system	Update data in the Village's GIS system	Operational	Existing	Medium
8	Lillooet and Bear Ave Water Main Looping	Inadequate fire flows to protect future (OCP) developments	Construct 38 m of 200 mm diameter water main	Fire protection	Growth	Low
9	Echo Ave and Eagle St Water Main Upgrade	Inadequate fire flows to protect future (OCP) developments	Upgrade 20 m of the 150 mm diameter water main to 200 mm	Fire protection	Growth	Low



Legend

- Reservoir
- Parcels
- Hydrant
- Water Project

Water Main Diameter (mm)

- 50
- 100 - 150
- 200 - 250
- 300 - 350

N

0 150 300 450 m

1:10,000

WATER STREET ENGINEERING

EGBC Permit to Practice #1000830

Water Master Plan	PROJECT NO. 456.1	**Capital Projects**
PREPARED FOR **Village of Harrison Hot Springs**	DATE 04 Dec 2025	
	REVISION 0	**Figure 10-1**

Document Path: D:\WSE Dropbox\001-Projects\456-Harrison Hot Springs Master Plans\430-GIS\Water_Upgrades.mxd

11 CAPITAL WORKS PLAN

Based on the identified deficiencies and project prioritization outlined in Section 10, a capital works plan has been developed. All proposed projects are based on capacity improvements to meet future development conditions and are summarised in the table below.

Table 11-1: Capital Projects

Project Number	Description	Deficiency	Priority	DCC Eligible?	Capital Cost
1	Cedar Ave Water Main Looping [1]	Unserviced properties without hydrant protection, inadequate fire flows to protect existing developments, and water quality concerns due to dead-end	High (Planned)	Partial	$283,000
2	Lillooet and Echo Ave Water Main Looping	Unserviced properties without hydrant protection, inadequate fire flows to protect existing developments, and water quality concerns due to dead-end	High (Planned)	Partial	$990,000
3	Naismith Ave and Mount St Water Main Looping	Unserviced properties without hydrant protection	Medium	No	$1,272,000
4	Water Hydrants	Properties with water main frontage that have insufficient hydrant protection	Medium	No	$120,000
5	McCombs Dr Water Main Looping	Water quality concerns due to dead-end	Medium (Planned)	No	$1,260,000
6	Universal Metering Study	Unmetered properties	Medium	No	$36,000
7	GIS System Data Update	Inaccuracies and/or missing data in Village GIS system	Medium	No	$24,000
8	Lillooet and Bear Ave Water Main Looping	Inadequate fire flows to protect future (OCP) developments	Low	Yes	$52,000
9	Echo Ave and Eagle St Water Main Upgrade	Inadequate fire flows to protect future (OCP) developments	Low	Yes	$32,000

Notes:
1. Cedar Ave Water Main Looping (Project 1) to be completed in conjunction with sewer improvements on Cedar Ave (Sewer Project 4 in the Sanitary Sewer Master Plan)

Capital costs for construction projects include 10% for design, 10% for construction administration / project management, and 30% contingency. No provisions were made for site specific costing. Projects without construction scopes include a 20% contingency.

Unit costs used in preparing the capital works plan are based on Water Street's experience with similar projects in other municipalities.

Water main unit costs include supply, install, road restoration, and isolation valves (if applicable) but do not include services or hydrants. It is assumed that new residential water services will have water meters installed, as per the Municipal Water Conservation Plan (Village of Harrison Hot Springs, 2018).

The unit cost used are as follows (excl. design, construction administration / project management, and contingency):

- Water Main, 150 mm: $960 per lin.m
- Water Main, 200 mm: $1,115 per lin.m
- Water Main, 250 mm: $1,308 per lin.m
- Water Hydrant: $16,025 ea
- Service Connection incl. Meter: $9,585 ea

For new water mains, the following allowance is assumed for hydrants and services:

- Hydrant spacing of 150 m for single-family areas, 90 m for multi-family and ICI areas.
- New service connections installed for all existing residential properties (one per lot).

For individual projects, see the project definition sheets are included in Appendix 3. Also listed in this appendix are potential external funding (grant) opportunities (where applicable).

12 CONCLUSIONS AND RECOMMENDATIONS

12.1 SUMMARY

The background review, demand development, and water system modelling revealed the following deficiencies:

- Insufficient fire flows to protect existing and/or future properties.
- Properties with insufficient hydrant protection.
- Properties without water service connections (unserviced an/or on private well systems).
- Water quality concerns due to dead-end at McPherson Rd.
- Unmetered properties.
- Inaccuracies and/or missing data in the Village GIS system.

12.2 RECOMMENDATIONS - CAPITAL PROJECTS

Nine capital projects are recommended. These projects have been given a project priority and high-level capital cost estimate. The total costs of the recommended projects are summarised by project priority in Table 12-1. There are two projects that are high priority, related to providing sufficient fire protection to existing properties:

- Project 1: Cedar Ave Water Main Looping
- Project 2: Lillooet and Echo Ave Water Main Looping

Additionally, three projects are noted to be currently planned:

- Project 1: Cedar Ave Water Main Looping –High Priority
- Project 2: Lillooet and Echo Ave Water Main Looping –High Priority
- Project 5: McComb Water Main Looping – Medium Priority

Table 12-1: Project Summary by Priority

Project Priority	Number of Projects	Total Capital Costs
High	2	$1,273,000
Medium	5	$2,712,000
Low	2	$84,000
Total	9	$4,069,000

12.3 RECOMMENDATIONS - OTHER

Other, non-capital, recommendations are as follows:

1. Review fire protection for 378 Lillooet Ave, 410 Lillooet Ave, 514 Lillooet Ave, 595 Lillooet Ave, 501 Hot Springs Rd (elementary school), and 386 Pine Ave.
2. Complete water quality monitoring (if required) and continue with regular flushing (twice per year) until water quality improvements are completed (Projects 1, 2, 5).
3. Modify reservoir operating levels to increase reservoir cycling volume and improve mixing of the reservoir for water quality.
4. Offer water main connection to residential properties that are currently unserviced and/or on private well systems, with water main frontage. It is noted that there are 31 such residential properties.

5. Offer residential customers with existing meters the opportunity to switch to volumetric billing. A rate review would be required to set a rate that would incentivise switching to volumetric billing but maintain sufficient cost recovery.
6. Recent SCADA upgrades have improved the data collection at various points in the water system. These upgrades should be leveraged through improved data analysis, such as monitoring for leakage.
7. Consider additional water use restrictions from June 1 to September 30. This may include further restricting days residents can irrigate to one or two weekdays per week (current restriction allow irrigation one weekday and one weekend day).
8. The 2015 WMP included the replacement of a damaged tee at Cedar and Hot Springs Rd. It is recommended that the Village further investigates this issue using flow monitoring data. The recent SCADA upgrades can be utilised here.
9. The capacity of the raw water pumps, treatment system, and treated water pumps should be reviewed in light of the future demands calculated in this Master Plan.
10. Further review fire flow requirements for current buildings (using FUS guide as a standard) to review adequacy of the 150 L/s requirement assumed.

13 CLOSURE

We trust this report meets your present requirements. Please contact the undersigned with any questions or comments.

WATER STREET ENGINEERING LTD.

Jade Sangha, EIT
Modelling Engineer

Neal Whiteside, MASc, PEng
Principal, Senior Municipal Engineer

EGBC permit number 1000830

14 REFERENCES

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ABBREVIATIONS

AFF	Available Fire Flow (amount available from modelling or testing of the system)
BD	Base Demand
DCC	Development Cost Charges
DEM	Digital Elevation Model
FF	Fire Flow
FUS	Fire Underwriter's Survey
GIS	Geographic Information System
ICI	Industrial, Commercial, Institutional
MDD	Maximum Day Demand
OCP	Official Community Plan
PHD	Peak Hour Demand
PVC	Polyvinyl Chloride
RFF	Required Fire Flow (amount required to meet design criteria)
SD	Seasonal Demand
TWL	Top Water Level
UFW	Unaccounted for Water
WMP	Water Master Plan
WTP	Water Treatment Plant

APPENDIX 1: POPULATION, BASE SANITARY FLOWS, AND BASE WATER DEMANDS MEMORANDUM

Bound separately

APPENDIX 2: HYDRANT FLOW TESTING RESULTS MEMORANDUM

Bound separately

APPENDIX 3: PROJECT DEFINITION SHEETS

Village of Harrison Hot Springs Water Master Plan
December 2025 Cost Estimate
Project Number 1
Cedar Ave Water Main Looping
Priority: High

Project Description: Construct 127 m of 250 mm diameter water main

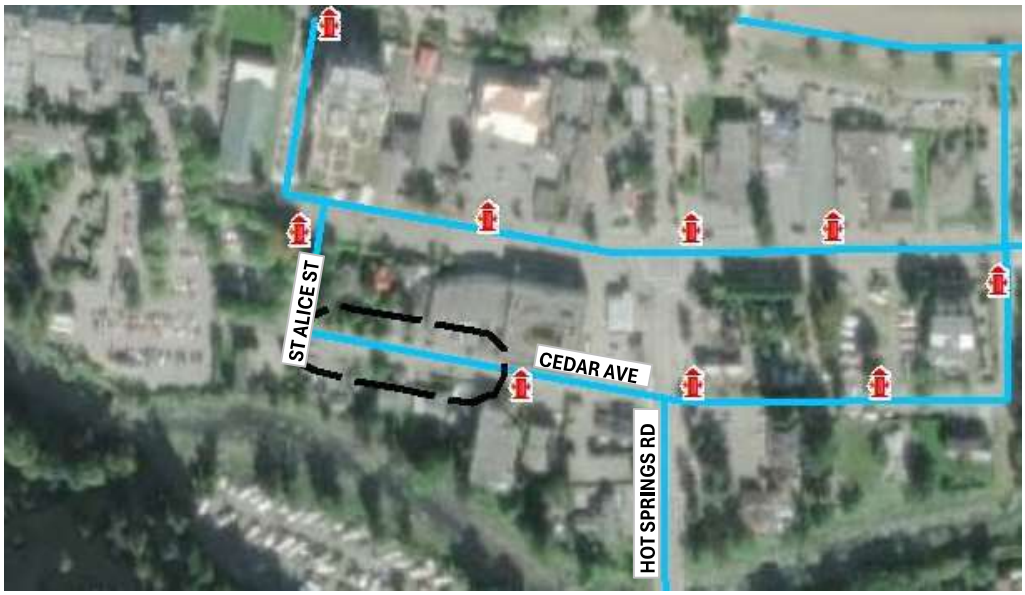
Deficiency: Unserviced properties without hydrant protection, inadequate fire flows to protect existing

Primary Justification: Fire protection

DCC Eligible: Partial

Grant Opportunities: Canada Community Building Fund, British Columbia Growing Communties Fund

Additional Notes: Planned project, to be completed in conjunction with sewer improvements on Cedar Ave (Sewer Project 4 in the Sanitary Sewer Master Plan). Increases available fire flows at hydrants on Lillooet Ave, west of Maple St, and provides servicing and hydrant protection to unserviced properties on Cedar Ave.



Assumptions: 90 m hydrant spacing for multi-family and ICI areas. New service connections and meters installed for all existing residential properties that are currently unserviced (one per lot).

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	250 mm Dia. Water Main	m	110	$ 1,308.00	$ 143,880
2	Water Hydrant	ea.	1	$ 16,025.00	$ 16,025
3	Water Service and Meter	ea.	3	$ 9,585.00	$ 28,755
			Subtotal:		**$ 188,660**
	Design / Construction Management / Contingency (%)			**50%**	**$ 94,330**
			Total Estimated Cost:		**$ 282,990**
			Rounded Total Estimated Cost:		**$ 283,000**

Village of Harrison Hot Springs Water Master Plan
December 2025 Cost Estimate
Project Number 2
Lillooet and Echo Ave Water Main Looping
Priority: High

Project Description: Construct 445 m of 200 mm diameter water main

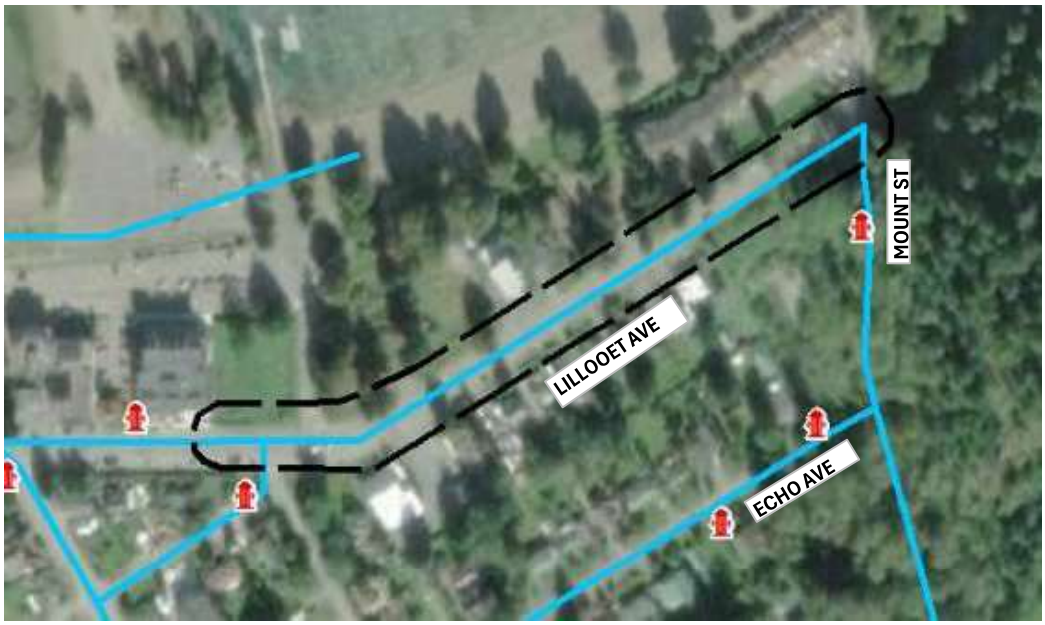
Deficiency: Unserviced properties without hydrant protection, inadequate fire flows to protect existing

Primary Justification: Fire protection

DCC Eligible: Partial

Grant Opportunities: Canada Community Building Fund, British Columbia Growing Communties Fund

Additional Notes: Planned project, to be completed during construction of multi-family development adjacent to Rendal Park. Increases available fire flows at hydrants on Lillooet Ave, east of Eagle St, and provides servicing and hydrant protection to unserviced properties on Lillooet Ave, east of Spruce St.



Assumptions: 90 m hydrant spacing for multi-family and ICI areas. New service connections and meters installed for all existing residential properties that are currently unserviced (one per lot).

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	200 mm Dia. Water Main	m	397	$ 1,115.00	$ 442,655
2	Water Hydrant	ea.	4	$ 16,025.00	$ 64,100
3	Water Service and Meter	ea.	16	$ 9,585.00	$ 153,360
			Subtotal:		**$ 660,115**
	Design / Construction Management / Contingency (%)			**50%**	**$ 330,058**
			Total Estimated Cost:		**$ 990,173**
			Rounded Total Estimated Cost:		**$ 990,000**

Village of Harrison Hot Springs Water Master Plan
December 2025 Cost Estimate
Project Number 3
Naismith Ave and Mount St Water Main Looping
Priority: Medium

Project Description: Construct 590 m of 150 mm diameter water main
Deficiency: Unserviced properties without hydrant protection
Primary Justification: Fire protection
DCC Eligible: No
Grant Opportunities: Canada Community Building Fund
Additional Notes: Provide servicing and hydrant protection to unserviced properties on Naismith Ave.

Assumptions: 150 m hydrant spacing for single-family areas. New service connections and meters installed for all existing residential properties that are currently unserviced (one per lot).

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	150 mm Dia. Water Main	m	587	$ 960.00	$ 563,520
2	Water Hydrant	ea.	4	$ 16,025.00	$ 64,100
3	Water Service and Meter	ea.	23	$ 9,585.00	$ 220,455
			Subtotal:		**$ 848,075**
	Design / Construction Management / Contingency (%)			**50%**	**$ 424,038**
			Total Estimated Cost:		**$ 1,272,113**
			Rounded Total Estimated Cost:		**$ 1,272,000**

Village of Harrison Hot Springs Water Master Plan
December 2025 Cost Estimate
Project Number 4
Water Hydrants
Priority: Medium

Project Description: Install 5 new hydrants

Deficiency: Properties with water main frontage that have insufficient hydrant protection

Primary Justification: Fire protection

DCC Eligible: No

Grant Opportunities: Canada Community Building Fund

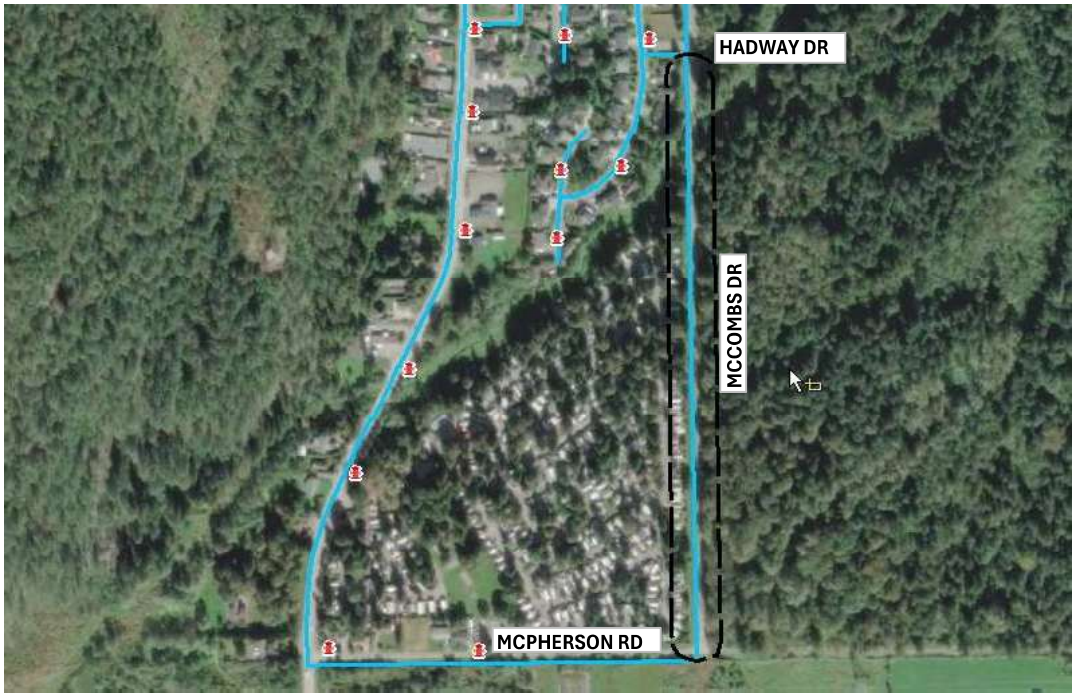
Additional Notes: Provides hydrant protection where FUS linear spacing and coverage guidelines are not met. Recommendation per the 2015 Water Master Plan.

Assumptions: n/a

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	Water Hydrant	ea.	5	$ 16,025.00	$ 80,125
			Subtotal:		**$ 80,125**
	Design / Construction Management / Contingency (%)			**50%**	**$ 40,063**
			Total Estimated Cost:		**$ 120,188**
			Rounded Total Estimated Cost:		**$ 120,000**

Village of Harrison Hot Springs Water Master Plan
December 2025 Cost Estimate
Project Number 5
McCombs Dr Water Main Looping
Priority: Medium

Project Description: Construct 650 m of 200 mm diameter water main
Deficiency: Water quality concerns due to dead-end
Primary Justification: Water quality
DCC Eligible: No
Grant Opportunities: Canada Community Building Fund
Additional Notes: Planned project. Addresses potential water quality concern on McPherson Rd.



Assumptions: 90 m hydrant spacing for multi-family and ICI areas. New service connections and meters installed for all existing residential properties that are currently unserviced (one per lot).

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	200 mm Dia. Water Main	m	653	$ 1,115.00	$ 728,095
2	Water Hydrant	ea.	7	$ 16,025.00	$ 112,175
				Subtotal:	**$ 840,270**
				Design / Construction Management / Contingency (%) **50%**	**$ 420,135**
				Total Estimated Cost:	**$ 1,260,405**
				Rounded Total Estimated Cost:	**$ 1,260,000**

Village of Harrison Hot Springs Water Master Plan
December 2025 Cost Estimate
Project Number 6
Universal Metering Study
Priority: Medium

Project Description: Complete a study to assess costs/benefits of universal metering
Deficiency: Unmetered properties
Primary Justification: Demand management
DCC Eligible: No
Grant Opportunities: British Columbia Infrastructure Planning Grant Program, Canada Community Building Fund
Additional Notes: Assess the costs and benefits of implementing universal metering.

Assumptions: Allowance only

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price		Estimated Amount
1	Project Allowance	ea.	n/a	n/a	$	30,000
				Subtotal:	**$**	**30,000**
				Contingency (%)	**20% $**	**6,000**
				Total Estimated Cost:	**$**	**36,000**
				Rounded Total Estimated Cost:	**$**	**36,000**

Village of Harrison Hot Springs Water Master Plan
December 2025 Cost Estimate
Project Number 7
GIS System Data Update
Priority: Medium

Project Description: Update data in the Village's GIS system

Deficiency: Inaccuracies and/or missing data in Village GIS system

Primary Justification: Operational

DCC Eligible: No

Grant Opportunities: Union of BC Municipalities Asset Management Planning Program, Canada Community Building Fund

Additional Notes: Inaccuracies and/or missing data have been noted in the Village's GIS System. Collection and review of record drawings, and surverying where required, is recommended.

Assumptions: Allowance only

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price		Estimated Amount
1	Project Allowance	ea.	n/a	n/a	$	20,000
				Subtotal:	**$**	**20,000**
				Contingency (%)	**20% $**	**4,000**
				Total Estimated Cost:	**$**	**24,000**
				Rounded Total Estimated Cost:	**$**	**24,000**

Village of Harrison Hot Springs Water Master Plan
December 2025 Cost Estimate
Project Number 8
Lillooet and Bear Ave Water Main Looping
Priority: Low

Project Description: Construct 38 m of 200 mm diameter water main

Deficiency: Inadequate fire flows to protect future (OCP) developments

Primary Justification: Fire protection

DCC Eligible: Yes

Grant Opportunities: n/a

Additional Notes: Contingent on future development. Increases available fire flows at the hydrant on the eastern end of Bear Ave.

Assumptions: 90 m hydrant spacing for multi-family and ICI areas.

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	200 mm Dia. Water Main	m	31	$ 1,115.00	$ 34,565
				Subtotal:	**$ 34,565**
				Design / Construction Management / Contingency (%) **50%**	**$ 17,283**
				Total Estimated Cost:	**$ 51,848**
				Rounded Total Estimated Cost:	**$ 52,000**

Village of Harrison Hot Springs Water Master Plan
December 2025 Cost Estimate
Project Number 9
Echo Ave and Eagle St Water Main Upgrade
Priority: Low

Project Description: Upgrade 20 m of the 150 mm diameter water main to 200 mm
Deficiency: Inadequate fire flows to protect future (OCP) developments
Primary Justification: Fire protection
DCC Eligible: Yes
Grant Opportunities: n/a
Additional Notes: Contingent on future development. Increases available fire flows at the hydrant at Echo Ave and Eagle St.

Assumptions: n/a

Item No.	Description	Unit	Estimated Quantity	Estimated Unit Price	Estimated Amount
1	200 mm Dia. Water Main	m	19	$ 1,115.00	$ 21,185
				Subtotal:	**$ 21,185**
				Design / Construction Management / Contingency (%) **50%**	**$ 10,593**
				Total Estimated Cost:	**$ 31,778**
				Rounded Total Estimated Cost:	**$ 32,000**

WATER STREET ENGINEERING

TECHNICAL MEMORANDUM			
Subject	Population, Base Sanitary Flows and Base Water Demands		
Project	Village of Harrison Hot Springs Sanitary Sewer and Water Master Plans		
To	Jace Hodgson Village of Harrison Hot Springs	**From**	Jade Sangha, EIT and Neal Whiteside, MASc, PEng
Date	29 Sep 2025	**File ref**	Water Street File # 456.300
Version	C	**Status**	Final

1. INTRODUCTION

1.1. PURPOSE

The Village of Harrison Hot Springs (the Village) has retained Water Street Engineering (Water Street) to complete village-wide sanitary sewer, storm, and water master plans.

This technical memorandum evaluates populations, base sanitary flows and base water demands for use in the sanitary sewer and water master plans. Specifically, this memorandum aims to:

1. Identify current and future village-wide residential populations based on BC Stats and Fraser Valley Regional District (FVRD) data.
2. Assess current and future Industrial, Commercial, and Institutional (ICI) population equivalents, to develop the current and future design population equivalents (sum of residential population and ICI population equivalent).
3. Estimate the (winter base and summer peak) residential populations and ICI population equivalents. connected to the sanitary sewer and water systems.
4. Develop estimated current sanitary sewer base sanitary flow (total and per capita rate), and groundwater infiltration (GWI) based on 2025 flow monitoring.
5. Develop estimates of current water demands (BD, SD, UFW), based on 2023 data.

1.2. BACKGROUND

The VHHS is experiencing population growth and redevelopment, which necessitates a long-term improvement plan to ensure the water and sanitary sewer systems can meet the increasing demands / loads and fire protection requirements.

As noted in the 2015 Water Master Plan, the growth in the village is unique and has not been consistent with the surrounding municipalities. The Village has a developed tourism industry and a significant number of seasonal residents. Estimating the seasonal residents and seasonal commercial population equivalents is important for planning and evaluation of the Village sanitary sewer and water systems.

1.3. PREVIOUS WORK

2016 LIQUID WASTE MANAGEMENT PLAN (CTQ, 2016)

The 2016 Liquid Water Management Plan (LWMP) noted a 2011 Census population of 1,468 ca and an average growth rate (1996 -2011) of 4.2%. A yr-2036 population forecast range of 2,367 to 2,733 ca was developed based

on growth rates. A "full-capacity" population of 4,447 ca was also developed based on current (at the time) land use zoning.

1.4. LIMITATIONS

This technical memorandum must be read with the Statement of Limitations at the end of this document.

2. BASE (WINTER) POPULATION

The BC Stats Population Estimates & Projections for British Columbia (BC Stats, 2024a) and the FVRD regional growth strategy (Fraser Valley Regional District, 2024) were used to assess current and future base (winter) village-wide populations. BC Stats uses the Component/Cohort-Survival method to project populations, which grows the population from the latest base year estimate by forecasting births, deaths and migration. Similarly, the BC Stats Household Estimates & Projections for British Columbia (BC Stats, 2024b) is used to assess current and future dwelling units and per-capita dwelling unit densities. Note that households include occupied dwellings only. The FVRD regional growth strategies presents populations and number of households for 2021 and projections for 2030, 2040 and 2050.

The historical estimates and future projections of populations and household within the Village are shown in Figure 1. Note the future projections provided by BC Stats only include up to the year 2046. The FVRD projections for populations and population per housing unit differ slightly from corresponding BC Stats projections.

For the Master Planning work, 2023 population data from BC Stats was selected to represent existing conditions, as this is consistent with the data available. The Village has selected the 2050 FVRD projections as their preferred option for future growth estimates. These are presented in Table 1.

Figure 1: BC Stats population and household estimates / projections

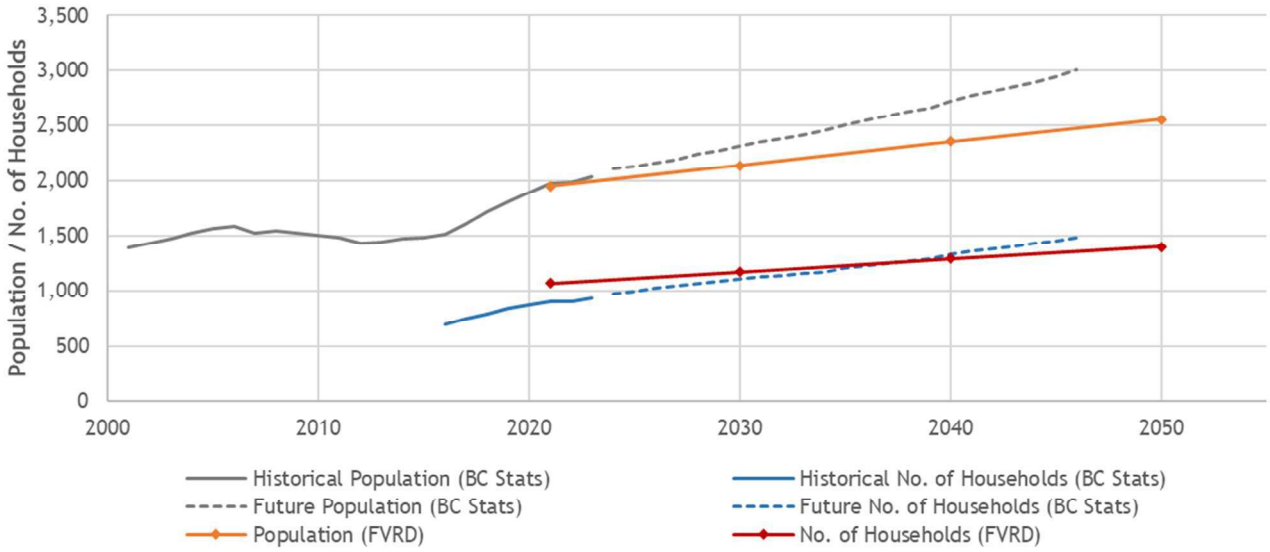


Table 1: Village-wide base (winter) populations

Master Plan Scenario	BC Stats		FVRD	
	Population	No. of Households	Population	No. of Housing Units
2021 for reference*	1,979	897	1,951	1,070
Existing (2023)	2,032	932	-	-
2046 BC Stats*	3,004	1,488	-	-
Future (2050)	-	-	2,553	1,400
* Not considered in master plan modelling, provided for reference only.				

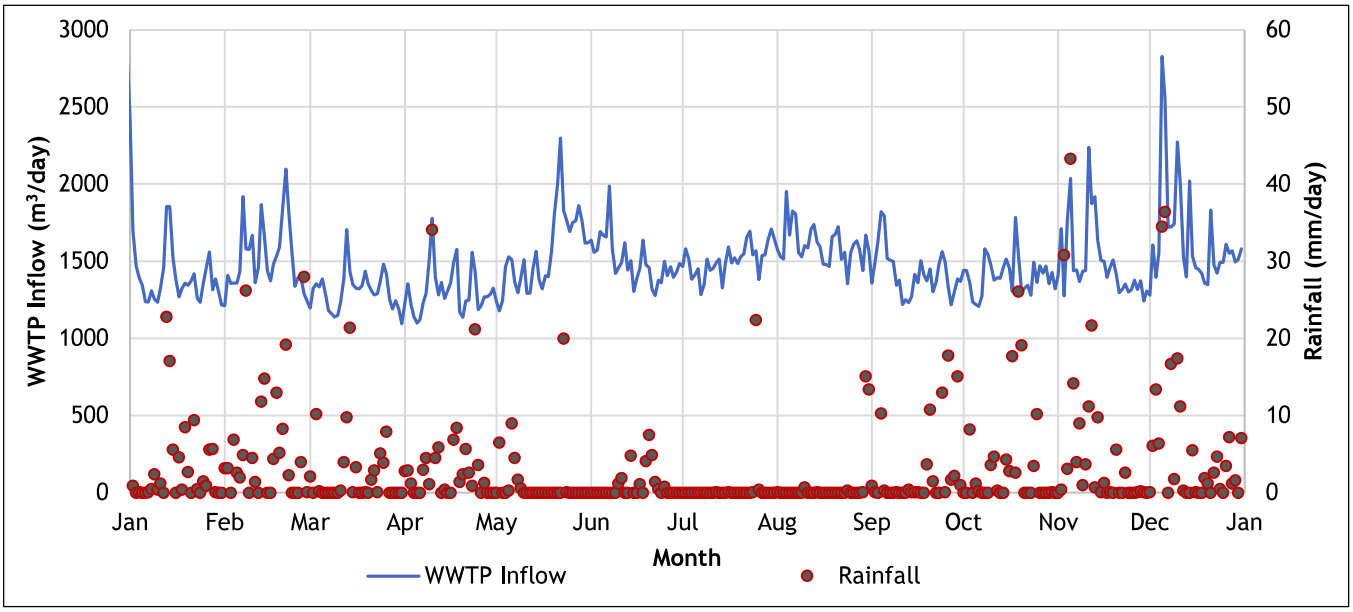
The 2023 BC Stats population projection is used for the existing master plan scenarios; the 2050 FVRD population projection is used for the future master plan scenarios.

3. WWTP & WTP FLOWS

3.1. WWTP EFFLUENT FLOWS

The daily recorded effluent discharge from 2023 is shown in Figure 2. The wastewater treatment plant (WWTP) effluent flows were used to assist in determining base sanitary flows (winter and seasonal component) and in turn establishing the seasonal population.

Figure 2: 2023 WWTP effluent flow



Implicitly included in the WWTP effluent flows would be:

- Some daily fluctuation compared to inflows to the WWTP (due to changes in levels in the WWTP aeration basins),
- Rainfall derived inflow and infiltration (RDII), and
- Sanitary ground water inflows (GWI)

The first two factors were minimized by averaging flows over a number of dry days in the summer and winter periods. It was assumed that the GWI would not vary considerably from summer to winter.

Table 2: 2023 WWTP effluent flow summary

Period	Flow		Dates
	m³/day	L/s	
Average (for reference incl. wet periods)	1479	17.1	1 Jan - 31 Dec
Winter Dry Weather	1185	13.7	5-10, 27-31 Mar, 4-6 Apr
Summer Dry Weather	1617	18.7	26 Jul - 29 Aug
Seasonal Component of DWF	432	5.00	Summer less Winter dry weather flow

Data for 2021 was checked and showed a similar increase in summer dry weather WWTP flows.

3.2. WTP FLOWS

Source flows to the Village are metered at the water treatment plant (WTP), which flows to the Village's tank before supplying the Village. The flows are manually recorded daily, and do not include peak hour consumption. The data for the village is shown in Figure 3 and Table 3.

Figure 3: 2023 WTP discharge

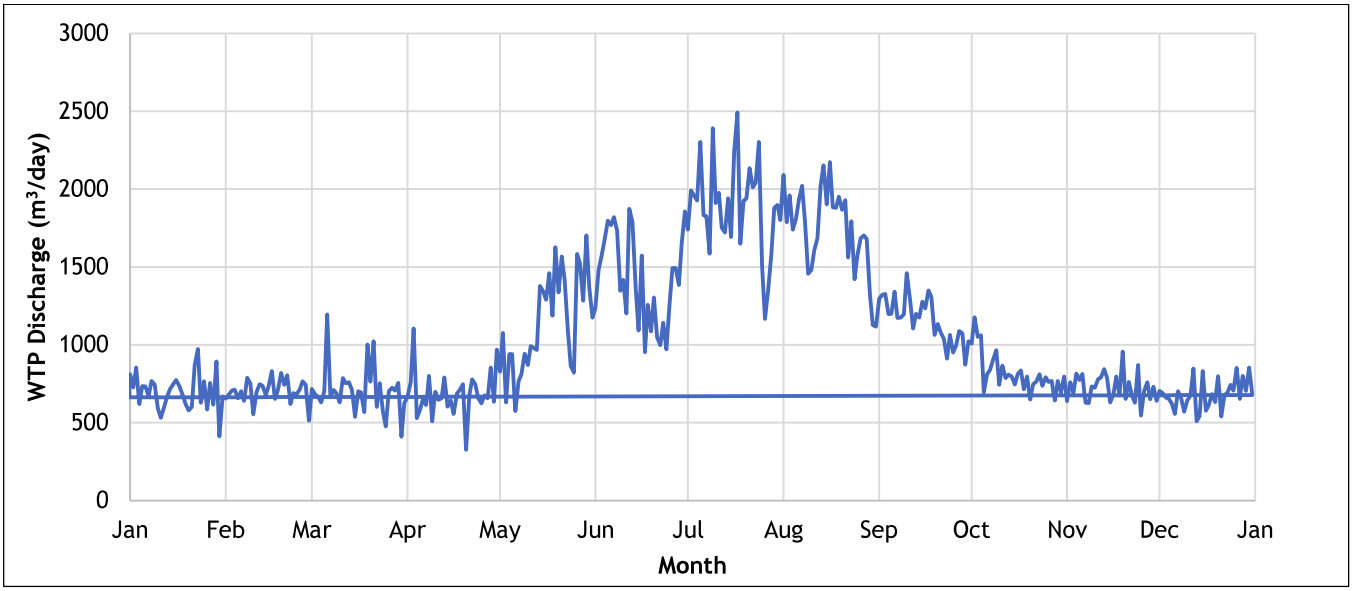


Table 3: 2023 WTP discharge summary

Demand Type	Demand		Dates
	m³/day	L/s	
Average Day (ADD)	1034	12.0	1 Jan - 31 Dec
Base (BD)	703	8.14	1 Jan - 31 Mar (Q1)
Maximum Day (MDD)	2492	28.8	17 Jul
Seasonal (SD)	1789	20.7	Maximum Day less Base demand

It is noted that due to the location of the WTP water meter, there can be significant fluctuations in the daily flow recordings (due to tank level fluctuations). As such, the above measured peak day flow (28.8 L/s) may be higher than the actual system MDD.

3.3. 2025 SANITARY SEWER FLOW MONITORING

Flow monitoring was completed between Jan and Jun 2025 as described in a separate technical memorandum (Water Street Engineering, 2025).

4. SERVICED & METERED PROPERTIES

4.1. SERVICED WATER AND SEWER LOTS

Not all of the Village is serviced by the respective water and sanitary sewer systems. A list of properties connected to the water and sanitary systems was provided by the Village, and mapped to GIS data to determine whether a property is serviced with water and/or sewer, or neither, and number of service connections. BCAA actual use codes were used to assign usage type and dwelling unit counts.

- Un-serviced lots: 175 GIS parcels were identified as un-serviced. These parcels include several large lots and the total area of unserviced parcels is 211.2 ha (63% of total lot area of parcels within Village).
- Lots serviced by **both water and sewer**: 659 lots, 78.4 ha, accounting for 1098 dwelling units, including 622 single-family dwelling units and 13 multi-family units (with a total of 475 water service connections noted). It is noted that many of the multi-family units are understood to be unoccupied in the winter.
- Lots serviced by **sanitary sewer only**: 82 lots, 47.3 ha, accounting for 97 dwelling units. A review of the lots serviced by sanitary but not water indicates that these generally have their own groundwater source (i.e. well(s)).
- Lots serviced by **water only**: 2 lots both indicated as vacant by BCAA actual use code.

Notable properties / exceptions are as follows:

- **Springs RV Resort (SRVR, 640 & 670 Hot Springs Rd.):** The SRVR is connected to both the Village water and sewer systems. HHP is set-up for seasonal RV use. The water system is metered. It is understood that the facility is open year-round.
    - Serviced area (for calculation of sanitary GWI and RDII): 47,464 m^2 / 4.75 ha
    - Metered water use: Winter 15 m^3/day (Q1 2023) and Summer 115 m^3/day (Q3 2023)
    - Outdoor water use allowance (summer typical only, not included in BSF): 9 m^3/day (assumed based on 3,000 m^2 irrigated area at 3 mm/day irrigation rate)
    - Winter and summer BSF water: Assumed equal to metered water consumption less outdoor usage. 15 m^3/day winter, 106 m^3/day summer total.
    - Typical winter and summer occupancy: 12% winter (back calculated from Q1 2023 meter data) and 90% summer (assumed)
    - Total number of RV pads: 288 sites plus additional 82 RV sites being added in 2025 (Phase 3).
    - Occupancy per occupied pad (based on indoor water consumption at 200 L/ca/day): 2.04 ca/site
- **Harrison Holiday Park (HHP, 973 Hot Springs Rd.):** The HHP has its own water supply system (groundwater wells). The sanitary system discharges to MH14 on McCombs Rd. HHP is set-up for seasonal RV use. It is understood that the facility is empty in the winter (except for caretaker occupancy), and open April - October.
    - BSF rate: 388 L/occupied site/ day; 2.04 ca/site at 190 L/ca/day (matching Springs RV rates)
    - Total number of RV pads: 400
    - Typical winter and summer occupancy: 32 % winter (126 sites) and 90% summer (360 sites)
    - Note winter occupancy derived from April calibration data
    - Serviced area (for calculation of sanitary GWI and RDII): 129,447 m^2 / 12.9 ha
    - Winter discharge BSF: 49 m^3/day
    - Summer BSF: 140 m^3/day

- **Harrison Hot Springs Resort (HHSR, 100 Esplanade Ave):** The HHSR has its own water supply but is connected to the sanitary sewer system. The sanitary sewer system is metered but volume measured is only the discharge from the onsite pools.[1] Key information on the HHSR:
    - Serviced area (for calculation of sanitary GWI and RDII): 60,347 m^2 / 6.03 ha
    - Total number of rooms: 342
    - Typical winter and summer occupancy: 30 % winter and 90 % summer (note this is arbitrary)
    - BSF rate: 460 L/occupied room/day; 2 BU x 230 L/BU/day (Province of BC (MFNRO), 2012)
    - Metered discharge (emptying of pools): 15.2 m^3/day (average from 2020 - 2023 meter data)
    - Winter discharge BSF estimate: 47 m^3/day (indoor), 62 m^3/day (total incl. pool) – pre-calibration
    - Summer BSF estimate: 142 m^3/day (indoor), 157 m^3/day (total incl. pool) – pre-calibration
    - Observed April 2025 average dry weather flow (ADWF) of 12.1 L/s (1,045 m^3/day) including 7.3 L/s GWI and 4.8 L/s BSF (see flow monitoring TM)Revised existing summer BSF estimate to match Apr 2025 data.

- **Harrison Hot Springs Public Mineral Pool (HHSMP, 101 Hot Springs Rd):** The HHSMP is not supplied from the Village water system but is connected to the sanitary sewer system. The HHSMP's discharge is metered.
    - Metered discharge (emptying of pools): 103 m^3/day (average from 2022 - 2023 meter data)
    - Assume other uses are not significant.
    - Winter and Summer BSF = 103 m^3/day

- **Harrison RV Country Club (398 Hot Springs Rd):** This site is also not supplied from the Village water system but is connected to the sanitary sewer system. No metering.
    - Estimated 70 RV sites (year-round occupancy assumed)
    - Assumed 2.04 ca/site and 160 L/ca/day, to arrive at 23 m^3/day
    - No future growth assumed.

4.2. WATER SERVICE METER DATA

The Village meters all ICI users and all new multi-family (MF) residential lots connected to the water system. Single-family and older multi-family residential lots are not metered. Meters are read quarterly, and the metered consumption customer data was provided by the Village. Note the exact dates of meter read were not provided (hence the length of billing periods is estimated as 365 /4 days for each period).

Meter data was matched to GIS parcel data, to determine existing metered consumption for each metered lot and assign metered consumption to a use type (ICI or MF residential).

The data provided included 30 active water meters including:

- 21 on ICI (industrial, commercial, institutional) properties
- 9 residential (multi-family) properties (incl. 3 mixed use properties with commercial uses as well)
- A total of 369 dwelling units (most of the estimated 506 MF dwelling units in the Village).

Metered consumption data was used to estimate water demands as follows:

- Base demand (BD): Q1 demand (excluding missing readings).
- Maximum day demand (MDD): Assume metered usage is same as Q3 consumption

[1] 27 Nov 2024 email from VHHS (Tyler Simmonds).

Table 4: 2023 ICI and multi-family metered consumption (L/s)

Use	Quarter				ADD	Winter BD	MDD
	Q1	Q2	Q3	Q4			
ICI	1.36	2.05	3.28	1.62	1.99	1.36	3.28
Residential (Multi-family)	0.54	0.85	1.22	0.59	0.79	0.54	1.22
Total	1.90	2.90	4.50	2.21	2.78	1.90	4.50

In 2023, metered consumption made up 23% of total water delivered by the WTP.

5. EXISTING WATER BALANCE

5.1. WATER BASE DEMANDS

Winter base and summer MDD water demands were derived from the data as follows.

Table 5: 2023 existing water demands

Use	Use Code	Demand (m^3/day)	Source / Unit Rates
Base Demand			
ICI	BD-ICI-M	117	From meter data
Residential MF Metered [1,2]	BD-RES-MF-M	46	From meter data. 280 DU, 232 ca
Residential MF Unmetered[1,2]	BD-RES-MF-UM	29	197 DUo x 0.63 ca/DU x 237 L/ca/day
Residential SF [1,2]	BD-RES-SF	363	622 DU x 2.47 ca/DU x 237 L/ca/day
Unaccounted for Water[3]	BD-UFW	147	125 L/service/day x 1176
Total Base Demand		704	
Seasonal Component (in addition to BD)			
ICI	SD-ICI-M	166	From meter data
Residential MF Metered	SD-RES-MF-M	58	From meter data
Residential MF Unmetered Addl. Indoor Use	SD-RES-MF-UM-I	7	Assume addl. 22 % occupancy
Residential MF Unmetered Outdoor Use	SD-RES-MF-UM-O	91	Same rate as SF lots
Residential SF Addl. Indoor Use[4]	SD-RES-SF-I	80	Assume addl. 22 % occupancy
Residential SF Outdoor Use[5]	SD-RES-SF-O	1390	4.78 L/m^2/day on irrigable area of 50% of lot area up to maximum of 2000 m^2/DU
Total Addl. Seasonal Demand		1791	
Maximum Day Demand		2494	

Notes:
1. 237 L/ca/day represents typical indoor water use rate observed in lower mainland with current mix of indoor water fixture (excl. unusual leakage)
2. Total population of 2032 ca for Harrison; distributed first to SF DU at 2.47 ca/DU; then remainder to MF DU. Note the low population density is expected to be primarily due to seasonal occupancy.
3. UFW estimated from water balance; i.e. total delivered water from source flow data less metered consumption and unmetered estimate.
4. Additional seasonal occupancy allowance of 22% (note 2021 census data indicates 18% of DU are not occupied normally).
5. Outdoor water use rate of 4.78 L/m^2/day is back-calculated from observed seasonal demand after accounting for an allowance for addl. occupancy.

5.2. SANITARY DRY WEATHER FLOWS

Sanitary dry weather flows were developed from the data as follows.

Table 6: Existing sanitary dry weather flows

Use	Use Code	Load (m^3/day)	Source / Unit Rates
ADWF (Winter) – April 2025			
ICI with Water Connection	BSF-ICI	92	80% of ICI water BD
ICI without Water Connection	BSF-ICI-NW	175	Incl. HHP and HHSMP (see section 4)
Residential with Water Connection	BSF-RES	351	Equal to residential water BD
Residential without Water Connection [1]	BSF-RES-NW	45	97 DU x 2.47 ca/DU x 190 L/ca/day
BSF HHSR	BSF-ICI-HHSR	410	From calibration
Groundwater Infiltration (except HHSR)	GWI	211	2,000 L/ha/day (calibrated)
GWI (HHSR)	GWI-HHSR	631	From calibration
Total ADWF (Winter)		1916	

Notes:
1. Residential base sanitary flow rates are 80% of indoor water use rates per calibration.
2. HHSR loads from calibration

Note that the base sanitary flow cannot be directly compared to the water base demand, as there are several properties serviced by the sanitary system but not the water system (these lots have a separate private water supply).

A summer forecast is not produced as the design flow condition (high rainfall and RDII) occurs in the winter season.

5.3. EXISTING POPULATION AND SUMMER (SEASONAL) COMPONENT

Harrison Hot Springs has a significant seasonal population. From the water balance a 22% increase in serviced water population (1834 ca winter to 2237 ca summer) is estimated. Compared to the water system, the sanitary sewer system services an additional 186 ca in the winter (2020 ca total). The total residential sanitary sewer service population in the summer is estimated as 2464 ca.

The above values exclude the additional flows from the SRVR and HHP and additional occupancy at hotels including the HHR.

The above values are substantiated by the increased WTP and WWTP flows that were used in the water and sewer flow balances. The 2023 dry weather flow increase at the WWTP was 36% from 1185 m^3/day in the winter to 1617 m^3/day in the summer.

The existing serviced residential populations are estimated as shown in Table 7.

Table 7: 2023 serviced residential populations

Utility System Serviced	Winter Population (ca)	Summer Population Increase	Summer Population Increase (ca)	Summer Population (ca)
Sanitary	1834	+22%	+403	2237
Water	2020		+444	2464

6. OCP FORECAST

6.1. LAND USE DESIGNATIONS

The future residential population was based on the FVRD population projects (see Section 2). The projected distribution of residential population and ICI growth was developed based on the Village's Official Community Plan (OCP).

The various OCP designations considered are provided in the table below.

Table 8: OCP designations

Abbr.	OCP Designation	Subtype	Residential Uses	Lot Area (ha)
LB	Lakeshore Beach	Park		19
LDR	Low Density Residential	Residential	Single-family, duplex	60
LR	Lakeshore Residential	Residential	Townhomes, row homes	1
MDR	Medium Density Residential	Residential	Townhomes, row homes	4
MTC	Marine Tourist Commercial	ICI		10
PU	Public Use	ICI or Park		75
R	Resources	Vacant		90
TC	Tourist Commercial	ICI		24
VC	Village Centre	Mixed Use	Apartments	6
WC	Waterfront Commercial	Mixed Use	Apartments	25
TC-HDR[1,2]	Tourist Commercial - High Density Residential	Residential	Apartments	2
TC-MDR[1,3]	Tourist Commercial - Medium Density Residential	Residential	Townhomes, row homes	4
TC-SLR[1,4]	Tourist Commercial - Small Lot Residential	Residential	Resort (small lot) residential	1
Total				325

Notes:
1. New categories created for residential properties with the Tourist Commercial (TC) OCP designation.
2. Singular property at 740 Hot Springs Rd (planned apartment development).
3. 628 McCombs Dr, 386 & 388 Pine Ave, and all properties on Schooner Pl.
4. 750 & 798 Hot Springs Rd.

6.2. RESIDENTIAL POPULATION GROWTH

The FVRD projects a Village 2050 residential population of 2,553 ca with 1,400 occupied housing units. This translates to a population increase of +521 ca (or +26%). Assuming a seasonal occupancy of 78% of units being occupied year-round (based on current occupancy), a total of 1,804 total dwelling units in the village are projected (with 404 unoccupied). This translates to +603 new dwelling units.

To distribute these dwelling units spatially amongst the Village, future densities (DU/ha or DU/lot) were set based on a combination of current densities, typical densities in other municipalities, and judgement, such that the total resulted in a net +603 new dwelling units. The actual densities will depend on the ultimate development of the lot.

Residential dwelling units were assigned as either the current number of dwelling units or calculated using the estimated future density, whichever resulted in a greater number of dwelling units for a given property. Constraints to buildable areas were created for larger lots, particularly those fronting Hot Springs Rd, where steep topography to the west limits the total developable area.

Two OCP designations are classified as mixed-use: Village Centre (VC) and Waterfront Commercial (WC). For properties with these OCP designations, future residential usage was considered only for properties that currently have residential usage (including both multi- and single-family uses).

The residential densities and resulting dwelling units for each OCP designation are shown in the table below.

Table: OCP residential dwelling unit projections

Abbr.	Lot Area (ha)	Buildable Area (ha)	Dwelling Unit Density		Dwelling Units (DU)	Dwelling Unit Growth (DU)
			DU/ha	DU/lot		
LDR	60	55	13	-	798	189
LR	1	1	25	-	35	4
MDR	4	4	25	-	110	53
VC	2*	2*	150	-	242	124
WC	2*	2*	150	-	319	79
TC-HDR	2	1	150	-	105	105
TC-MDR	4	4	25	-	107	5
TC-SLR	1	1	-	1	87	52
Total	76	69	-	-	1803	611
Dwelling Unit Decrease on ICI Properties						-9
Net Dwelling Unit Growth						602
* Mixed-use OCP designations; this table only includes those properties identified as residential.						

The future residential population (2,553 ca as per FVRD projections) was distributed using estimated population densities. The population densities were set for each land use category generally based on current densities such that the total population was approximately equal to the FVRD projection of 2,553 ca. Note the population densities used for the future projections are less than existing population density estimates. This trend of declining population density is consistent with the BC Stats projections.

Table 9: OCP residential population projections

Abbr.	Dwelling Units (DU)	Population Density (ca/DU)		Population (ca)		Population Growth (ca)	
		Winter	Summer	Winter	Summer	Winter	Summer
LDR	798	2.16	2.64	1724	2103	296	361
LR	35	1.40	1.71	48	59	25	31
MDR	110	1.40	1.71	154	187	61	74
VC	242	0.53	0.65	128	157	36	44
WC	319	0.53	0.65	169	206	7	9
TC-HDR	105	0.53	0.65	56	68	56	68
TC-MDR	107	1.40	1.71	150	183	25	31
T-SLR	87	1.40	1.71	122	149	36	43
Total	1803	-	-	2553	3112	541	660
Population Decrease on ICI Properties						-22	-27
Net Population Growth						519	633

Note the above tables indicate a dwelling unit and population decrease for some ICI properties. These properties are currently used for single-family dwellings, however their OCP designations indicate they will be used for ICI or be vacant in the future.

6.3. ICI GROWTH

ICI growth is assumed to be consistent with residential growth (i.e. an overall ICI growth of +26% is assumed).

There are some properties which are currently residential but have ICI OCP designations. These properties are as follows:

- Town Centre (TC): 694, 674, 682, 690, and 728 Hot Springs Rd. Assumed to be commercial in the future. Assigned new water and sanitary demands.
- Public Use (PU): 590 Hot Springs Rd and 520 Lillooet Ave. Assumed to be vacant or used as parks in the future, with no water or sanitary demands.
- Resources (R): 480 and 980 Hot Springs Rd. Assumed to be vacant in the future, with no water or sanitary demands.

Additionally, there are some properties that are currently vacant ICI but are assumed to be developed at OCP:

- Town Centre (TC): 720 Hot Springs Rd. Assumed to be commercial in the future. Assigned new water and sanitary demands.
- Village Commercial (VC): 316 Hot Springs Rd, 260 Esplanade Ave, and 260 Cedar Ave. Assumed to be commercial in the future. Assigned new water and sanitary demands.
- Waterfront Commercial (WC): 490 Esplanade Ave, 498 Esplanade Ave, and 511 Lillooet Ave. Assumed to be commercial in the future. Assigned new water and sanitary demands.
- Public Use (PU): 22 lots throughout the Village. Assumed to remain vacant or used as parks in the future, with no water or sanitary demands.

It is assumed that properties with Marine Tourist Commercial (MTC) OCP designation will not be developed / not produce water or sanitary demands at OCP.

6.4. WATER BASE DEMANDS

Projected winter base and summer MDD water demands are summarized in Table 10.

It is assumed that all new residential and ICI properties will be connected to both the water and sanitary systems at OCP, and that currently un-serviced residential properties will become connected. Currently un-serviced ICI properties are assumed to remain un-serviced.

Table 10: OCP water demands

Use	Use Code	Demand (m^3/day)	Source / Unit Rates
Base Demand			
ICI New [1]	OCP-BD-ICI-N	34	2.01 L/m^2/day x 1700 m^2
ICI Existing [2]	OCP-BD-ICI	127	Assume 117% existing demand
Residential [3]	OCP-BD-RES	605	2551 ca x 237 L/ca/day
Unaccounted for Water [3,4]	OCP-BD-UFW	237	125 L/service/day x 1900 services
Total Base Demand		1004	Overall growth of +300 m^3/day (43%)
Seasonal Component (in addition to BD)			
ICI New [5]	OCP-SD-ICI-N	26	1.55 L/m^2/day x 1700 m^2
ICI Existing [2]	OCP-SD-ICI	190	Assume 117% existing demand
Residential Addl. Indoor Use [6]	OCP-SD-RES-I	133	Assume addl. 22 % occupancy

Residential Outdoor Use [3]	OCP-SD-RES-O	1808	4.78 L/m^2/day on irrigable area of 50% of lot area up to maximum of 2000 m^2/DU
Total Addl. Seasonal Demand		2157	Overall growth of +366 m^3/day (20%)
Maximum Day Demand		3161	Overall growth of +657 m^3/day (26%)

Notes:
1. New ICI BD rate of 2.01 L/m^2/day selected based on existing ICI BD.
2. 117% selected to maintain an overall ICI winter BSF growth of 26%. See Table 11.
3. Unit-rate as per existing water balance. See Table 5.
4. Includes existing services plus new services, which consist of currently un-serviced residential properties and all new residential or ICI properties.
5. New ICI SD rate of 1.55 L/m^2/day selected based on existing ICI SD.
6. Additional seasonal occupancy allowance of 22% as per existing water balance.

6.5. SANITARY DRY WEATHER FLOWS

Projected OCP sanitary dry weather flows were developed as follows

- Using unit rates for base sanitary loads (190 L/PE/day, 80% of water BD) and RDII (2000 L/ha/day)
- Note that the forecast assumes that the observed high BSF and GWI loads from HHSR are significantly reduced to design criteria values (460 L/room/day BSF and 2000 L/ha/day for GWI).
- HHP, Springs RV and Harrison RV Country Club full occupancy (as opposed to winter occupancy observed from flow monitoring)

Due to the large impact of the HHSR reduction, OCP flows (for ADWF) are similar to existing (i.e. the increase in loading from other areas can be offset by reductions in HHSR flows).

Table 11: OCP sanitary dry weather flows

Use	Use Code	Demand (m^3/day)	Source / Unit Rates
ADWF (Winter)			
ICI New	OCP-BSF-ICI-N	27	80% of water BD
ICI Existing [1]	OCP-BSF-ICI	93	Assume 117% existing loads + HHSR
ICI Existing (no current water connection)	OCP-BSF-NW	360	HHP, Springs RV, HHMP, Harrison RV Country Club
Residential	OCP-BSF-RES	470	80% of water BD
Groundwater Infiltration	OCP-GWI	228	2,200 L/ha/day (calibrated)
HHSR BSF		157	
HHSR GWI		12	
Total ADWF (Winter)		1347	Overall growth of + m^3/day (%)

Notes:
1. 117% selected to maintain an overall ICI winter BSF growth of 26%
2. HHSR loads reduced from existing observed.

7. CONCLUSIONS AND RECOMMENDATIONS

The recommended water demands for the water master plan are summarized in Table 12, and the sanitary dry weather flows recommended for the sanitary master plan are summarized in Table 13.

Table 12: Water demands summary

Use	Demand (m^3/day)	
	Existing	OCP
Base Demand		
ICI	117	162
Residential	439	605
Unaccounted for Water	147	237
Total Base Demand	704	1004
Seasonal Component (in addition to BD)		
ICI	166	216
Residential	1625	1941
Total Addl. Seasonal Demand	1791	2157
Maximum Day Demand	2494	3161

Table 13: Sanitary dry weather flows summary

Use	Demand (m^3/day)	
	Existing	OCP
ADWF (Winter)		
ICI BSF (water connected)	94	120
ICI BSF (no water connection)	175	360
HHSR BSF	410	157
Residential BSF	396	470
Groundwater Infiltration	211	227
HHSR GWI	631	12
Total ADWF (Winter)	1916	1347

WATER STREET ENGINEERING LTD. *(EGBC permit to practice # 1000830)*

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA W.N. WHITESIDE 29 Sep. 2025

Jade Sangha, EIT
Project Engineer

Neal Whiteside, MASc, PEng
Senior Municipal Engineer

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ABBREVIATIONS

ADD	Average Day Demand (Water)
ADWF	Average Dry Weather Flow
BD	Base Demand (Water)
BSF	Base Sanitary Flow (Sanitary)
GWI	Ground water Infiltration (Sanitary)
HHP	Harrison Holiday Park
HHSMP	Harrison Hot Springs (Public) Mineral Pool
HHSR	Harrison Hot Springs Resort
FVRD	Fraser Valley Regional District
ICI	Industrial, Commercial, and Institutional
LWMP	Liquid Water Management Plan
MDD	Maximum Day Demand (Water)
MF	Multi-Family
RDII	Rainfall Derived Inflow and Infiltration (Sanitary)
SD	Seasonal (Outdoor) Demand
SF	Single-Family
SRVR	Springs RV Resort
UFW	Unaccounted for Water
Village	Village of Harrison Hot Springs
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant

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REVISION HISTORY

Version	Status	Date	Description of Revisions	Author
A	Draft	15 Apr 2025	For client review	JAS / NW
B	Draft	17 Jun 2025	Add OCP forecast, address comments	JAS / NW
C	Final	29 Sep 2025	Updated sanitary flows per flow monitoring	NW

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WATER STREET ENGINEERING

TECHNICAL MEMORANDUM			
Subject	Hydrant Flow Testing Results		
Project	Village of Harrison Hot Springs Water Master Plan		
To	Jace Hodgson Village of Harrison Hot Springs	**From**	Jade Sangha and Laura Christensen
Date	08 Sep 2025	**File ref**	Water Street File # 456.301
Version	0	**Status**	Final

1. INTRODUCTION

1.1. PURPOSE

The Village of Harrison Hot Springs (VHHS) has retained Water Street Engineering (Water Street) to complete a village-wide water master plan. This technical memorandum presents the results of the fire flow tests completed within the VHHS, for the purpose of calibrating the Village's water model.

1.2. BACKGROUND

The VHHS water system includes approximately 14 km of water mains. It is understood that these are primarily PVC pipe, but there are some areas of ductile iron (DI) pipe, although the locations are not fully clear. The size of water mains range from 100 mm (4") diameter to 350 mm (14") diameter. The installation year of the pipes range from 1984 to 2024, with approximately 27% of the total length installed in 1984.

2. TESTING PLAN

Hydrant testing was completed by SFE Global, with directions from Water Street and assistance from the City (for recording of information from City SCADA).

Two types of hydrant testing were completed within the Village.

1. Three system flow tests were performed, used to verify system operation.
2. Three C-factor tests were performed, used to calibrate the C-factors for the model pipes.

For each test, the pressures were monitored at static hydrant and the residual hydrant (if applicable). The flow hydrant was opened and allowed to flow for several minutes to allow pressures to stabilize. The flow from the flow hydrant was measured using a pitot tube flow meter.

For the system static tests, the pressure at the static hydrant, along with the flow rate, will be compared to modelled results to validate model operational assumptions.

For the C-factor tests, the C-factor of the pipe between the flow hydrant and static hydrant will be calculated by comparing the pressures before and after the test, along with the flow rate. For each C-factor test, two tests were completed: one with the valves closed and one without the valves closed. This resulted in a total of 6 completed C-factor tests.

Preliminary modelling was completed to identify hydrant flow test locations provided the maximum amount of information. Locations are summarized in Table 1 and fire flow test maps are shown attached showing valve closure and test hydrant locations for each test.

Other testing requirements were as follows:

- Time for work: Weekday from 09:00 to 15:00
- Flow condition: One or two 2.5" ports, with Hose Monster diffusers (2nd diffuser to be added if needed to meet desired pressure drop)
- Test duration: 5 minutes minimum or until pressures have stabilized
- Dechlorination: All chlorinated water will be neutralized upon discharge. Water to drain to existing gutter / storm drain system following dechlorination.
- Desired pressure drop: >10 psi
- Fire flow tests will be conducted as per NFPA 291. All flow rates along with static pressures and residual pressures (if applicable) will be recorded during each test.
- Reservoir levels to be recorded before, during, and after each test (from City SCADA system). The Reservoir should be in normal operation range prior to each test.

Table 1: Hydrant Testing Plan

Test No.	Location	Test Main Dia & Material	Closed Valves (Refer to Figures)	Flow Hydrant ID	Residual Hydrant ID	Static Hydrant ID
System Test						
1	Echo Dr, east of Eagle St	150 mm PVC	n/a	FH9	n/a	FH10
2	McCombs Dr, between Alder and Emerald Ave	200 mm PVC	n/a	FH52	n/a	FH65
3	Hot Springs Rd and McPherson Dr	200 - 350 mm PVC	n/a	FH59	n/a	FH63
C-Factor Test						
4	Cottonwood & Driftwood Ave, east of Eagle St	150 mm PVC	Driftwood Ave & Eagle St (1 valve)	FH17	FH16	FH19
5	Miami River Dr, north of Walnut Ave	150 mm PVC	Walnut Ave & Miami River Dr (1 valve)	FH29	FH30	FH27
6	Hot Springs Rd, between Schooner Pl and Emerald Ave	250 mm PVC	Alder Ave & Hot Springs Rd (1 valve), Hot Springs Rd adjacent to 730 McCombs Dr (1 valve), Emerald Ave & Hot Springs Rd (2 valves)	FH55	FH56	FH46
Note: Pipe materials are as indicated in previous master planning reports and/or assumed based on information provided.						

3. TESTING RESULTS

All hydrant flow testing was completed on 29 Jul 2025. The hydrant flow rate was measured using a Hose Monster 2 ½" diffuser and the observed pitot pressure reading was converted to flow using the Hose Monster table. For all tests, two hydrant ports were required, and the flow from each was combined. The pressure at the static and residual hydrants were visually observed using a dial pressure gauge and recorded via a pressure sensor with data logger. The water level within the reservoir supplying the water to the Village was also determined from SCADA data during the test period to support accurate calibration of the water model. Table 2 summarizes the measured flow rates and pressures during the fire flow testing.

Table 2: Measured Fire Flow Test Results

Location	Test No.	Test Type	Hydrant Flow (L/s)	Reservoir Level (% Full)	Flow Condition	Static Hydrant HGL (m)	Residual Hydrant HGL (m)
Echo Dr, east of Eagle St	1.0	System	90.3	95.1	No Flow	58.7	-
					Flow	49.2	-
					ΔHGL	9.5	-
McCombs Dr, between Alder and Emerald Ave	2.0	System	98.5	94.6	No Flow	58.4	-
					Flow	50.6	-
					ΔHGL	7.7	-
Hot Springs Rd and McPherson Dr	3.0	System	89.5	95.2	No Flow	59.4	-
					Flow	49.6	-
					ΔHGL	9.8	-
Cottonwood & Driftwood Ave, east of Eagle St	4.0	C-factor - Valves Open	88.9	93.8	No Flow	59.1	59.1
					Flow	47.5	44.6
					ΔHGL	11.6	14.4
	4.1	C-factor - Valves Closed	65.7	94.2	No Flow	59.4	59.4
					Flow	43.9	23.6
					ΔHGL	15.5	35.9
Miami River Dr, north of Walnut Ave	5.0	C-factor - Valves Open	91.2	94	No Flow	59.8	59.4
					Flow	53.4	49.2
					ΔHGL	6.3	10.2
	5.1	C-factor - Valves Closed	80.6	94.7	No Flow	59.8	59.4
					Flow	51.0	31.6
					ΔHGL	8.8	27.8
Hot Springs Rd, between Schooner Pl and Emerald Ave	6.0	C-factor - Valves Open	96.3	94.7	No Flow	59.1	57.7
					Flow	52.4	49.2
					ΔHGL	6.7	8.4
	6.1	C-factor - Valves Closed	86.5	95.3	No Flow	59.1	57.7
					Flow	52.4	47.1
					ΔHGL	6.7	10.5

4. CALCULATED C-FACTORS

For the three C-factor tests (Test 4, 5 and 6), Hazen-Williams C-factors were calculated for the isolated portion of main during the closed valve tests. Table 3 summarizes the calculated C-factors, which are in the range of 142-166. Note that the previous water model from the 2015 Water Master Plan used a C-factor of 130. Further model calibration with result from all the hydrant flow tests will be completed.

Table 3: Calculated C-Factors from Fire Flow Test Results

Test No.	Location	Test Main Dia & Material	Installation Year	Length of Piping	Calculated C-Factor (1)
4	Cottonwood & Driftwood Ave, east of Eagle St	150 mm PVC	1984	311 m	151
5	Miami River Dr, north of Walnut Ave	150 mm PVC	1984	277 - 334 m (2)	166
6	Hot Springs Rd, between Schooner Pl and Emerald Ave	250 mm PVC	1995	382 m	142

Notes:
1. C-factors were manually calculated (without the benefit of the model). Model calibration may vary calculated C-factors slightly to account for different pipe materials and looping pipes. C-factors are relative to the nominal diameters (i.e. 150 mm or 250 mm).
2. A portion of the Test 5 main is looped. Equal headloss (and hence identical C-factors) is assumed for each branch.

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2025-09-08

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ATTACHMENTS

Fire Flow Test Key Plan

Fire Flow Test 1: Echo Dr

Fire Flow Test 2: McComb Dr

Fire Flow Test 3: McPherson Dr

Fire Flow Test 4: Cottonwood & Driftwood Ave

Fire Flow Test 5: Miami River Dr

Fire Flow Test 6: Hot Springs Rd

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REVISION HISTORY

Version	Status	Date	Description of Revisions	Author
0	Final	08 Sep 2025	Original	JAS / LC

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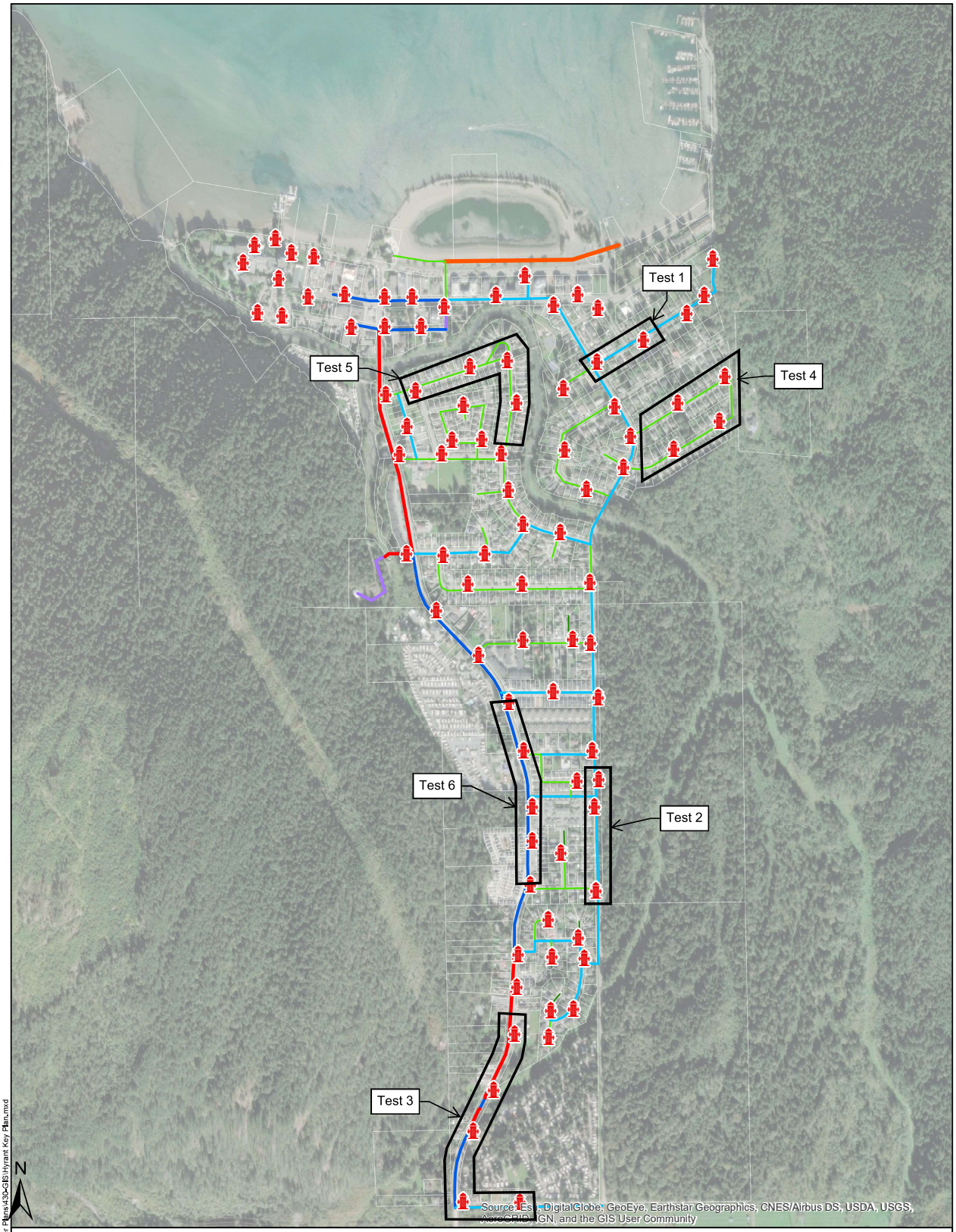


Legend

Fire Hydrants

Watermain Diameter (mm)

- 50
- 100
- 150
- 200
- 250
- 300
- 350

0 100 200 300 m

1:10,000

WATER STREET ENGINEERING

EGBC Permit to Practice #1000830

Water Master Plan

PREPARED FOR

Village of Harrison Hot Springs

PROJECT NO. 456

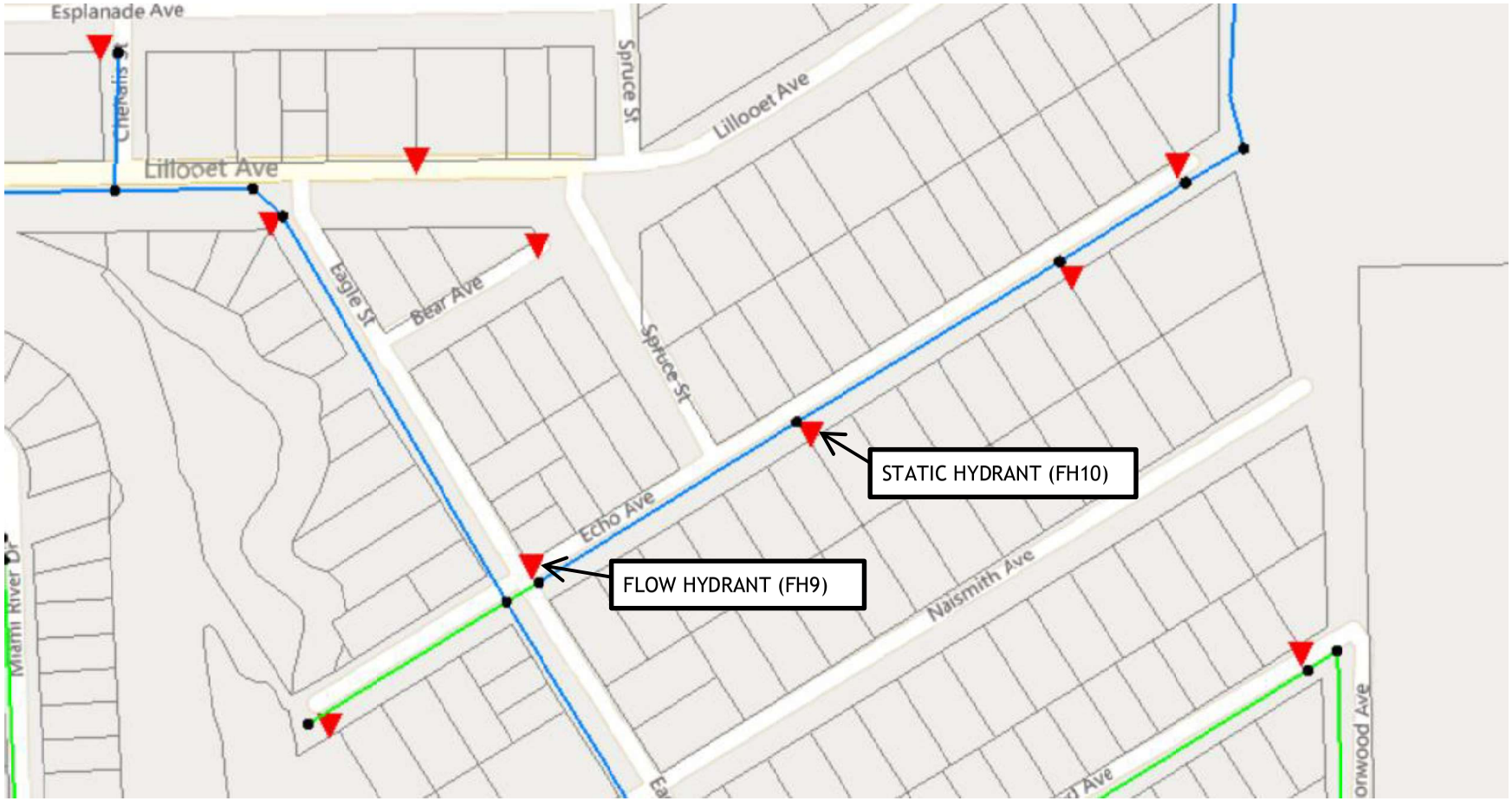
DATE 03 JUL 2025

REVISION 0

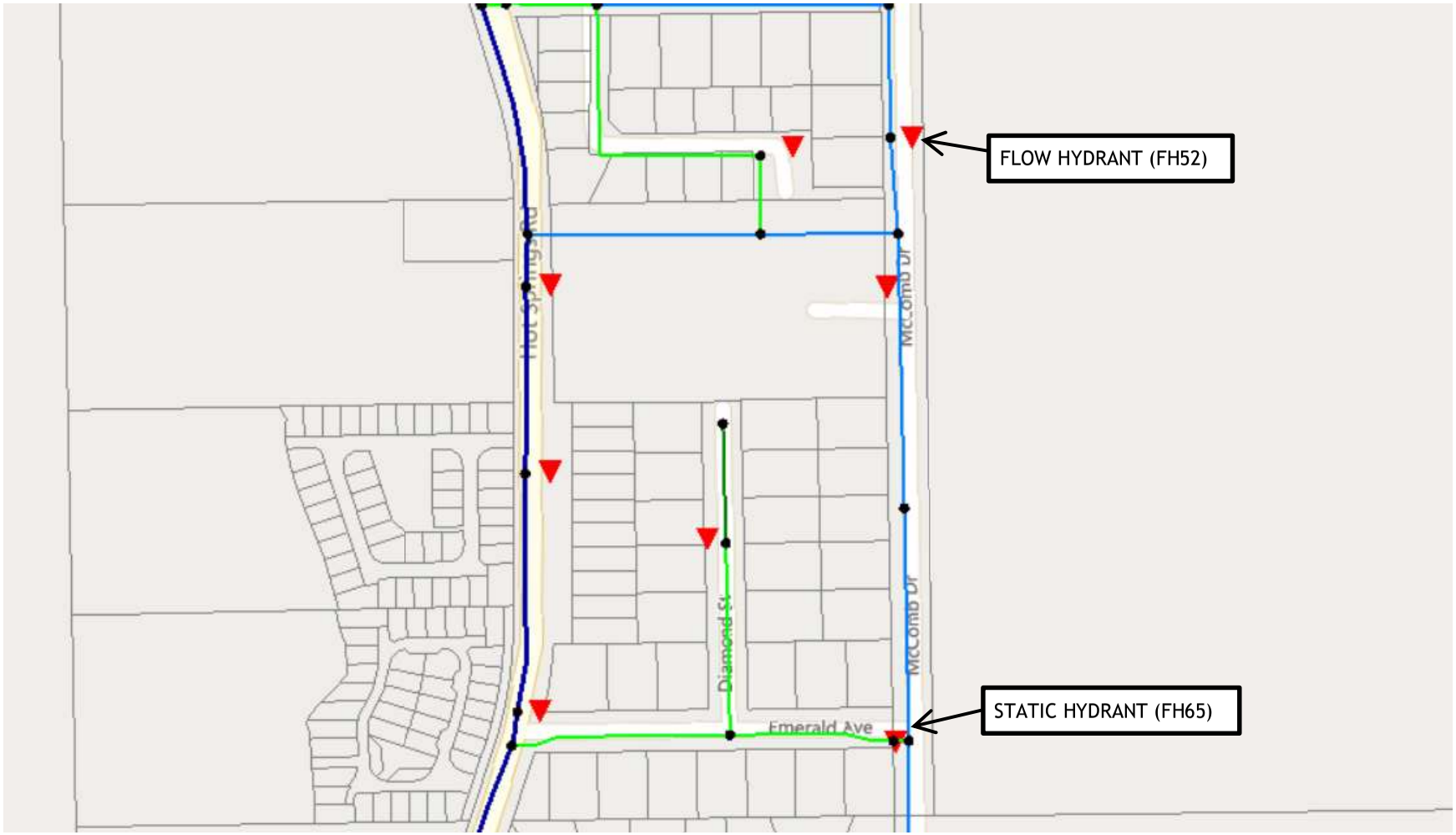
Fire Flow Test Key Plan

Document Path: D:\WSE Dropbox\001-Projects\456-Harrison Hot Springs Master Plans\430-GIS\Hyrant Key Plan.mxd

Fire Flow Test 1: Echo Dr



Fire Flow Test 2: McComb Dr



Pipe Diameter (mm)

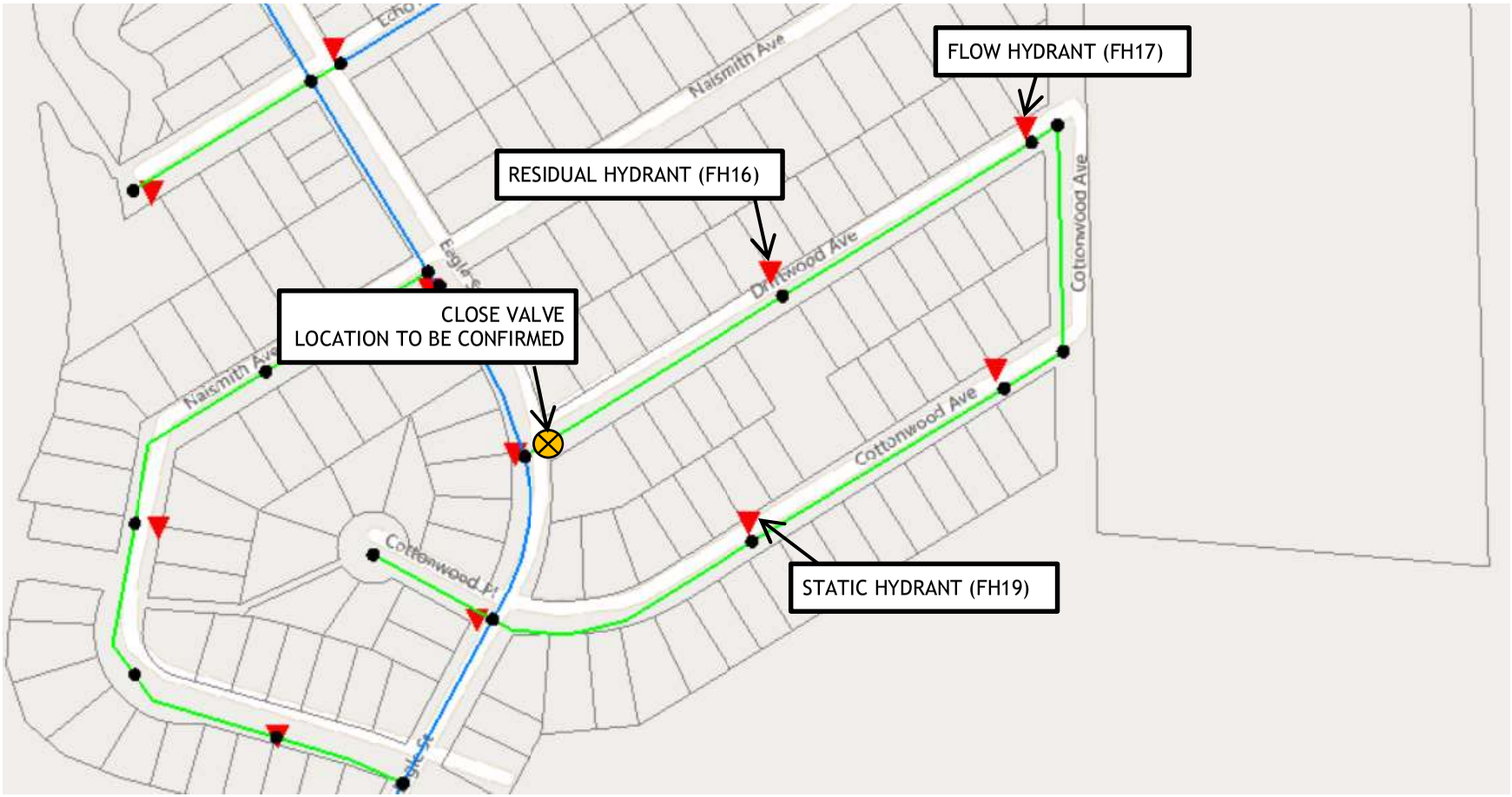
100	250
150	300
200	350

Fire Flow Test 3: McPherson Dr

Pipe Diameter (mm)

100	250
150	300
200	350

Fire Flow Test 4: Cottonwood & Driftwood Ave



Pipe Diameter (mm)

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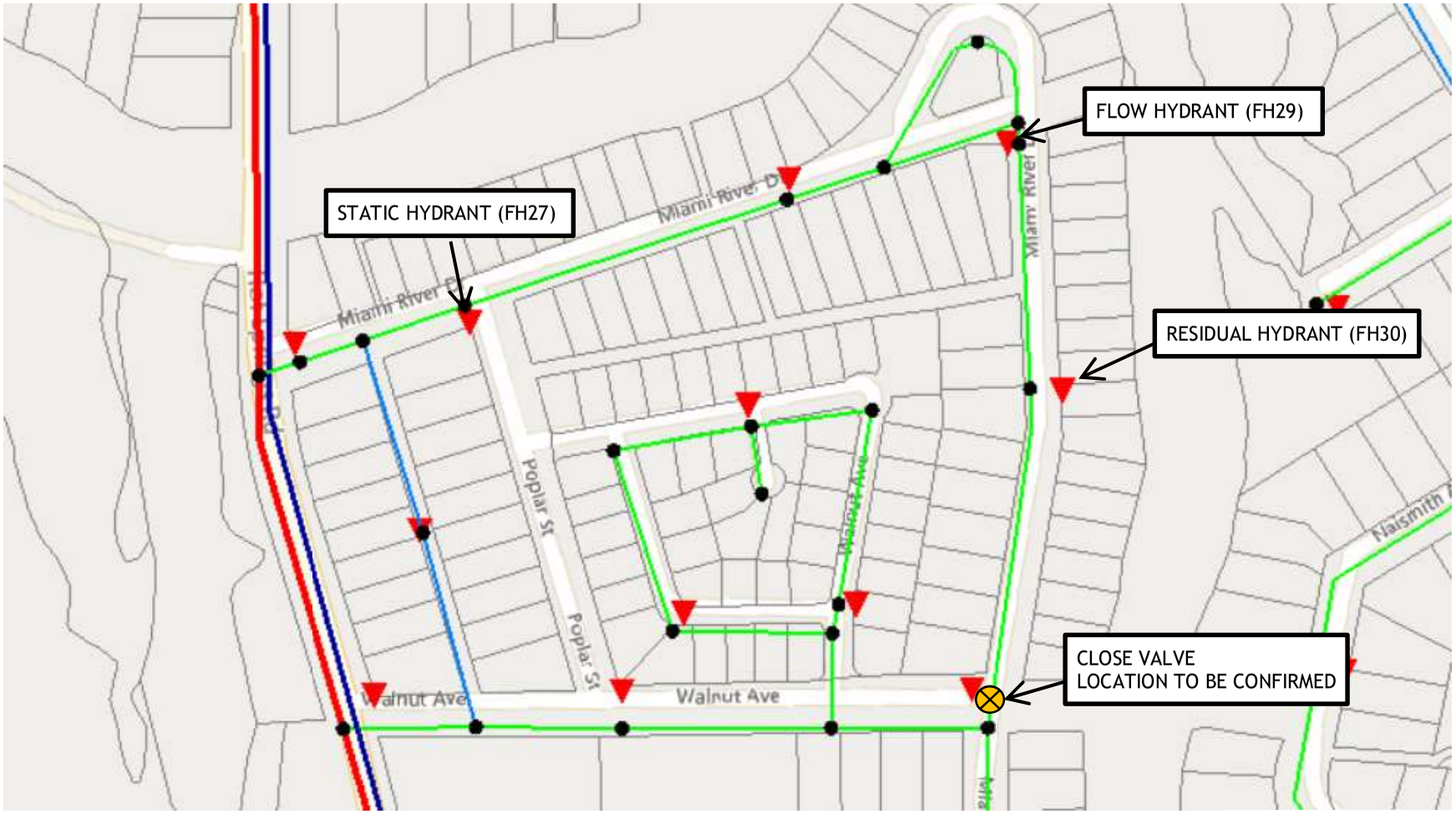
150	300
200	350

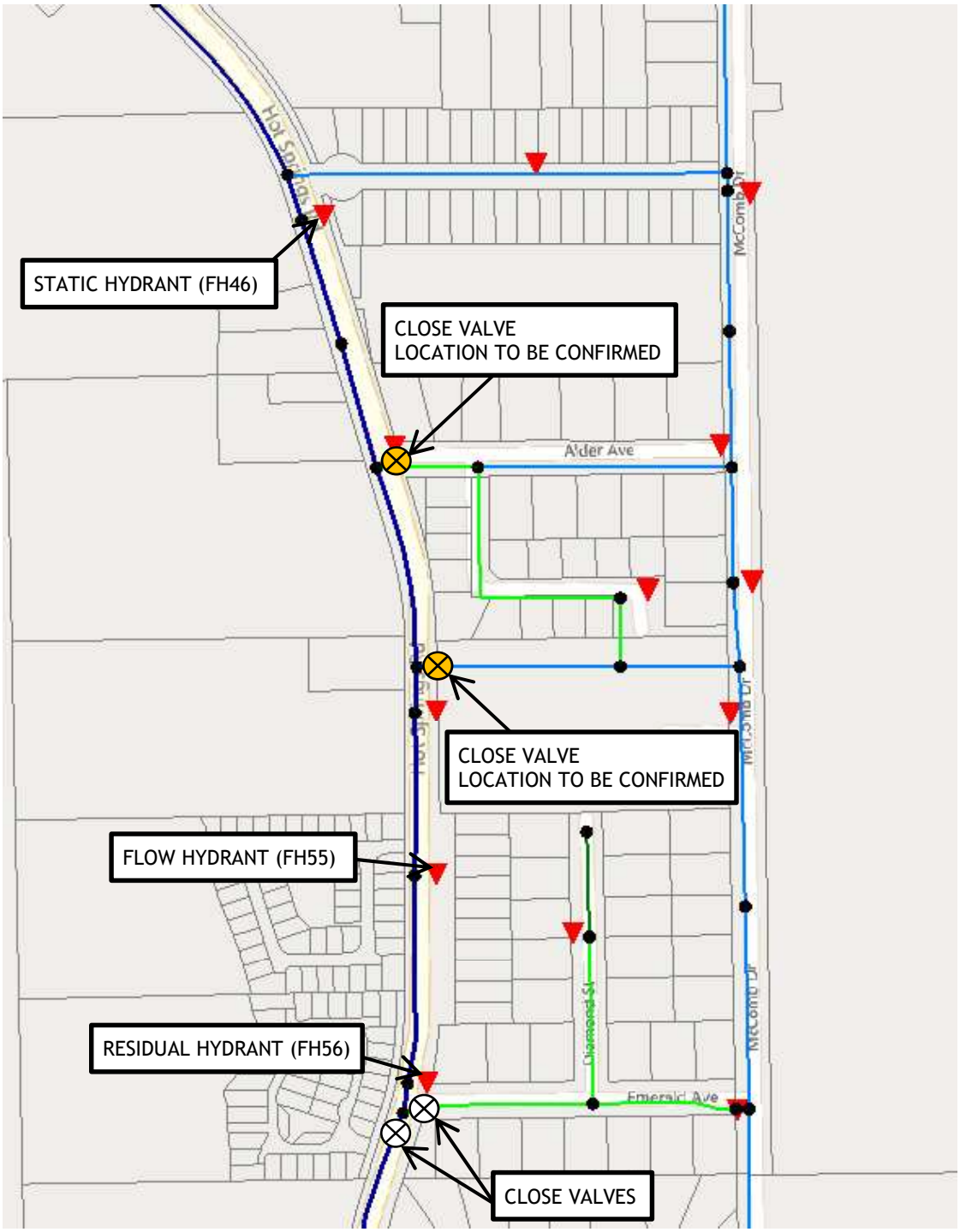
Fire Flow Test 5: Miami River Dr



Pipe Diameter (mm)

100	250
150	300
200	350

Fire Flow Test 6: Hot Springs Rd



Pipe Diameter (mm)

100	250
150	300
200	350