DISTRICT OF UCLUELET

Sanitary Master Plan

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- FINAL REPORT -

June 30, 2023

KOERS & ASSOCIATES ENGINEERING LTD.
Consulting Engineers

Parksville, BC

Serving Vancouver Island since 1987

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June 30, 2023

1863-02

District of Ucluelet
P.O. Box 999
200 Main St
Ucluelet, BC V0R 3A0

Attention: **Mr. James MacIntosh**
Director of Engineering

Re: Sanitary Master Plan, Final Report

We are pleased to provide a sealed pdf copy and two bound copies of our report entitled, District of Ucluelet Sanitary Master Plan, FINAL REPORT, dated June 30, 2023. This Master Plan is based on the 2020 OCP, Map 9 Low (ish) Growth Scenario which was adopted by Council in January 2022. This scenario anticipates:

- An average annual population growth rate of 1% per year, resulting in a permanent population of 2,600 by Year 2050
- the construction of 1,140 additional residential dwelling units
- the construction of an additional 335 tourist accommodation units

The detailed review of available lift station run-hour data and forcemain flow metering data indicates that there is significant Inflow and Infiltration in the sanitary sewer collection which is:

- having a negative impact on the District's sewage collection system (lift stations, forcemains, gravity mains)
- having a negative impact on the sewage lagoon during the fall and winter months, and during very heavy rainfall events resulted in the daily volume discharged from the lagoon exceeding the permitted maximum day discharge limit.

Methods to identify and works to reduce Infiltration & Inflow (I/I) throughout the entire collection system have been identified with associated estimated costs for each.

Capital works have been identified to address immediate-term needs as well as the longer-term needs (to Year 2050). The estimated cost of the identified works totals $24,600,00+GST and is comprised of:

- Immediate Term Works $11,890,000+GST
- Longer Term Works $12,710,000+GST

The immediate-term works includes more than $6 Million associated with the Infiltration & Inflows Identification and Reduction Program.

…/2

District of Ucluelet
Mr. James MacIntosh

The costs are in present dollars as of June 2023 when the Engineering News Record Construction Cost Index was 13,345. The cost estimates are Class D (order of magnitude) as they are based on a number of assumptions and unknowns and are derived from cost from similar projects completed for the mid-Vancouver Island area. The estimates include a 40% allowance for contingencies and engineering and may be used in developing long term capital plans and for preliminary discussion of proposed capital projects.

Significant inflation has occurred since the beginning of this year and inflationary pressures are expected to continue over the immediate term. The estimated project costs in this report will need to be reviewed and updated as part of future project budget planning processes, beginning as early as next year.

We thank you for the opportunity to work on this interesting and complex assignment and welcome the opportunity to assist the District in implementing the study recommendations.

Yours truly,

KOERS & ASSOCIATES ENGINEERING LTD.

PROFESSIONAL PROVINCE OF G. L. DOWNEY BRITISH COLUMBIA ENGINEER

PROFESSIONAL C. M. D. HOLMES BRITISH COLUMBIA ENGINEER
Jun 30, 2023

Chris Downey, P. Eng.	Chris Holmes, P.Eng.	Richard Cave, AScT
Principal	Project Engineer	Sr Design Technologist

Permit to Practise No. 1001658

DISTRICT OF UCLUELET

Sanitary Master Plan

Table of Contents

TABLES

FIGURES **after page**

DRAWINGS

APPENDICIES

1 INTRODUCTION

1.1 Authorization

The District of Ucluelet authorized Koers & Associates Engineering Ltd. to develop a Master Plan for the District's sanitary sewer system (collection, treatment and discharge).

1.2 Study Purpose

This Master Plan document is to serve as the guiding document for the District in carrying out upgrading and expansion works on its sanitary sewer collection, treatment, and discharge infrastructure to accommodate future development within the:

- District in accordance with the 2020 Official Community Plan, and
- First Nations communities that are connected to the District's sewerage system.

1.3 Scope of Work

To meet the study objectives, a work plan was established. The list of tasks to be carried is presented below.

Task 1 – Information Collection, Scope of Work Confirmation

Task 2 – Information: Detailed Review & Processing

Task 3 – Growth Projections: Population & Land Development

Task 4 – Sewage Flows, Existing & Future

Task 5 – Design Standards

Task 6 – Computer Model Development, Calibration, & Analyses

- Existing Conditions (Calibration)
- Future Conditions

Task 7 – Discharge Permit, Sewage Lagoon, & Outfall Capacity Review

Task 8 – Upgrading Works Phasing

Task 9 – Cost Estimates

Task 10 – Draft Report

Task 11 – Final Report

1.4 Background & Relevant Information

The development of this report utilized a number of reports and studies which are listed below in **Table 1**.

Table 1 – Reference Documents

No.	Document Description	Date	Author
District of Ucluelet Bylaws			
1	*Bylaw No. 1236, 2020 Official Community Plan*	*2022 Jan*	*District of Ucluelet*
2	*Bylaw No. 1160, 2013 Zoning*	*2021 April*	*District of Ucluelet*
3	*Bylaw No. 738, 1996 Development Cost Charges*	*1997 June*	*District of Ucluelet*
4	*Bylaw 521, 1989 Subdivision Services Control Schedule "B" Sanitary Sewers*	*1989 May*	*District of Ucluelet*
	District of Ucluelet Reports & Studies		
5	*Coastal Flood Mapping Final Report*	*2020 June*	*ebbwater Consulting, Cascadia Coast Research Ltd.*
6	*Ucluelet Marine Outfall Receiving Environmental Monitoring 2016*	*2017*	*Great Pacific Engineering & Environment*
7	*Sewage Lagoon Upgrading Project*	*2017*	*Koers & Associates Engineering Ltd.*
8	*Water Master Plan*	*2017*	*Koers & Associates Engineering Ltd.*
9	*Sewage Lagoon Sludge Removal Options Study*	*2009*	*Faris Consulting Group, Koers & Associates Engineering Ltd.*
10	*Sanitary Sewer Pump Stations Emergency Power Review*	*2007*	*Koers & Associates Engineering Ltd.*
11	*Municipal Infrastructure Review DL 281 & 282 and Former Forest Land Reserve*	*2007*	*Koers & Associates Engineering Ltd.*
12	*Sewage Lagoon Assessment*	*2007*	*Novatec Consultants Inc.*
13	*Sanitary Sewer System Inflow & Infiltration Study*	*2002*	*Koers & Associates Engineering Ltd.*
14	*Water Supply and Sewage Disposal Study*	*1994*	*Koers & Associates Engineering Ltd.*

No.	Document Description	Date	Author
	Proposed Development Plans		
15	*Minato Bay* *221 Minato Road (Rezoning Application)* *229 Units*	*2022 Jan 25*	*Formisis Architecture*
16	*Marine Drive & Forbes Road, Lot A, DL 283* *Weyerhaeuser, Phase 5* *33 Lot Subdivision*	*2020 Aug*	*Newcastle Engineering Ltd.*
17	*Marine Drive, Lot 13, DL 283* *Micro Residential* *33 units*	*2020 Feb*	*macdonald gray*
18	*Marine Drive, Lot 16, DL 281* *Nored Development Inc.* *Mixed Use Residential* *113 units*	*2019 Nov*	*Newcastle Engineering Ltd.*
	Yuułuʔiłʔatḥ First Nation		
19	*Official Community Plan*	*2013 Oct*	Yuułuʔiłʔatḥ First Nation

1.5 Acknowledgements

Koers & Associates Engineering Ltd. acknowledges with thanks the assistance provided by the following District staff during the course of this study:

- Mr. James MacIntosh – Director of Engineering
- Mr. Bruce Greig – Director of Community Planning

2 EXISTING SYSTEM

2.1 Construction History

Ucluelet's municipal infrastructure has developed from a typical small unincorporated village system, serving a few hundred people, to one servicing almost 2,000 permanent residents and a growing influx of seasonal vacationers/tourists/visitors.

The majority of the present municipal sewerage system was constructed in the late 1970's to early 1980's. System expansion occurred during two notable construction booms:

- In the mid 1990's with developments such as:
  i) Reef Point
  ii) Waters Edge (formerly Tauca Lea) Resort
  iii) Forbes Road Eco-Industrial Park,
  iv) subdivision of DL 281 & DL 282

- In the 2000's with developments such as:
  i) Black Rock Oceanfront Resort
  ii) Weyerhaeuser Lands with the extension of Marine Drive and the creation of the Rainforest Drive subdivision,
  iii) Circle Drive as part of the formerly proposed Wyndansea golf course development,
  iv) St. Jacques Blvd subdivision
  v) Edward Place subdivision
  vi) Pass of Melfort Place subdivision
  vii) Elina Road subdivision

The above noted development resulted in four municipal lift stations being added to the sewage collection system. They are:

• Reef Point Lift Station	along Peninsula Road	Year 2000
• Big Beach Lift Station	along Marine Drive	Year 2006
• Olson Bay Lift Station	along Peninsula Road	Year 2008
• Forbes Road Lift Station	along Marine Drive	Year 2010

Since 2008, upgrades and replacements to the existing pumping stations and the sewage treatment system have included:

• Fraser Lane Lift Station	Electrical/Control Kiosk	Year 2008
• Victoria Rd Lift Station	Electrical/Control Building	±Year 2008
• Edge/Kimoto Lift Station	Electrical/Control Building	±Year 2009
• Helen Rd Lift Station	Upgrade	Year 2010
• Sewage Lagoon	Upgrade	Year 2017
• Bay St Simplex Lift Station	Upgraded to Duplex	Year 2019
• Bay St Lift Station	Abandoned	Year 2020

A brief overview of the collection system, lift stations, treatment lagoon, and submarine outfall is presented below.

2.2 Collection System

The sewage collection system consists of gravity mains, pressurized mains, and fourteen (14) municipal lift stations and their associated forcemains. Properties have either a gravity service that discharges into a gravity main or an on-site grinder pump that discharges into; a gravity main; a pressurized main; or a lift station forcemain.

The gravity mains range in diameter from 100 mm to 300 mm and are made of Asbestos Cement (AC) or Poly Vinyl Chloride (PVC).

The processing water and fish waste from the fish plants in the District do not discharge into the municipal collection system. The waste from the fish processing plants (Whalley Fish on Peninsula Road, Canadian Seafood Processors on Harbour Crescent, and Ucluelet Seafood Processors (USP) on Cedar Road) is pumped into a standalone forcemain that was installed in 1999 to service only the fish plants. It is more than 4 kms long, with a diameter varying from 250 mm to 300 mm, and discharges directly into the District's submarine outfall pipeline just after the sewage lagoons. The

2.3 Lift Stations

The District operates fourteen (14) lift stations. All stations have two pumps. The electrical controls for three stations (Big Beach, Reef Point and Helen Road) are housed in a concrete block control building. For each of the remaining eleven (11), their controls are housed in either an electrical kiosk or a pole mounted electrical box adjacent to the station.

The smallest pumps require 2 hp motors and are installed at the Imperial Lane and the Marine Drive stations. The largest pumps require 85 hp motors and are installed at the Helen Road station. All sewage passes through the Helen Road station on its way to the sewage lagoon.

The existing sanitary sewer collection system (gravity mains, lift stations, forcemains, sewage lagoon and outfall), the individual (sub) and total catchment area for each lift station is shown on **Figure 1**. The total catchment area is the sum of all the sub catchment areas that the lift station receives flows from. A flow diagram of how the lift stations function within the overall system is shown in **Figure 2**.

The characteristics of each of the District's fourteen (14) lift stations are presented in **Table 2**.

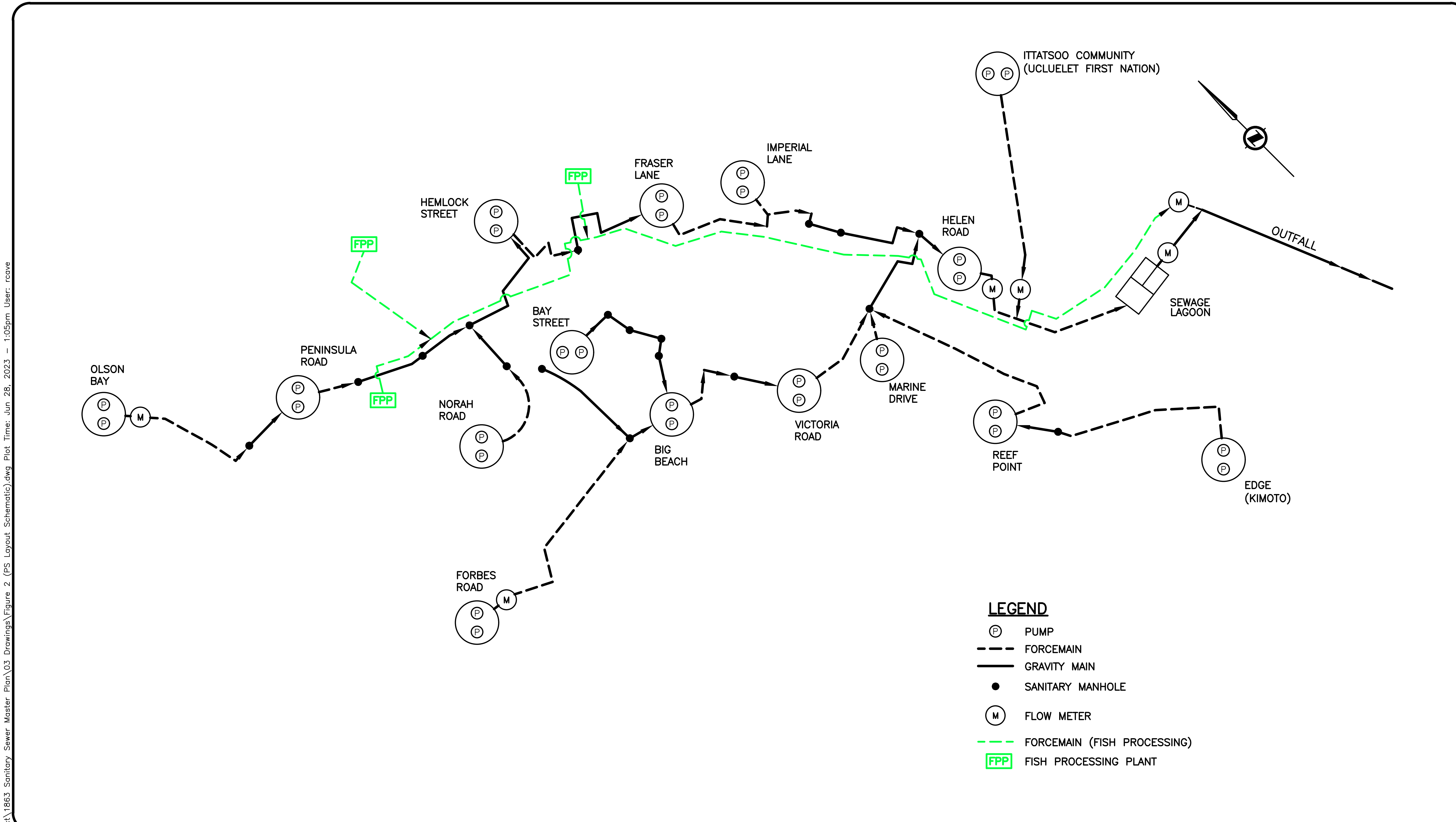
Table 2 – Lift Station Characteristics

Lift Station Name	Pump			Duty Point		Forcemain		
	Manufacturer	Model	Motor (hp)	Flow (L/s)	Head (m)	Dia. (mm)	Length (m)	Discharges to Lift Station
Olson Bay	Flygt	3171.181 HT	34	13.2	43.9	100 & 250	1,010 each	Peninsula Rd
Peninsula Rd (Minato)	Flygt	3127.180 HT	7.4	9.1	16.5	100	290	Hemlock St
Norah Rd	Flygt	3127.180 HT	5.5	7.9	17.1	100	340	Hemlock St
Hemlock St	Flygt	3127.180 MT	10	20	16.3	200	375	Fraser Lane
~~Bay St (duplex)~~	~~Flygt~~	~~3085.182 MT~~	~~20~~	~~4.5~~	~~10.8~~	~~100~~	~~535~~	~~Fraser Lane~~
Bay St (simplex)	Gorman-Rupp	T3CSC-B-4	3	6.5	7.0	100	300	Fraser Lane
Fraser Lane	Flygt	3152.181 HT	20	48	21.2	250	560	Helen Rd
Imperial Lane	Meyers	WGL20-21	2	2.5	17.6	250	220	Helen Rd
Forbes Rd	Flygt	3127.181 HT	7.5	31.3	10.4	200	1,000	Big Beach
Big Beach	Flygt	3127.181 HT	10	34.4	14.6	150	235	Victoria Rd
Victoria Rd	Paramount	4L-SVWS	10	23	18.7	150	505	Helen Rd
Marine Dr	Meyers	WGL20-21	2	2.4	19.2	150	240	Helen Rd
Edge (Kimoto)	Flygt	3127.180 HT	10	14	25.8	150	1,700	Reef Point
Reef Point	Flygt	CP 3140	15	22	27.8	150	900	Helen Rd
Helen Rd	Flygt	3301.180 MT	85	124	28.0	300	840	(to sewage lagoon)

Notes:

1 Bay St (duplex) lift station decommissioned in June 2020 with the construction of a gravity main to Big Beach lift station.

A lift station data sheet and a copy of the manufacturer's pump curve for each station are located in **Appendix A**.



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CLIENT: DISTRICT OF UCLUELET

PROJECT: SANITARY MASTER PLAN

TITLE: SEWAGE LIFT STATION SCHEMATIC EXISTING CONDITIONS

APPROVED		SCALE	Not to Scale
DATE	JUNE 2023	DWG No.	FIGURE 2
PROJECT No.	1863		

File: H:\8250 Ucluelet District\1863 Sanitary Sewer Master Plan\03 Drawings\Figure 2 (PS Layout Schematic).dwg Plot Time: Jun 28, 2023 - 1:05pm User: rcave

2.4 Hitacu Community

The Yuułuʔiłʔatḥ First Nation community of Hitacu (Itattsoo) is located on the northeast side of the Ucluelet Inlet. Sewage from the community is conveyed to the District of Ucluelet by a submarine forcemain (100 mm dia. HDPE) underneath the inlet. The forcemain comes to land adjacent to the District's Helen Road lift station. It passes through a flow meter and enters a double check valve station (owned by the Yuułuʔiłʔatḥ First Nation) before connecting to the District's Helen Road lift station forcemain which conveys the raw sewage to the sewage lagoon for treatment.

2.5 Sewage Lagoon

The sewage lagoon is a three cell aerated treatment system located on Hyphocus Island at the southern tip of the District. The lagoon system was constructed in 1984 with four cells.

Upgrading works on the lagoon was carried out over a nine month period, commencing in August 2016. An emergency bypass line was installed to facilitate the bypassing of the lagoon and discharging directly to the ocean outfall. The cells were dredged, removing the sludge that had accumulated from 30 years of service. The storage volume was increased by removing the earthen berm between cell 1 and 2 and deepening the cells.

To increase the treatment flow path through the cells (preventing flow from short-circuiting through the lagoon and creating "dead flow zones"), the inlet to cell 1 was relocated and floating curtain baffle walls were installed in the now combined cell 1/2 and in cell 3. Each cell was sealed with the installation of a HDPE geomembrane liner on the floor and walls to prevent leakage. Larger horsepower and additional floating aerators were added to cell 1/2 to increase the amount of oxygen available for the aerobic digestion treatment process.

The sewage lagoon has a total storage volume of 23,700 m^3 based on the bottom elevation of 12.0 m and an overflow pipe invert elevation of 15.35 m, geodetic. The volume of each cell is:

- Cell #1/2 = 9,800 m^3
- Cell #3 = 10,900 m^3
- Cell #4 = 3,000 m^3

It is reported the lagoon operates with a normal water level of 15.25 m with a storage volume of 22,700 m^3, providing 1,000 m^3 of additional storage up to the invert of the overflow pipe.

Each of the three cells of the sewage lagoon is designed to perform a specific biological process/function in the treatment process. The purpose of each cell is noted below in **Table 3**.

Table 3 – Sewage Lagoon Treatment Processes Descriptions

Cell No.	Treatment Process (1)	Function (1)
1/2	Complete Mixed Aerated & Partial Mixed Aerated	To convert dissolved organic material to cellular material (measured as Biochemical Oxygen Demand [BOD]) which can then be removed from the wastewater by sedimentation in subsequent cells. Upper layer to continue to convert dissolved organic material to settleable solids through the action of aerobic (oxygen consuming) microorganisms. Lower layer to allow solids to settle to the bottom of the lagoon where anaerobic (without oxygen) microorganisms digest and stabilize the organic matter.
3	Sedimentation	To provide a quiescent basin where settleable solids can continue to settle through the water column to the bottom of the lagoon.
4	Polishing	To provide additional removal of BOD and suspended solids by sedimentation.

Notes:

1 District of Ucluelet Sewage Lagoon Sludge Removal Options Study, August 2009, Faris Consulting Group and Koers & Associates Engineering Ltd.

In 2018/19, the electrical control building was replaced with a larger building and the flow meter on the outfall was replaced.

2.6 Submarine Outfall

When first constructed (1984), treated effluent from the lagoon was discharged into Ucluelet Inlet by a marine outfall approximately 200 m in length. In the summer of 1998, a new outfall was installed which consisted of 1.5 kms of 450 mm dia. HDPE pipe. The new outfall terminates approximately 500 m southeast of Francis Island in Alpha Passage at a reported depth of approximately 20.5 m (below chart datum). The original outfall remains as an emergency overflow from the lagoon.

2.6.1 Licenced Users & Capacity

The submarine outfall is used to discharge treated effluent from the sewage lagoon as well as processing waste from the seafood processing plants. The seafood processing waste from the plants is pumped into a dedicated forcemain that bypasses the District's sewage lagoon and connects to the submarine outfall after the lagoon.

Flows discharged from the sewage lagoon and from seafood processing plant forcemain are recorded daily by separate flow meters prior to being discharged into the submarine outfall. The dedicated seafood processing forcemain, the sewage lagoon, and the two flow meters are schematically shown on **Figure 2**.

When the new outfall was installed in 1998, a joint agreement between the District of Ucluelet and three seafood processing plants regarding ownership and outfall capacity was developed. In addition, the provincial government issued discharge permits to each. In 2005 one of the plants ceased operation and cancelled its permit it 2010. The licenced discharge volumes for the District of Ucluelet and the two remaining seafood processors are summarized in **Table 4**.

Table 4 – Marine Outfall Licenced Users & Quantity

Permit No.	Holder	Licenced Discharge	
		Average Day m^3/day	Maximum Day m^3/day
PE-14515	District of Ucluelet	1,885	4,750
PE-14661	Ucluelet Harbour Seafoods	-	2,560
PE-16022	Pacific Seafood Barkley Plant	-	450
	Combined Total:	**-**	**7,760**

The capacity of the outfall is approximately 182 L/s, which equates to a maximum daily volume of 16,000 m^3/day.

2.7 Discharge Permit

The operation of the District's sewage lagoon and the marine outfall is governed by the waste management permit No. P14515, issued by the BC Ministry of Environment. The permit authorizes the following discharges volumes:

- Average Day: 1,855 m^3/day
- Maximum Day: 4,750 m^3/day

and that the characteristics of the effluent discharged to the environment shall not exceed:

- 5-day Biochemical Oxygen Demand (BOD_5): 45 mg/L
- Total Suspended Solids (TSS): 60 mg/L

2.8 Septic Tank Discharge

Prior to the upgrading of the sewage lagoon, septage (from septic tanks) from properties in the outlining areas that are not connected to the District's sanitary sewer collection system was transported by truck and discharged, unscreened into cell 1. This resulted in rags and stringy material becoming caught-up in and plugging the aerator impeller resulting in a loss of aeration. This resulted in a reduction in the treatment performance of the sewage lagoon (until the aerator was unplugged).

After the upgrading of the sewage lagoon, the discharge of septage was relocated to the Forbes Road lift station. This has resulted in:

- Increased pump runhours at this station and at the Helen Road lift station.
- Increase O&M and pump wear and tear at this station and at the Helen Road lift station.
- Odour issues associated with the discharge of septage.

3 AVAILABLE DATA

3.1 Flow Meter Data

District staff provided daily volume readings for four flow meters in the sanitary sewer system:

- Two record the flows pumped into the sewage lagoon,
- One records the flow leaving the sewage lagoon, and
- One records the flow from the fish processing plants.

3.2 Lift Station Run-hours

Each pump at each lift station is equipped with a meter that records the number of hours that the pump has run.

3.3 Rainfall

Daily (24 hour total) rainfall data was obtained from Environment Canada's Ucluelet Kennedy Camp weather station (Climate ID No: 1038332).

3.4 Population

Historic
Historic population data was obtained from two sources:

- Census Canada, and
- BC Stats.

Projected Future
Population projection data was obtained from the BC Stats website which provides annual growth projections by various regional areas in BC, including by Regional Districts, for next 20 to 30 years. The most current population projection data is to Year 2041.

4 SEWAGE FLOWS

4.1 Flow Meter Data

There are six flow meters in the sanitary sewer system. The location of the meters is shown in **Figure 1** and a description of each is presented in **Table 5**.

Table 5 – Sewage Flow Meters, Location & Period of Record

Name	Location	Period of Record Available
Olson Bay Forcemain	Olson Bay Lift Station	Lift Station not active (1)
Forbes Rd Forcemain	Forbes Rd Lift Station	None (2)
Helen Rd Forcemain	Helen Rd Lift Station	Daily, until January 2016. Replaced Aug 15, 2019 (3)
Hitacu Community	Adjacent to Helen Rd Lift Station	Daily, since 2011 (4)
Sewage Lagoon	Lagoon Outlet	Daily, since Aug 15, 2019 (5)
Fish Processing Plant Forcemain	At Sewage Lagoon	Daily, since Aug 15, 2019 (6)

Notes:

1. The Olson Bay lift station and forcemain were constructed in Year 2008 as part of the then proposed WyndandSea golf course development. To date, the lift station has not been used as there is no developed properties.
2. The Forbes Road lift station and forcemain were constructed in Year 2010 and services the properties that have been developed in the catchment. Pump run-hour data for this station was provided by the District for this study.
3. Sewage flows from the Helen Road lift station were recorded by the flow meter located on the forcemain (see **Figure 1**) until the flow meter malfunctioned in January 2016; after which volumes were estimated based on daily pump run-hours and the estimated pumping rate. In the summer of 2019, a new flow meter was installed.
4. In 2011, a submarine forcemain was installed across the Ucluelet Inlet. The forcemain conveys sewage from Hitacu, on the east side of the inlet, to the west side of the inlet and connects to the forcemain that conveys sewage from the Helen Road lift station to the sewage lagoon. Prior to sewage from Hitacu entering the Helen Road lift station forcemain, it passes through a flow meter and a dual check valve located adjacent to the Helen Road lift station.
5. In the summer of 2019, a flow meter was installed to record the daily volume of the treated sewage leaving the lagoon.
6. In the summer of 2019, a flow meter was installed on the fish processing plants forcemain to record the daily volume entering the submarine outfall.

A review of the recorded and calculated flows from the Helen Road lift station and the Hitacu community is presented below .

4.1.1 Years 2014 – 2018

Annual Volumes

A review of total annual metred sewage volumes entering the sewage lagoon showed that the volume generated from Hitacu were significantly lower than the volume generated by the District of Ucluelet (generally, the Hitacu volume equated to 5% to 10% of District of Ucluelet volume) as shown in **Table 6**.

Table 6 – Annual Sewage Volumes, 2014 - 2018

Year	Annual Rainfall (1) mm	Volume (2,3) Flow Meter m^3	Volume (2,3) Pump Run-hour m^3	Average Day m^3	Population Estimate (4,5) #	Ave Day per Capita lpcd (6)
District of Ucluelet (Helen Rd Lift Station)						
2014	3,128	467,000	-	1,280	1,653	775
2015	3,180	454,400	-	1,245	1,706	730
2016	4,096	-	485,300	1,325	1,812	730
2017	3,035	-	394,300	1,080	1,897	570
2018	3,354	-	517,800	1,420	1,834	775
Hitacu						
2014	3,127	26,200	-	72	260	275
2015	3,180	34,300	-	94	267	350
2016	4,096	41,900	-	114	274	415
2017	3,035	34,800	-	95	281	340
2018	3,354	37,500	-	103	288	360

Notes:

1 Environment Canada Ucluelet Kennedy Camp weather station (Climate ID No. 1038332).

2 District of Ucluelet volumes are rounded to the nearest 100 m^3.

The District of Ucluelet metered volumes (Year 2014 & Year 2015) are from the flow meter installed on the forcemain from the Helen Road lift station (see **Figure 1**).

For Years 2016 - 2018, Helen Road lift station flow meter data was not available. The District of Ucluelet volumes for these years are based on the pump run-hour meters at the Helen Road lift station multiplied by the estimated average pumping rate of 212 m^3/hr (59 L/s).

The District of Ucluelet volumes are those that go into the sewage lagoon. They do not include the volumes in the fish processing plant's forcemain that bypass the lagoon.

3 Hitacu metered volumes (rounded) are from the readings of the flow meter installed on the Hitacu forcemain just before it connects to the Helen Road lift station forcemain (as shown on **Figure 1** and schematically shown on **Figure 2**).

4 District of Ucluelet population estimate from BCStats Municipal and Regional District Annual Population Estimates, Year 2011 to Year 2022, published January 2023.

5 Hitacu Year 2016 population estimate from Canada Census 2016. Population estimates before and after Year 2016 are based on the historical average annual growth rate of 6.8 capita per year for the 10 year period from Census 2006 to Census 2016.

6 Average Day per Capita rounded to nearest 5 lpcd.

5 INFILTRATION & INFLOW

5.1 Infiltration & Inflow Definition

Certain amounts of storm water infiltration and inflow (I&I) are unavoidable, but excessive amounts can cause hydraulic overloading, where parts of the sewer system (gravity mains, lift stations, forcemains) can reach their capacity prematurely, requiring large expenditures for capacity upgrading. Excessive storm water entering the sewer system also increases the loadings on the sewage treatment facility, using up unnecessary capacity and increasing operation and maintenance costs. The difference(s) between infiltration and inflow can be explained by the means that rainfall/groundwater enters the sewage collection system:

Infiltration: Groundwater that infiltrates into the sanitary sewer system.

Infiltration is mostly associated with the rainy season when groundwater tables rise. It can occur along the sewer main or service connection piping that suffer from cracks, deflection, offset joints, and plant root intrusion because of deterioration of pipe material, pipe settlement, and damage from subsequent construction. Manholes are constructed of stacked concrete rings and infiltration can occur when joints separate due to uneven settlement, or from intrusion of roots between the joints, or deterioration of the gasket material between the rings.

Inflow: Storm water that flows directly into the sanitary sewer system.

Inflow can occur from the intentional or unintentional connection of drains (from building gutters, building perimeter drains, building basement floor drains, private and public property catchbasins) to the sanitary sewer system. These connections can be the result of a mistake when the sanitary sewer system is confused with the storm drain system, or illegally, without the District's knowledge or consent. Storm water can also enter sanitary sewer manhole lids that are in low lying locations or gutter areas of the roadway subject to flooding, and through lifting holes in the manhole lids.

During the summer months, I&I decreases as rainfall events become less frequent and the groundwater table drops. With winter rains, I&I increases as rainfall events become more frequent and the groundwater table rises.

5.2 Lift Station Run-hour Analyses

The District's sewage lift stations are equipped with a run-hour meter for each pump. Public Works staff record the run-hours each weekday (Monday through Friday) except for the Helen Road lift station where run-hours are automatically recorded each day by the District's SCADA system.

The District provided the daily readings for Year 2018. The data was reviewed for fourteen (14) of the District's lift stations to assess dry weather vs wet weather runtimes and to compare runtimes between pumps at each station. The Olson Bay lift station was not reviewed as there was no data (no buildings have been constructed within its service/catchment area). The findings of the data review are presented below.

5.2.1 Year 2018

Daily and monthly average pump run-hours for each of the 14 lift stations were reviewed against daily and monthly average rainfall data. The analysis revealed that:

- Pump run-hours at each lift station did increase with rainfall.
- Some increases did not correspond with rainfall and were uncharacteristic to the run-hours for the days leading up to and after the event. It is suspected that there may have been an issue that caused the pump to keep running such as: float switch malfunction, pump intake partially plugged.
- Seven (one half) of the lift stations (Peninsula, Norah, Hemlock, Bay, Fraser, Imperial, and Reef) had periods lasting a month or more (typically several months) where one of the two pumps did not operate/malfunctioned. This included the Bay Street lift station where there was only one operational pump for the entire year.

Daily run-hour readings for each of the 14 lift stations vs rainfall for Year 2018 are presented in **Figure 3** to **Figure 16**.

An overview of the impact of rainfall on increased run-hours for each lift station by comparing average daily run-hours for the months of January vs May in Year 2018 is presented in **Table 7**.

Table 7 – Summary of Lift Station Run-hours in Response to Rainfall

Lift Station	2018 Daily Ave, hrs/day			Comment
	Jan	May (1)	Ratio	
Estimated (Inferred) Very High I/I				
Reef Pt	3.4	0.7	4.9	Noticeable increases and high increases with larger rainfall events. Receives flow from Edge/Kimoto.
Edge/Kimoto	1.3	0.3	4.3	Large increase Receives flow from Elina Rd Lift Station (private strata).
Norah Rd	5.9	1.5	3.9	Very large/excessive increases
Bay (simplex)	1.2 (3)	0.4	3	Large increases (2) Very small catchment area
Peninsula Rd	2.6	0.9	2.9	Large increases in response to large rainfall events
Bay St (2)	17.5	7.1	2.5	Large increases Very high/excessive run-hours during rainfall events
Estimated (Inferred) High I/I				
Helen Rd	7.8	3.2	2.4	Large and high increases to larger rainfall events Receives flow from all other lift stations
Fraser Lane	6.9	3	2.3	Large increases Receives flows from Hemlock & Bay St (2) Lift Stations
Imperial Lane	2.9	1.3	2.2	Very noticeable and large increases in response to larger rainfall events
Hemlock St	7.7	3.8	2	Large increases Receives flows from Norah & Peninsula Lift Stations
Forbes Rd	0.2	0.1	2	Large Increases in response to rainfall are evident Very low run-hours in response to undeveloped lots in the catchment area and high pumping flow rate

Estimated (Inferred) Moderate I/I				
Marine Dr	1.3	0.8	1.6	Large increases in response to larger rainfall events Small catchment area
Big Beach	1.2	0.9	1.3	Increases in response with larger rainfall are evident Receives flow from Forbes Rd Lift Station
Victoria Rd	4.5	3.8	1.2	Noticeable increases Receives flow from Big Beach Lift Station

Notes:

1 The month of May was selected as it was a relatively dry month with minimal rainfall. Typically, a summer month would be drier and would experience less I/I but several of the catchment areas experience an increase in flows in the summer months because of an increase in tourism.

2 Bay St lift station was decommissioned in June 2020 with the construction of a gravity main to direct flows to the Big Beach lift station.

3 It is noted that Prior to spring of Year 2019, the forcemain from the Bay St (simplex) lift station discharged into a gravity main that drained to the Bay St lift station. The gravity main that the forcemain discharged into had minimal slope (0.5%) and was connected to the Bay St (simplex) lift station. As result, when flows were high in the gravity main and the Bay St (simplex) pump was running, the depth of flow in the gravity flow would increase and if/when it reached a certain level (depth) the sewage would begin to flow back into the Bay St (simplex) lift station. This "double pumping" of sewage would result in an increase in pump run-hours at the Bay (simplex) lift station. In 2019, the simplex station was upgraded to a duplex station and the forcemain connected directly to the forcemain servicing the Bay Street lift station.

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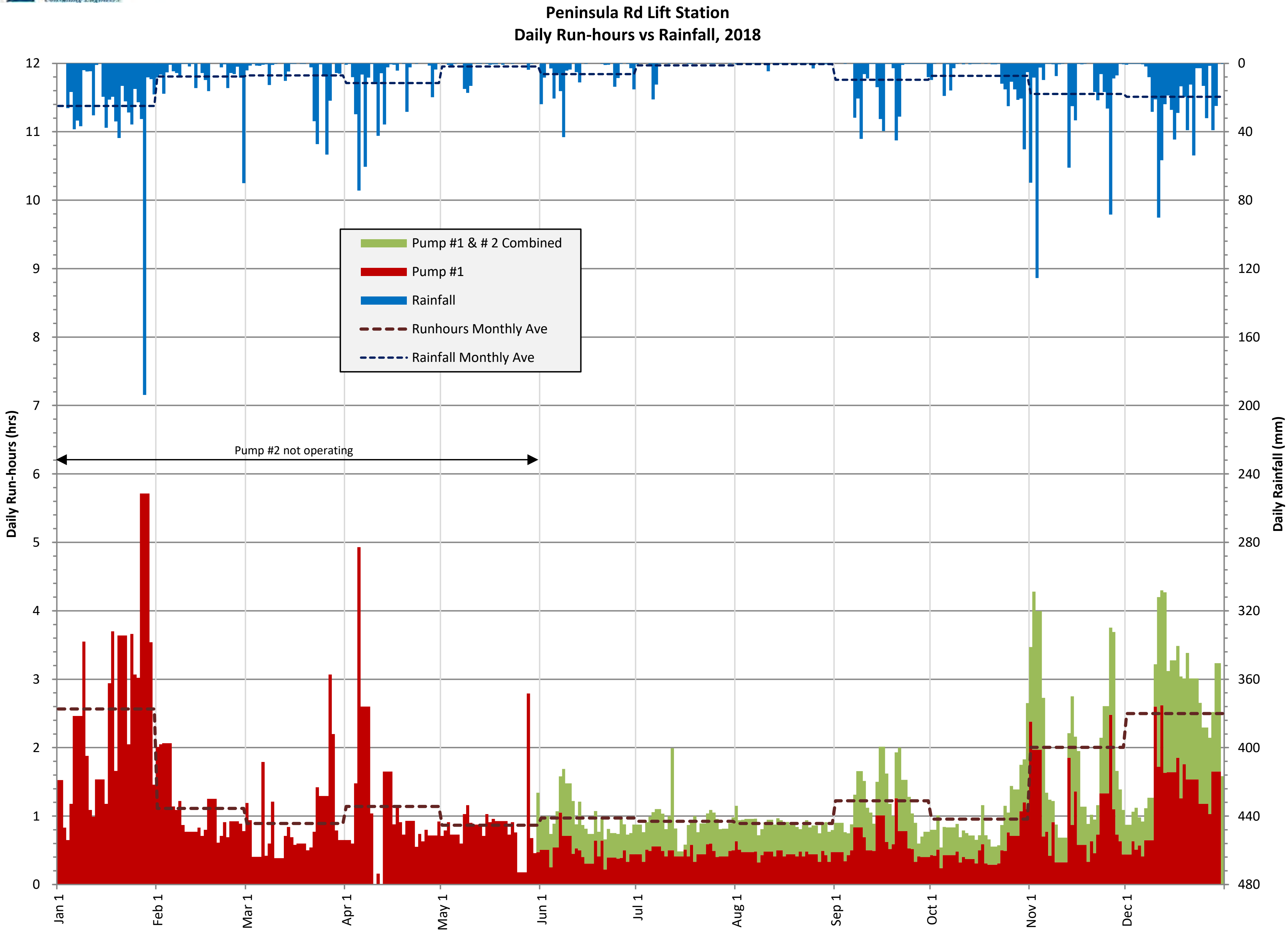

FIGURE 3

KOERS & ASSOCIATES ENGINEERING LTD. Consulting Engineers

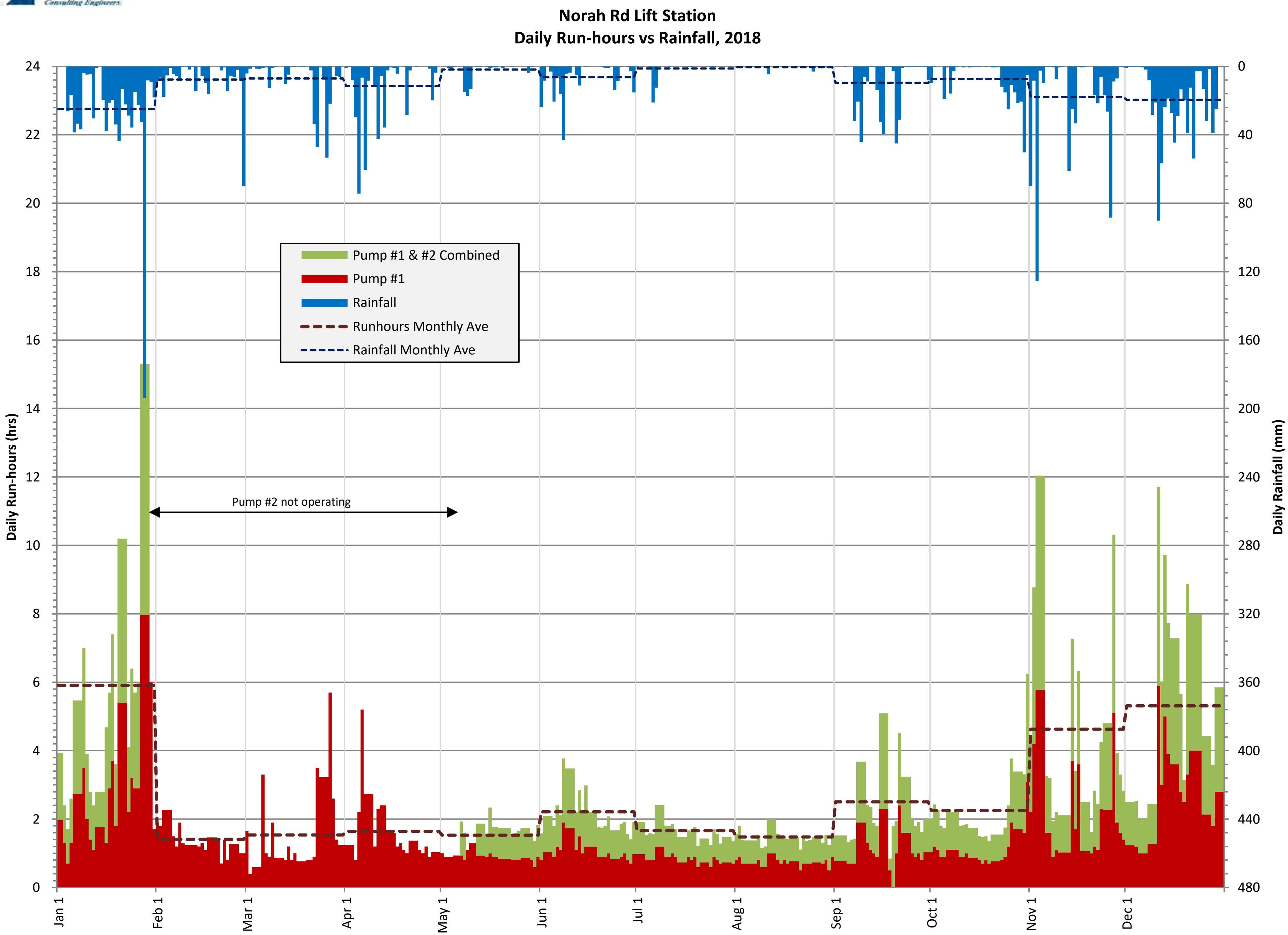

FIGURE 4

KOERS & ASSOCIATES ENGINEERING LTD.
Consulting Engineers

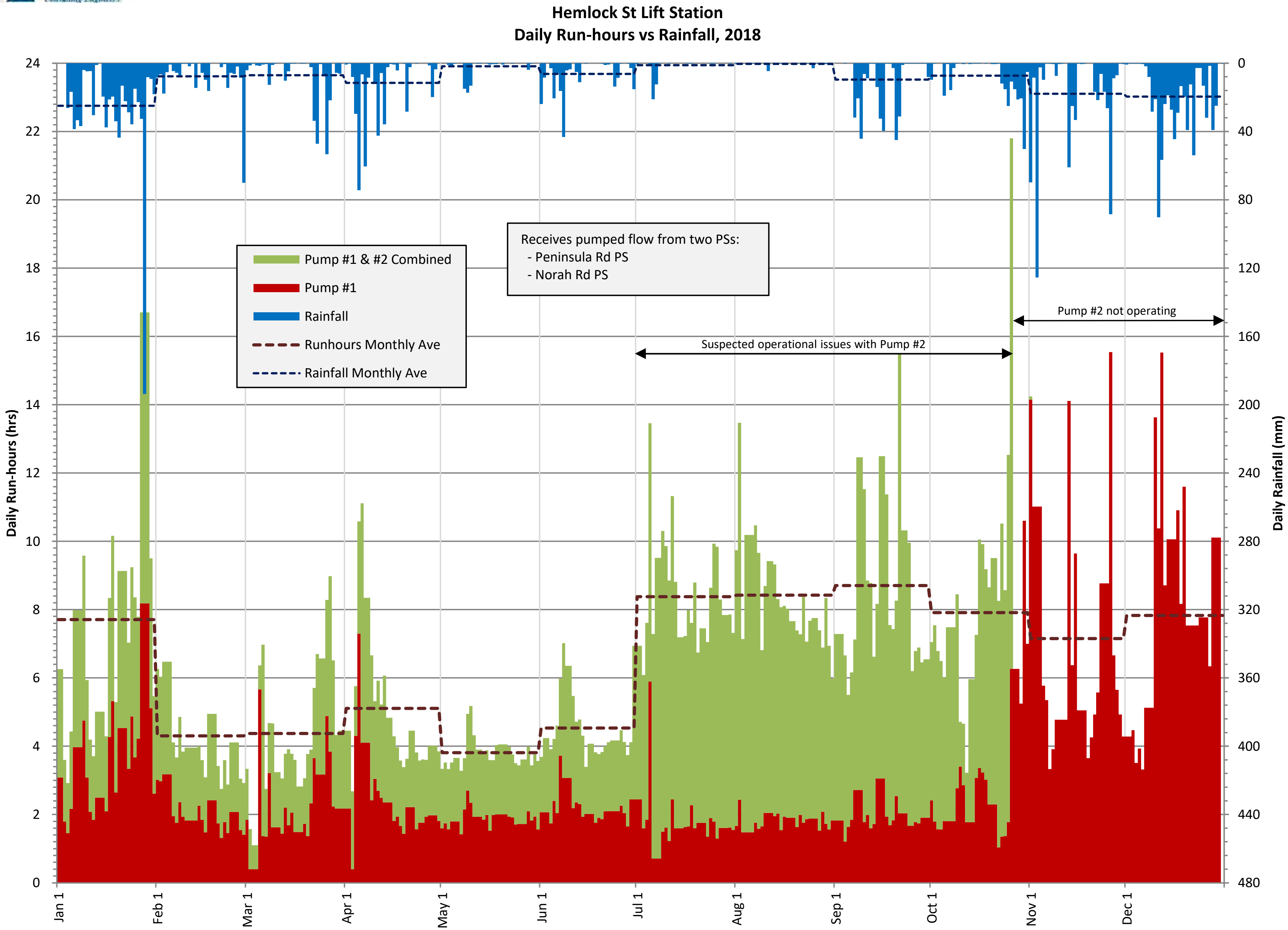

FIGURE 5

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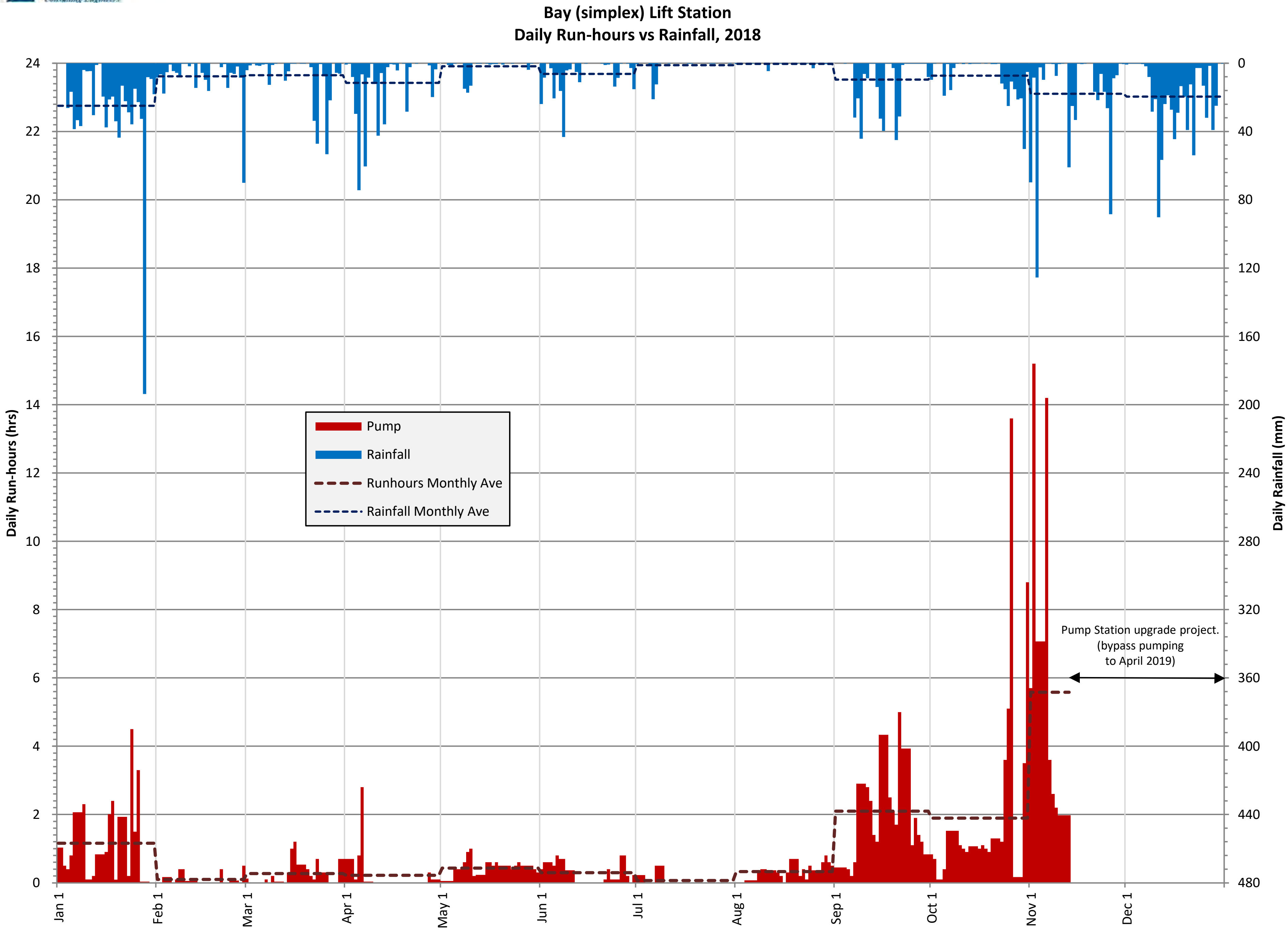

FIGURE 6

KOERS & ASSOCIATES ENGINEERING LTD. Consulting Engineers

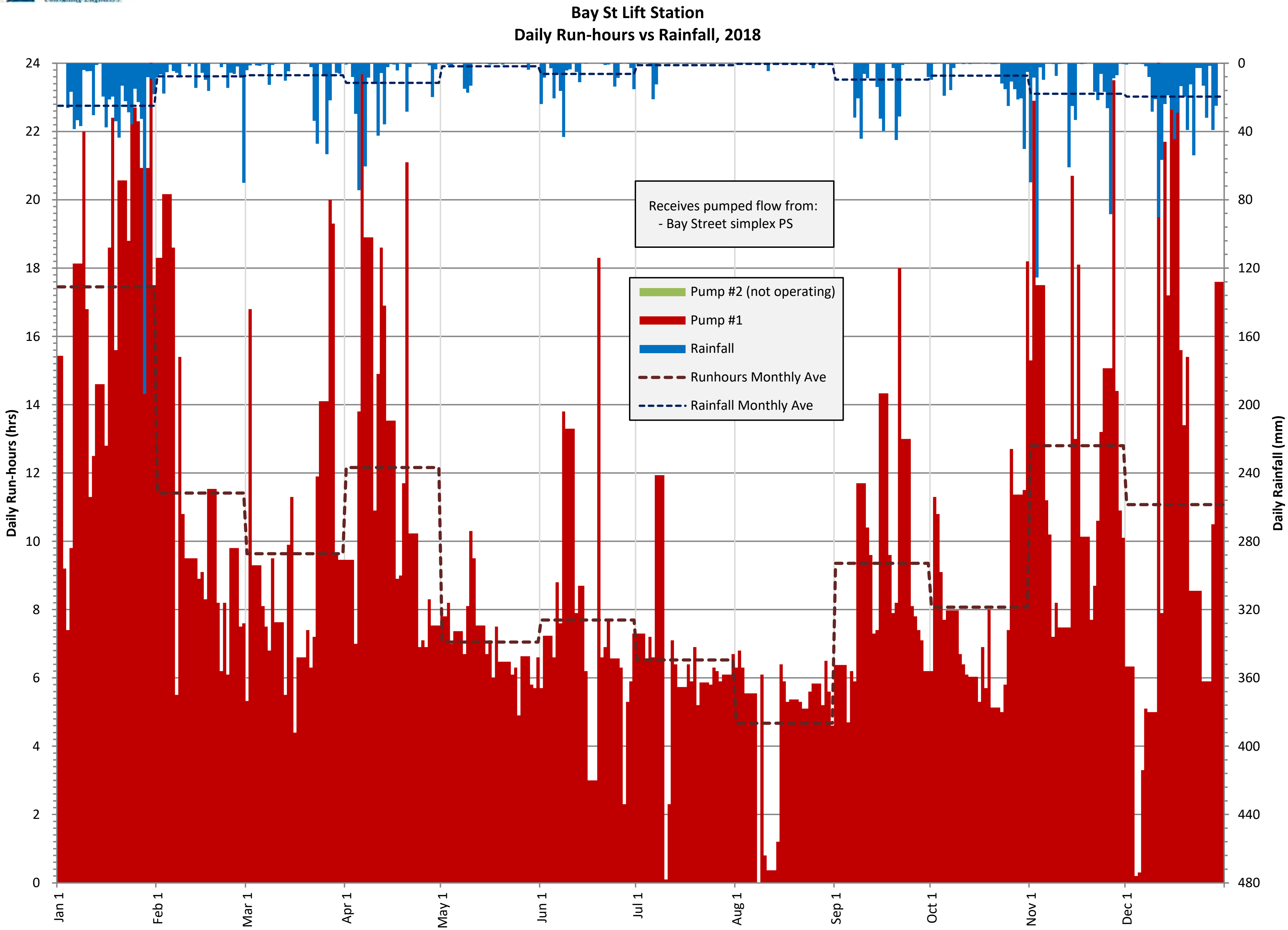

FIGURE 7

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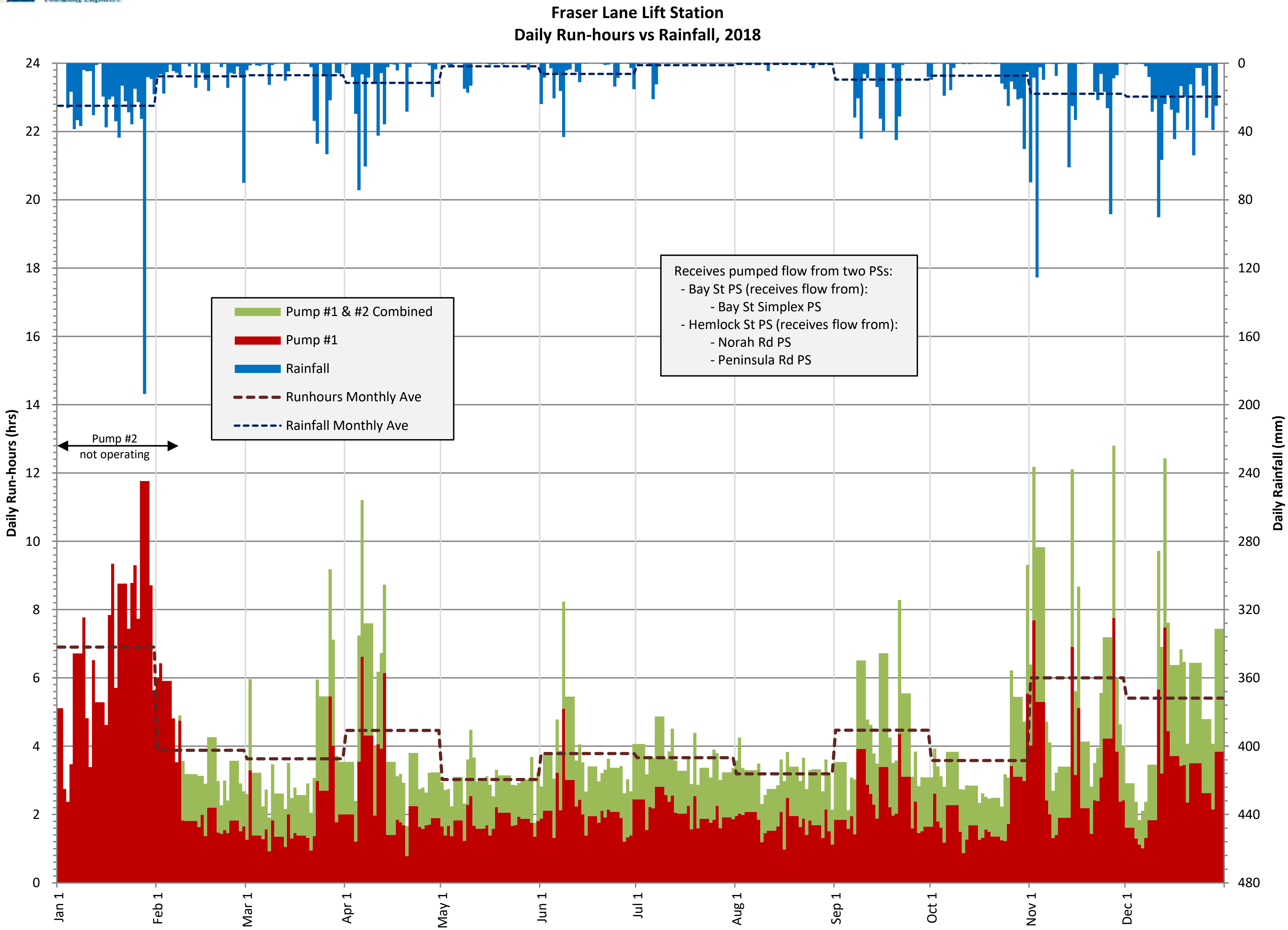

FIGURE 8

KOERS & ASSOCIATES ENGINEERING LTD.
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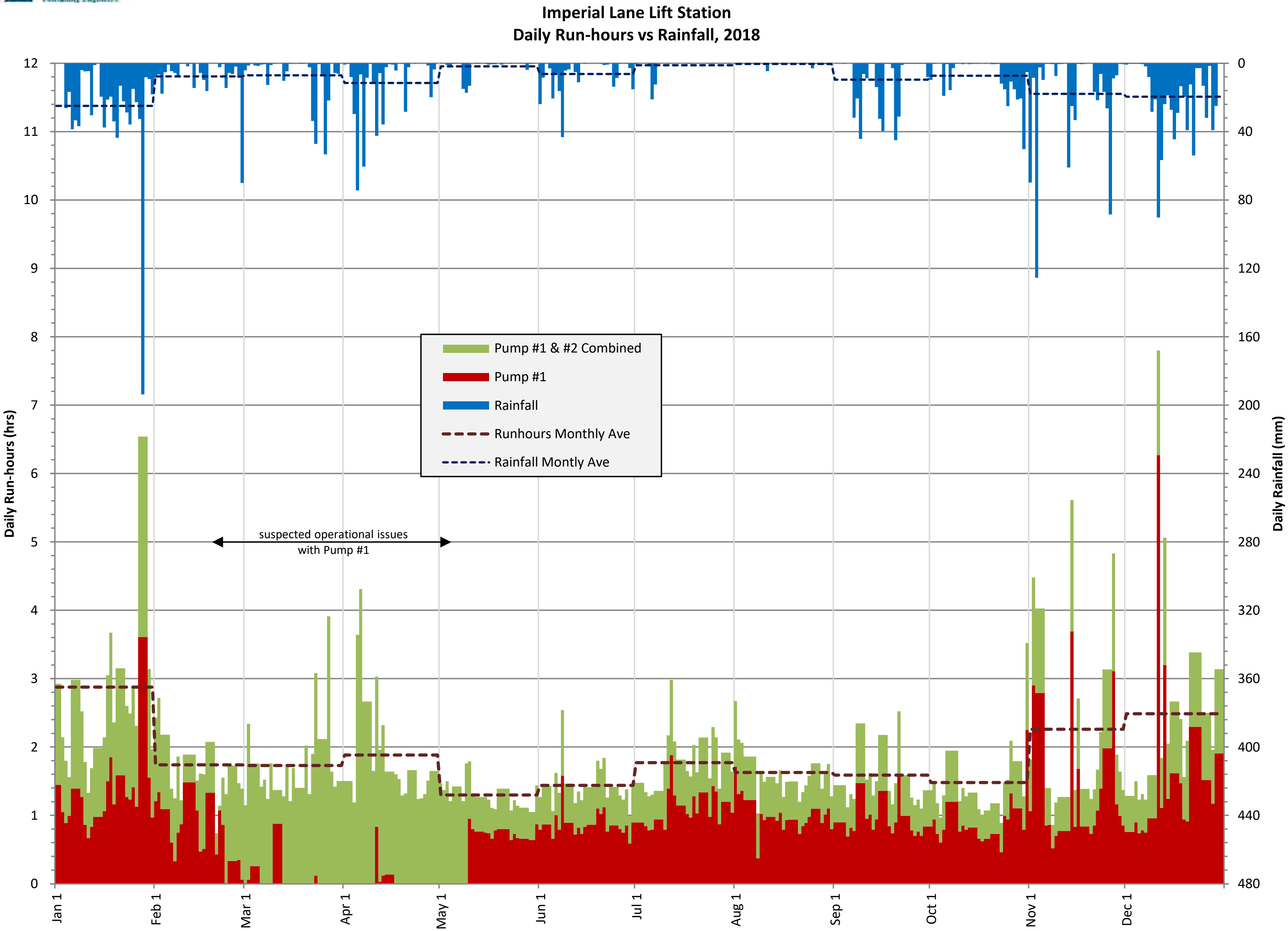

FIGURE 9

KOERS & ASSOCIATES ENGINEERING LTD.
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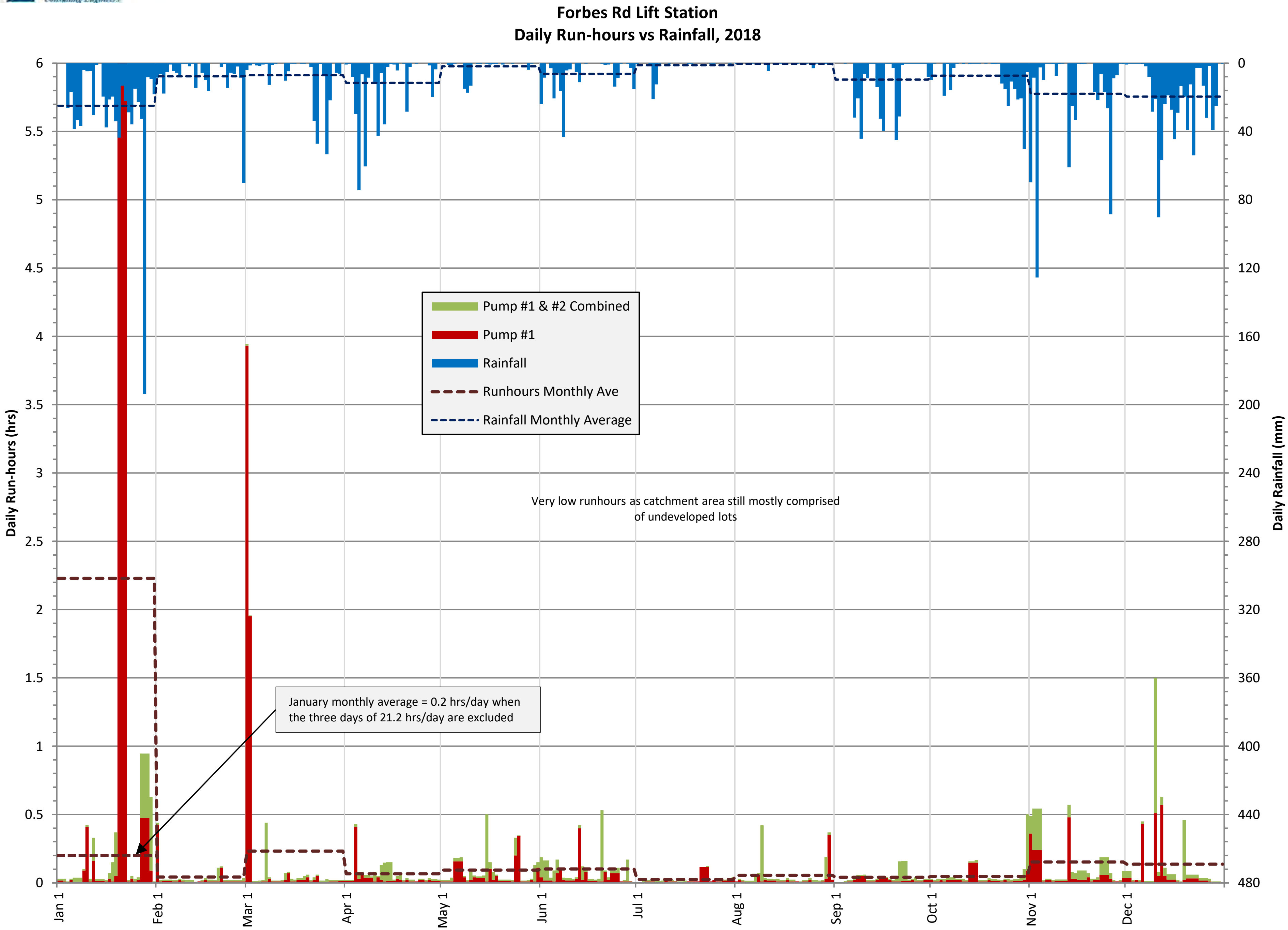

FIGURE 10

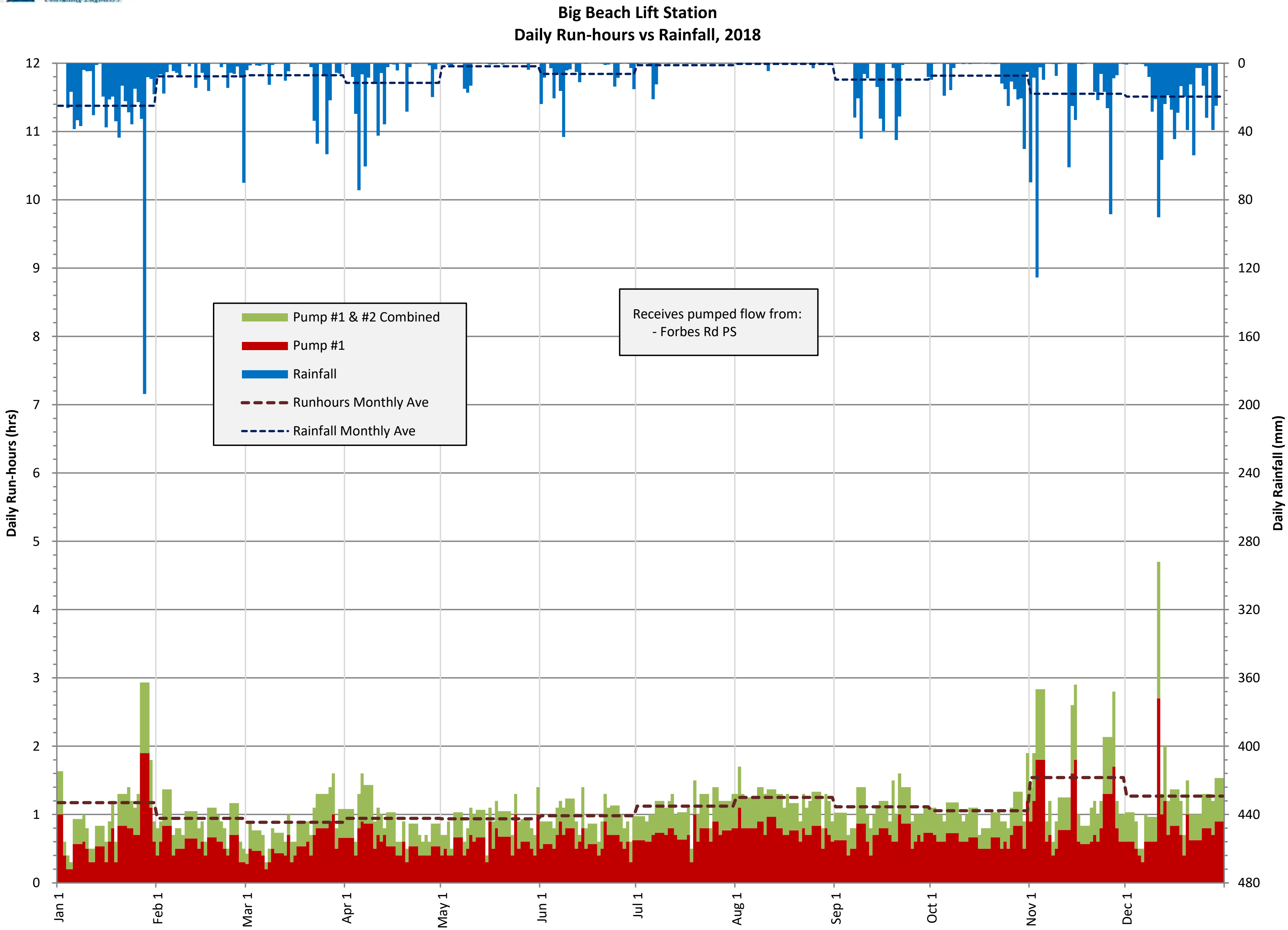
Big Beach Lift Station
Daily Run-hours vs Rainfall, 2018
Pump #1 & #2 Combined
Pump #1
Rainfall
Runhours Monthly Ave
Rainfall Monthly Ave
Receives pumped flow from:
- Forbes Rd PS
Daily Run-hours (hrs)
Daily Rainfall (mm)
0
1
2
3
4
5
6
7
8
9
10
11
12
0
40
80
120
160
200
240
280
320
360
400
440
480
Jan 1
Feb 1
Mar 1
Apr 1
May 1
Jun 1
Jul 1
Aug 1
Sep 1
Oct 1
Nov 1
Dec 1

FIGURE 11

KOERS & ASSOCIATES ENGINEERING LTD.
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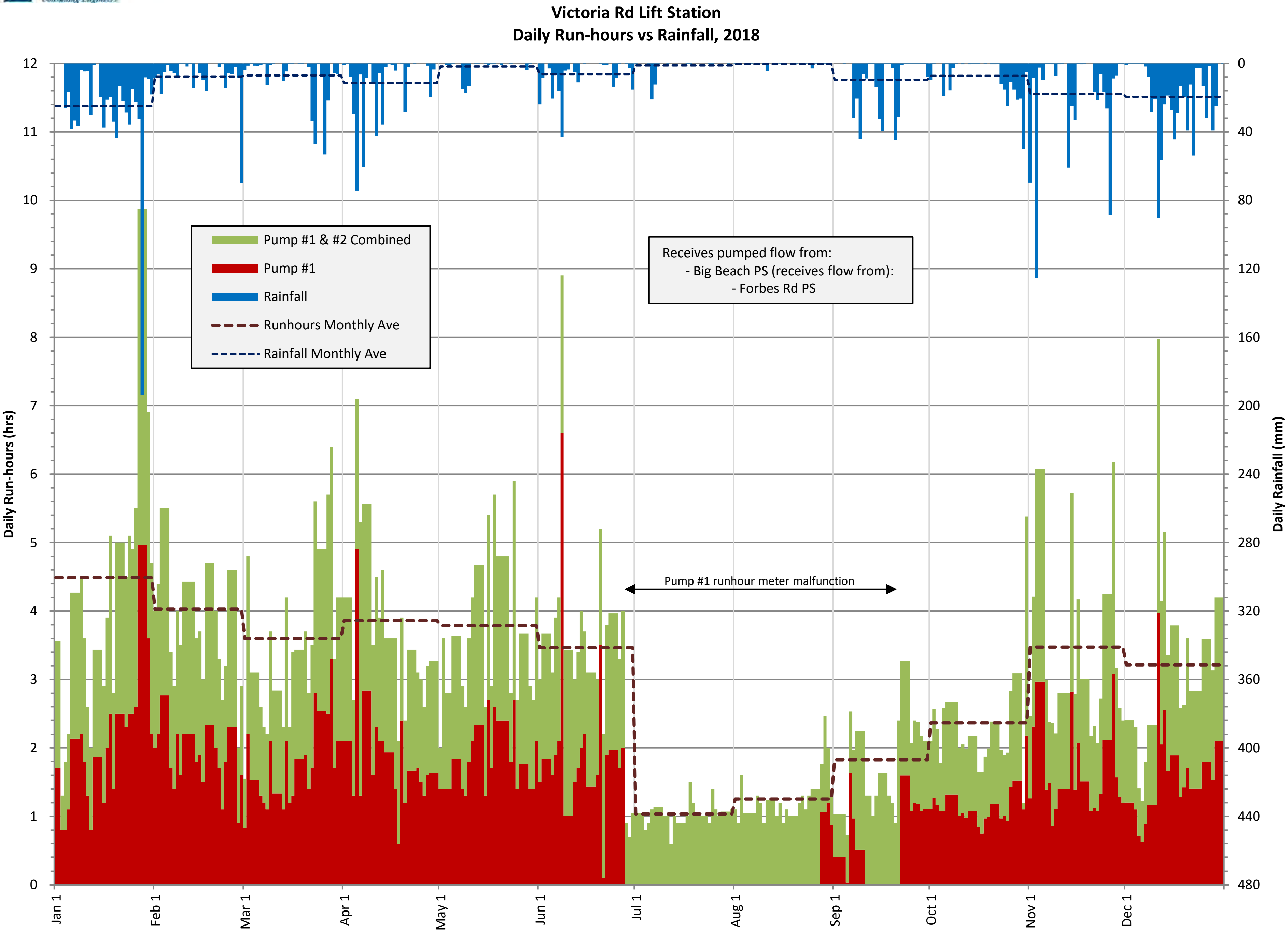


FIGURE 12

KOERS & ASSOCIATES ENGINEERING LTD. Consulting Engineers

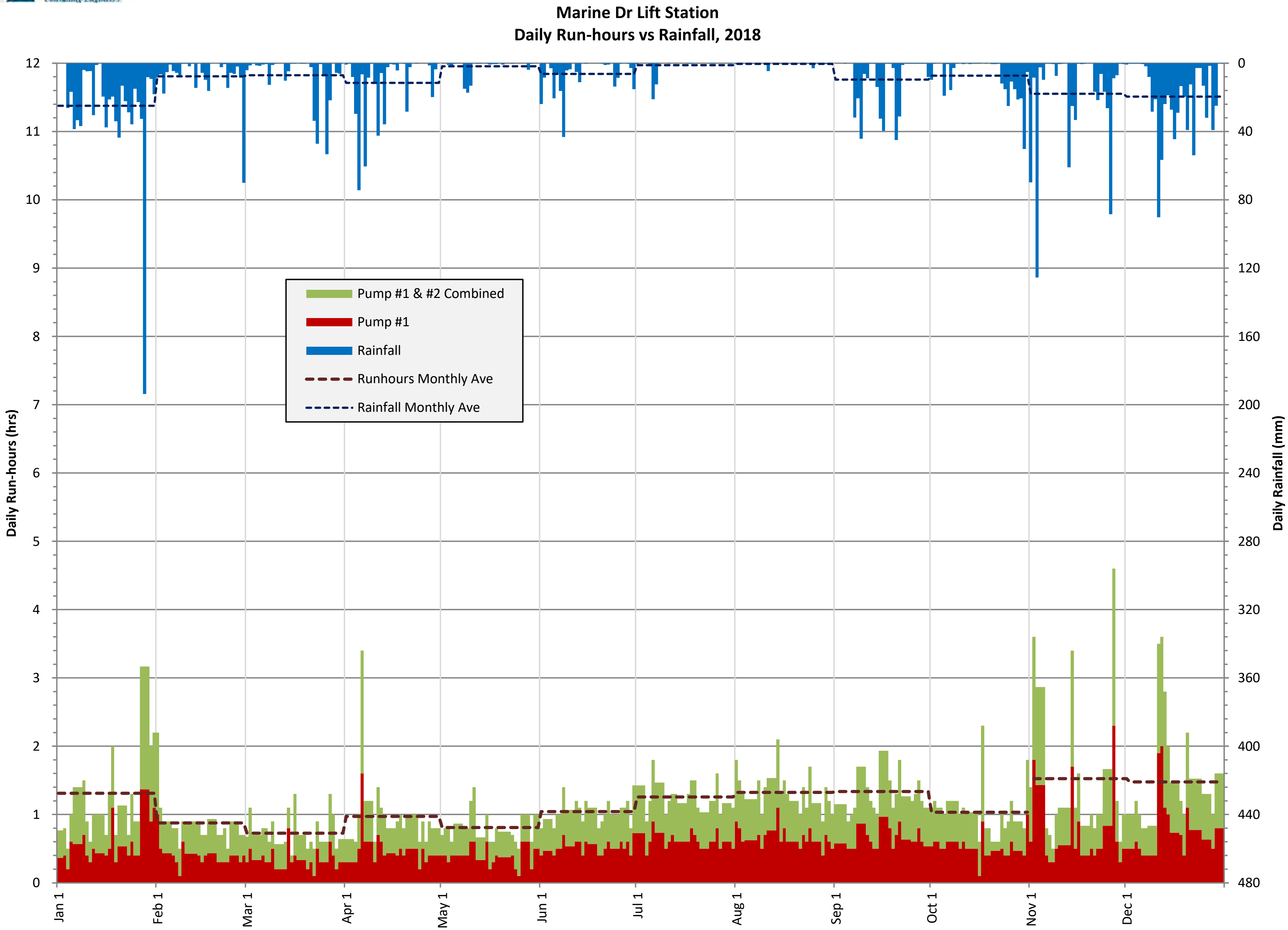


FIGURE 13

KOERS & ASSOCIATES ENGINEERING LTD.
Consulting Engineers

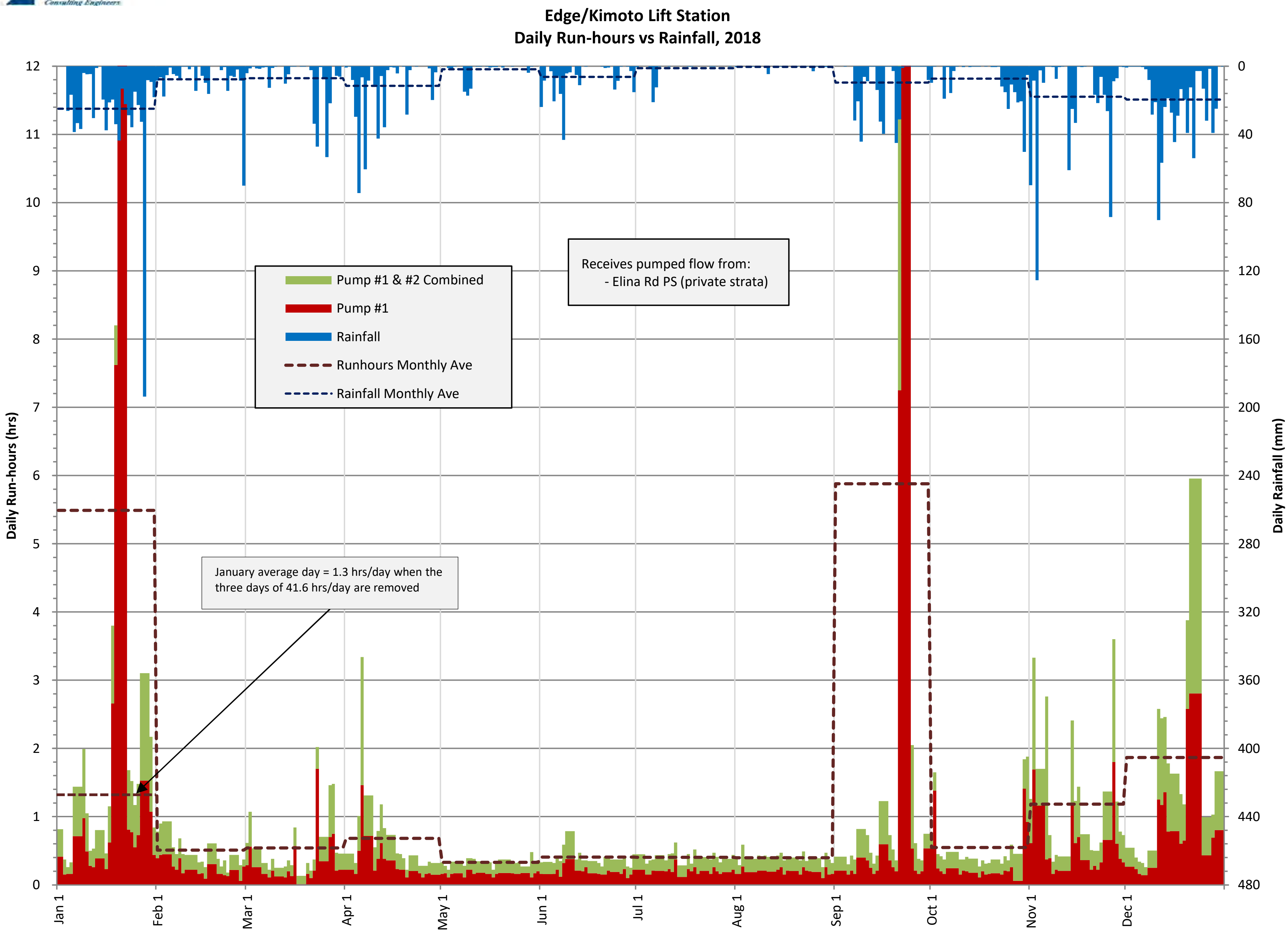


FIGURE 14

KOERS & ASSOCIATES ENGINEERING LTD. Consulting Engineers

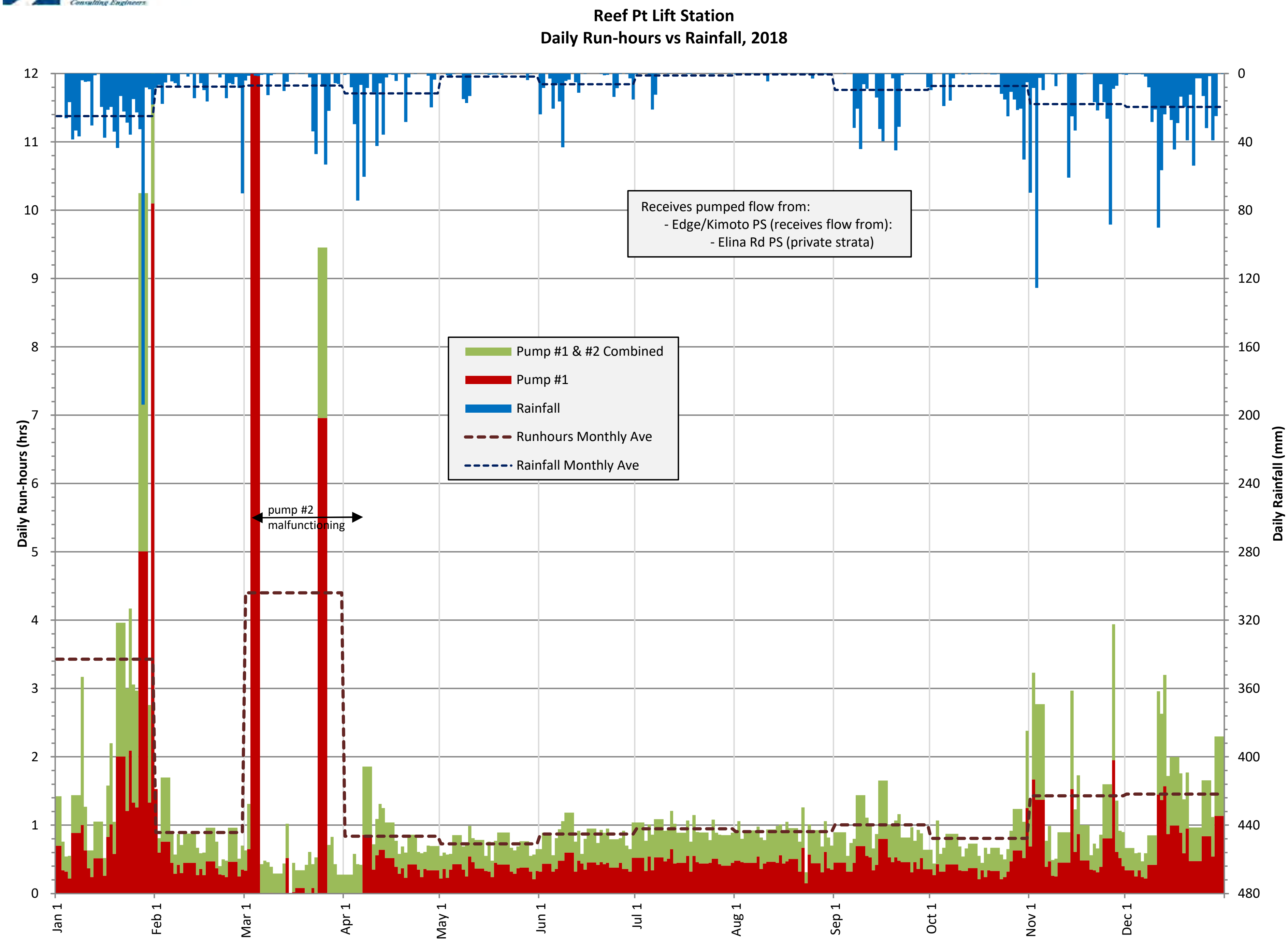


FIGURE 15

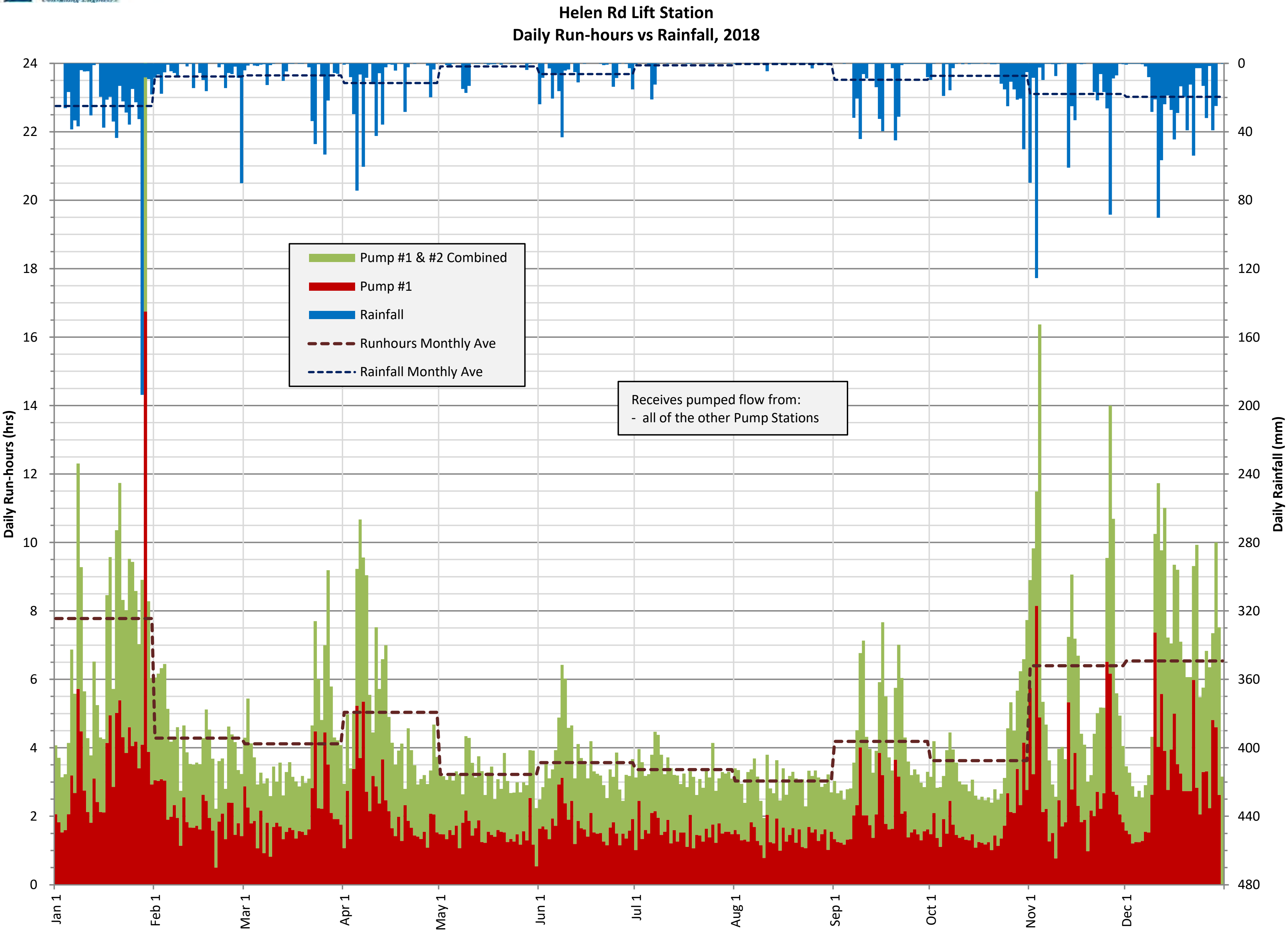

Helen Rd Lift Station
Daily Run-hours vs Rainfall, 2018
Pump #1 & #2 Combined
Pump #1
Rainfall
Runhours Monthly Ave
Rainfall Monthly Ave
Receives pumped flow from:
- all of the other Pump Stations
Daily Run-hours (hrs)
Daily Rainfall (mm)
Jan 1
Feb 1
Mar 1
Apr 1
May 1
Jun 1
Jul 1
Aug 1
Sep 1
Oct 1
Nov 1
Dec 1

FIGURE 16

5.2.2 January 28, 2018

On January 28, 2018, a total of 194 mm of rainfall was recorded at the Environment Canada Ucluelet Kennedy Camp weather station (Climate ID No. 1038332). This event resulted in a significant increase in run-hours at each of the 14 lift stations as well as at the Hitacu flow meter.

An estimate of the run-hours attributed to I/I for each lift station was carried out by comparing the pump run-hours for the storm event (peak wet weather event) against an average day dry weather flow. The extent of the increase (ratio) was also reviewed to see if it could be determined if Inflow or Infiltration was more dominant during this event. The analyses are presented below in **Table 8** and graphically shown in **Figure 17**.

Table 8 – Jan 27 - 29, 2018 Estimated Daily Pump Run-hours Attributed to I&I

Lift Station	Year 2018		Difference	Jan 27 - 29 / May Ave Day (2)
	Wet Weather Jan 27 – 29 (1) (hrs/day)	Dry Weather May Ave Day (hrs/day)	(hrs)	(ratio)
Bay St (3)	20.9	7.1	13.8	2.9
Norah Rd	15.3	1.5	13.8	10.2
Hemlock St	16.7	3.8	12.9	4.4
Helen Rd (4)	16.9	3.2	13.7	5.3
Reef Point	10.3	0.7	9.6	14.7
Fraser Lane	11.8	3	8.8	3.9
Victoria	9.9	3.8	6.1	2.6
Imperial Lane	6.5	1.3	5.2	5
Peninsula Rd	5.7	0.9	4.8	6.3
Marine Dr	3.2	0.8	2.4	4
Edge/Kimoto	3.1	0.3	2.8	10.3
Big Beach	2.9	0.9	2	3.2
Forbes Rd	0.9	0.1	0.8	9
Bay St (simplex)	n/a	0.4	n/a	n/a
Hitacu (5)	236 m^3	87 m^3	149 m^3	2.7

Notes:

1. A total of 194 mm of rainfall was recorded at the Kennedy Camp weather station on January 28, 2018 (Sunday). Lift station run-hours are only recorded during the weekday (Mon – Fri), except at Helen Rd where they are recorded automatically every day. The daily average run-hours shown above were calculated based on the difference in the meter readings taken on Friday Jan 26 and Monday Jan 29 and divided by three (days).
2. Higher ratios indicate that Inflow (stormwater flowing directly into the sanitary sewer system is dominant and Infiltration (groundwater entering the sanitary sewer system) is less dominant. Lower ratios indicate Infiltration is dominant.
3. Bay St lift station was decommissioned in June 2020 with the construction of a gravity main to direct flows to the Big Beach lift station.

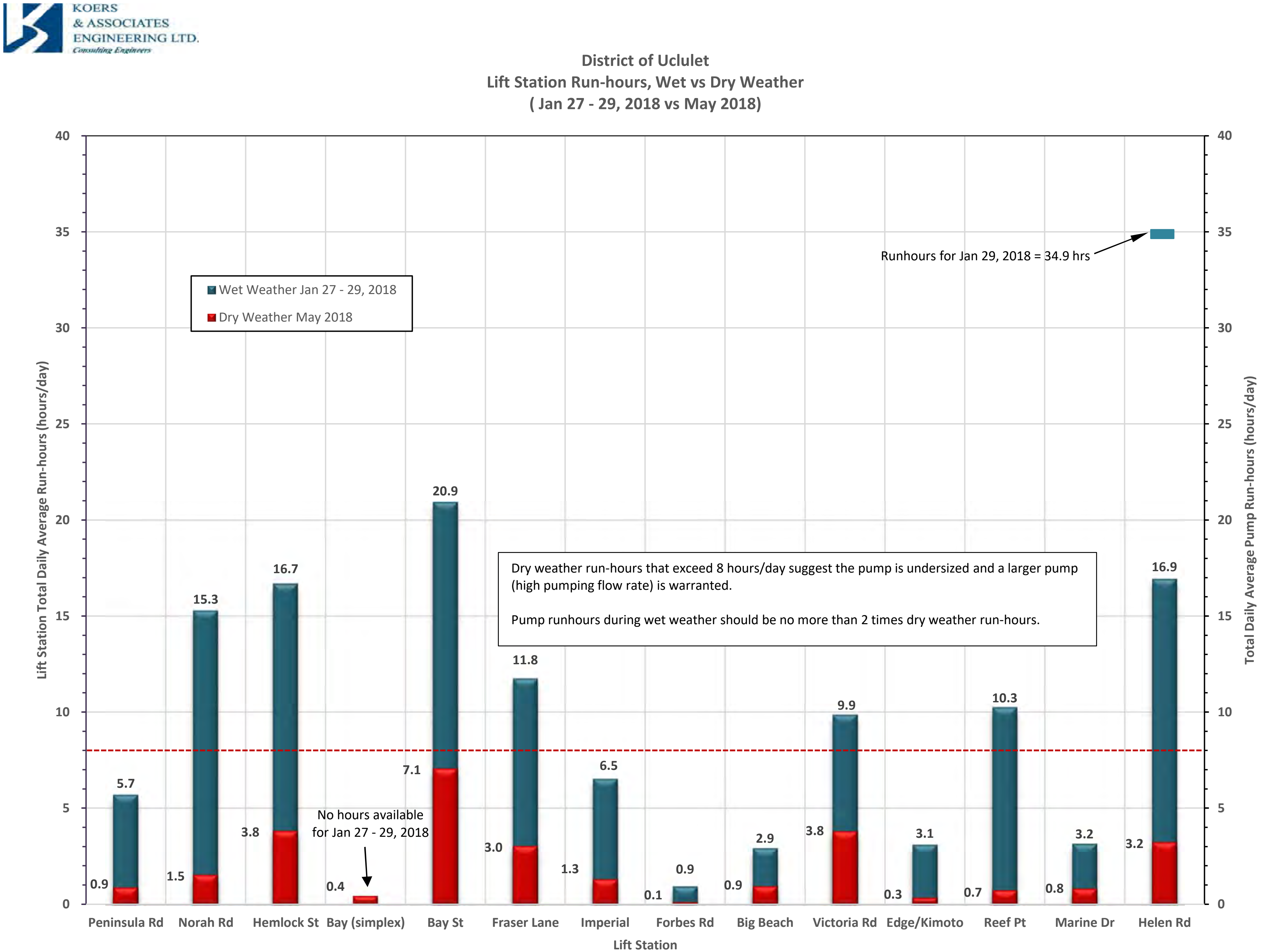

KOERS & ASSOCIATES ENGINEERING LTD.
Consulting Engineers
District of Ucluelet
Lift Station Run-hours, Wet vs Dry Weather
(Jan 27 - 29, 2018 vs May 2018)
Wet Weather Jan 27 - 29, 2018
Dry Weather May 2018
Runhours for Jan 29, 2018 = 34.9 hrs
Dry weather run-hours that exceed 8 hours/day suggest the pump is undersized and a larger pump (high pumping flow rate) is warranted.
Pump runhours during wet weather should be no more than 2 times dry weather run-hours.
No hours available for Jan 27 - 29, 2018
Lift Station Total Daily Average Run-hours (hours/day)
Total Daily Average Pump Run-hours (hours/day)
Lift Station
Peninsula Rd 5.7 0.9
Norah Rd 15.3 1.5
Hemlock St 16.7 3.8
Bay (simplex) 0.4
Bay St 20.9 7.1
Fraser Lane 11.8 3.0
Imperial 6.5 1.3
Forbes Rd 0.9 0.1
Big Beach 2.9 0.9
Victoria Rd 9.9 3.8
Edge/Kimoto 3.1 0.3
Reef Pt 10.3 0.7
Marine Dr 3.2 0.8
Helen Rd 16.9 3.2
0 5 10 15 20 25 30 35 40

FIGURE 17

4 Helen Road lift station run-hours are recorded automatically each day by the District's SCADA system. The average for the three days was 16.9 hours/day. The recorded run-hours for each day were:

- Jan 27 = 7.0 hours
- Jan 28 = 8.9 hours
- Jan 29 = 34.9 hours

Runhours totalling more than 24 hours/day (Jan 29) indicate that both pumps would have been running simultaneously for one or more times.

5 Sewage flows from the Hitacu community sewage flow meter located directly upstream of the sewage lift station. The volumes for each day were as follows:

- Jan 27 = 119 m^3
- Jan 28 = 121 m^3
- Jan 29 = 236 m^3

The analysis of the lift station pump run-hour meter data indicates I/I is a significant issue in the sanitary sewer collection system. Excessive I/I is having a negative impact on the District's lift stations, forcemains, and gravity mains, resulting in:

- Higher O&M costs, e.g., increased electricity usage to run pumps
- More than one pump operating at the same time
- Excessive wear and tear on equipment
- Reducing the capacity of gravity mains for the conveyance of sewage flows, which can result in the premature need to replace existing mains with larger diameter mains.

5.3 Sewage Lagoon Flow Analyses

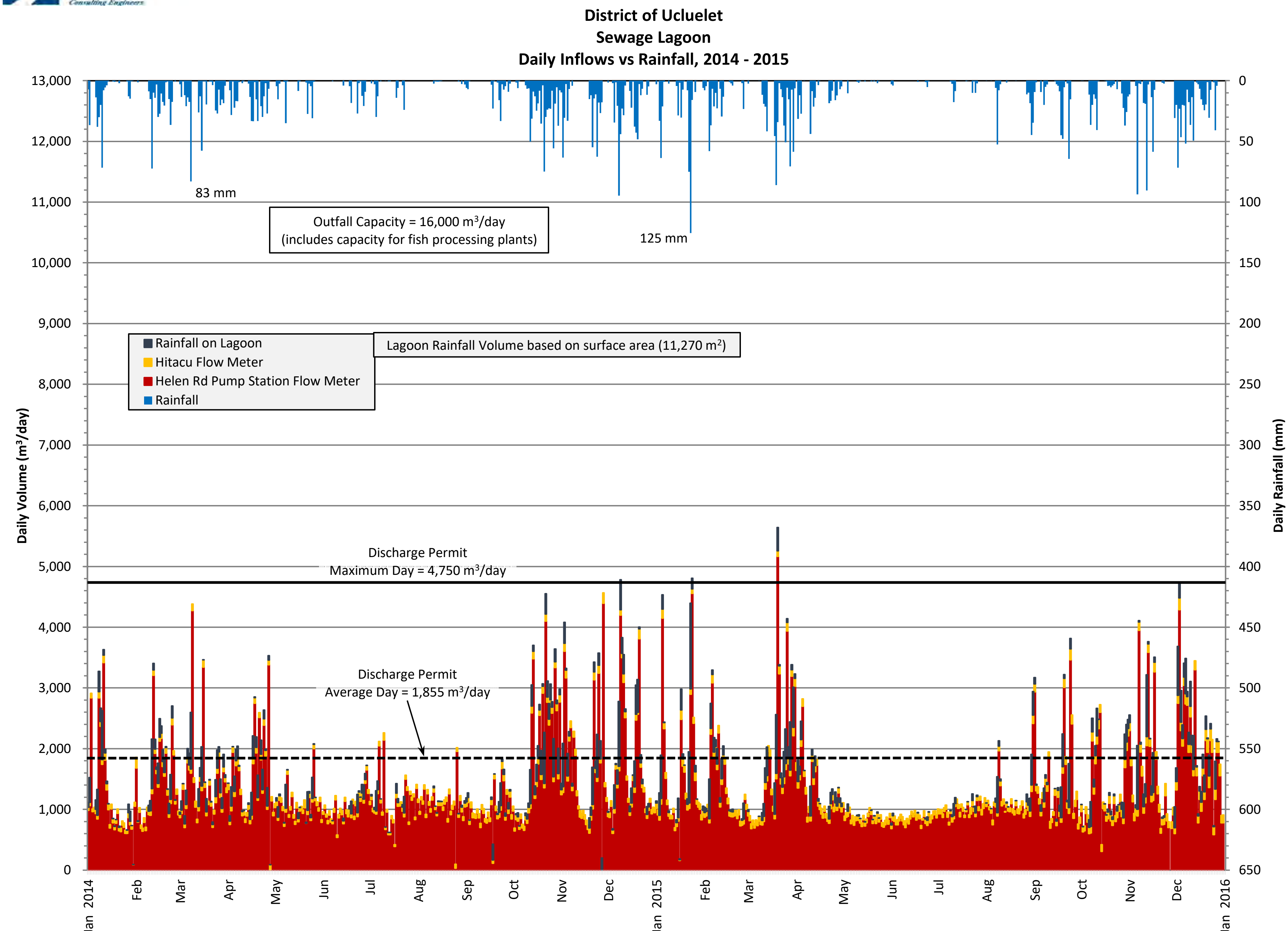
A review of daily flow volumes into the sewage lagoon vs rainfall showed the flows from the District of Ucluelet (Helen Road lift station) increased significantly in response to rainfall.

5.3.1 Years 2014 - 2015

There was a total of twelve days where the flow into the sewage lagoon exceeded 4,000 m^3/day and all corresponded with heavier rainfall events. The largest event occurred on March 20, 2015. The flow recorded by the Helen Road lift station flow meter was 5,165 m^3/day. This was more than 6 times the average day dry weather flow of 816 m^3/day (recorded for the two months of May and June which were notably dry).

Flows from Hitacu were much lower than those from the District of Ucluelet and did not show as strong a correlation between rainfall and changes in flow. The average day dry weather flow for Hitacu in Year 2015 was 66 m^3/day recorded for the two months of June and July.

Daily metered flows into the sewage lagoon versus rainfall for Year 2014 and Year 2015 along with calculated volume of rain falling on the surface area (11,270 m^2) of the lagoon are graphically presented in **Figure 18**. It is not known if any of the events with inflows greater than 4,750 m^3/day (the maximum day permitted discharge limit) exceeded this limit as there would have been flow attenuation in the lagoon resulting in a reduction in the peak discharge flow.



District of Ucluelet
Sewage Lagoon
Daily Inflows vs Rainfall, 2014 - 2015
83 mm
125 mm
Outfall Capacity = 16,000 m³/day
(includes capacity for fish processing plants)
Rainfall on Lagoon
Hitacu Flow Meter
Helen Rd Pump Station Flow Meter
Rainfall
Lagoon Rainfall Volume based on surface area (11,270 m²)
Discharge Permit
Maximum Day = 4,750 m³/day
Discharge Permit
Average Day = 1,855 m³/day
Daily Volume (m³/day)
Daily Rainfall (mm)
13,000
12,000
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
0
50
100
150
200
250
300
350
400
450
500
550
600
650
Jan 2014
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan 2015
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan 2016

FIGURE 18

5.3.2 Years 2016 - 2018

For Years 2016, 2017, and 2018, the calculated flow (Helen Road lift station run-hours) and the metered flow (Hitacu community) into the sewage lagoon vs rainfall along with the calculated volume of rain falling on the surface area (11,270 m^2) of the lagoon are graphically presented in **Figure 19**. The impact of rainfall on the District of Ucluelet generated sewage flows is clearly visible.

The largest flow into the lagoon occurred on January 28, 2018 and was calculated to be 11,036 m^3/day). It corresponded with 194 mm of rainfall and resulted in a discharge flow from the lagoon that exceeded the maximum day discharge limit of 4,750 m^3/day. There were four other events in 2018 that resulted in a calculated flow into the lagoon that exceeded 4,750 m^3/day. It is suspected that each of these may have also resulted in a flow out of the lagoon exceeding the maximum day discharge limit.

5.3.3 August 2019 to March 2020

Sewage flows are metered as they leave the sewage lagoon and enter the marine outfall. A new flow meter was installed in August 2019, with the recording of daily flows by the District's SCADA system starting on August 15, 2019. The daily data up to and including April 1, 2020 (7½ months) was compared with daily flow data from the Hitacu flow meter and daily rainfall data. The review showed the flows out of the lagoon increased and decreased quickly and significantly with rainfall events. Flows from Hitacu also varied in response to rainfall but to a much lesser extent.

Flow out of the lagoon exceeding the maximum day discharge permit (4,750 m^3/day) occurred during the rainy season in respond to significant rainfall events . Exceedance on eight days were recorded (Oct 22; Nov 16 – 18; Dec 19 – 20; Jan 24; Feb 1) with the highest recorded discharge from the lagoon being 8,708 m^3 on November 18, 2019. These eight events equate to an annual exceedance rate of 2.2% assuming exceedances do not occur during the drier spring and summer months.

<u>November 16, 2019 Rainfall Event</u>

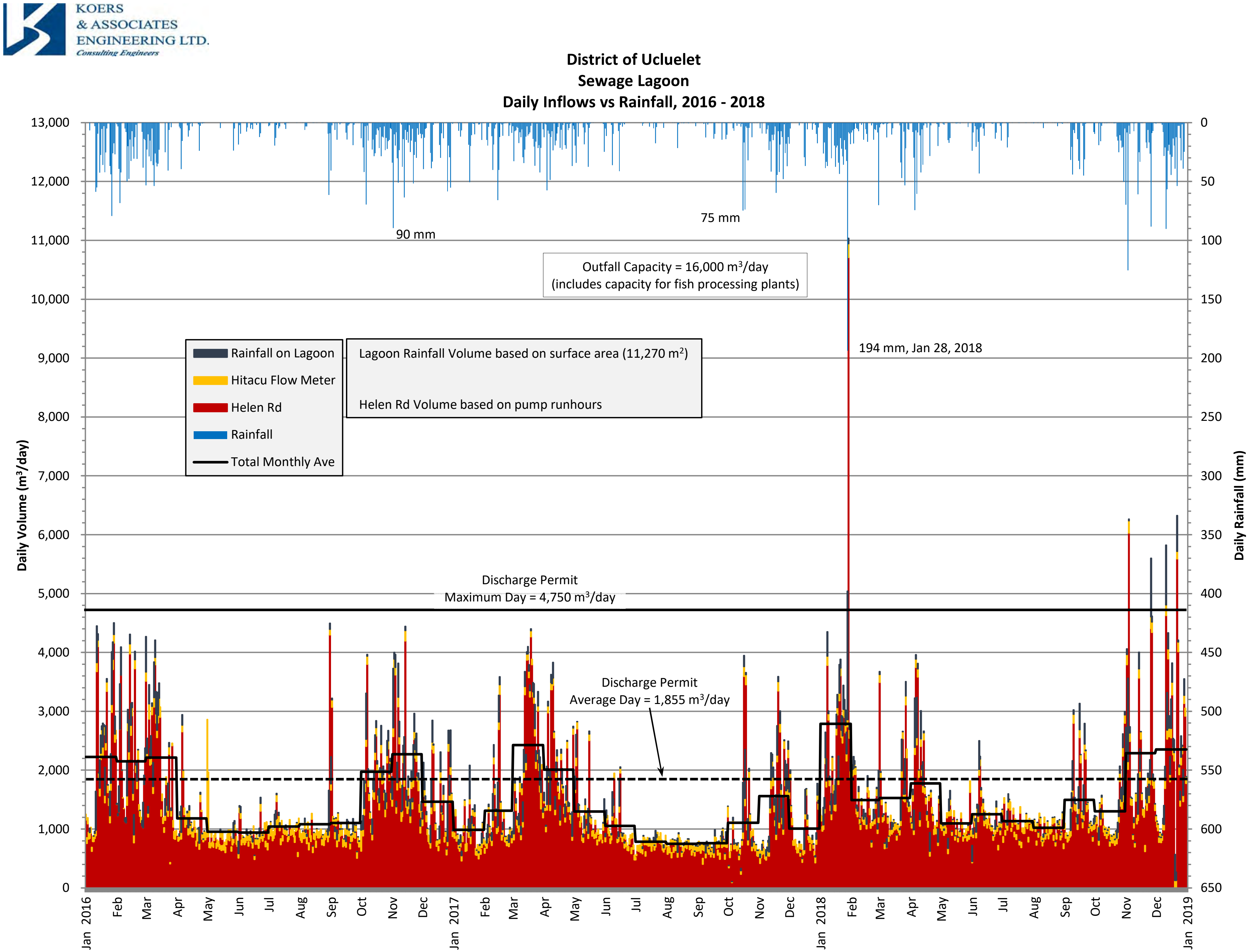
A very large rainfall event occurred on November 16, 2019, with 210 mm of rainfall being recorded by the Environment Canada Ucluelet Kennedy Camp weather station (Climate ID No. 1038332). As noted above, this event resulted in flows out of the lagoon exceeding the maximum day discharge permit (4,750 m^3/day) for three consecutive days (Nov 16, Nov 17 and Nov 18) with the highest recorded discharge being 8,708 m^3 on Nov 18. Of this volume it is estimated that less than 12% (1,000 m^3) was attributed to actual sewage flow. The remaining 88% was attributed to I/I as follows:

- 27% (2,400 m^3) attributed to the 210 mm of rainfall on the on the surface area (11,270 m^2) of the lagoon,
- 61% (5,300 m3) attributed to I/I within the sewage collection system.

Daily flows into and out of the sewage lagoon along with daily rainfall are presented in **Figure 20** along with the MoE permitted discharge limits. No flow data was available for the two weeks of Jan 1 through Jan 14, 2020. The significant impact of rainfall on the District of Ucluelet generated sewage flows is clearly visible.

The analysis of the sewage lagoon discharge flow meter data indicates I/I is a very significant issue in the sanitary sewer collection. Excessive I/I is having a negative impact on the Village's sewage lagoon, resulting in:

- Sewage volumes that exceed the maximum day allowed by the discharge permit.



KOERS & ASSOCIATES ENGINEERING LTD.
Consulting Engineers
District of Ucluelet
Sewage Lagoon
Daily Inflows vs Rainfall, 2016 - 2018
Outfall Capacity = 16,000 m³/day
(includes capacity for fish processing plants)
Rainfall on Lagoon
Hitacu Flow Meter
Helen Rd
Rainfall
Total Monthly Ave
Lagoon Rainfall Volume based on surface area (11,270 m²)
Helen Rd Volume based on pump runhours
90 mm
75 mm
194 mm, Jan 28, 2018
Discharge Permit
Maximum Day = 4,750 m³/day
Discharge Permit
Average Day = 1,855 m³/day
Daily Volume (m³/day)
Daily Rainfall (mm)
13,000
12,000
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
0
50
100
150
200
250
300
350
400
450
500
550
600
650
Jan 2016
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan 2017
Jan 2018
Jan 2019

FIGURE 19

KOERS & ASSOCIATES ENGINEERING LTD.
Consulting Engineers

District of Ucluelet
Sewage Lagoon
Daily Inflow & Outflow Volumes vs Rainfall
Aug 15, 2019 - Apr 1, 2020

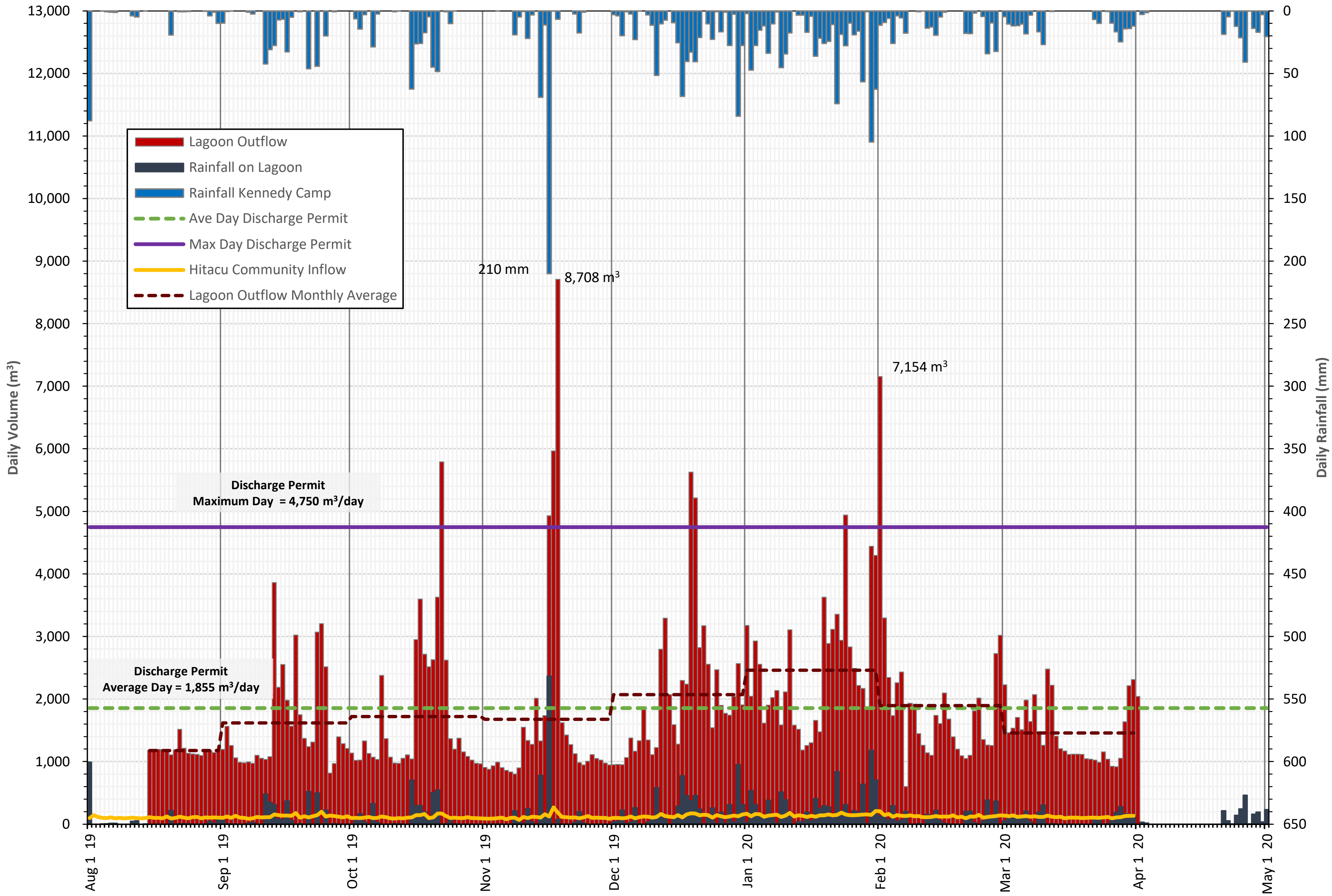


FIGURE 20

5.4 Sewage Lagoon Impact

5.4.1 Hydraulic Retention Time

Hydraulic retention time is one of the parameters used in assessing the treatment capacity of a sewage lagoon. The hydraulic retention time is defined as the average time interval it takes for sewage to flow through the sewage lagoon. This can be calculated by dividing the storage volume of the lagoon by the average daily flow. The amount of I/I in the District's sanitary sewer collection system is having a significant impact on the hydraulic retention time as shown in **Table 9**.

Table 9 – Sewage Lagoon Detention Times

Description		Precipitation Total (1) (mm)	Averaged Daily Flow (2) (m^3/day)	Hydraulic Retention Time (3) (days)
Average Year	2018	3,354 (4)	1,630 (8)	14
Dry Summer Month	Aug 2018	11 (5)	1,000 (9)	23
Wet Winter Month	Jan 2020	785 (6)	2,500 (10)	9
Large Winter Storm	Nov 15 – 19, 2019	297 (7)	4,600 (10)	5

Notes:

1. Rainfall from Environment Canada Ucluelet Kennedy Camp weather station (Climate ID No. 1038332). Period of Record = 66 Years (1957 – to present).
2. Rounded to nearest 10 or 100 m^3/day.
3. Based on a lagoon storage volume of 22,700 m^3 and rounded to the nearest one day.
4. Period of record (66 years) Average Annual Precipitation = 3,395 mm
5. Period of record (66 years) August Average Precipitation = 106 mm
6. Period of record (66 years) January Average Precipitation = 476 mm
7. Precipitation Total is for the period Nov 14 – 18, 2019.
8. Year 2018 Averaged Daily Flow comprised of average daily flow for Hitacu Community (103 m^3/day, **Table 6**), District of Ucluelet (1,420 m^3/day, **Table 6**), and volume of precipitation on the sewage lagoon surface (103 m^3/day).
9. Aug 2018 Averaged Daily Flow is derived from the sum of the Hitacu Community flow meter, the estimated pumped volume from the Helen Road lift station based on pump run-hours, and the volume of rainfall on the lagoon surface.
10. Jan 2020 and Nov 15-19, 2019 Averaged Daily Flow derived from the sum of the metered flows from the Hitacu Community flow meter, the Helen Road lift station flow meter, and the volume of precipitation on the lagoon surface.

Typical design standard retention times for each cell is shown below in **Table 10** along with the resulting design standard treatment flow based on the storage volumes of each cell of the District's sewage lagoon.

Table 10 – Sewage Lagoon Typical Design Standard Detention Times

Cell No.	Treatment Process	Typical Design Standard Retention Time (days)	Actual Storage Volume (m^3)	Resulting Typical Design Standard Treatment Flow (m^3/day) (1)
1/2	Complete Mixed Aerated & Partial Mixed Aerated	3 to 6 4 to 10	9,800	3,260 to 1,630 2,450 to 980
3	Sedimentation	4 to 10	10,900	2,725 to 1,090
4	Polishing	4 to 10	3,000	750 to 300
	Combined Total	12 to 30	23,700	1,975 to 750

Notes:

1 Resulting Typical Design Standard Treatment Flow (m^3/day) calculated as follows:

$$\frac{\text{Actual Storage Volume, m}^3}{\text{Typical Design Standard Retention Times, days}}$$

The *Sewage Lagoon Assessment Report* (January 2007 by Novatec) noted that for a multiple cell lagoon system such as Ucluelet, the lower end of the range (12 days) could be acceptable. For a 12 day retention time, the calculated annual average flow would be 1,975 m^3/day. This is slightly higher than the permitted annual average day discharge limit of 1,855 m^3/day. A comparison of the projected permanent serviceable population of the sewage lagoon based on the discharge permit vs a 12 day retention time is shown in **Table 11**.

Table 11 – Sewage Lagoon Projected Serviceable Permanent Population

Description	Annual Average Day (m^3/day)	Permanent Population (capita)	OCP Time Horizon (1) (Year)
Year 2018	1,630 (2)	2,122 (3)	2018
Discharge Permit Limit	1,855	2,610 (4)	2036 to 2047 (5)
12-Day Retention Time	1,975	2,900 (6)	2045 to 2057 (7)

Notes:

1 The OCP Time Horizon projections are estimates only and reflect a potential range based on several assumptions including annual growth rate projections for both the District of Ucluelet and the Hitacu community (see **6 POPULATION**).

2 Year 2018 Annual Average Day demand based on the following flows:

District of Ucluelet Dry Weather Flow (August):	931 m^3/day
Hitacu Community Dry Weather Flow (August):	89 m^3/day
I/I Estimate:	610 m^3/day
Combined Total:	1,630 m^3/day

3 Year 2018 permanent population based on Stats BC population estimate for the District of Ucluelet (1,834) and interpolation of population for Hitacu community (288) based on Canada Census data for Year 2016 and Year 2021.

4 Discharge Permit Limit permanent population estimate (rounded to the nearest 10) derived from the estimated sewage flow data for Year 2018 (Annual Average and month of August), the difference in annual average day flow rate for Year

2018 and the Discharge Permit Limit, and the Year 2018 estimate permanent population.

5 Year 2036 based on the District of Ucluelet OCP Low(ish) Growth rate (1.0% per year) plus the low growth rate for the Hitacu community (1.82% per year). Year 2047 based on Hitacu community no longer contributing flows to the sewage lagoon. A review of historical and projected population for the District of Ucluelet and the Hitacu community is presented in **6 POPULATION**.

6 12-Day Retention Time permanent population estimate (rounded to the nearest 10) derived from the estimated sewage flow data for Year 2018 (Annual Average and month of August), the difference in annual average day flow rate for Year 2018 and the 12-Day Retention Time annual average day flow rate, and the Year 2018 estimate permanent population.

7 Year 2045 based on the District of Ucluelet OCP Low(ish) Growth rate (1.0% per year) plus the low growth rate for the Hitacu community (1.82% per year). Year 2057 based on Hitacu community no longer contributing flows to District's sewage lagoon. A review of historical and projected population for the District of Ucluelet and the Hitacu community is presented in **6 POPULATION**.

The **Table 11** data suggests that the sewage lagoon can continue to service the District of Ucluelet and the Hitacu community without exceeding the annual average day discharge permit limit (1,855 m^3/day) during an average annual rainfall year, for at least the next 13 years, and potentially for the next 24 years, based on a low growth rate scenario.

The **Table 11** data indicates the servicing of a permanent population greater than 2,610 requires either: a reduction in I/I flows in the sewage collection system; an increase in the discharge permit limit; or a combination of both. It is expected that an increase in the discharge permit limit (by the BC Ministry of Environment) would be contingent on demonstration of a significant reduction in I/I flows.

5.4.2 Treatment Capability

The high I/I flows (see **Figure 18**, **Figure 19** and **Figure 20**) result in a short term reduction in the hydraulic retention time of the lagoon which can negatively impact the treatment process (biological, sedimentation, polishing) performed by each cell (see **Table 3)**. This can result in the reduction in the quality of the treated effluent discharged to the environment and potential exceedance of the permitted limits of 45 mg/L for BOD_5 and 60 mg/L for TSS. The sewage lagoon upgrading works carried in 2016/17 were done in part to restore and improve the treatment efficiency. These works consisted of:

- Sludge removal (1st time since construction of the lagoon in 1986: 30 years)
- Storage volume increased (removal of earthen berm between cell 1 and cell 2)
- Increasing flow path through the lagoon (cell 1 inlet relocated, and curtain baffle walls installed in cell 1/2 and cell 3)
- Increased aeration (larger horsepower and additional floating aerators added to cell 1/2)

The *Sewage Lagoon Sludge Removal Options Study* (August 2009) noted that the sewage lagoon system at that time (prior to the completion of the above noted upgrading works in 2016/17) was removing BOD at overall rate of 79% which was consistent with the expected combined removal rate of cell 1 and 2 (50% to 33%) and cell 3 and 4 (30% to 40%). The overall TSS removal rate was found to be 87%.

The last known treatment performance review of the sewage lagoon was carried out in 2007 (*Sewage Lagoon Assessment Report* (January 2007 by Novatec); 21 years after the lagoon system commenced operation in 1986. The study findings included:

- both the BOD and TSS concentrations of the treated effluent were below the discharge permit licence limits of 45 mg/L and 60 mg/L respectively.
- municipal sewage lagoons normally require desludging every 25 to 30 years.
  Septage discharges to the lagoon were estimated to:
  i) contribute organic loadings equivalent to 120 capita per day during the peak dumping months (May/June),
  ii) contribute organic loading equivalent to ±40 capita per day for the remainder of the year, and
  iii) be causing plugging problems for the floating aerator.
- Expansion of cell 4 to 6,400 m^3 (current volume = 3,00 m^3, **Table 10**), would increase the hydraulic retention time and service an estimated additional 850 permanent residents.
- Unlike mechanical treatment plants, lagoon treatment systems are much better suited to absorb the wide fluctuations in flow in the District of Ucluelet caused by I/I. However, the high I/I flows cause a short term reduction in the high retention time of the lagoon system which in-turn results in a reduction in treatment capacity and very high I/I flows result in exceedance of the maximum day discharge limit.

It is assumed the with the completion of the upgrading works carried out in 2016/17, the effluent discharged from the lagoon has improved.

A review of District's monthly BOD and TSS testing results should be carried out to assess the operating performance of the lagoon. Based on the 25 to 30 years desludging time frame, the next desludging of the cells is projected to be warranted in 19 to 24 years time (Year 2042 to Year 2047).

Reducing I/I flows will improve the performance of the sewage lagoon during the fall and winter months and accommodate additional population growth without requiring expansion of cell 4.

The recommendations from the *Sewage Lagoon Sludge Removal Options Study* (August 2009) regarding the installation of a grit removal system at the outlet of the forcemain into cell 1 and construction of a septage receiving station to improve the operating performance of the lagoon continue to be relevant.

6 POPULATION

6.1 Historic

6.1.1 District of Ucluelet

Statistics Canada

Statistics Canada records population in 5 year intervals, with the most recent census occurring in Year 2021. Census data for the past 60 years (1961 to 2021) was reviewed to identify historical trends. The District's population has increased and decreased during the past 60 years, with population peaks recorded in 1966, 1981, and 1996, followed by lows recorded in 1971, 1986 and 2006. Since 2006, the population has steadily increase.

For the 10 year period between 2006 to 2016, the population increased by 230 capita: equating to an average increase of 23 capita per year (1.45% per year). However, during the past five years (2016 to 2021) a population increase of 349 capita was recorded; equating to an average increase of 70 capita per year (3.75% per year).

In Year 2021, a permanent population of 2,066 was recorded; the highest ever for the District of Ucluelet.

BCStats

In January of each year, BCStats publishes population estimates as of July 1 of the previous year for regional districts and municipalities. For those years when a national census has been taken, the population estimate is generally slightly higher than that reported by Census Canada, as BCStats includes an allowance for census undercount.

Statistics Canada's population counts and BCStats population estimates for the District of Ucluelet for the past 60 years is graphically shown in **Figure 21**.

6.1.2 Hitacu

Statistics Canada

A review of Statistics Canada population counts for the past 35 years (since Year 1986) revealed that the population has fluctuated from a low of 191 in Year 1996 to a high of 321 in Year 2021. During the past 15 years (since 2006), the population steadily increased from 200 in Year 2006 to 321 in Year 2021. This 121 capita increase equates to 8 capita per year (3.2% per year) for the past 15 years.

It is noted that the census counts do not include the YFN members that live off YFN lands. For Year 2012, the YFN population estimated to be living off YFN lands was estimated to be just under 430 as reported in the Yuułuʔiłʔatḥ First Nation Official Community Plan, October 2013.

BCStats

BCStats does not provide population estimates for persons living on First Nations lands.

Statistics Canada's population counts for Hitacu for the past 35 years is graphically shown in **Figure 22**.

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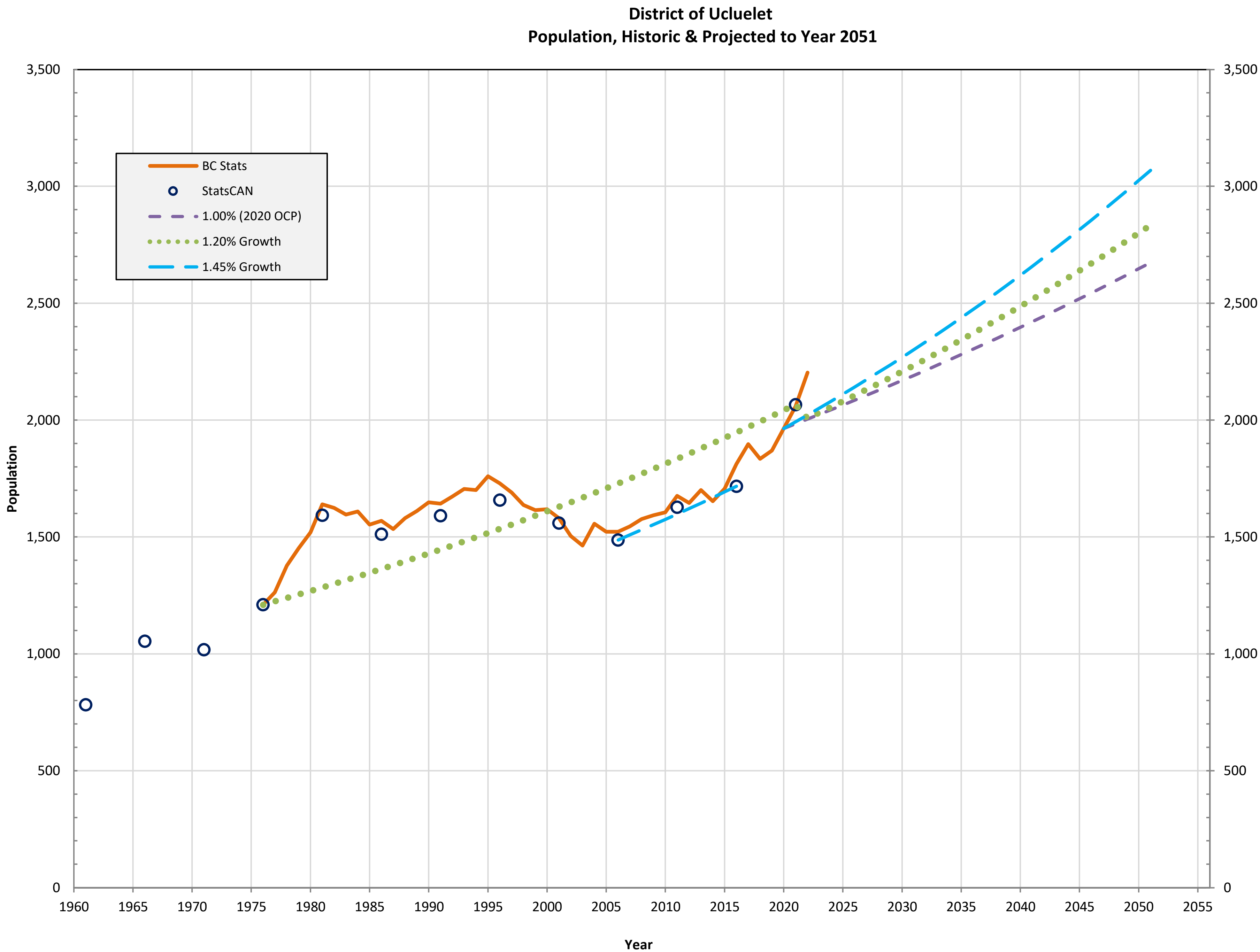

FIGURE 21

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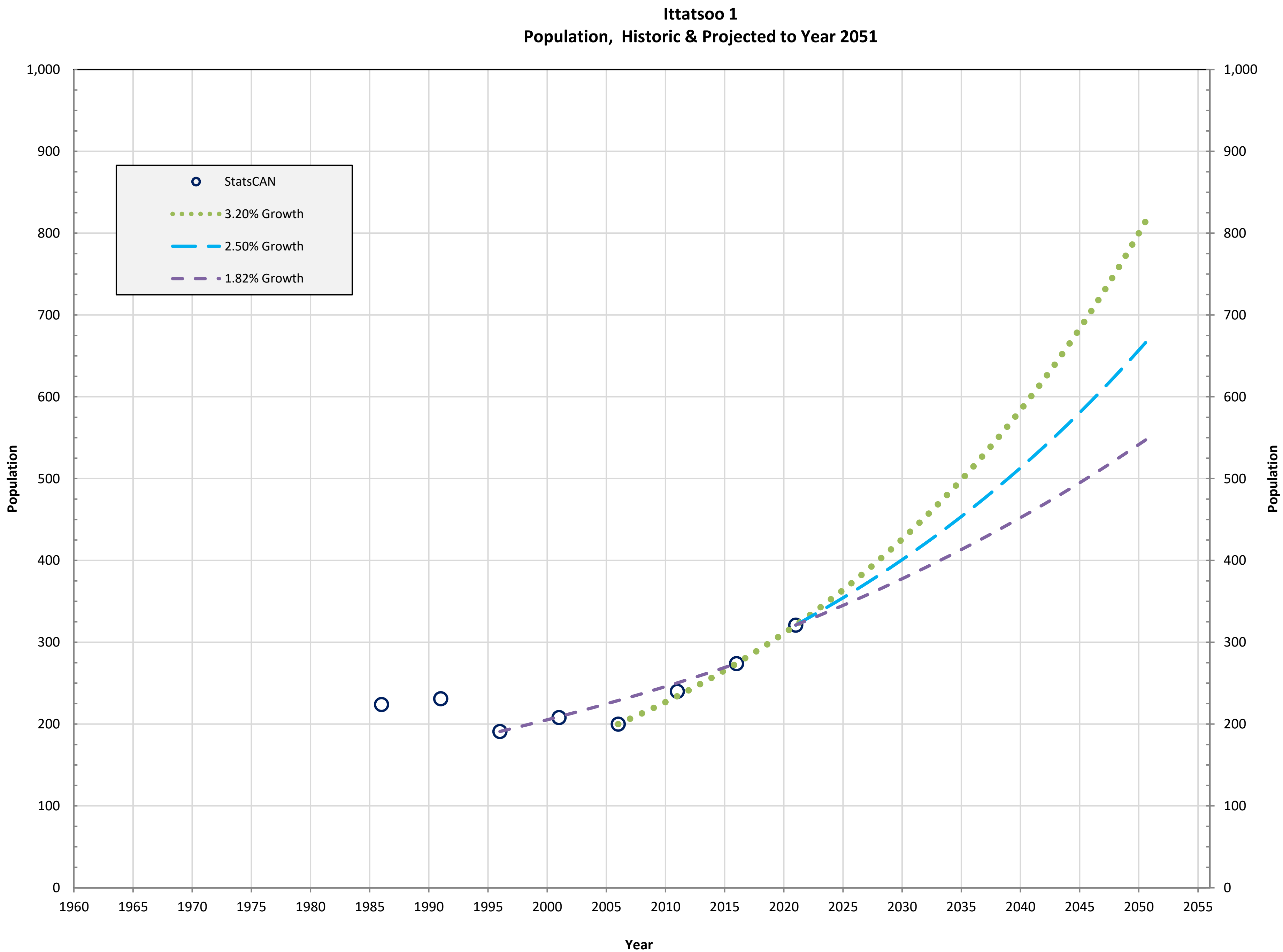

FIGURE 22

6.2 Projected

Population projections for both communities have been developed to Year 2051, a 30 year time frame beyond the last Statistics Canada census (Year 2021) for varying growth rates based on:

- information in their OCP's,
- population projections by BCStats, and
- extrapolation of historical growth rates, as discussed below for each community.

6.2.1 District of Ucluelet

Three growth rates were applied to develop population projections to Year 2051 as follows:

Low: 1.00% per year.
This is the growth rate from the 2020 OCP.

Moderate: 1.20% per year.
This was the historical growth rate for the 45 year period of 1976 to 2021.

High: 1.45% per year.
This was the historical growth rate over the 10 year period of 2006 to 2016.

The population projections for the District of Ucluelet to Year 2051 for each of the three growth rates is graphically shown in **Figure 21**. A summary of the population projections in 10 year increments is presented in **Table 12**.

6.2.2 Hitacu

The 2013 OCP included four population projections (0.5%, 1%, 1.5% and 2%) for the 30 year period spanning from Year 2012 to Year 2042. With consideration of these four growth rates and historical growth rates, three growth rates were applied to develop population projections to Year 2051. These growth rates are:

Low: 1.82% per year.
This was the historical growth rate for the 20 year period of 1996 to 2016.

Moderate: 2.50% per year.

High: 3.20% per year.
This was the historical growth rate for the 15 year period of 2006 to 2021.

The population projections for Hitacu to Year 2051 for each of the three growth rates is graphically shown in **Figure 22**. A summary of the population projections in 10 year increments is presented in **Table 12**.

Table 12 – Ucluelet & Hitacu Projected Populations to Year 2051

Year	DoU	Hitacu	Combined
Canada Census Data			
2001	1,559	208	1,767
2006	1,487	200	1,687
2011	1,627	240	1,867
2016	1,717	274	1,991
2021	2,066	321	2,387
20 Year Increase	507 32 %	113 54 %	620 35 %
Year	**Low Growth**		**Combined**
	1.00%	**1.82%**	
2031	2,190	385	2,575
2041	2,420	460	2,880
2051	2,670	550	3,220
30 Year Increase Slow Growth (%)	604 29 %	229 71 %	833 35 %
Year	**Moderate Growth**		**Combined**
	1.20%	**2.50%**	
2031	2,230	410	2,640
2041	2,515	525	3,040
2051	2,830	675	3,505
30 Year Increase Moderate Growth (%)	764 37 %	354 110 %	1,118 47 %
Year	**High Growth**		**Combined**
	1.45%	**3.20%**	
2031	2,300	440	2,740
2041	2,655	600	3,255
2051	3,065	825	3,890
30 Year Increase High Growth (%)	999 48 %	504 157 %	1,503 63 %

The combined historical and projected populations for the two communities is graphically presented in **Figure 23**.

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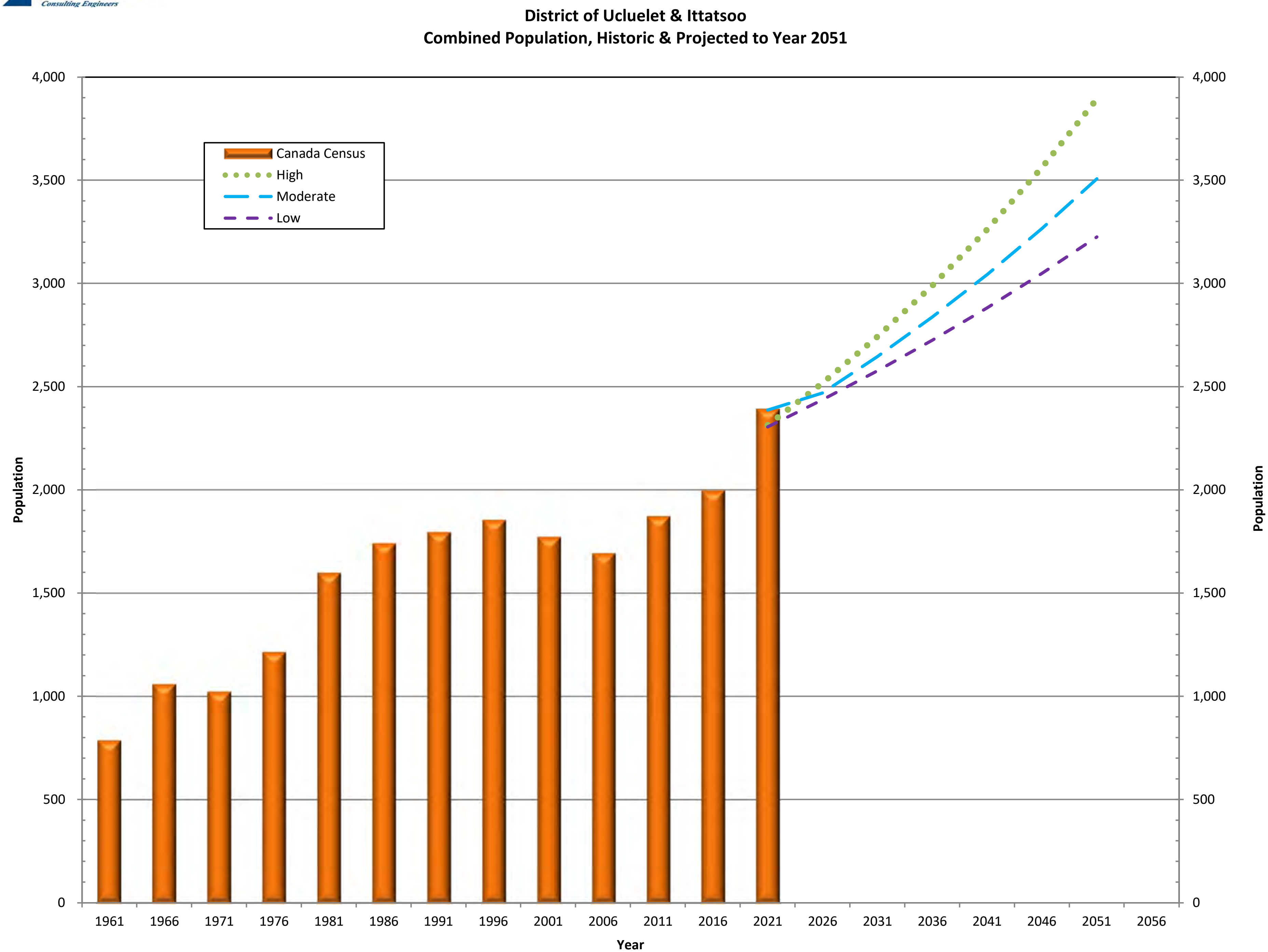


FIGURE 23

7 FUTURE DEVELOPMENT

7.1 District of Ucluelet

On Jan 25, 2022, the District of Ucluelet Council adopted the 2020 Official Community Plan (OCP). The OCP is a statement of objectives and policies to guide Council in decisions on land use planning, management, infrastructure development, protection of natural areas, and development of a vibrant and active community. The OCP is a document projecting 30 Years into the future of what the community of Ucluelet could grow to become.

The OCP served as the basis for identifying how future growth might be serviced and what upgrading works to the existing infrastructure would be required to accommodate the full extent of the development shown in the OCP, specifically Schedule 'A' Long Range Land Use Plan and Map 9 – Low(ish) Growth Scenario. Copies of both are presented in **Figure 24** and **Figure 25**; respectively.

At present, the land area serviced by the collection system encompasses approximately 225 ha. If the extent of development of the next 30 years were to occur as presented in the OCP Map 9 Low(ish) Growth Scenario (see **Figure 25**), the collection system would service an additional 82 ha (36% increase) for a combined total of 308 ha. With the addition of the future potential growth areas (see **Figure 24** & **Figure 25**), the ultimate serviceable land area would encompass a total of approximately 410 ha. An overview of the lands yet to be serviced is presented below.

7.1.1 Undeveloped & Underdeveloped Land Areas

7.1.1.1 Former Forest Land Reserve Lands

Most of the increase in lands to be serviced is associated with the former Forest Land Reserve (FLR) lands (in the north end of the District) that were removed from the FLR in 2002. Two major development proposals have been put forward encompassing most of these lands as follows:

<u>Weyerhaeuser Lands</u> These continuously connected parcels encompass approximately 80 ha of land and include more than 2 kilometres of coast-line along the outer west side (Pacific Ocean) of the Ucluelet Peninsula. Approximately 20 ha of these lands are now serviced by the District's sanitary sewer system with the 600 m extension of Marine Drive north to Cynamocka Road.

The Weyerhaeuser lands are serviced by three existing lift station:

- i Big Beach Lift Station: Services the southern portion of the Weyerhaeuser lands
- ii Forbes Road Lift Station: Services the middle portion of the Weyerhaeuser lands
- iii Olson Bay Lift Station: Services the northern portion of the Weyerhaeuser lands

<u>Former Wyndandsea Golf Course Lands</u> This proposed 145 ha development which began with the development of Signature Circle Drive, collapsed due to the 2010 economic crisis. In 2016, it was taken over by the Onni Group. In July 2018 a new development plan was put forward at a public openhouse. It had a similar amount of residential and tourist commercial development but instead of a golf course, proposed that 37% of the area (54 ha) would be maintained as parks and open green space. This development encompasses waterfront on both the outer west side (Pacific Ocean) and the inner east side (Ucluelet Inlet).

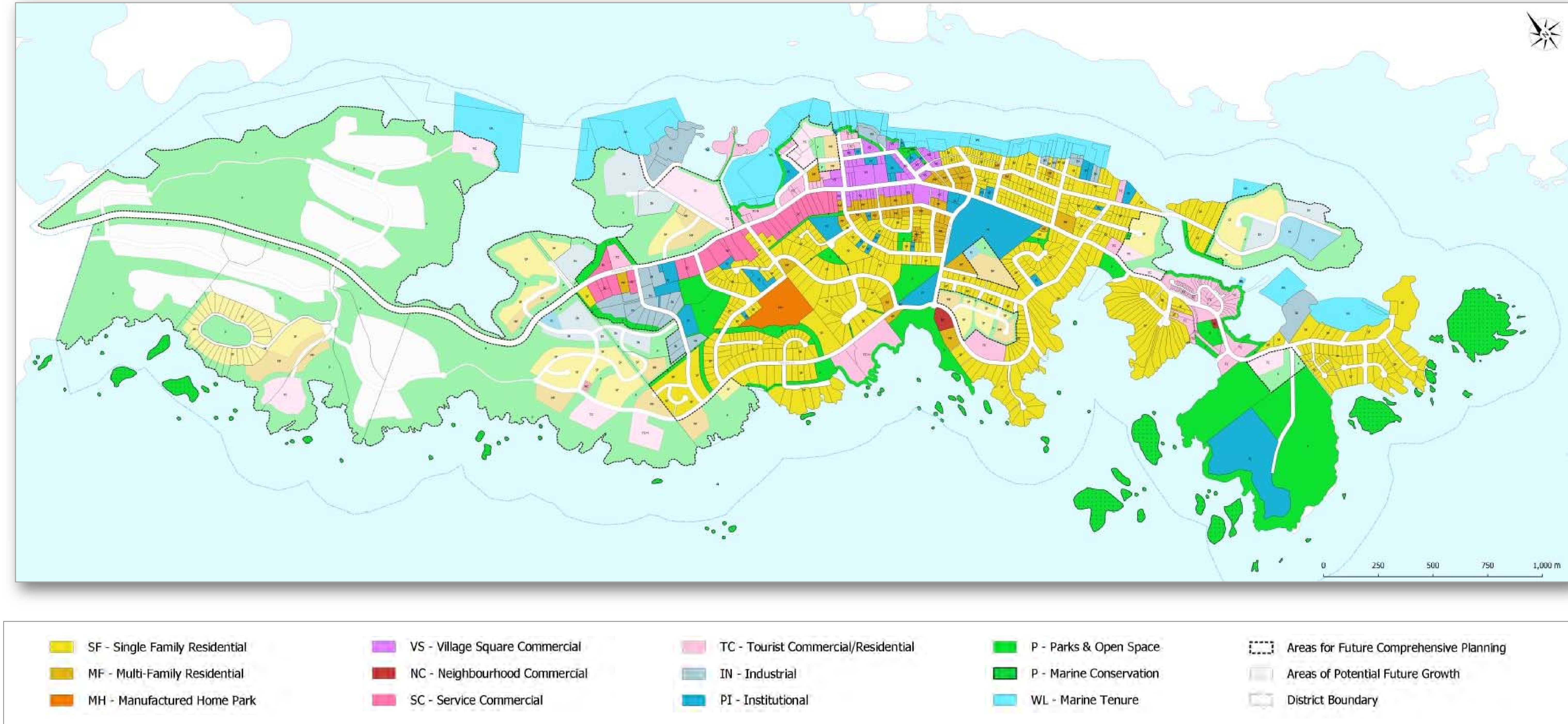


Figure 24 – OCP Schedule A, Land Use Plan

<u>Future Potential Growth Areas</u>

Note that within the scope of the OCP, areas labelled as "Future Potential Growth" may be designated for no development at this time - and to be preserved in their natural state. OCP policy may direct that development in these areas be considered beyond the year 2050. These areas could be considered for development sooner if necessary, by amending the OCP - once an acceptable comprehensive plan is presented showing a community benefit and providing for the servicing to these sites. This is a policy area that should be reviewed as time goes by and as development unfolds outwards from the centre of town.

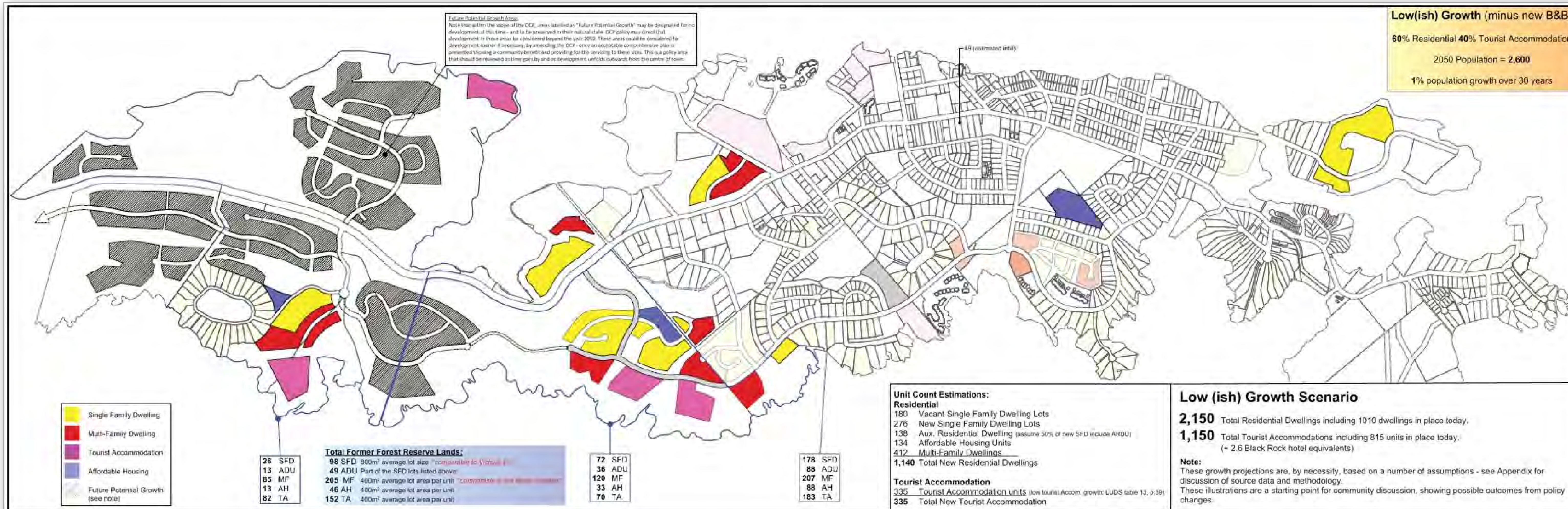


Figure 25 – OCP Map 9, Low(ish) Growth Scenario

These lands will be serviced by the Olson Bay lift station. Depending on how the sewage collection system for these lands is developed, other localized stations may be required to convey flows to the Olson Bay lift station.

Lot 2, DL 471 & DL 472 This large undeveloped parcel of former FLR land is located to the north of Signature Circle Drive and encompasses approximately 30 ha with waterfront on the outer west side (Pacific Ocean). These lands would be serviced by the Olson Bay lift station. Depending on how the sewage collection system for these lands and the adjacent ONNI Group lands (to the south) are developed, one or more localized stations may be required to convey flows to the Olson Bay lift station.

7.1.1.2 Existing Serviced Area

Within the existing service area of the collection system, there are several locations with large undeveloped or only partially developed lands with a combined potential developable area of approximately 50 ha as follows:

Minato Road Area	9 ha
Seaplane Base Road Area	13 ha
Victoria Road	8 ha
Coast Guard Drive	12 ha
Hyphocus Island	8 ha
Total:	50 ha

A brief discussion of each is presented below.

Minato Road Area These parcels of land, encompassing around 9 ha of proposed developable area, are within the Peninsula Road lift station catchment. Depending on how the sewage collection system for the lands along the foreshore (Ucluelet Inlet) area developed, one or more localized stations may be required to convey flows to the Peninsula Road lift station. Alternatively, the Peninsula Road lift station could be relocated to the north end (foreshore) of Minato Road. The viability of relocating the lift station would need to be assessed in conjunction with detailed development plans for this area.

Seaplane Base Road Area These parcels of land total around 13 ha of proposed developable area and include the Ucluelet Campground property, a small apartment building, a community building, and a public boat launch. Detailed design drawings have been developed for construction of a lift station on Seaplane Base Road just north of Harbour Crescent.

Victoria Road There are two large parcels of land, one of either side of Victoria Road Drive, totalling around 7 ha. They can be serviced from gravity services off the gravity main on Victoria Road. There is also an approximately 1 ha parcel on Marine Dr at Matterson Dr that would connect to the existing forcemain on Marine Dr.

Coast Guard Drive These parcels of land total around 12 ha. They consist of approximately 3 ha in and around Peninsula Road and approximately 9 ha in and around the former coast guard building (at the end of Coast Guard Drive) that was recently turned over to the District of Ucluelet.

The lands around Peninsula Road can be serviced with an extension of the gravity main along Peninsula Road that is part of the Reef Point gravity sewer system. Servicing the 9 ha in and around the former coast guard building will require construction of a lift station and a forcemain. The forcemain would discharge to the gravity main along Peninsula Road that is part of the Reef Point gravity sewer system.

Hyphocus Island This development area encompasses approximately 8 ha. A portion of the area could be service by an extension of the gravity main on Helen Road that drains to the Helen Road lift station. Another portion of the area could be serviced by a gravity collection system that would convey flows into the sewage lagoon. Other portion(s) of the area would be serviced by individual lift station(s) that would discharge to either the Helen Road gravity main or the gravity collection system that would convey flows into the sewage lagoon.

A comparison of the land area serviced by the collection system under current conditions and for Low(ish) Growth is presented in **Table 13**. The individual service area for each lift station is presented in **Figure 1**.

7.1.2 Land-Use

The OCP anticipates that most of the lands yet to be developed will be needed for residential development and tourist commercial. A breakdown of the land-use within each lift station catchment area for existing conditions, for Low(ish) Growth, and for Ultimate Build-out is presented in **Table 14**.

Table 13 – Lift Station Catchment Areas, Existing Conditions & OCP Build-Out

Lift Station / Catchment Area		Catchment Area				Comment
		Individual			Existing Cumulative Total (ha)	
		Exist. (ha)	Low(ish) Growth (ha)	Difference (ha)		
1	Olson Bay	-	18	18	-	
2	Peninsula Rd	13	18	5	13	
FPS	*Seaplane Base Rd*	-	*11*	*11*	-	*future lift station*
3	Norah Rd	13	13	-	13	
4	Hemlock St	20	20	-	46	Current receives flow from Peninsula & Norah lift stations.
5	Bay St	1	1	-	1	*Formerly known as Bay St Simplex*
-	Bay St (1)					Lift Station removed June 2020 (1)
6	Fraser Lane	22	22	-	69	Currently receives flow from Hemlock lift station
7	Imperial Lane	1	1	-	1	
8	Forbes Rd	11	42	31	11	
9	Big Beach (1)	42	46	4	53	Bay St catchment added June 2020 (1) Receives flow from Forbes lift station
10	Victoria Rd	18	26	8	71	Currently receives flow from Big Beach lift station
11	Marine Dr	6	6	-	6	
12	Edge/Kimoto (2)	9	9	-	11	Currently receives flow from Elina Rd lift station (private strata lift station)
FPS	*Coast Guard Rd*	-	-	-	-	*future lift station*
13	Reef Pt	29	29	-	40	Currently receives flow from Edge/Kimoto lift station
14	Helen Rd	38	38	-	225	
-	Hyphocus Is.	-	5	5	-	gravity flow to sewage lagoon
-	Hitacu	?	?	?	?	flows to YFN owned WWTP
	Total:	225	307	82	225	

Notes:

1 Bay St lift station decommissioned in June 2020 with the construction of a gravity main to convey flow to the Big Beach lift station.

2 Edge/Kimoto lift station catchment includes 2 ha of catchment area from the private lift station servicing the Elina Rd subdivision.

Table 14 – Land-Use, Existing & Future Ultimate

Lift Station / Catchment Area		Existing Conditions				Low(ish) Growth				Future Ultimate			
		Res ha	Com ha	I/I [(1)] ha	Total ha	Res ha	Com ha	I/I [(1)] ha	Total ha	Res ha	Com ha	I/I [(1)] ha	Total ha
1	Olson Bay					13	5		18	76	8		84
2	Peninsula Rd	1	3	9	13	4	4	10	18	8	4	21	33
15	*Seaplane Base Rd*					3	5	3	11	3	5	8	16
3	Norah Rd/Whispering Pines	9		4	13	9		4	13	9		4	13
4	Hemlock St	3	16	1	20	3	15	2	20	3	15	2	20
5	Bay (simplex)	1			1	1			1	1			1
-	Bay St [(2)]												
6	Fraser Lane	3	17	2	22	6	13	3	22	6	13	3	22
7	Imperial Lane	1			1	1			1	1			1
8	Forbes Rd	10		1	11	30	9	3	42	30	9	3	42
9	Big Beach	30	5	7	42	34	5	7	46	34	5	7	46
10	Victoria Rd	16	2		18	24	2		26	24	2		26
11	Marine Dr	6			6	6			6	6			6
12	Edge/Kimoto [(3)]	11			11	11			11	11			11
16	*Coast Guard Rd*											9	9
13	Reef Pt	16	9	4	29	16	10	4	30	16	10	4	30
14	Helen Rd	27	1	10	38	26	1	11	38	28	2	12	42
-	Hyphocus Is.					5			5	5		3	8
-	Hitacu												
	Total (ha):	134	53	38	225	192	69	47	308	261	73	76	410
	Total (%):	60%	23%	17%	100%	63%	22%	15%	100%	64%	18%	18%	100%

Notes:

1 I/I = Industrial and Institutional lands. Includes park land.

2 Bay St lift station decommissioned in June 2020 with the construction of a gravity main to direct flow to the Big Beach lift station.

3 Includes 2 ha of catchment area from the private lift station servicing the Elina Rd subdivision.

7.1.3 Permanent Residential Housing

The District's OCP indicates there are presently (Year 2020) 1,010 residential dwelling units. The OCP anticipates the permanent population to grow at an annual averaged rate of 1% per year, resulting in a permanent population of 2,600 by Year 2050. To accommodate this growth, an additional 1,140 residential dwelling units are projected to be built consisting of:

180	Existing Vacant Single Family Lots
276	New Single Family Lots
138	Auxiliary Residential Dwellings (1)
134	Affordable Housing Units
412	Multi-Family Dwellings
1,140	Additional Residential Dwelling Units by Year 2050

Notes:

1 Based on 50% of New Single Family Lots having an Auxiliary Residential Dwelling.

The anticipated location for future residential development is shown in **Figure 24**. A summary of the number of existing residential dwelling units by lift station catchment area for Year 2051 are presented in **Table 15**.

7.1.4 Tourist Accommodation

The District's OCP indicates there are presently (Year 2020) 815 tourist accommodation units. By Year 2050, the construction of an additional 335 units is anticipated, resulting in a combined total of 1,150 tourist accommodation units. The anticipated location of these additional units is shown in **Figure 25**. A summary of the number of existing tourist accommodation units by lift station catchment area and for Year 2050 are presented in **Table 15**.

7.2 Hitacu

In 2013, the Yuułuʔiłʔatḥ First Nation (YFN) published an Official Community Plan for the 5,400 ha of land under its control (the District of Ucluelet encompasses 649 ha). The YFN community of Hitacu, where the majority of the YFN people live, is located on the northeast side of Ucluelet Inlet. The District of Ucluelet provides treated water to, and receives sewage back from, the community via two submarine pipelines.

The 2013 OCP has a planning horizon to Year 2042 and notes that "residential land-uses will remain focused at Hitacu, and other lands will be identified for commercial, industrial or tourist focused uses" (page 11). The OCP lists the infrastructure goal of YFN owning their own water and sanitary sewer facilities, including a wastewater treatment plant constructed at Hitacu (page 28).

Table 15 – Dwelling & Accommodation Units, Existing & Year 2050

Lift Station / Catchment Area		Existing			Year 2050		
		Perm. Res.[1] DU	Tourist Accom. [2] DU	Total DU	Perm. Res.[1] DU	Tourist Accom. [2] DU	Total DU
1	Olson Bay	30	-	30	154	82	236
2	Peninsula Rd	5	4	9	149	24	173
FPS	*Seaplane Base Rd*	6	-	6	145	50	195
3	Norah Rd/Whispering Pines	112	-	112	112	-	112
4	Hemlock St	119	249	386	214	289	503
5	Bay (simplex)	16	-	16	16	-	16
-	Bay St [3]						
6	Fraser Lane	99	128	227	135	148	283
7	Imperial Lane	25	1	26	25	1	26
8	Forbes Rd	38	-	38	299	70	369
9	Big Beach	141	229	370	210	249	459
10	Victoria Rd	92	40	132	248	40	288
11	Marine Dr	16	6	22	16	6	22
	Elina Rd (private PS)	13	-	13	13	-	13
12	Edge/Kimoto	64	8	72	64	8	72
FPS	*Coast Guard Rd*	-	-	-	-	-	-
13	Reef Pt	47	94	141	68	112	180
14	Helen Rd	187	56	243	222	71	293
-	Hyphocus Is.	-	-		60	-	60
-	Hitacu	102	-	102	-[4]	-	-[4]
	Total:	1,112	815	1,927	2,150	1,150	3,300

Notes:

1 Perm. Res. = Permanent Residential dwelling unit.

2 Tourist Accom. = Tourist Accommodation dwelling unit.

3 Bay St lift station decommissioned in June 2020 with the construction of a gravity main to direct flow to the Big Beach lift station.

4 For Year 2050, no residential units from Hitacu are shown as it is assumed that the YFN's goal to operate their own wastewater treatment plant (YFN 2013 OCP, page 28) has been achieved.

8 COASTAL FLOOD HAZARD

Coastal flooding can generally be attributed to two mechanisms:

- Storm events, and
- Tsunamis.

The District of Ucluelet Coastal Flood Mapping, Final Report dated June 26, 2020 by Ebbwater Consulting Inc. includes a series of flood hazard maps. The maps were developed based on assessing coastal flood hazards from coastal storms and tsunamis with varying allowances for potential future Sea Level Rise (SLR). A brief summary of the report findings is presented below.

8.1 Coastal Storms & Flood Construction Level

Coastal storm events result in temporary localized rises in sea level that increase as the atmospheric pressure drops and wind speed across the surface of the ocean and shoreline increases.

The Flood Construction Level (FLC) is defined as the elevation of the underside of a wooden floor system or the top of a concrete slab for habitable buildings and is calculated for a design storm event using the following formula:

FCL = HHWLT + SLR + Storm Surge + Wave Effect + Freeboard

Where:

FCL = Flood Construction Level

HHWLT = Higher High Water Large Tide. This is the average of the highest annual tides taken over a 19-year tidal cycle. A value of 2 m was calculated for Ucluelet.

SLR = An allowance for future Sea Level Rise

Storm Surge = Increase in water levels due to the drop in air pressure caused by the storm.

Wave Effect = Increase in water level due to a disturbance on the ocean (generally wind blowing across the surface) plus an increase in water level near the shore from wind blowing over shallow water and pushing it further up onto the shore.

Freeboard = An allowance (for safety) to account for uncertainties with the estimation of the components of the Flood Construction Level. Provincial guidelines state a freeboard of 0.6 m should be applied.

The Coast Flood Mapping report carried out modelling for five storm events:

Storm Event	Frequency of Occurrence	Likelihood of Occurrence	
		Return Period	AEP *
Small	Frequent	15 years	6.7%
Small-Moderate	Moderately Frequent	50 years	2%
Moderate-Large	Moderately Infrequent	100 years	1%
Large	Rare	200 years	0.5%
Very Large	Very Rare	500 years	0.2%

Notes:

* Annual Exceedance Probability (AEP). The likelihood of the storm event occurring in any given year and is calculated using the equation:

AEP = (1 ÷ return period) * 100%

The report developed Flood Construction Levels (FCLs) and flood elevation maps for the following four scenarios:

- A large (rare) coastal storm event (200 year return period storm event), plus
- Allowances for a potential near future sea level rise for two scenarios (0.5 m rise and 1.0 m rise), plus
- 0.6 m of freeboard.

The calculated FCLs for the outer (Pacific Ocean) side of Ucluelet are notably higher than those for the inner (Ucluelet Inlet) side, reflecting the impact of the wave effect. For example, with a 1 m allowance for potential future sea level rise, the FCLs for the Pacific Ocean side ranged from 8.0 m to 14.2 m compared to 4.5 m to 7.5 m for the Ucluelet Inlet side.

8.1.1 Lift Station Flood Construction Levels

A comparison of the ground elevation at each of the existing and future lift stations to the calculated FCLs suggests that ten or eleven of the sites would be above the FCL and five or six would be below the FCL as shown in **Table 16**.

Table 16 – Lift Station Flood Construction Level

Lift Station	Ground Elevation [1] (m)	Projected FCL for 200 Year Event [2] (m)	Ground El. Greater than Projected FLC Yes ✓		No (m)
Existing Lift Stations					
Victoria Rd	16.1	7.6	✓		
Bay St (simplex)	18.4	10.0	✓		
Marine Dr	±14	7.6	✓		
Norah Rd	±16	10.0	✓		
Forbes Rd	16.0	14.2 / 10.0 [3]	✓		
Peninsula Rd (Minato)	7.5	4.5	✓		
Big Beach	11.4	10.0	✓		
Olson Bay	4.7	4.5	✓		
Reef Point	5.8	5.1 / 8.9 [4]	✓	to	-3.1
Edge (Kimoto)	4.8	9.6			**-4.8**
Imperial Lane	2.7	5.1			-2.4
Helen Rd	4.0	5.1			-1.1
Hemlock St	3.6	4.5			-0.9
Fraser Lane	4.0	4.5			-0.5
Future Lift Stations					
Seaplane Base Rd	4.5	4.5	✓		

Lift Station	Ground Elevation [1] (m)	Projected FCL for 200 Year Event [2] (m)	Ground El. Greater than Projected FLC Yes ✓	No (m)
Coast Guard Rd	±15	12.2	✓	

Notes:

1. Existing ground elevations obtained from various sources, e.g., design or record drawings, District contour maps. The accuracy of the data is unconfirmed.
2. FCL = Flood Construction Level. Elevations are from the District of Ucluelet Coastal Flood Mapping, Final Report, Appendix C: Coastal Flood Hazard Map Atlas, Map Series 2/4: Coastal Storm Flood Planning Support, Map 5/5 dated June 26, 2020. This 200 year event has a 0.5% Annual Exceedance Probability (0.5% probability occurring in any given year). The projected FCL elevation is based on:
    - a storm event with a return period of 200 years, plus
    - an allowance of 1.0 m for potential future sea level rise, plus
    - 0.6 m of freeboard.
3. FCL elevations shown are those for Zone 4 / Zone 5 as the lift station is located at the boundary of the two zones.
4. FCL elevations shown are for Zone 14 (Ucluelet Inlet side) / Zone 9 (Pacific Ocean side) as it is unclear which one would govern at the Reef Point lift station.

8.2 Tsunami Inundation/Flooding

A Tsunami is a series of waves in a body of water that are generated by the displacement of a large volume of water. Tsunamis from seismic activity that create long and very fast moving waves resulting in coastline inundation/flooding are a threat in the District of Ucluelet.

The west coast of Vancouver Island is exposed to the generation of tsunamis from four local regional earthquake generating sources:

Under Ocean

- Cascadia Subduction Zone (Juan de Fuca Plate moves under the North American Plate)
- Queen Charlotte Fault (Pacific Plate slides past the North American Plate)

Under Ground

- Shallow (crustal) Earthquake (within the North American Plate)
- Deep underground earthquake (Juan de Fuca Plate well below the North American Plate)

It is believed that the Cascadia Subduction Zone can create the highest magnitude earthquakes and these “megathrust” earthquakes would generate the greatest Tsunami hazard for the District of Ucluelet.

The Coastal Flood Mapping study carried out computer model simulations of a megathrust earthquake utilizing 6 types of earthquake ruptures and four potential future sea level allowances ranging from 0 m to 2 m (a total of 24 scenarios were run). The modelling identified that a splay faulting rupture earthquake (the ground is thrust or spread out and apart) would result in greater inundation/flooding compared to a buried rupture earthquake (no visible offset of the ground surface). It is noted that for the ‘megathrust” earthquake, the computer modelling calculated that the land surface in the District of Ucluelet will subside (drop) by around 2 m.

Six tsunami flood planning maps were created from the computer modelling results. The extent of the tsunami flooding was based on:

- Earthquake location: Cascadia Subduction Zone
- Type of Earthquake rupture: splay faulting or buried
- Starting oceanwater elevation: Higher High Water Large Tide (HHWLT): 2 m elevation
- Ground subsidence (drop): 2 m allowance
- Potential future Sea Level Rise: 1 m allowance
- Safety Factor: 0% or 50% applied to the tsunami runup (elevation)

The calculated tsunami inundation/flooding elevations ranged from:

v) Lowest: 15 m geodetic (for a buried rupture earthquake plus 0% safety factor).
vi) Highest: 27 m geodetic (for a splay faulting rupture plus 50% Safety Factor).

9 COMPUTER MODELLING

9.1 XP-SWMM Program

Computer modelling of existing and OCP Build-Out conditions were carried out using the computer program XP-SWMM; a comprehensive software package that has been in use for over 25 years for planning, modeling, and managing storm drainage and sanitary sewer systems. It is a powerful, user friendly graphical computer program that allows the user to easily change data parameter on an individual or global basis and to interact with the modelling input and output data both graphically and in tabular format. The program can interface with AutoCAD and GIS programs.

The sanitary sewer component of the program is used for:

- Development of sewer master plans
- Inflow & infiltration studies
- Wet weather flows scenarios
- Pumping and pressure sewers
- Prediction of overflows

Sanitary sewer flows can be loaded globally or locally with different allowances for both dry and wet weather flows. Flows may be varied using hourly and daily temporal variation factors. Wet weather (I&I) flows can be incorporated into the model both globally or to specific manholes as constant (base) flows, simulated rainfall, simulated groundwater mounting, unit hydrographs or user defined hydrographs.

Lift stations can be represented as either an in-line lift station or an off-line node representing a wet-well. Up to seven pumps may be assigned to a single lift station, each with their own operating settings, including variable speed pumps. Pump curves, on/off levels and pumping rates based on wet well depth, pump curves and forcemain diameter and lengths can be entered to accurately model existing and proposed conditions.

The program allows displaying of input and output data using layers which can be switched on or off. Background images, AutoCAD drawings or GIS data can be imported into the program for model development and analyses.

Customized tables can be generated for both data input and modelling results. Graphs of model results can be displayed for a single or multiple objects. Up to 16 graphs can be displayed on a single page. Results for any pipe can be viewed by clicking on the pipe. Digital Terrain Models (DTMs) can be incorporated into the model and used for animation of modeling results.

9.2 Data Collection & Entry

Two unique computer models were developed:

- Existing Conditions – Calibrated
- Future Conditions – OCP Build-out with Proposed Design Standards.

A calibrated model was the first to be developed and served as the basis to create the future conditions model. A discussion of how the two models were developed is presented below.

9.2.1 Existing Conditions

The computer model of the sanitary sewer system was developed as follows:

1. The District's sanitary sewer system infrastructure map that we have on file (in AutoCAD) was imported. The imported information included District cadastral (legal property number, civic address, and road name), pipe diameters, pipe slopes, pipe materials, manholes, lift stations and forecemain locations.

2. Lift station information was entered from record drawing and from past reports/studies that we have on file.

3. The District's current zoning information was imported from the plan drawings (in AutoCAD) we have on file.

4. Recent new development and upgrading works, not yet incorporated into the District's infrastructure map (AutoCAD file), were added to the model from the information on available record drawings or design drawings if record drawings were not available.

5. Catchment area boundaries for each lift station and sub-catchment area boundaries for the gravity mains draining into the lift stations were created digitally within the model based on how/where the properties connect to the gravity mains.

6. Permanent residential population for each lift station catchment area was established based on the number of developed residential lots in each catchment area, which were based on airphotos (Year 2017) provided by the District, and the calculated residential population per dwelling based on the Canada 2021 Census data.

7. An average day dry weather flow (ADDWF) model was developed utilizing the available sewage flow data, which came from the flow meter at the outlet of the sewage lagoon and the flow meter at the inlet of the Ittatsoo lift station. The difference between the two was assigned to the District of Ucluelet collection system and was applied throughout the model based on the portion of the permanent residential population assigned to each lift station catchment area.

8. A peak wet weather flow (PWWF) model was developed by applying the estimated peak I/I flow for the District of Ucluelet and for the Ittatsoo Community to the ADDWF model. Estimated peak I/I flow was proportionally added to each lift station based on its individual catchment area.

9. The two computer models were run separately and the peak flow rates into and out of each lift station were reviewed along with the peak flows into the sewage lagoon. The modelling results were reviewed to assess the accuracy of the model and if components of the collection system (gravity mains, lift stations or forcemains) were undersized. It is noted that the calibration of the model for each lift station and its catchment area was limited due to the lack of flow metering data, the numerous assumptions made regarding pump run-hours and pumping flow rates, and limited hourly rainfall data.

9.2.2 OCP Year 2050

The OCP Year 2050 computer model was developed as follows:

Undeveloped Lands and Developed Lands Proposed for Redevelopment/Densification

1. 2020 OCP Land-Use Plan (see **Figure 24**) was added into the model.
2. The amount and type of future development as noted in OCP 2020 Map 9, Low(ish) Growth (see **Figure 25**) was added into the model.
3. A population density of 2.07 capita per dwelling unit was applied to all future residential (Single Family, Auxiliary Residential, Affordable Housing and Multi-Family) and all future Tourist Accommodation units.
4. An average day dry weather per capita design flow of 350 lpcd was applied to future residential and tourist accommodation unit population calculations.
5. A peaking factor of 2.5 was applied to all dry weather flows.
6. A design I/I allowance of 11,200 l/day per hectare was applied to all future development areas.
7. For the Ittatsoo Community, flows were removed as it is assumed that their proposed community sewage treatment and discharge system will be in place by Year 2050.

Modelling Results Analyses

8. The OCP Build-Out computer model was run under peak wet weather flow. The results were reviewed to assess the accuracy of the model and identify the components of the collection system (gravity mains, lift stations or forcemains) that were undersized. The calculated peak flows into and out of each lift station were reviewed along with the peak flows into the sewage lagoon.

9.3 Modelling Results

Table 17 presents a summary of the peak design flows entering each lift station under existing conditions compared to the Year 2050 peak design flows for five routing options based on the point of discharge of various lift stations as follows:

Route A: No changes in lift station points of discharge; same as existing conditions.

Route B: Olson Bay lift station redirected to discharge to the Forbes Rd lift station.

Route C: Olson Bay lift station and Peninsula Rd lift station redirected to discharge to Forbes Rd lift station.

Route D: Route C and Big Beach lift station redirected to proposed gravity main to be installed on Peninsula Rd from Matterson Rd to Marine Dr.

Route E: Route D and Norah Road lift station redirected to discharge to Big Beach lift station via existing gravity main on Rainforest Drive.

The redirection of the discharge of the Olson Bay and Peninsula Road lift stations to the Forbes Road lift station catchment (accounted for with Routing Option B, C, D and E) is contingent on securing a designated corridor between Peninsula Road and Marine Drive to route the forcemain.

Table 17 – Lift Station Design Flows, Existing Conditions & Year 2050

Lift Station / Catchment Area		Routing Option Design Peak Flow (1, 2)							Lift Station Current Pumping Capacity		Comment
		Existing Conditions, (L/s)		Year 2050 - OCP Map 9 Low(ish) Growth					One Pump (3) (L/s)	Both Pumps (3) (L/s)	
		No Change	Norah to Big Beach (4)	A (5) (L/s)	B (6) (L/s)	C (7) (L/s)	D (8) (L/s)	E (9) (L/s)			
1	Olson Bay	-	-	15	15	15	15	15	13	14	Increased pumping capacity may be warranted in the future
2	Peninsula Rd	5	5	23	11 (6)	11 (7)	11 (7)	11 (7)	9	12	Increased pumping capacity required if Olson Bay lift station continues to discharge into this lift station (Route A). Increased pumping capacity may be warranted in the future for Route B, C, D and E
15	*Seaplane Base Rd*			14	14	14	14	14	-	-	*future lift station*
3	Norah Rd	8	8	8	8	8	8	8	8	8.5	
4	Hemlock St	27	21 (4)	52	42 (6)	41 (7)	41 (7)	34 (4)	20	29	**Immediate redirection of Norah Rd forcemain or increase in pumping capacity required (3,4)**
5	Bay (simplex)	1.3	1.3	1.3	1.3	1.3	1.3	1.3	6	7	
6	Fraser Lane	40	34	66	56 (6)	48 (7)	48 (7)	42	48	63	Increased pumping capacity required for Route A and B (3)
7	Imperial Lane	2	2	2	2	2	2	2	2.5	>2	
8	Forbes Rd	4	4	22	30 (6)	41 (7)	41 (7)	41 (7)	31	40	Increased pumping capacity required for Route C, D and E (3)
9	Big Beach	26	29	45	49 (6)	57 (7)	57 (7)	62 (7)	34	44	Increased pumping capacity required for all routing options (3)
10	Victoria Rd	31	37 (4)	51	62	70	17 (8)	17 (8)	23	26	**Immediate redirection of Big Beach forcemain or increase in pumping capacity required (3)**
11	Marine Dr	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.4	>2	
12	Edge/Kimoto	7	7	7	7	7	7	7	14	16	
16	*Coast Guard Rd*										*future lift station*
13	Reef Pt	17	17	17	17	17	17	17	22	25	
14	Helen Rd (4)	89	89	146	146	146	146	146	124	144	Increased pumping capacity required in the future (3)
-	Hyphocus Is.	-	-	4	4	4	4	4	-	-	gravity flow to sewage lagoon
-	Hitacu	6	6	-	-	-	-	-	?	?	flows to YFN owned WWTP by Year 2050
	Total:	95	95	148	148	148	148	148	-	-	

Notes:

1. Design Peak Flows based on the District's Subdivision Services Control Bylaw No. 521, Schedule "B" Engineering Standards and Specifications, Sanitary Sewers, 1.1 Sewage Quantity.
2. Peak flow values in red text indicate they exceed the current pump capacity of the lift station.
3. The Lift Station Current Pumping Capacity pumping rates are theoretical calculations which are graphically shown in **Appendix A** for each lift station. The actual pumping rates are not known as there are no flow meters at any of the lift stations except for the Helen Road lift station. Duplex lift stations (equipped with two pumps) are to be capable of conveying the peak flow with one pump operating.
4. Redirection of the Norah Rd lift station forcemain to discharge to the Big Beach catchment would have the immediate impact of reducing flows to the Hemlock Rd lift station which in turn would immediately reduce flows to the Fraser Lane lift station but would increase flows to the Big Beach lift station. This scenario would replace the pumping of flows by two lift stations (Hemlock and Fraser) with one (Big Beach).
5. Route A – No changes in lift station points of discharge; same as existing conditions.
6. Route B – Olson Bay lift station redirected to discharge to the Forbes Rd lift station.
7. Route C – Olson Bay lift station and Peninsula Rd lift station redirected to discharge to Forbes Rd lift station.
8. Route D – Route C and Big Beach lift station redirected to proposed gravity main to be installed on Peninsula Rd from Matterson Rd to Marine Dr.
9. Route E – Route D and Norah Rd lift station redirected to discharge to the Big Beach lift station via the existing gravity main on Rainforest Dr.
10. These lift stations are estimated (inferred) to be receiving high I&I flows based on a review of pump run-hours (see **Table 7**). Upgrading of their pumping capacity may be deferred with the reduction of I&I flows to each station. A reduction in I&I to Hemlock will result in an automatic reduction at the Fraser Lane lift station and the Helen Road lift station.

10 PROPOSED WORKS

As the District continues to grow and develop, municipal infrastructure must be renewed or developed to pro-actively address future community needs. The Sanitary Master Plan identifies infrastructure works that are anticipated to support growth based on the OCP. These works will be phased over time in response to actual growth patterns, funding, and Council direction.

Capital works have been identified to maintain the current system and to support growth based on the OCP. While some of the works would be phased incrementally and reviewed and refined as needs are confirmed, this long-range planning helps ensure short-term investments will support a range of long-term scenarios. The proposed capital works are discussed below, and their locations are shown in **Figure 26**.

The proposed capital works are based on the implementation of Routing Option E.

10.1 Immediate-Term

10.1.1 Infiltration & Inflow Identification and Reduction Program

Based on the findings in **Table 7** and **Table 8**, a system wide Inflow & Infiltration source identification and reduction program should be implemented. The two most common methods used in identifying the sources and locations of I/I are:

- Flow Metering
- Video Inspection and Smoke Testing

Flow Metering

The installation of flow monitoring equipment such as flow meters on the forcemains, or possibly the Zylem MultiSmart Controller at each lift station equipped with Flygt pumps, would allow the District to confirm dry and wet weather flows and volumes. The resulting data could then be used to identify the extent of I/I in each lift station catchment and to undertake works (video inspection and smoke testing) to the identify location and sources of I/I. Once the location and sources are identified, repair works could then be carried out.

As a number of the District's lift stations receive flows from one or more other District owned lift stations (e.g., Hemlock receives flow from Peninsula and Norah lift stations), installation of flow metering equipment beginning with those stations with very high increases run-hours that pump to other stations is suggested in the following order:

i) Peninsula
ii) Norah
iii) Hemlock
iv) Big Beach
v) Edge/Kimoto
vi) Reef Point
vii) Bay St
viii) Fraser Lane
ix) Imperial Lane
x) Victoria
xi) Marine

Video Inspection and Smoke Testing

Video inspection of gravity mains when the groundwater level is high (the fall and winter months) is an important tool in identifying the locations of Infiltration. Smoke testing is used to identify the

FIGURE 26
PROPOSED SANITARY SEWER SYSTEM, YEAR 2050

locations where surface runoff flows directly into the gravity mains. The approximate lengths of gravity mains within each lift station catchment area for video inspection and smoke testing are shown in **Table 18**.

Table 18 – Length of Gravity Main by Lift Station Catchment Area

No.	Lift Station	Length of Gravity Main m
1	Peninsula Rd	880
2	Norah Rd	560
3	Hemlock St	1,740
4	Big Beach (2,120 m)	
	a) Bay St/Holy Cres	1,300
	b) Rainforest/Marine Dr	820
5	Edge/Kimoto	1,145
6	Reef Pt	960
7	Bay St (simplex)	160
8	Fraser Lane	2,015
9	Imperial	360
10	Forbes Rd	600
11	Victoria Rd	615
12	Marine Dr	220
13	Helen Rd	3,225
14	Olson Bay	230
	Total Length:	14,830

10.1.2 Lift Station Forcemain Point of Discharge Relocation

Big Beach Lift Station Forcemain

The forcemain from this lift station discharges to the gravity main on Victoria Road that conveys flows to the Victoria Road lift station. This forcemain is to be redirected to discharge into the recently constructed (completed in November 2022) 375 mm dia. gravity trunk main along Peninsula Road (from Matterson Drive to Otter Place). This redirection work requires the installation of ± 430 m of 300 mm dia. forcemain from Victoria Rd to Matterson Drive, which has been just completed (June 2023) but has not yet been commissioned.

The redirection of the forcemain will result in the much needed immediate reduction in flow going to the Victoria Road lift station as the current design flows into the Victoria Road lift station are very close to the calculated pumping rate for the lift station (as noted in **Table 17**).

The redirection of the forcemain point of discharge combined with the increasing of the pumping capacity of the Big Beach lift station will necessitate:

- the construction of the 375 mm dia. gravity main extension along Peninsula Rd (between Otter St and Marine Drive),
- the upgrading of the gravity main along Marine Drive (Rupert Rd to Helen Rd), and
- the upgrading of the gravity main along Helen Rd (Marine Dr to 1141 Helen Rd)

Norah Rd Lift Station Forcemain

The forcemain from this lift station discharges to the gravity main on Norah Road that conveys flow to the Hemlock Road lift station. The existing conditions peak design flow (27 L/s) into the Hemlock lift station is greater than its design pump rate (20 L/s) as shown in **Table 17**. Redirecting the point of discharge of the Norah Road lift station to discharge into the existing gravity main on Rainforest Drive would reduce the peak flows into the Hemlock lift station but would increase flows into the Big Beach pump station (see **Table 17**). The redirection of the forcemain would require, as a minimum:

- ±110 m of forcemain on Rainforest Drive from Norah Road to near (south of) 853 Rainforest Drive.
- a blow-off on the forcemain at the local low spot (south of 869 Rainforest Drive).
- modification of the pumps (possibly larger diameter impellers) to ensure no reduction in pumping rate capacity.

Given the age of the existing forcemain and resulting increase in the pump station operating head (estimated to be in the range of ±4 m):

- replacement of the existing forcemain may be required.

The redirection of the forcemain to the Big Beach lift station catchment would:

- accelerate the need to for construction of the gravity main along Peninsula Road (Otter to Main) as discussed below under **10.1.3 Proposed Gravity Trunk Main** and upgrading the gravity main on Marine Drive (Rupert to Helen) and along Helen Road (Marine Drive to 1141 Helen Rd) as discussed below under **10.1.4 Proposed Gravity Upgrades**.
- Alleviate flows to the Hemlock Rd and Fraser Lane lift stations, which may facilitate some of the proposed development in the Peninsula Rd lift station in advance of the redirection of the Peninsula Road lift station forcemain to the Forbes Road lift station catchment.

10.1.3 Proposed Gravity Trunk Main

Peninsula Road, Otter St to Marine Dr

Installation of ±390 mm of 375 mm dia. gravity main is required to facilitate the redirection of the Big Beach lift station forcemain (Option D & E). This main will connect to recently installed 375 mm dia. gravity main between Matterson Drive and Otter Street (completed in November 2022) and the existing 375 mm dia. gravity main stub at 1260 Peninsula Road. This main will service:

- the Big Beach lift station, and
- properties along both side of Peninsula Road.

This gravity main will facilitate the redirection of the points of discharge for two other lift stations associated with Option D (Olson Bay and Peninsula Road lift station forcemains to the Forbes Road lift station catchment) and the redirection of the Norah Road lift station forcemain associated with Option E. These forcemain redirections will:

- free up capacity in the gravity trunk mains in the Hemlock Rd and Fraser Lane collection systems, and
- free up pumping capacity at the Hemlock and Fraser Lane lift stations so they can better accommodate future growth, including growth in the Peninsula Road lift station catchment.

The removal of the Big Beach lift station forcemain from discharging into the Victoria Road catchment eliminates the need for the upgrading of:

- ±400 m of 200 mm dia. gravity main along Victoria Rd (Matterson and Marine),
- the pumping capacity of the two pumps in the Victoria Rd lift station,
- the Victoria Road lift station forcemain (±400 m of 150 mm dia.),

and

- frees up capacity in the gravity main along Victoria Road and pumping capacity at the Victoria Road lift station. This will better accommodate future development of the two largest undeveloped properties in the Victoria Road lift station catchment:

  i) Lot 16, DL 281 (proposed 113 unit residential development)
  ii) Rem. DL 281 (potential ±84 residential units)

10.1.4 Gravity Main Upgrades

Marine Drive, Rupert Rd to Helen Rd
The ±80 m of 200 mm dia. AC gravity main is to be replaced with a 375 mm dia. pipe with a minimum grade of 1.0%. This work is to be carried out in conjunction with the proposed gravity main on Peninsula Road between Otter Street and Marine Drive (**10.1.3 Proposed Gravity Trunk Main**) and the project noted below.

Helen Road, Marine Dr to 1141 Helen Rd
The ±125 m of 200 mm dia. AC gravity main at 0.33% is to be replaced with a 375 mm dia. pipe with a minimum grade of 1.0%. This work is to be carried out in conjunction with the above project (**Marine Drive, Rupert Rd to Helen Rd**) and with the proposed gravity main on Peninsula Road between Matterson Drive and Marine Drive (**10.1.3 Proposed Gravity Trunk Main**).

Peninsula Road, Norah St to Lyche Rd
The ±170 m of 150 mm dia. AC gravity main (at a reported slope of 2.44%) is to be replaced with 250 mm dia. pipe at the same or steeper slope to accommodate future growth and match the diameter of the existing main (250 mm) upstream and downstream of it.

Peninsula Road at Seaplane Base Road
Allowance is to be made for the connection/discharge into the gravity sanitary main along Peninsula Road at Seaplane Base Road of the future forcemain from the future Seaplane Base Road lift station.

Hemlock Street, Lyche Rd to Existing Lift Station
The ±115 m of 200 mm dia. AC gravity main (at a reported 0.52% to 0.56% slope) is to be replaced with a 250 mm dia. pipe at the same or steeper slope to accommodate future growth and match the diameter of the existing main (250 mm) upstream and downstream of it.

If the Hemlock Road lift station is relocated to near the Lyche Road intersection in order to be above the future 200 year Flood Construction Level (see **Table 16**), the pipe slope would need to be reversed. Preliminary review suggests this reverse graded pipe could be 200 mm dia.

10.1.5 Gravity Main Relocation/Replacement

Peninsula Road, Hemlock St to Main St
District staff have indicated that the 100 mm dia. gravity main in the rear yard SRW (from 1816 Peninsula Rd to 1728 Peninsula Rd) requires regular (weekly to monthly) maintenance (cleaning/flushing). The existing diameter is less than the minimum design standard (200 mm) and its installation in the rear yard SRW is problematic and a hinderance to ongoing O&M. A new main (minimum 200 mm dia.) should be constructed within the existing road allowances (Bay Street and

Peninsula Road) and the 100 mm dia. main abandoned. The service connections for the properties connected to the rear yard SRW will need to be re-directed to the new main along Bay Street and Peninsula Road).

Bay Street Area
District staff have indicated that the gravity mains in the Bay Street catchment area are in poor condition and in need of replacement.

The diameter of several of the mains are less than the minimum design standard (200 mm dia., except where 150 mm dia. is acceptable for the last section of residential sewer where future extension is not possible).

A total length of 1,180 m of gravity main is within the Bay Street area. This includes 465 m in rear and/or sideyard SRWs. District staff have indicated a preference to relocate these mains into the road allowances as much as possible due to accessing the mains in the SRWs for O&M is very problematic.

10.1.6 Lift Station Pumping Capacity Increases

Hemlock Lift Station
The existing conditions peak design flow into the station (27 L/s) is greater than the design pumping rate from the station (20 L/s) as shown in **Table 17**. Increasing the pumping capacity to 34 L/s would support the implementation of routing option E, which is based on the redirection of the Olson Bay and Peninsula Road lift station forcemains to the Forbes Road lift station catchment and the Norah Rd lift station to the Big Beach lift station catchment (see **Table 17**). This pumping rate increase would accommodate future growth within the Hemlock Road lift station catchment and flows from the proposed Seaplane Base Rd lift station.

Increasing the pumping rate beyond 34 L/s to support routing options A, B, C or D (see **Table 17**) would result in the need to:

- upgrade gravity mains in the Fraser Lane lift station catchment area that receive flows from the Hemlock Rd lift station, such as the ±150 m of existing 250 mm dia. of gravity trunk main at 0.5% on Cypress Rd and Park Lane,
- increase the pumping rate of Fraser Lane lift station, and
- upgrading gravity mains in the Helen Road lift station catchment area that receive flows from the Fraser Lane lift station, such as the ±560 m of the 300 mm dia. gravity trunk main at 0.5% (±330 m along Eber Rd and ± 230 m along the foreshore).

It is noted that the ground elevation of the existing Hemlock St lift station is reported to be between 3.0 m and 3.6 m geodetic, which is below the future 200 year Flood Construction Level elevation of 4.5 m geodetic (see **Table 16**). Ground elevations at or above 4.5 m geodetic are to the east along Waterfront Drive or to the south near the Lyche Road intersection. Relocation of the lift station to higher ground would impact upgrading work of the existing gravity main along Hemlock Road (see **10.1.4 Gravity Main Upgrades**, ***Hemlock Street, Lyche Rd to Existing Lift Station***).

Victoria Road Lift Station
The existing conditions peak design flow into the station (31 L/s) is greater than the design pumping rate from the station (23 L/s) as shown in **Table 17**. Increasing the pumping capacity is required until the point of discharge from the Big Beach lift station can be redirected to Peninsula Road and

discharge into the proposed 375 mm dia. a gravity main to be constructed between Otter St and Marine Dr (see **10.1.3 Proposed Gravity Trunk Main, *Peninsula Road, Otter St to Marine Dr***).

10.2 Longer-Term

10.2.1 Gravity Main Upgrades

100 mm & 150 mm Dia. Mains

There are many mains throughout the District that are less than the minimum design standard. Mains should have a minimum diameter of 200 mm. The exception to this would be the last section of a residential sewer where future extension is not possible and a 150 mm dia. is acceptable; subject to design flow review.

10.2.2 Gravity Main Extension

Peninsula Road, 1002 Peninsula Rd to Coast Guard Rd

The existing gravity sanitary main that ends at 1002 Peninsula Road is to be extended to service the future development of 985 Peninsula Road and the forcemain from the future Coast Guard lift station. The need for this extension would be driven by development.

10.2.3 Lift Station Electrical/Control Kiosks & Emergency Power

In addition to the installation of flow metering at each lift station (see **10.1.1 Infiltration & Inflow Identification and Reduction Program**), the ongoing relocation of lift stations electrical equipment and controls from metal kiosks to concrete block building and installation of an emergency standby power generator with automatic transfer switch should continue. This includes:

- Hemlock Road lift station (Immediate-Term project)
- Fraser Lane lift station
- Norah Road lift station (emergency standby power generator already in place)
- Peninsula Road lift station
- Edge/Kimoto lift station
- Marine Drive lift station

10.2.4 Lift Station Pumping Capacity Increases

In addition to increasing the pumping capacity of the Hemlock Rd and Victoria Rd lift stations (see **10.1.6 Lift Station Pumping Capacity Increases**) pumping capacity increase has been identified for an additional six lift stations (see **Table 17**). All eight lift stations identified for upgrading are:

Lift Station	Routing Option Requiring Pumping Capacity Increase				
Olson Bay	A	B	C	D	E
Peninsula Rd	A	B	C	D	E
Hemlock Rd	A	B	C	D	E
Fraser Lane	A	B	-	-	-
Forbes Rd	-	-	C	D	E
Big Beach	A	B	C	D	E
Victoria Rd	A	B	C	-	-
Helen Rd	A	B	C	D	E

10.2.5 Lift Station Forcemain Point of Discharge Relocation

A flow diagram of how the lift stations are to ultimately function within the overall system is shown in **Figure 27**.

Olson Bay Lift Station Forcemain
The forcemain from this lift station presently discharges to a gravity main on Peninsula Road that then conveys flow to the Peninsula Road lift station. Ultimately, the Olson Bay lift station forcemain is to be redirected to discharge to the Forbes Road lift station (Option B, C, D & E). This redirection will alleviate flows in the Peninsula, Hemlock and Fraser lift station catchment areas and reduce the peak flows required to be pumped by each of these stations.

The timing of this diversion is dependent on several factors, including but not limited to:

i) a designated corridor between Peninsula Road and Marine Drive to route the forcemain.

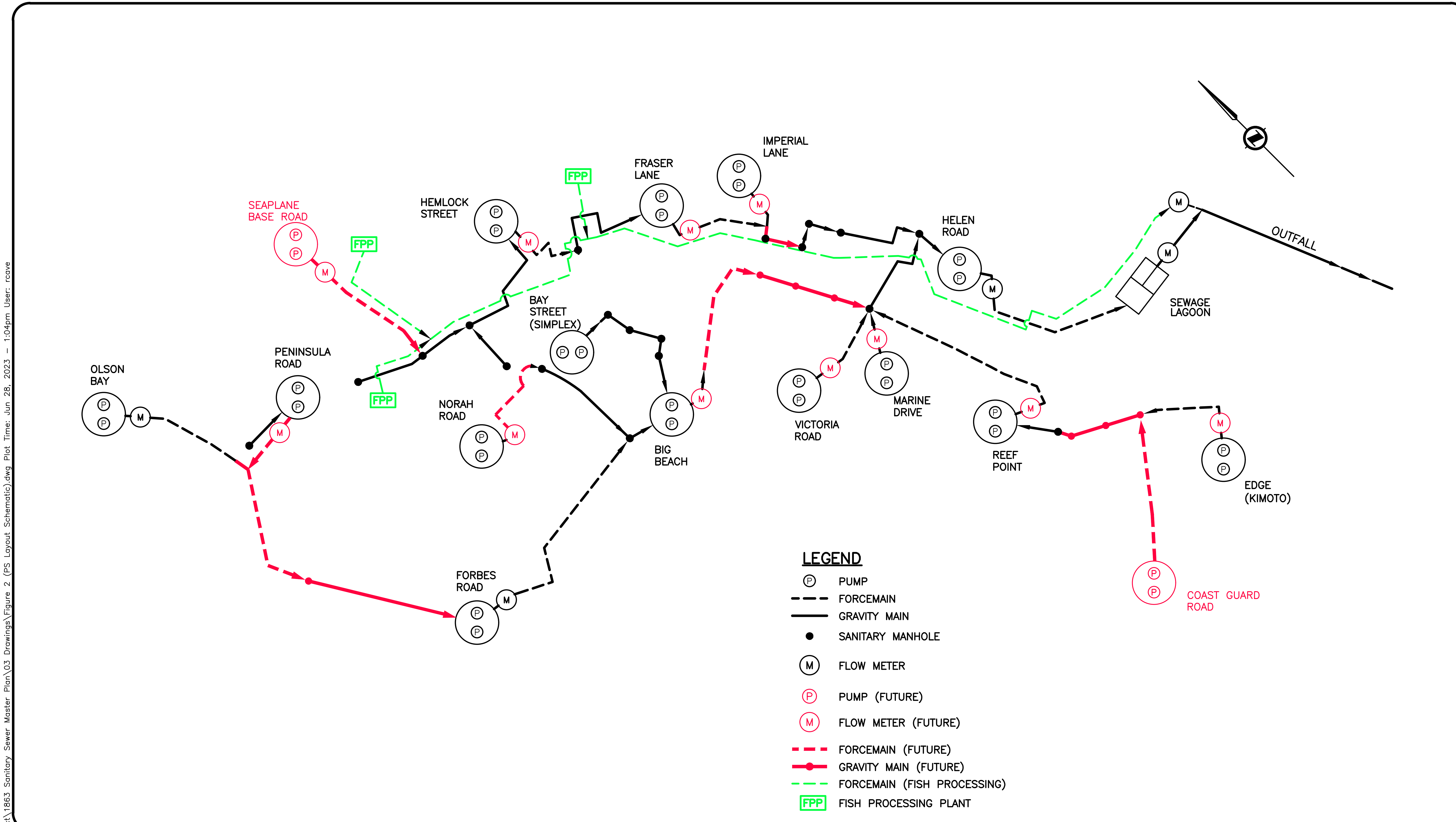
ii) capacity limits being reached on the sanitary collection system (gravity mains and lift station maximum pumping rates) between the Peninsula Road lift station and the Helen Road lift station.

The redirection of the Olson Bay lift station forcemain add flows to the Forbes Road lift station which eventually require an increase the pumping capacity of the Forbes Road lift station, which will lead to the need to increase the pumping capacity of the Big Beach lift station. Prior to increasing the Big Beach lift station pumping capacity, the gravity trunk main along Peninsula Road from Otter St to Marine Dr will need to be in place (see **10.1.3 Proposed Gravity Trunk Main, *Peninsula Road, Otter St to Marine Dr***).

Peninsula Road Lift Station Forcemain
The forcemain from this lift station presently discharges to the gravity main on Peninsula Road that conveys flow to the Hemlock Road lift station. Ultimately, the Peninsula Road lift station forcemain is to be redirected to discharge to the Forbes Road lift station (option C, D & E). This redirection will alleviate flows in the Hemlock and Fraser lift station catchment areas and reduce the peak flows required to be pumped by both lift stations.

The factors determining when this redirection is needed are the same as those for the Olson Bay lift station forcemain redirection (see above under ***Olson Bay Lift Station Forcemain***).

Fraser Lane & Imperial Lane Lift Station Forcemain
District staff have indicated the desire to eliminate the section of the forcemain that is installed in the foreshore (between Otter St and Garden St) because of the difficulty in accessing it when repair work is needed. The forcemain can be redirected up Otter St to discharge into the gravity sanitary main on Helen Road at the intersection of Otter St. This will precipitate the need for upgrading the 155 m of 200 mm dia. gravity main on Helen Road between Otter St and Garden St to 250 mm dia.



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CLIENT: DISTRICT OF UCLUELET

PROJECT: SANITARY MASTER PLAN

TITLE: SEWAGE LIFT STATION SCHEMATIC FUTURE CONDITIONS

APPROVED		SCALE	Not to Scale
DATE	JUNE 2023	DWG No.	FIGURE 27
PROJECT No.	1863		

File: H:\8250 Ucluelet District\1863 Sanitary Sewer Master Plan\03 Drawings\Figure 2 (PS Layout Schematic).dwg Plot Time: Jun 28, 2023 - 1:04pm User: rcave

10.2.6 Future Lift Stations

It is anticipated that over time, two additional municipal lift stations will be constructed in response to development. They are:

Seaplane Base Road Lift Station
This lift station would service existing and future development along Seaplane Base Road and Harbour Crescent. Detailed design drawings for this lift station were completed for the District of Ucluelet in December 2020 and used in support of a federal/provincial grant funding application.

The forcemain from the lift station would discharge to the gravity main on Peninsula Road which conveys flows to the Hemlock Road lift station.

Coast Guard Road Lift Station
This lift station would service existing and future development of the more than 18 hectares of land in and around the former federal Coast Guard building that were turned over to the District of Ucluelet in 2017.

The forcemain from the proposed Coast Guard Road Lift Station would discharge to the future gravity extension on Peninsula Road that would service 985 Peninsula Rd (see **10.2.2 Gravity Main Extension**, ***Peninsula Road, 1002 Peninsula Rd to Coast Guard Rd***).

11 COST ESTIMATES & SCHEDULE

11.1 Basis of Cost Estimates

The estimated project costs in this report are **Class D** (±50%) as defined by Engineers & Geoscientists BC as:

> "An estimate which, due to little or no site information, indicates the approximate magnitude of cost of the proposed project, based on the client's broad requirements. This overall cost estimate may be derived from lump sum or unit costs for a similar project. It may be used in developing long term capital plans and for preliminary discussion of proposed capital projects."

11.2 Cost Estimate Source

Cost estimates are derived from on our in-house construction lump sum and unit cost data of similar municipal infrastructure construction projects for the mid-Vancouver Island area.

The estimates are Class D and as such have been developed without any preliminary design input and are based a number of assumptions and unknowns at this time.

11.3 Allowances

The cost estimates presented in this report include an allowance of 40% for contingencies and engineering, reflective of the class of the cost estimate (Class D).

11.4 Time Frame

Construction cost estimates have a limited life span and are subject to inflation and market conditions. The estimates in this report are as of June 2023 when the Engineering News Record Construction Cost Index (ENR CCI) was 13,345 and the local (Vancouver Island) construction market was considered to be active.

Significant inflation has occurred since the beginning of this year and inflationary pressures are expected to continue over the immediate term. The estimated project costs (Class D) will need to be reviewed and updated as part of future project budget planning processes, beginning as early as next year.

11.5 Proposed Works

11.5.1 Immediate-Term Works

The Class D (order-of-magnitude) cost estimate for each of the proposed works discussed in 10.1 Immediate-Term are presented in Table 19 and followed by a brief description of the project.

The purpose of the projects listed in **Table 19** is to address one or more of the following needs of the sanitary sewer collection system:

- I&I Identification and Reduction,
- Infrastructure Renewal, and/or
- Support future development.

The location of each of the recommended projects is shown on:

- **Figure 26**, and
- **Dwgs Nos. 183-SAN-1 to -4**.

Table 19 – Proposed Works, Immediate-Term

No.	Description	Quantity	Unit Cost ($)	Class D Cost Estimate (Rounded)
	Infiltration & Inflow Identification and Reduction Program			
1	Lift Station Flow Meters	11	$ 50,000	$ 550,000
2	Gravity Main Video Inspection & Smoke Testing	14,800 m	$ 20	$ 300,000
3	Manhole Rehabilitation	30	$ 6,700	$ 200,000
4	Bay St Area Sewer Main Replacement	1,200 m	$ 2,080	$ 2,500,000
5	Gravity Sewer Main Replacement (other areas)	1,500 m	$ 1,665	$ 2,500,000
	Lift Station Forcemain Point of Discharge Relocation			
6	Big Beach Lift Station	430	(constructed in June 2023)	
7	Norah Rd Lift Station	450	$ 1,535	$ 690,000
	Proposed Gravity Trunk Main			
8	Peninsula Rd, Otter St to Marine Dr	390	$2,100	$ 820,000
	Gravity Main Upgrades & Relocations			
9	Marine Dr, Rupert Rd to Helen Rd	80 m	$ 2,100	$ 170,000
10	Helen Rd, Marine Dr to 1141 Helen Rd	125 m	$ 2,100	$ 260,000
11	Peninsula Rd, Norah St to Lyche Rd	170 m	$ 2,500	$ 425,000
12	Peninsula Rd at Seaplane Base Rd	20 m	$ 2,500	$ 50,000
13	Hemlock St, Lyche Rd to Existing Lift Station	115 m	$ 1,900	$ 220,000
14	Peninsula Rd, 1860 Pen Rd to 1816 Pen Rd	70 m	$ 2,500	$ 175,000
15	Peninsula Rd, 1620 Pen Rd to Bay St	285 m	$ 2,500	$ 702,000
15	Bay St, Peninsula Rd to 1800 Bay St	40 m	$ 1,900	$ 75,000
15	Sideyard SRW, 1685 Pen Rd and 1638 Cedar Rd	150 m	$ 1,900	$ 285,000
	Lift Station Upgrades			
16	Hemlock Rd Lift Station	1		$ 1,700,000
17	Victoria Rd Lift Station	1		$ 250,000
	Infiltration & Inflow Reduction Program Total:			$ 6,050,000
	Lift Station Forcemain Point of Discharge Relocation Total:			$ 690,000

No.	Description	Quantity	Unit Cost ($)	Class D Cost Estimate (Rounded)
	Proposed Gravity Trunk Main Total:			$ 820,000
	Gravity Upgrades & Relocations Total:			$ 2,265,000
	Lift Station Upgrades Total:			$ 1,950,000
	Immediate-Term Total (excluding GST):			**$ 11,890,000**

Notes:

Infiltration & Inflow Identification and Reduction Program

1 *Lift Station Flow Meters - $ 550,000*

Estimated typical cost for installation of a flow meter in a chamber on the lift station forcemain. No specific allowance has been made for trench rock excavation or upgrading of the District's SCADA system for remote monitoring and automatic recording of the meter. A potential alternate option might be the installation of the Zylem MultiSmart Controller for those lift stations with Zylem/Flygt pumps. See **10.1.1 Infiltration & Inflow Identification and Reduction Program**, ***Flow Metering*** for suggested priority of flow meter installations. The lift stations on which flow meters are to be installed are shown in **Figure 27**.

2 *Gravity Main Video Inspection & Smoke Testing - $ 300,000*

The Unit Cost assumes at least 10% of the District's ±14,800 m of gravity sanitary sewer mains is video inspected and smoke tested at any one time. If 10% is done each year, it will take a total of ten (10) years to complete.

3 *Manhole Rehabilitation - $ 200,000*

This estimate allows for the rehabilitation of 10% of the District's ±230 sanitary sewer manholes and 20 sanitary cleanouts. Rehabilitation of manholes to reduce infiltration would encompass such things as: sealing of leaks in the manhole barrel/ wall, replacement/installation of gaskets between manhole rings, sealing of the interface between the manhole barrel and the manhole base, sealing of leaks around the pipes where they enter and exit the manhole.

4 *Bay St Sewer Main Replacement - $2,500,000*

District staff have indicated that the gravity mains in the Bay Street catchment area are in poor condition and in need of replacement.

District staff have indicated a preference to eliminate mains in rear and side yards as much as possible as accessing mains in the SRWs is very problematic.

A total length of 1,200 m of gravity main is within the Bay Street area. This includes 465 m in rear and/or sideyard SRWs.

5 *Gravity Main Replacement (other areas) - $2,500,000*

Allowance has been made for replacement of 1,500 m of gravity sewer mains in the collection system. This represents 10% of the total length of gravity sewer mains in the District (**Table 18**). The location and extent of main replacement will be based on the findings of the Infiltration & Inflow Identification and Reduction Program.

Lift Station Forcemain Point of Discharge Relocation

6 Big Beach Lift Station Forcemain Redirection - (completed June 2023)

This cost estimate is for the construction of a ±430 m of 300 mm dia. forcemain from Victoria Road to Peninsula Road to facilitate the relocation of the point of discharge of the Big Beach lift station.

The need for the work is noted in **10.2.6 Lift Station Forcemain Point of Discharge Relocation**.

7 Norah Lift Station Forcemain Redirection - $ 690,000

This cost estimate allows for:

The redirection of the forcemain would require, as a minimum:

- ±110 m of new forcemain on Rainforest Drive from Norah Road to near (south of) 853 Rainforest Drive.
- a blow-off on the forcemain at the local low spot (south of 869 Rainforest Drive).
- modification of the pumps (possibly larger diameter impellers) to ensure no reduction in pumping rate capacity.
- Replacement of the existing forcemain, 340 m long.

The need for the work is noted in **10.1.2 Lift Station Forcemain Point of Discharge Relocation**.

Proposed Gravity Trunk Main

8 Peninsula Road, Otter St to Marine Dr - $ 820,000

This construction of this gravity main will facilitate:

i) the redirection of the Big Beach lift station forcemain from discharging into the Victoria Road lift station catchment area, and

ii) the redirection of the Olson Bay and Peninsula Road lift station forcemains to the Forbes Road lift station catchment.

The benefits of these two redirections are noted in **10.1.3 Proposed Gravity Trunk Main**, ***Peninsula Road, Otter St to Marine Dr***.

9 Marine Dr (Rupert to Helen) - $ 170,000

10 Helen Rd (Marine to 1141 Helen) - $ 260,000

Both upgrade projects are to be carried out in order to accommodate the increase in flow by the construction of the Peninsula Road, Matterson Dr to Marine Dr gravity trunk main. The existing 200 mm dia. mains is to be replaced with 375 mm dia. at a slope of 1.0% or greater for both projects.

Gravity Main Upgrades, Extensions & Relocations

11 Peninsula Road, Norah St to Lyche Rd - $ 425,000

To accommodate future development, this ±170 m length of 150 mm dia. main requires upgrading. The main should be upsized to the same diameter as the pipe directly upstream and downstream of it (250 mm dia.).

The upsizing of this main should be carried out as part of the District's Peninsula Road, Safety & Revitalization (Forbes Rd to Main St) Project.

12 Peninsula Road at Seaplane Base Road - $ 50,000

To accommodate future development along Seaplane Base Road and the associated proposed future Seaplane Base Road lift station to be constructed near Harbour Crescent, a 200 mm dia. gravity main should be installed across Peninsula Road for the lift station forcemain to discharge into.

The installation of this gravity main should be carried out as part of the District's Peninsula Road, Safety & Revitalization (Forbes Rd to Main St) Project.

13 Hemlock Street, Lyche Rd to Existing Lift Station - $ 220,000

To accommodate future development, this ±115 m length of 200 mm dia. main requires upgrading. The main should be upsized to a minimum 250 mm dia. at the same slope or steeper than the existing.

See discussion under **10.1.4 Gravity Main Upgrades**, ***Hemlock Street, Lyche Rd to Existing Lift Station*** regarding the impact on upgrading this main if the Hemlock Road lift station were to be relocated to be near the Lyche Road intersection.

14 Peninsula Road, 1860 to 1816 Pen Rd. - $ 175,000

This project facilitates the abandonment of the sanitary main (100 mm dia. AC) in the SRW on 1816 Peninsula Rd and 1800 Bay St.

The installation of this gravity main should be carried out as part of the District's Peninsula Road, Safety & Revitalization (Forbes Rd to Main St) Project.

15 Peninsula Road, 1620 Pen Rd. to Bay St. $ 720,000
Bay St, Pen Rd to 1800 Bay St $ 75,000
SRW, 1685 Peninsula Rd to Cedar Rd $ 285,000

This project facilitates:

- the abandonment of the sanitary main (100 mm dia. AC) in the SRW from Bay St to 1728 Peninsula Road, and
- the upgrading of the 150 mm dia. AC main along Peninsula Rd, from 1728 to 1620 Peninsula Road.

The installation of this gravity main on Peninsula Road and Bay Street should be carried out in conjunction with the District's Peninsula Road, Safety & Revitalization (Forbes Rd to Main St) Project.

Lift Station Upgrades

16 Hemlock Rd Lift Station - $ 1,700,000

Cost estimate encompasses the following work:

- ongoing operation of the existing lift station during construction,
- construction of a new deeper wet well,
- replacement of the two existing pumps with two larger capacity (higher flow rate) pumps,
- replacement of the electrical control kiosk with a concrete block building,
- installation of an emergency power generator with automatic transfer switch, and

- construction of the lift station above the Projected Flood Construction Level for a 200 year event (see **Table 16**).

The cost for installation of a flow meter is accounted for under project no. 1.

17 Victoria Rd Lift Station - $ 250,000

Cost estimate encompasses the following works:

- replacement of the two existing pumps with two larger capacity (higher flow rate) pumps, and
- installation of an emergency power generator with automatic transfer switch.

The cost for installation of a flow meter is accounted for under project no. 1.

11.5.2 Longer-Term Works

These projects have been identified for one or both of the following reason:

- To accommodate future development
- To strengthen system operation.

The location of each of the recommended projects is shown on:

- **Figure 26**, and
- **Drawing Nos. 183-SAN-1 to -4**.

The Class D (order-of-magnitude) cost estimate for each of the proposed works are presented in **Table 20** followed by a brief description of the project need/timing.

Table 20 – Proposed Works, Longer-Term

No.	Description	Quantity	Unit Cost ($)	Class D Cost Estimate (Rounded)
	Gravity Main Upgrades			
18	Upgrading of 100 mm and 150 mm Dia. Mains	1,640 m	$ 1,900	$ 3,100,000
	Gravity Main Extension			
19	Peninsula Rd, 1002 Pen Rd to Coast Guard Rd	200	$ 1,400	$ 280,000
20	Helen Rd, Otter St to Garden St	155	$ 1,700	$ 260,000
	Lift Station Electrical/Controls Kiosks & Emergency Power			
21	Electrical/Controls Kiosk Replacement	5	$ 420,000	$ 2,100,000
22	Emergency Power Generator	4	$ 160,000	$ 640,000
	Lift Station Pumping Capacity & Forcemain Capacity Increases			
23	Routing Option E	5	$ 160,000	$ 800,000
24	Big Beach Lift Station Forcemain Capacity Increase	235	$ 1,535	$360,000
	Lift Station Forcemain Point of Discharge Relocation			
25	Olson Bay Lift Station Forcemain	360 m	$ 550	$ 200,000
26	Peninsula Rd Lift Station Forcemain	350 m	$ 550	$ 195,000
27	Fraser Lane & Imperial Lift Station Forcemain	100 m	$1,550	$ 155,000

No.	Description	Quantity	Unit Cost ($)	Class D Cost Estimate (Rounded)
	Future Lift Station			
28	Seaplane Base Rd	1		$ 1,200,000
29	Coast Guard Rd	1		$ 1,200,000
	Sewage Lagoon			
30	Performance Assessment			$ 70,000
31	Septage Receiving Station	1		$ 1,100,000
32	Forcemain Discharge Grit Removal Chamber	1		$ 775,000
33	Sludge Removal	1		$ 275,000
34	Cell 4 Enlargement/Addition of Sewage Treatment Plant	1		TBD
			Gravity Main Upgrades Total:	$ 3,100,000
			Gravity Main Extension Total:	$ 540,000
			Electrical/Control Buildings & Emergency Power Generators Total:	$ 2,740,000
			Pumping Capacity & Forcemain Capacity Increase Total:	$ 1,160,000
			Forcemain Point of Discharge Relocation:	$ 550,000
			Future Lift Stations:	$ 2,400,000
			Sewage Lagoon Total:	$ 2,220,000
			Longer-Term Total (excluding GST):	**$ 12,710,000**

Notes:

Gravity Main Upgrades

18 100 mm and 150 mm Dia. Mains - $ 3,100,000

There is ±1,640 m of 100 mm dia. and 150 mm dia. gravity main in various locations throughout the District that are less than the minimum design standard diameter. Allowance has been made to upgrade these mains.

Gravity Main Extension

19 Peninsula Rd, 1002 Peninsula Rd to Coast Guard Rd - $ 280,000

This project would provide gravity service to the future development of 985 Peninsula Road and the discharge of the forcemain from the future Coast Guard lift station (project no. 29). The existing forcemain from the Edge/Kimoto lift station would be redirected into this gravity main.

20 Helen Rd, Otter St to Garden St - $ 260,000

This project facilitates the relocation of the point of discharge of the forcemain servicing the Fraser Lane and Imperial Lane lift stations (project no. 27). The 155 m of existing 200 mm dia. main is to be replaced with 250 mm dia. based on the reported slope of the existing mains (5.01% and 1.75%).

Lift Station Electrical/Controls Kiosks & Emergency Power

21 <u>Electrical/Control Kiosk Replacement - $ 2,100,000</u>

22 <u>Emergency Power - $ 640,000</u>

The estimate is for continuation of the relocation of lift station electrical equipment and controls from metal kiosks to a concrete block building and installation of an emergency standby power generator with automatic transfer switch. They are:

- Fraser Lane lift station
- Norah Road lift station (emergency standby power generator already in place)
- Peninsula Road lift station
- Edge/Kimoto lift station
- Marine Drive lift station

The upgrading of the Hemlock Road lift station is not included as this work has been identified as an Immediate Term project (**Table 19**).

The estimate assumes the relocation of the electrical/controls and the installation of the emergency generator at a lift station would be done at the same time. The works should be appropriately sized to manage the electrical loads of both the existing pumps and any future pumping capacity increases.

Lift Station Pumping Capacity & Forcemain Capacity Increases

23 <u>Routing Option E Lift Stations - $ 800,000</u>

The estimate is for the pumping capacity increases based on implementation of Routing Option E and are for these five lift stations, as listed in **Table 1**:

- Olson Bay Lift station
- Peninsula Rd Lift station
- Forbes Rd Lift station
- Big Beach Lift station
- Helen Rd Lift station

The upgrading of the pumping capacity of the Hemlock Road lift station is not included as this work has been identified as an Immediate Term project (**Table 19**).

As noted in **10.2.4 Lift Station Pumping Capacity Increases**, the need for and the timing of the increase in the pumping capacity of the above noted lift stations is dependent on several factors. These include, but are not limited to:

i) The development and successful implementation of a I/I Identification & Reduction program that results in a decrease in I/I flows at the lift station.

ii) The amount and timing of new development, resulting in additional flows to the lift station.

iii) The timing of the implementation of Routing Option A, B, C, D or E.

24 <u>Big Beach Lift Station Forcemain Capacity Increase - $ 360,000</u>

This estimate is for the adding of a second forcemain from the Big Beach lift station to Victoria Road to accommodate the future pumping increase of the Big Beach lift station (project no. 23). The main would be in addition to the existing 150 mm dia. forcemain and would connect to the 300 mm dia.

forcemain installed along Matterson Dr from Victoria Road to Peninsula that facilitates the relocation of the point of discharge of the Big Beach lift station (see project no. 6).

Lift Station Forcemain Point of Discharge Relocation

25 Olson Bay Lift Station Forcemain Redirection - $ 200,000

The cost estimate is for the construction of ±360 m of new forcemain from Peninsula Road to a future gravity main extension along Marine Drive that will convey sewage to the Forbes Road lift station. The cost estimate is based on:

- The forcemain installed as part of the construction of the proposed future road between Peninsula Road and Marine Drive.
- The future gravity main extension along Marine Drive is in place.

The need for and timing of the work is noted in **10.2.5 Lift Station Forcemain Point of Discharge Relocation**.

26 Peninsula Rd Lift Station Forcemain Redirection - $ 195,000

The cost estimate is for the construction of ±350 m of new forcemain along Peninsula Road from the lift station back (to the west) along Peninsula Road to connect to the redirected Olson Bay lift station forcemain (project no. 25) that will convey sewage to the Forbes Road lift station.

The need for and the timing of the work is noted in **10.2.5 Lift Station Forcemain Point of Discharge Relocation**.

27 Fraser Lane & Imperial Lane Lift Stations Forcemain Relocation - $ 155,000

This estimate encompasses:

- 100 m of new forcemain from Imperial Lane lift station to the sanitary manhole on Helen Road at Otter Street intersection.
- abandonment of the existing forcemain along the foreshore between Otter St and Garden St.
- Modifications to the Fraser Lane and Imperial Lane pumps to accommodate the increase in static head, estimated to be ±5 m for Fraser Lane and ±10 m for Imperial Lane.

The relocation of the forcemain will require the upgrading of the 155 m of gravity main along Helen Road from Otter St to Garden St (project no. 20).

Future Lift Station

28 Seaplane Base Rd - $ 1,200,000

This estimate encompasses the construction of:

- a duplex lift station with a separate valve chamber
- a concrete block electrical/control building
- an emergency standby power generator in a metal housing
- a forcemain (±400 m of 75 mm dia.)
- sanitary sewer collection system consisting of gravity mains and a forcemain with service connections to service existing development along Harbour Crescent and Seaplane Base Rd.

The timing of this work is dependent on sufficient funding being in place and/or future development within the lift stations catchment area.

29 Coast Guard Rd - $ 1,200,000

This estimate envisions the construction of:

- a duplex lift station with a separate valve chamber
- a concrete block electrical/control building
- an emergency standby power generator in a metal housing
- a forcemain, ±700 m long that would connect to the future extension (to the east) of the gravity main along Peninsula Road (project no. 19).

The timing of this work is dependent on development needs.

Sewage Lagoon

30 Performance Assessment - $70,000

A performance assessment of the sewage lagoon should be carried out to confirm how the upgraded system is performing. The assessment should as a minimum include:

- A review of BOD, TSS, outflow and rainfall data for a three to five year period.
- Assessment of average and maximum day discharges vs permitted discharge limits.
- Review of current hydraulic retention time and projected hydraulic retention time with population increase.
- Assessment of the ability of the existing lagoon system to accommodate the OCP.
- Assessment of the impact of enlargement of cell 4 and if/when it would be warranted.
- Assessment of if/when the addition of a sewage treatment plant would be warranted.
- Sludge depth survey and estimate of when sludge removal may next be required.

31 Septage Receiving Station - $1,100,000

This estimate encompasses the installation of a septage receiving station at the sewage lagoon consisting of:

- A locked connection with a keypad entry, an invoice printout and a billing recording program.
- A rock/stone catcher.
- A flow meter to record the discharge volume.
- A screening system (self-cleaning) to remove rags and stringy material.
- Gravity discharge into the beginning of Cell 1/2.
- Water service connection for washing the system after each use.

32 Forcemain Grit Removal Chamber - $ 775,000

Redirecting the Helen Road forcemain to discharge into a screen and a grit removal system prior to discharge into Cell 1/2 would prevent debris and grit from entering the lagoon. This would prevent the plugging and ragging of aerator impellers, reduce the abrasive effects of grit on the shafts, bearings and impellers, and reduce the organic loading on the lagoon system. The screen would be equipped with an automatic cleaning system and a water service connection.

33 Sludge Removal - $ 275,000

The cost estimate is based on sludge removal by the same process used during the lagoon upgrading completed in 2019, i.e., a permeable fabric tube system. No allowance has been made for disposal of the dewatered sludge.

34 Cell 4 Enlargement/Addition of Sewage Treatment Plant – To Be Determined

The need for and timing of enlargement of Cell 4 and/or addition of a sewage treatment plant would be based on several factors, including:

- the success of the I/I Identification and Reduction Program.
- the findings of a sewage lagoon performance assessment report.
- the inability of the existing system to meet the MoE discharge permit requirements.

The addition of a sewage treatment plant was identified in the *Municipal Infrastructure Review DL 281 & 282 and Former Forest Land Reserve, February 2007* by Koers & Associates Engineering Ltd. and was one of the projects included in the calculation of the sanitary sewer DCCs bylaw. The estimate cost for the addition of a 3,000 m^3/day Sequencing Batch Reactor along with operating improvements at the lagoon was $6,500,000. In today's dollars, this equates to $11,000,000+GST based on the increase in the ENR CCI to June 2023.

The District's continued use of the aerated lagoons for as long as possible is a reasonable approach as it is less susceptible to the widely fluctuating flows to I/I (compared to a mechanical treatment process), and the system provides reliable treatment at minimal costs of power, operation and maintenance.

It is expected that development and implementation of an I/I Identification and Reduction Program, inclusive of the annual dedication of personnel and financial resources to the program, would have a significant impact on improving/increasing the ability of the existing sewage lagoon to handle the OCP population growth projects without the need for cell 4 enlargement and/or the need for the addition of a sewage treatment plant.

12 CONCLUSIONS

Based on the findings of this study, the following conclusions are made:

Existing Dry Weather Sewage Flows

1. District of Ucluelet - A review of the total monthly pump run-hour readings for the Helen Road lift station indicate an average day dry weather flow of 1,000 m^3/day (August 2018). This equates to ±520 litres per capita per day for the permanent residential population estimate of 1,930 for the District of Ucluelet.

   Hitacu - An average day dry weather flow of 87 m^3/day was recorded by the Hitacu community flow meter. This equates to ±305 litres per capita per day for the permanent residential population estimate of 284.

Existing Wet Weather Sewage Flows (Inflow & Infiltration)

2. Certain amounts of storm water inflow and infiltration (I/I) in a sanitary sewer system are unavoidable, but excessive amounts can:
   - overwhelm the systems (gravity mains, lift stations, forcemains and treatment processes), requiring large capital expenditures to handle the excess flows and volumes,
   - increase operation and maintenance costs (lift stations and sewage treatment facility), and
   - disrupt the performance of the sewage treatment facility.

3. A review of a lift station run-hour and sewage lagoon outfall flow meter readings shows flows increase noticeably with rainfall events and high rainfall events can result in a daily discharge volume from the lagoon that exceeds the District's licenced maximum day limit (4,750 m^3/day).

4. Based on wet vs dry weather period run-hours, very high to high I/I is occurring in ten of the District's 14 lift station catchment areas as listed below:

Estimated Very High I/I	Estimated High I/I
- Norah Rd lift station	- Peninsula Rd lift station
- Hemlock St lift station	- Bay (simplex) lift station
- Bay St lift station (decommissioned)	- Reef Pt lift station
- Fraser Lane lift station	
- Imperial Lake lift station	
- Edge/Kimoto lift station	
- Helen Rd lift station	

5. Only three (3) of the District's lift stations have a flow meter. Installation of flow meters on all lift stations, beginning with those with Very High I/I (see above and **Table 7**), would quantify the amount of I/I in each catchment area and the reduction in flows achieved through the implementation of an I/I control program.

6. On November 16, 2019, a heavy rainfall event (210 mm), resulting in the discharge volume from the sewage lagoon exceeding the licenced maximum day limit (4,750 m^3/day) for three consecutive days (Nov 16 – 18), with the highest recorded discharge being 8,708 m^3 on Nov 18. Of this volume:

- 1,000 m^3 (less than 12%) was estimated to be attributed to actual sewage flow.

The remaining 7,708 m^3 (88%) was estimated to be attributed to rainfall as follow:

- 27% (2,400 m^3) attributed to rainfall on the surface of the sewage lagoon, and
- 61% (5,308 m^3) attributed to I/I within the sewage collection system.

Inflow & Infiltration Impact on Sewage Lagoon

7. I/I flow has a negative impact on the treatment capacity of the sewage lagoon by reducing the hydraulic retention time. During a dry summer, the hydraulic retention time can reach 23 days. This compares to only 5 days during a very heavy rainfall event (Nov 16 – 18, 2019). A hydraulic retention time of 12 days could be considered appropriate for the District's sewage lagoon system.
8. It is anticipated that the current storage volume of the sewage lagoon system (22,700 m^3) can treat an annual average day flow of 1,975 m^3/day which corresponds to a permanent population of 2,900. However, the licenced average day discharge limit from the sewage lagoon is 1,855 m^3/da. This corresponds to a permanent population of 2,610, which may be reached within the next 13 years (by Year 2036).
9. Expansion of cell 4 from its present 3,000 m^3 of storage to 6,400 m^3 could service an additional 850 permanent residents.
10. Reductions in I/I would improve the performance of the sewage lagoon during the fall and winter months and accommodate additional population growth without requiring expansion of cell 4 and/or the need for the addition of a sewage treatment plant.

Populations, District of Ucluelet and Hitacu

11. The 2021 Census recorded a permanent population of 2,066 for the District of Ucluelet and 321 for Hitacu.
12. The District's OCP anticipates the permanent population to reach 2,600 by Year 2050 based on an annual averaged growth rate of 1.0% per year over 30 years (Year 2020 to Year 2050).

200 Year Flood Construction Levels

13. As many as six (6) of the District's lift stations are located below the recently developed 200 year flood construction levels. They are:

- Reef Point
- Edge (Kimoto)
- Helen Road
- Imperial Lane
- Fraser Lane
- Hemlock St

Future Municipal Lift Station

14. Two future lift stations are anticipated based on the OCP future growth areas (**Figure 25**):

- Seaplane Base Rd
- Coast Guard Rd

Lift Station Pumping Capacity Increases

15. Increased pumping capacity is required now at two stations:

- Hemlock St

- Victoria Rd

The Hemlock Rd increase can be delayed with the relocation of the Norah Rd lift station forcemain point of discharge to the Big Beach lift station catchment. This relocation would facilitate some of the anticipated development within the Peninsula Road lift station catchment until the Peninsula Road lift station forcemain point of discharge is relocated to the Forbes Road lift station catchment.

The Victoria Rd increase can be prevented with the relocation of the discharge of the Big Beach lift station forcemain.

16. Increased pumping capacity is required at five other lift stations to accommodate future growth:
    - Peninsula Rd
    - Olson Rd
    - Forbes Rd
    - Big Beach
    - Helen Rd

Gravity Main Upgrades

17. Upgrading of gravity mains have been identified for the immediate-term and longer-term:

Immediate-Term

Peninsula Rd	390 m	Otter St to Marine Dr
Marine Dr	80 m	Rupert Rd to Helen Rd
Helen Rd	125 m	Rupert Rd to 1141 Helen Rd
Peninsula Rd	170 m	Norah St to Lyche Rd
Peninsula Rd	20 m	at Seaplane Base Rd
Hemlock St	115 m	Lyche Rd to Existing Lift station
Peninsula Rd	70 m	1860 Pen Rd to 1816 Pen Rd
Peninsula Rd	285 m	1620 Pen Rd to Bay St
Bay St	40 m	Peninsula Rd to 1800 Bay St
SRW	150 m	1685 Peninsula Rd to Cedar Rd

Longer-Term

Various Areas	1,640 m	upgrading 100 mm and 150 mm dia.
Peninsula Rd	200 m	1002 Peninsula Rd to Coast Guard Rd
Helen Rd	155 m	Otter St to Garden St

Lift Station Forcemain Point of Discharge Relocation

18. To accommodate the future growth anticipated in the OCP (see **Figure 25**) the relocation of the point of discharge for the following lift stations is required based on Routing Option E:
    - Norah Rd lift station forcemain to discharge to Big Beach lift station catchment area.
    - Olson Bay lift station forcemain to discharge to the Forbes Road lift station catchment area.
    - Peninsula Rd lift station forcemain to discharge to the Forbes Road lift station catchment area.

- Big Beach lift station forcemain to discharge to the Helen Road lift station catchment area.

19. The relocation of the point of discharge of the forcemain servicing the Fraser Lane and Imperial Lane lift station to the gravity manhole on Helen Rd at Otter St will facilitate the abandonment of the section of forcemain in the foreshore.

13 RECOMMENDATIONS

Based on the conclusions listed in this report, it is recommended that the District carry out the following in the order they are listed:

1. Carry out a major amendment to the District's Development Cost Charge Bylaw.
2. Develop an annual Infiltration & Inflow Identification and Reduction Program to aggressively pursue the identification and reduction in I/I in the sewage collection system.
3. Carry out the immediate term gravity main and lift station upgrade projects (**Table 19**) to meet existing needs and to accommodate future growth.
4. Carry out the longer-term proposed works (**Table 20**) to accommodate future growth and strengthen system operation.

APPENDIX A

-

Manufacturer's Pump Curves & Lift Station Data Sheet

- Olson Bay
- Peninsula Rd
- Norah Rd (Whispering Pines)
- Hemlock St
- Bay St Simplex
- Fraser Lane
- Imperial Lane
- Forbes Rd
- Big Beach
- Victoria
- Marine Dr
- Edge/Kimoto Dr
- Reef Point
- Helen Rd

OLSON BAY

Performance Curve

FLYGT	Performance Curve	Product: NP3171.181	Type: HT
Date: 2019-06-27	Project:	Curve No: 63-453-00-6050	Issue: 4

	1/1-Load	3/4-Load	1/2-Load
Power Factor	0.86	0.81	0.70
Efficiency	89.5 %	90.5 %	90.0 %
Motor Data	---	---	---

Rated Power ...	34 hp (25.35 kW)	
Starting Current ...	228	A
Rated Current ...	32	A
Rated Speed ...	1765	rpm
Tot. Mom. of Inertia ...	0.18	kgm2
No. of Blades	2	

Impeller Diameter: 286 mm

Motor #	Stator	Rev
25-19-4AA	06D	10

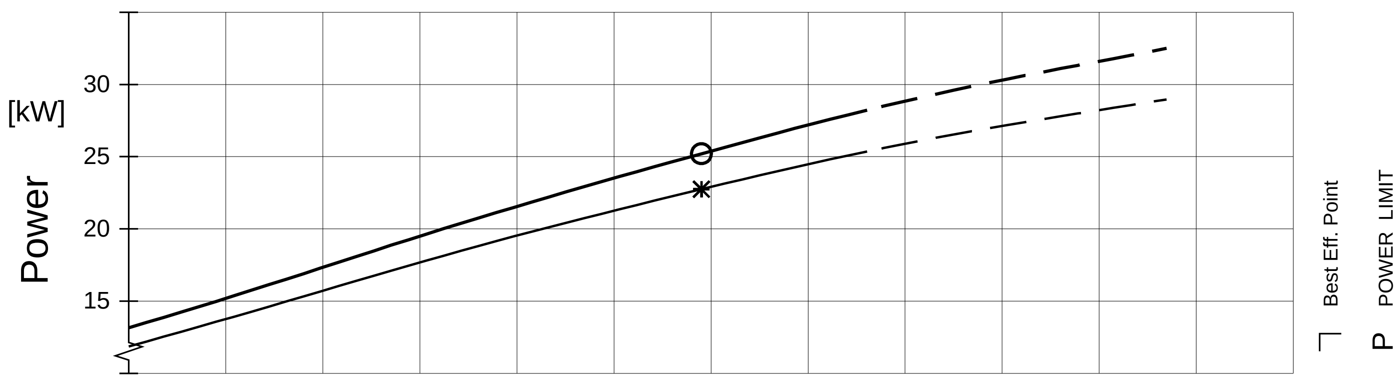
Freq.	Phases	Voltage	Poles
60 Hz	3	600 V	4

Geartype	Ratio
---	---

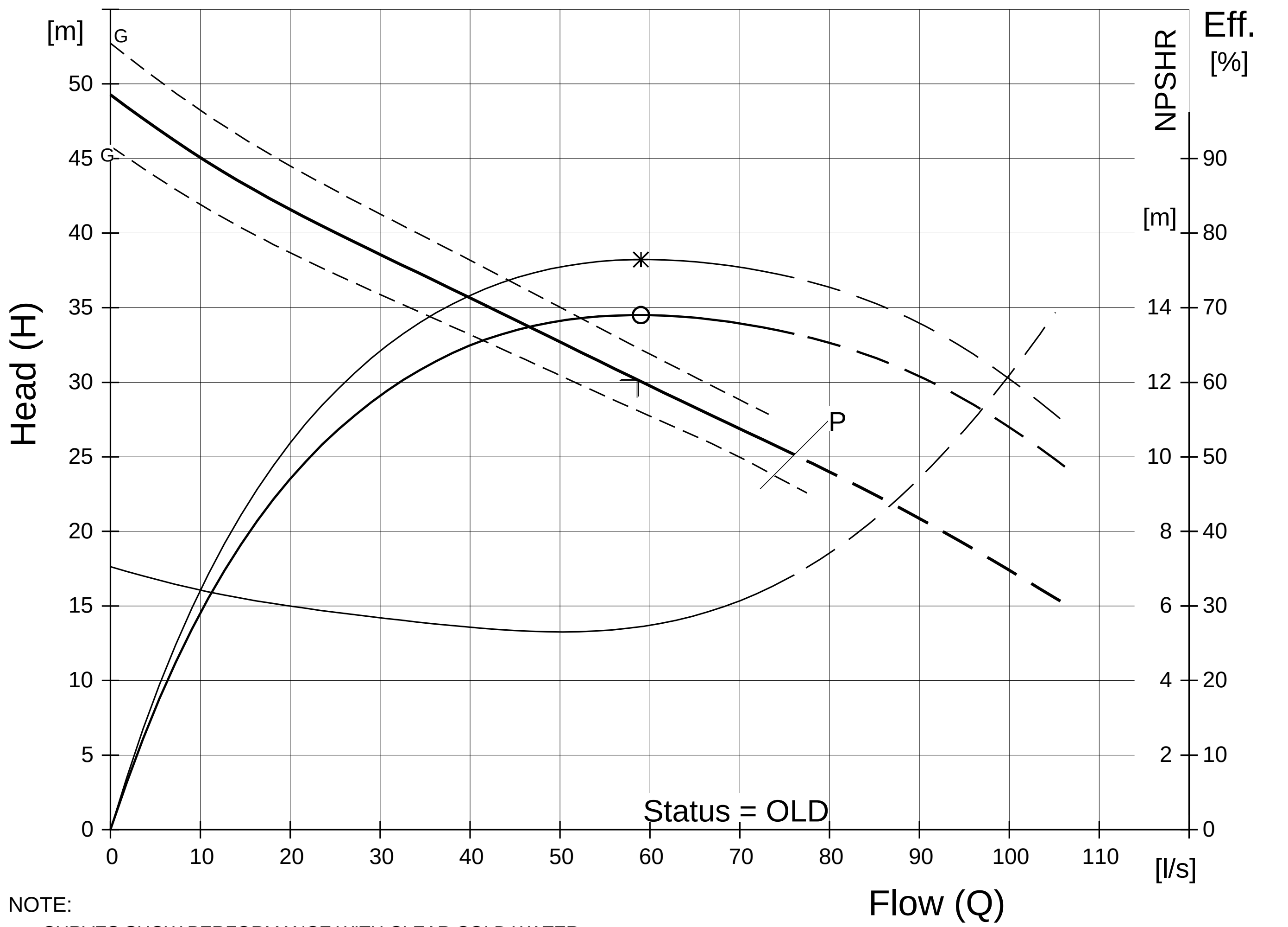
Comments

Inlet/Outlet: -/100 mm

Imp. Throughlet: ---



Duty-Point	Flow [l/s]	Head [m]	Power [kW]	Eff. [%]	NPSHR[m]
B.E.P.	59.0	30.0	25.3 (22.8) *	69.0 (76.5) *	5.5



NOTE:
CURVES SHOW PERFORMANCE WITH CLEAR COLD WATER
* : Pump EFFICIENCY/Shaft POWER
O : Overall EFFICIENCY/Input POWER
NPSHR = NPSH3 + min. operational margin

Guarantee between limits (G) acc. to
ISO 9906:2012 & ANSI/HI 11.6:2012 / grade 3B-

unix AUTHOR: XY81618 SACU (rev:8.1)

KOERS & ASSOCIATES ENGINEERING LTD. Consulting Engineers

Sewer Lift Station Details & Peformance Curves

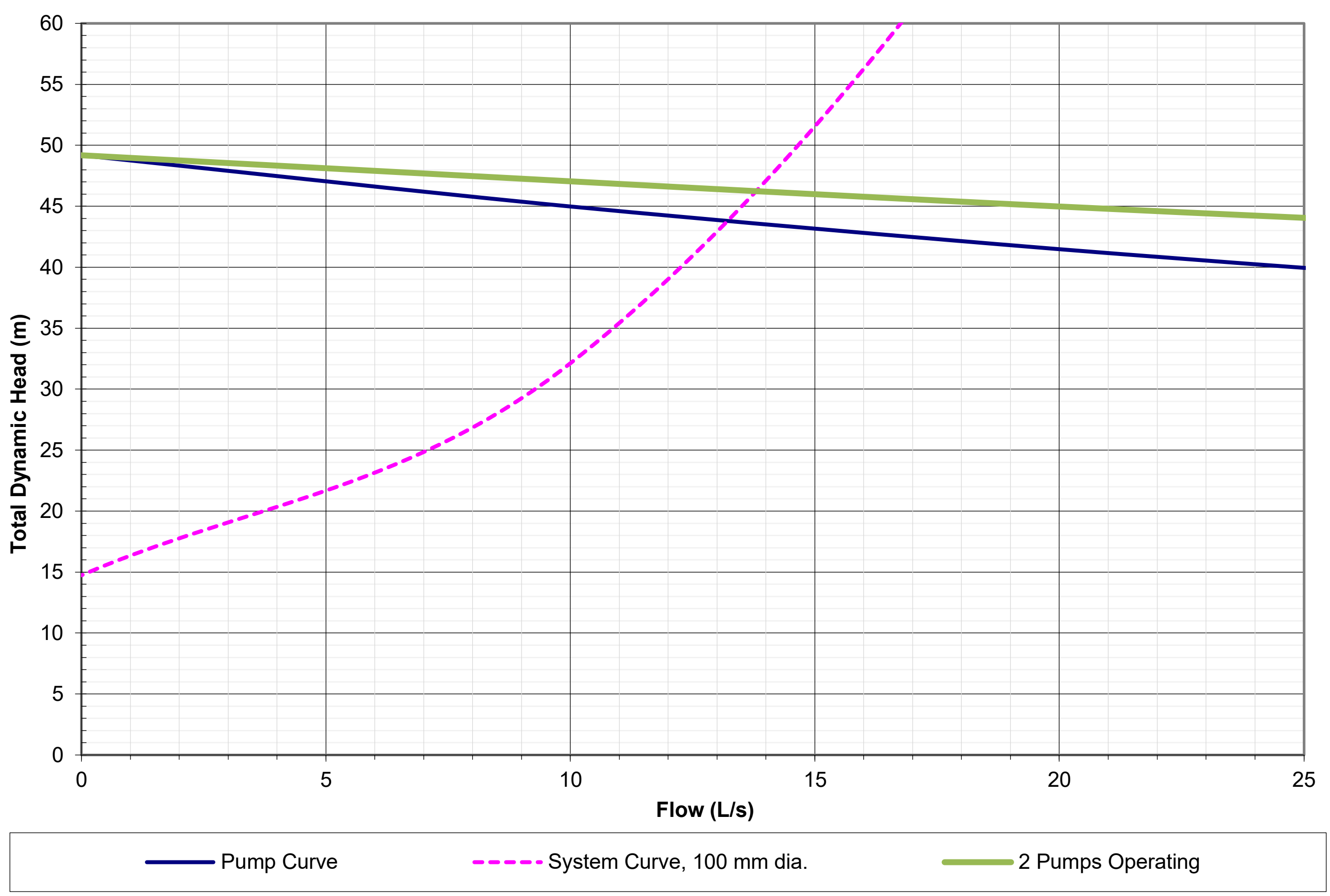
Olson Bay

Koers File: 1863

Motor Details		Power Supply		Pump Curve			System Curve	
				Flow (l/s)	Head (m)	Hydaulic Efficieny %	100 dia. (m)	250 dia. (m)
Power (hp)	34 (25kw)	**Volts**	600	90	20.8	61%	1,036	28.4
Voltage	600	**Phase**	3	80	24.0	65%	836	25.7
Phase	3			70	26.8	68%	656	23.3
RPM	1765			60	29.7	69%	496	21.2
Amps	228 / 32			50	32.7	68%	358	19.3
Pump Details				40	35.7	65%	242	17.8
Manufacturer	Flygt			30	38.5	58%	148	16.5
Model	NP3171.181 HT			20	41.5	47%	78	15.6
Impeller Dia.	286 mm			10	45.0	29%	32.2	15.0
				0	49.2	0%	14.8	14.8

Forcemain Details						Duty Point Calculations	
C Value:	130	**Minor losses:**	**k**	**Minor losses:**	**k**	Flow:	13.2 L/s
Class & Type:	HDPE, DR21	Bends, 90º:	0.13	Valve:	0.13	Pump off el.	0.76 m
Nominal Ø, mm:	100	45º:	0.07	Tee:	1.00	forcemain el.	15.51 m
Actual ø, mm:	103	22½º:	0.05	Check:	0.90	Static head:	14.75 m
Length, m:	1,008	11¼º:	0.03	Outlet:	1.00	friction:	28.60 m
Area, m²:	0.0083			Discharge:	0.25	minor:	0.52 m
	Number of Bends	90º	6	22½º	0	Head loss:	**43.87** m
		45º	0	11¼º		Velocty:	1.59 m/s

Pump Performance Curves



PENINSULA

FLYGT	PERFORMANCE CURVE	PRODUCT CP3127.180	TYPE HT
DATE 2000-02-29	PROJECT	CURVE NO 61-485-00-3055	ISSUE 3

	1/1-LOAD	3/4-LOAD	1/2-LOAD
MOTOR COS PHI	0.96	0.99	0.99
MOTOR EFFICIENCY	83.0 %	84.5 %	83.0 %
GEAR EFFICIENCY	---	---	---

MOTOR SHAFT POWER	7.4	Hp
STARTING CURRENT ...	58	A
RATED CURRENT ...	30	A
RATED SPEED	1750	rpm
TOT.MOM.OF INERTIA ...	0.097	kgm2
NO. OF BLADES	1	

IMPELLER DIAMETER 200 mm

MOTORTYPE	STATOR	REV
21-12-4AL	12-	10

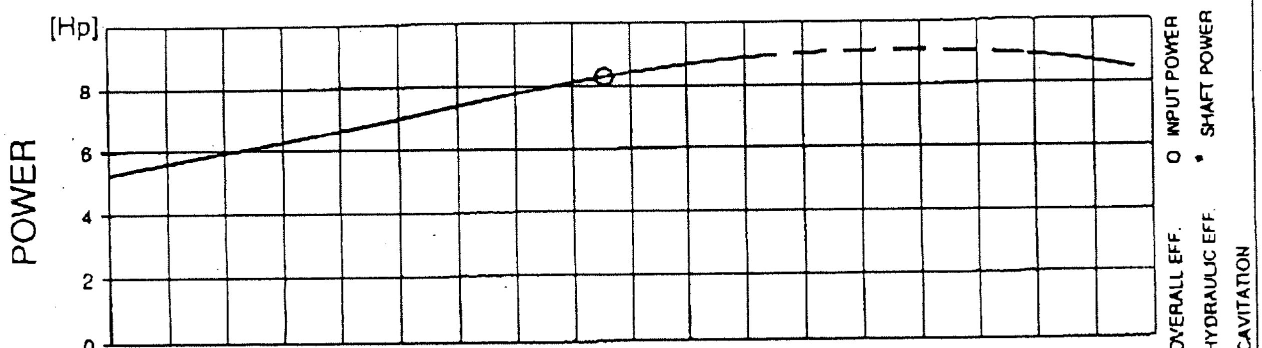
FREQ.	PHASES	VOLTAGE	POLES
60 Hz	1	~~230~~ 208 V	4

GEARTYPE	RATIO
---	---

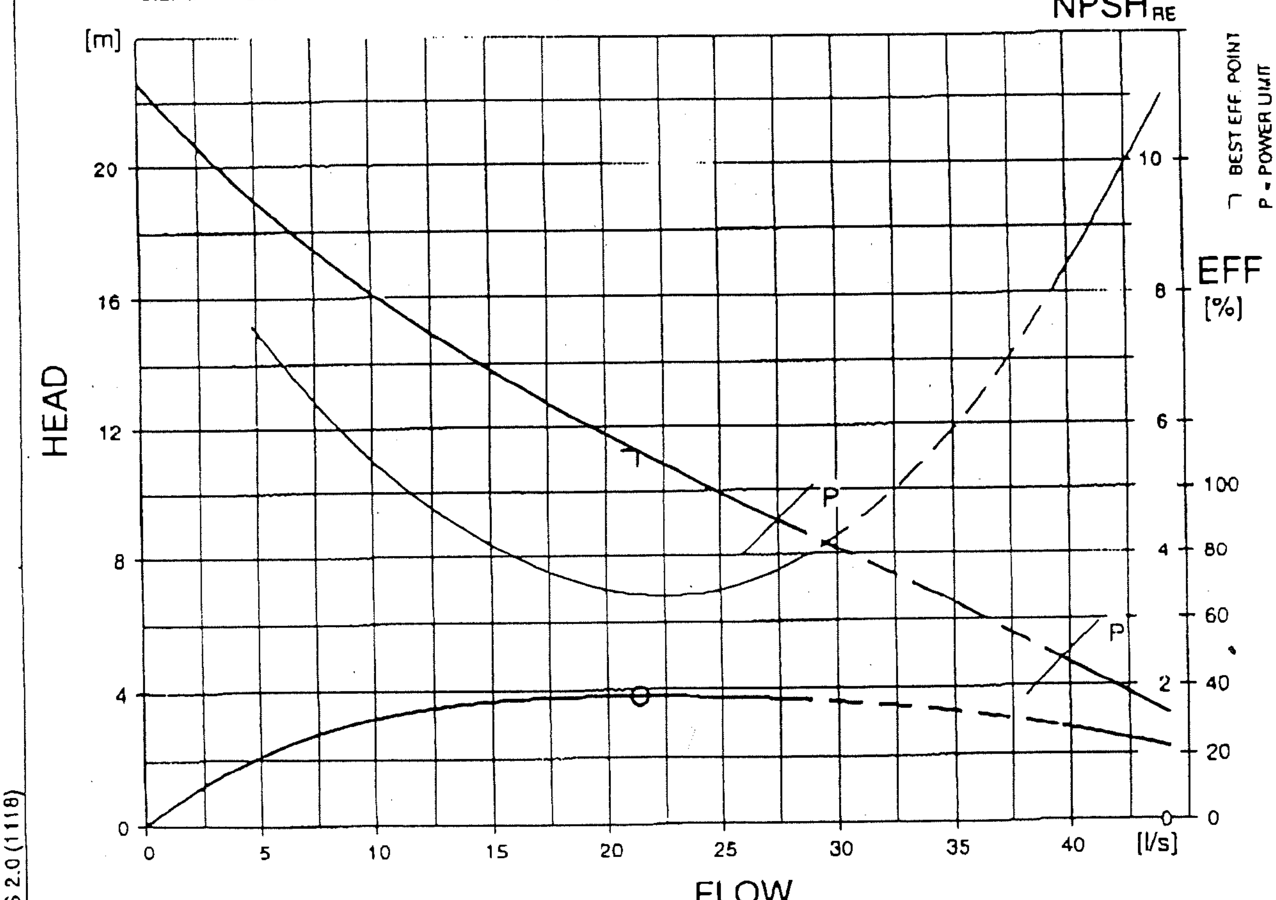
COMMENTS

INLET/OUTLET - /100 mm

IMP. THROUGHLET 76 mm



DUTY-POINT:	FLOW[l/s]	HEAD[m]	POWER[Hp]	EFF[%]	NPSH[m]	GUARANTY
B.E.P.:	21.37	11.25	8.29 (0.00)	38.2 (0.0)	3.41	



FLYPS 2.0 (1118)

FLYGT	CURVE

Performance with clear water and rating data at 40 °C

KOERS & ASSOCIATES ENGINEERING LTD.
Consulting Engineers

Sewage Lift Station Details & Peformance Curves

Peninsula Road

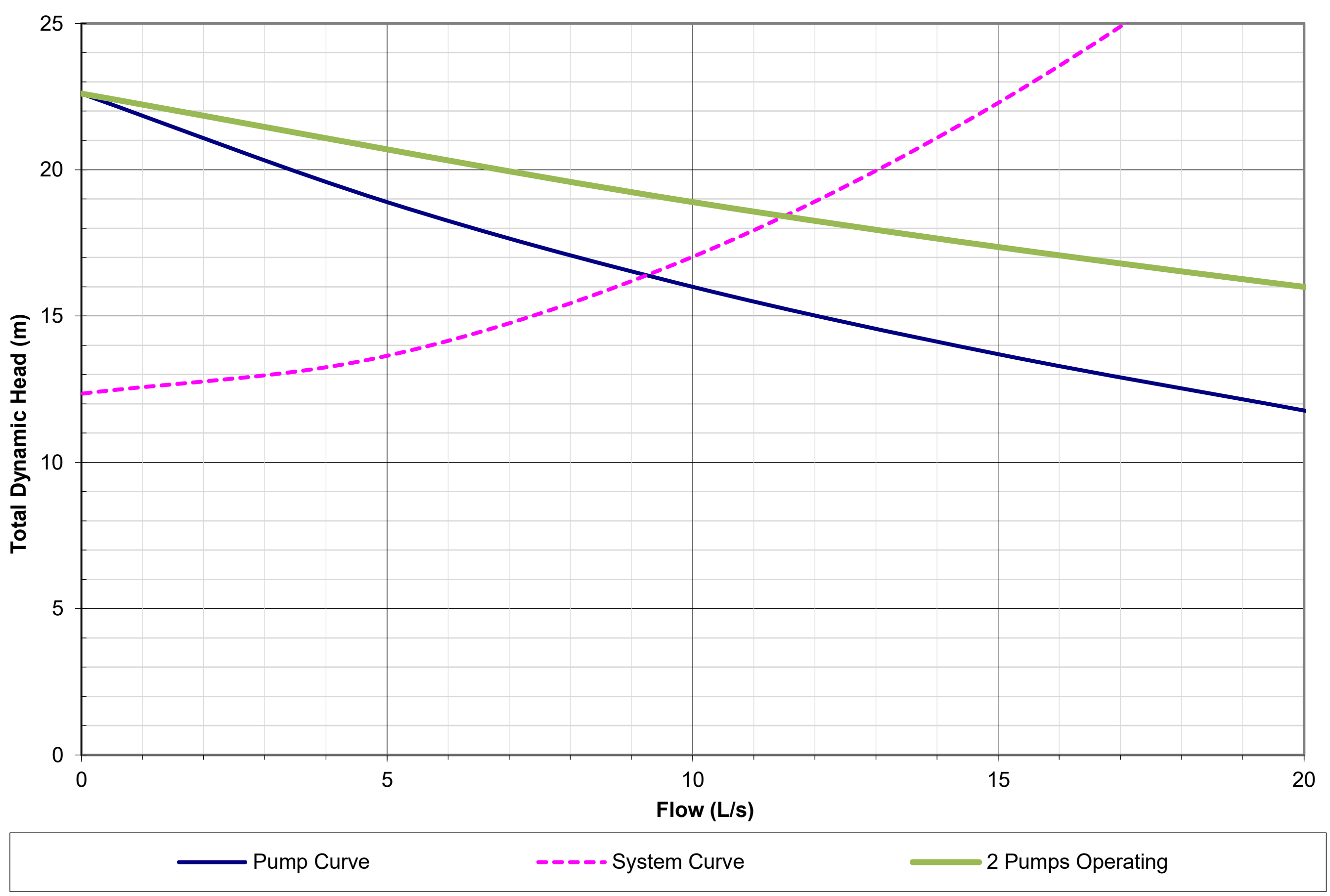
Koers File: 1863

Motor Details		Power Supply		Pump Curve Flow (l/s)	Pump Curve Head (m)	Pump Curve Hydaulic Efficiency %	System Curve (m)
Power (hp)	7.4 (4.1kw)	**Volts**	120/208	35	6.4	32.3	60.4
Voltage	208	**Phase**	single	30	8.1	35.0	48.4
Phase	three			25	9.8	36.4	38.1
RPM	1750			20	11.8	38.0	29.3
Amps	21			15	13.7	36.4	22.3
Pump Details		**Serial Nos.**		10	16.0	32.0	17.0
Manufacturer	Flygt	180-9360023		5	18.9	20.0	13.6
Model	CP 3127	180-636002		0	22.6		12.4
Impeller Dia.	485						

Forcemain Details					
C Value:	120	**Minor losses:**	**k**	**Minor losses:**	**k**
Class & Type:	100 PVC	Bends, 90º:	0.13	Valve:	0.13
Nominal Ø, mm:	100	45º:	0.07	Tee:	1.00
Actual ø, mm:	108	22½º:	0.05	Check:	0.90
Length, m:	292	11¼º:	0.03	Outlet:	1.00
Area, m²:	0.0092			Discharge:	0.25
	Number of Bends	90º	6	22½º	0
		45º	2	11¼º	0

Duty Point Calculations		
Flow:	9.3	L/s
Static head:	12.35	m
friction:	3.87	m
minor:	0.22	m
Head loss:	**16.44**	m
Velocty:	1.01	m/s

Pump Performance Curves



WHISPERING PINES

FLYGT PERFORMANCE CURVE

PRODUCT	TYPE
CP3127.180	HT

CURVE NO	ISSUE
61-485-00-3055	3

DATE: 2000-02-29

PROJECT:

	1/1-LOAD	3/4-LOAD	1/2-LOAD
MOTOR COS PHI	0.96	0.99	0.99
MOTOR EFFICIENCY	83.0 %	84.5 %	83.0 %
GEAR EFFICIENCY	---	---	---

COMMENTS:

INLET/OUTLET: - /100 mm

IMP. THROUGHLET: 76 mm

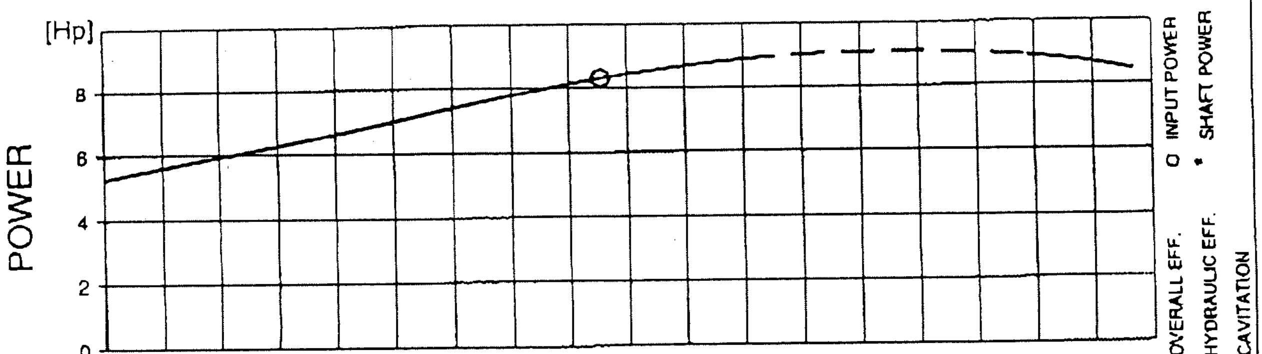
MOTOR SHAFT POWER	7.4	Hp
STARTING CURRENT ...	58	A
RATED CURRENT ...	30	A
RATED SPEED	1750	rpm
TOT.MOM.OF INERTIA ...	0.097	kgm2
NO. OF BLADES	1	

IMPELLER DIAMETER: 200 mm

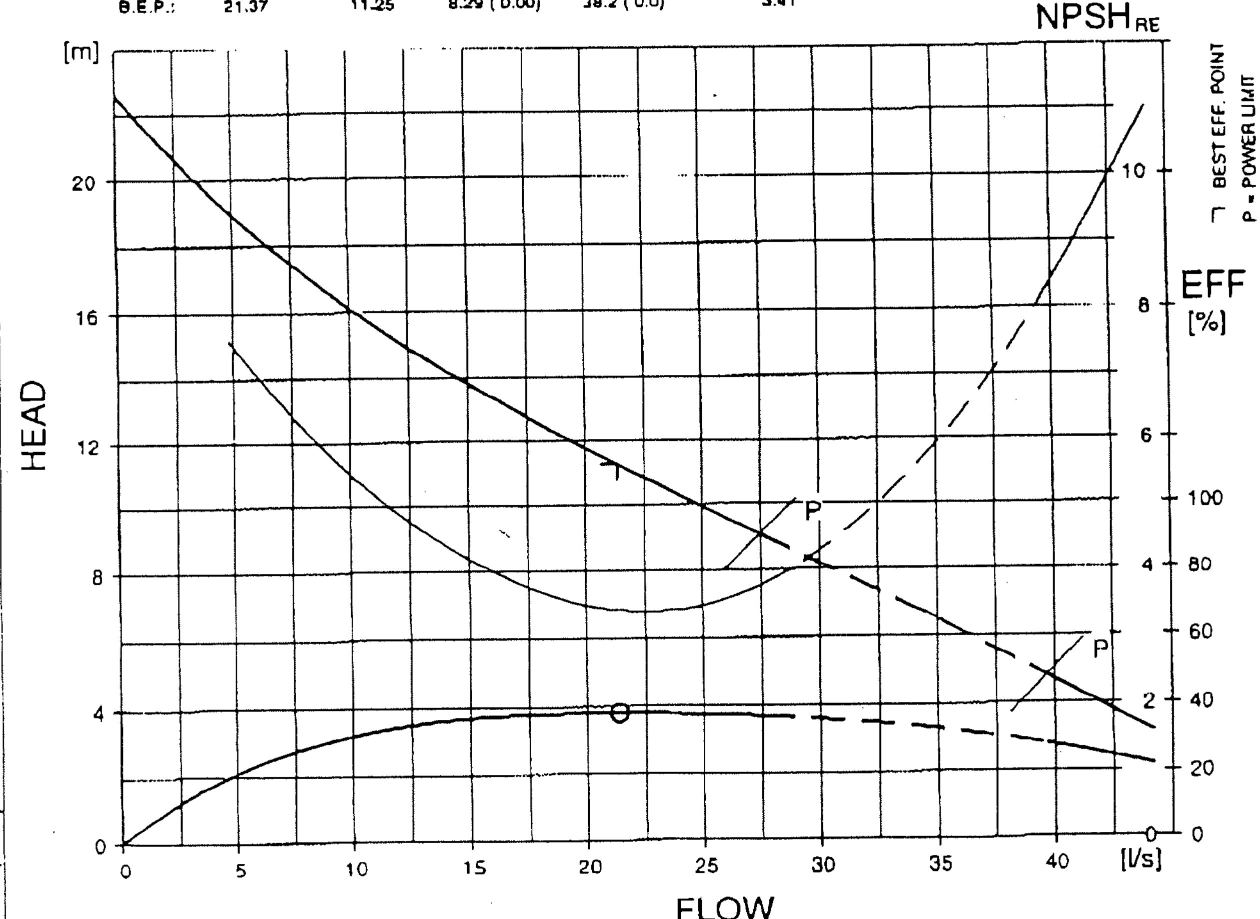
MOTORTYPE	STATOR	REV
21-12-4AL	12-	10

FREQ.	PHASES	VOLTAGE	POLES
60 Hz	1	230 V	4

GEARTYPE	RATIO
---	---



DUTY-POINT:	FLOW[l/s]	HEAD[m]	POWER[Hp]	EFF[%]	NPSH[m]	GUARANTY
B.E.P.:	21.37	11.25	8.29 (0.00)	38.2 (0.0)	3.41	



FLYPS 2.0 (1118)

Performance with clear water and rating data at 40 °C

FLYGT CURVE

FROM: ITT FLYGT   FAX NO.: 604 941 3659   03-01-00 12:10P P.04

KOERS & ASSOCIATES ENGINEERING LTD.
Consulting Engineers

Sewage Lift Station Details & Peformance Curves

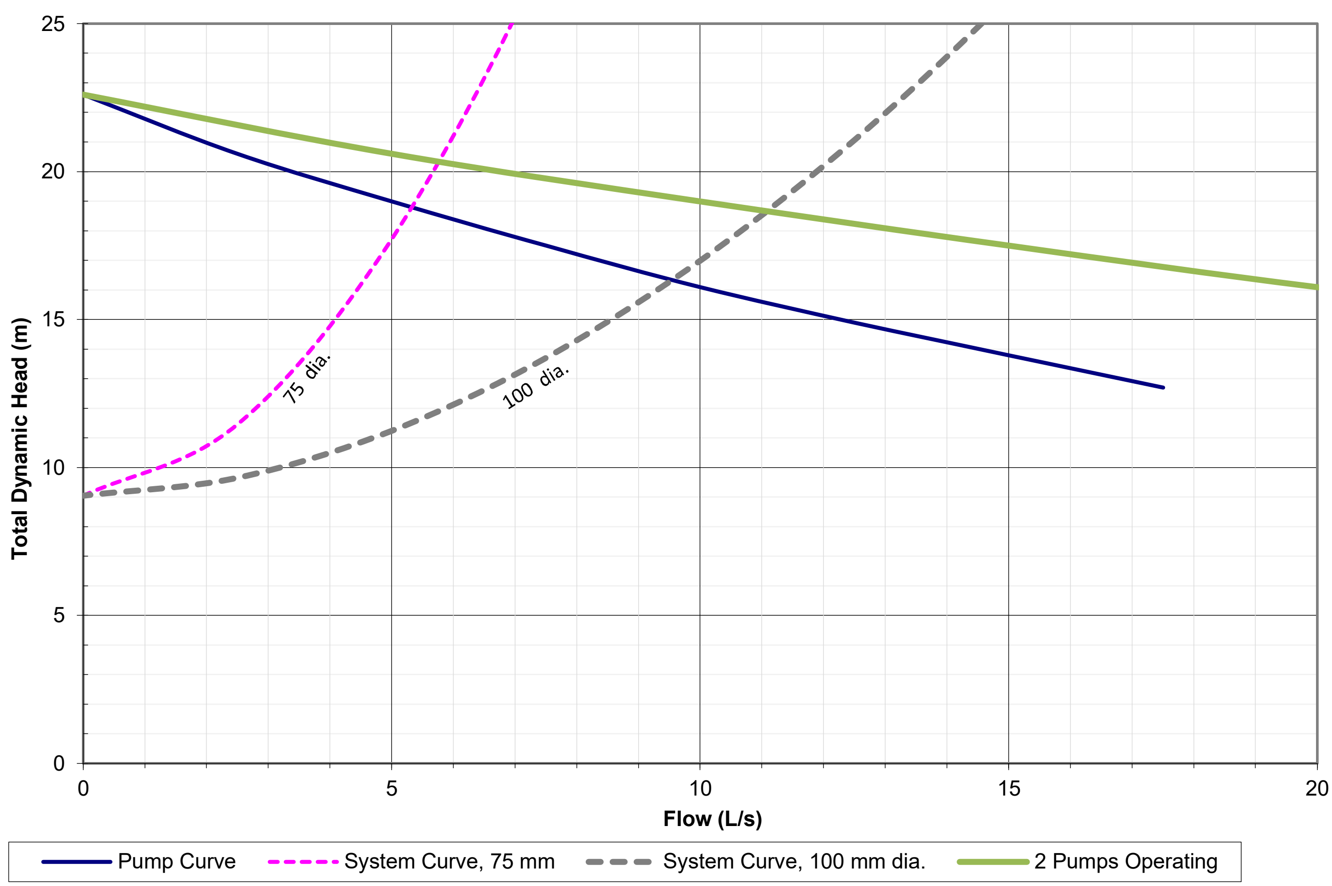
Norah Road (Whispering Pines)

Koers File: 1863

Motor Details		Power Supply		Pump Curve			System Curve	
				Flow (l/s)	Head (m)	Hydaulic Efficieny %	100 dia. (m)	75 dia. (m)
Power (hp)	5.5 (4.1kw)	Volts	120/208	17.5	12.7	32.3	31.5	97.4
Voltage	230	Phase	single	15	13.8	35.0	25.9	75.4
Phase	single			12.5	14.9	36.4	21.1	56.4
RPM	1750			10	16.1	38.0	17.0	40.4
Amps	30			7.5	17.5	36.4	13.7	27.4
Pump Details		**Serial Nos.**		5	19.0	32.0	11.2	17.7
Manufacturer	Flygt	180-361136		2.5	20.6	20.0	9.7	11.5
Model	CP 3127	180-361137		0	22.6	0	9.1	9.1
Impeller Dia.	485							

Forcemain Details						Duty Point Calculations		
C Value:	120	**Minor losses:**	**k**	**Minor losses:**	**k**	Flow:	9.5	L/s
Class & Type:	Sched 40	Bends, 90º:	0.13	Valve:	0.13	Pump off el.	11.75	m
Nominal Ø, mm:	100	45º:	0.07	Tee:	1.00	High pt el.	20.8	m
Actual ø, mm:	100	22½º:	0.05	Check:	0.90	Static head:	9.05	m
Length, m:	340	11¼º:	0.03	Outlet:	1.00	friction head:	6.95	m
Area, m²:	0.0079			Discharge:	0.25	minorhead:	0.27	m
	Number of Bends	90º	3	22½º	0	Head loss:	**16.28**	m
		45º	0	11¼º	0	Velocty:	1.21	m/s

Pump Performance Curves



HEMLOCK

FLYGT

PERFORMANCE CURVE

PRODUCT	TYPE
NP3127.180	MT
CURVE NO 63-438-00-3730	ISSUE 1

PROJECT

DATE 1999-07-08

	1/1-LOAD	3/4-LOAD	1/2-LOAD
MOTOR COS PHI	0.88	0.86	0.79
MOTOR EFFICIENCY	84.0 %	85.0 %	84.5 %
GEAR EFFICIENCY	---	---	

COMMENTS

INLET/OUTLET - /140 mm

IMP. THROUGHLET ---

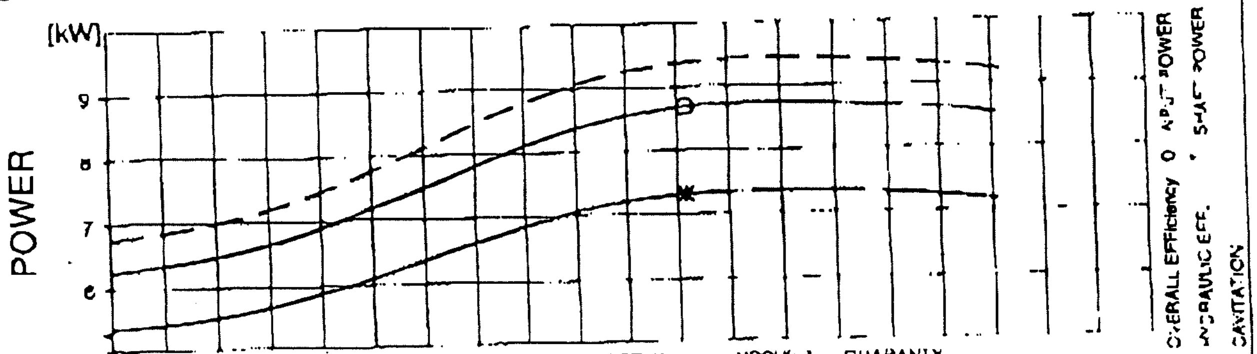
MOTOR SHAFT POWER	10 (7.5 kW)	hp
STARTING CURRENT .	169	A
RATED CURRENT ...	28	A
RATED SPEED	1735	rpm
TOT.MOM.OF INERTIA ...	0.052	kgm2
NO. OF BLADES	2	

IMPELLER DIAMETER 204 mm

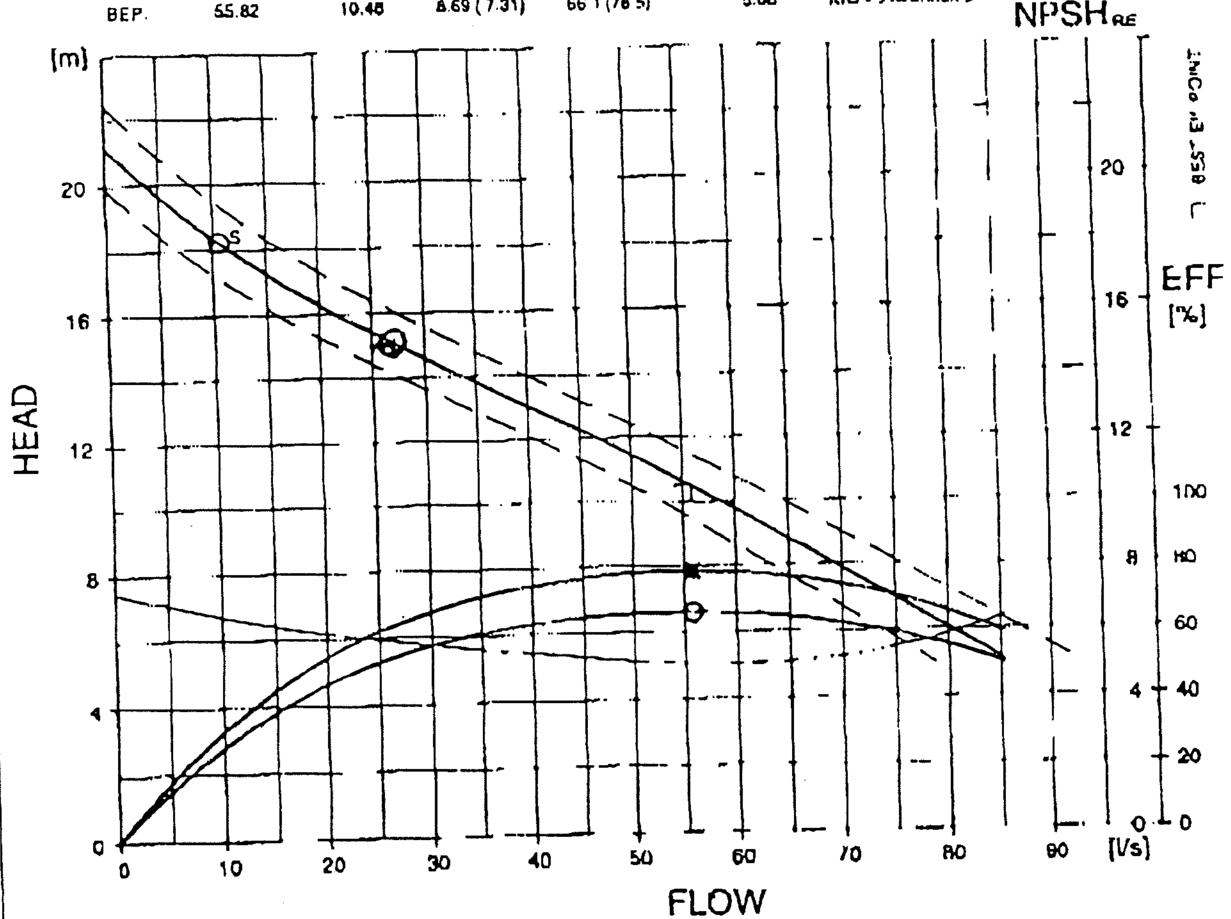
MOTORTYPE	STATOR	REV
		10

FREQ	PHASES	VOLTAGE	POLES
60 Hz	3	208V	4

GEARTYPE RATIO ---



DUTY-POINT	FLOW[l/s]	HEAD[m]	POWER[kW]	EFF[%]	NPSH[m]	GUARANTY
BEP.	55.82	10.48	8.69 (7.31)	66.1 (78.5)	5.06	ISO 2548/annex B



S RISK OF SEDIMENTATION AT VELOCITY BELOW 0.6 m/s (STANDARD DIAM 150 mm)

unix AUTHOR FCDN010 SACU (rev 5.8)

CURVES SHOW PERFORMANCE WITH CLEAR WATER

FLYGT ISO CURVE

Sewage Lift Station Details & Peformance Curves

Hemlock Street

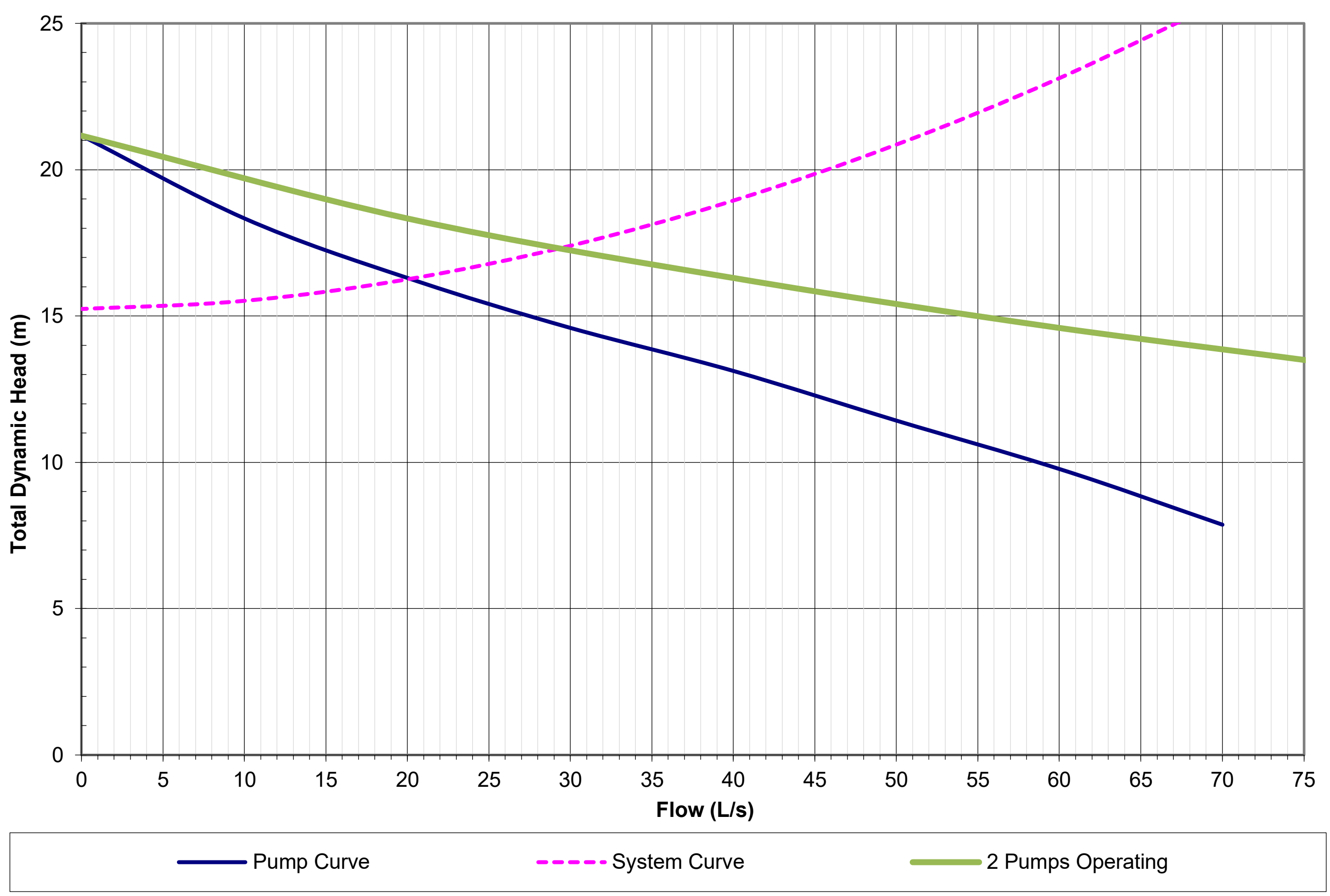
Koers File: 1863

Motor Details		Power Supply		Pump Curve			System Curve
				Flow (l/s)	Head (m)	Hydaulic Efficieny %	(m)
Power (hp)	10 (7.5kw)	**Volts**	120/208	70	7.9	62.0	25.8
Voltage	208	**Phase**	single	60	9.8	66.0	23.1
Phase	three			50	11.4	65.0	20.9
RPM	1740			40	13.1	63.0	18.9
Amps	28			30	14.6	57.0	17.4
Pump Details		**Serial Nos.**		20	16.3	46.0	16.3
Manufacturer	Flygt	180 9961031		10	18.3	27.0	15.5
Model	NP 3127	180 9961032		0	21.2		15.2
Impeller Dia.	438						

Forcemain Details					
C Value:	120	**Minor losses:**	**k**	**Minor losses:**	**k**
Class & Type:	150 PVC	Bends, 90º:	0.13	Valve:	0.13
Nominal Ø, mm:	200	45º:	0.07	Tee:	1.00
Actual ø, mm:	204	22½º:	0.05	Check:	0.90
Length, m:	373	11¼º:	0.03	Outlet:	1.00
Area, m²:	0.0327			Discharge:	0.25
	Number of Bends	90º	4	22½º	2
		45º	4	11¼º	2

Duty Point Calculations	
Flow:	20 L/s
Static head:	15.24 m
friction:	0.94 m
minor:	0.08 m
Head loss:	**16.26** m
Velocty:	0.61 m/s

Pump Performance Curves



TOTAL HEAD

REPRIMING LIFTS

RPM	650	750	850	950	1050	1150	1250	1350	1450	1550	1650-1750	1850-2150
FEET	4	5	8	10	13	16	18	19	20	21	22	25
METERS	1.2	1.5	2.4	3.1	4.0	4.9	5.5	5.8	6.1	6.4	6.7	7.6

Figure NPSH required prior to using above table.
DO NOT use as available Suction Lift.

2.50"/[63.5 MM] DIA. MAX. SPHERICAL SOLIDS

BAY ST SIMPLEX

PERFORMANCE CURVE

VOLUTE 11405D 11405B

CURVE T3CSC-B-4

IMPELLER 11406

MODEL T3CSC-B

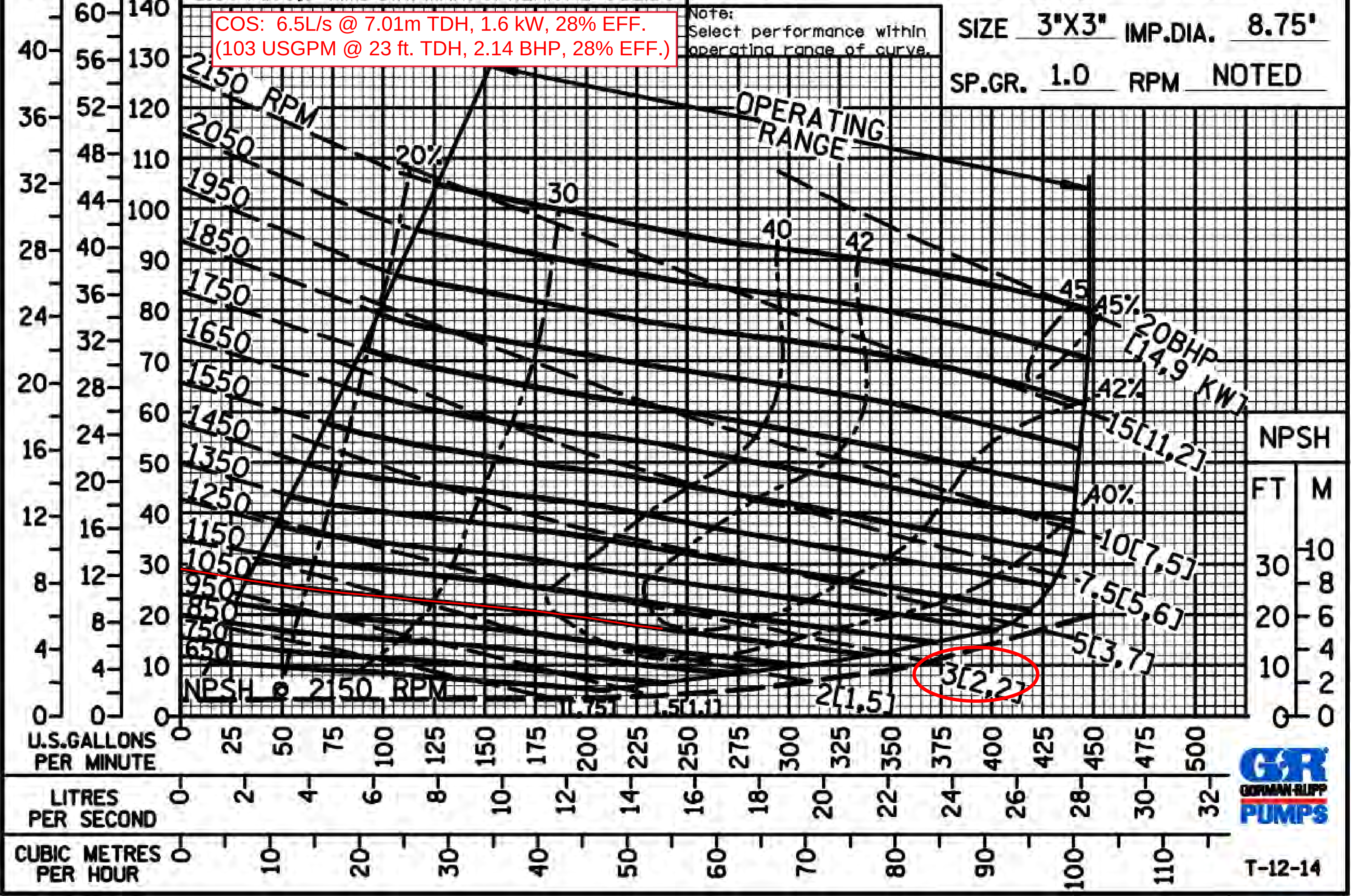
SIZE 3"X3"

IMP.DIA. 8.75"

SP.GR. 1.0

RPM NOTED

Note:
Select performance within operating range of curve.



T-12-14

Sewage Lift Station Details & Peformance Curves

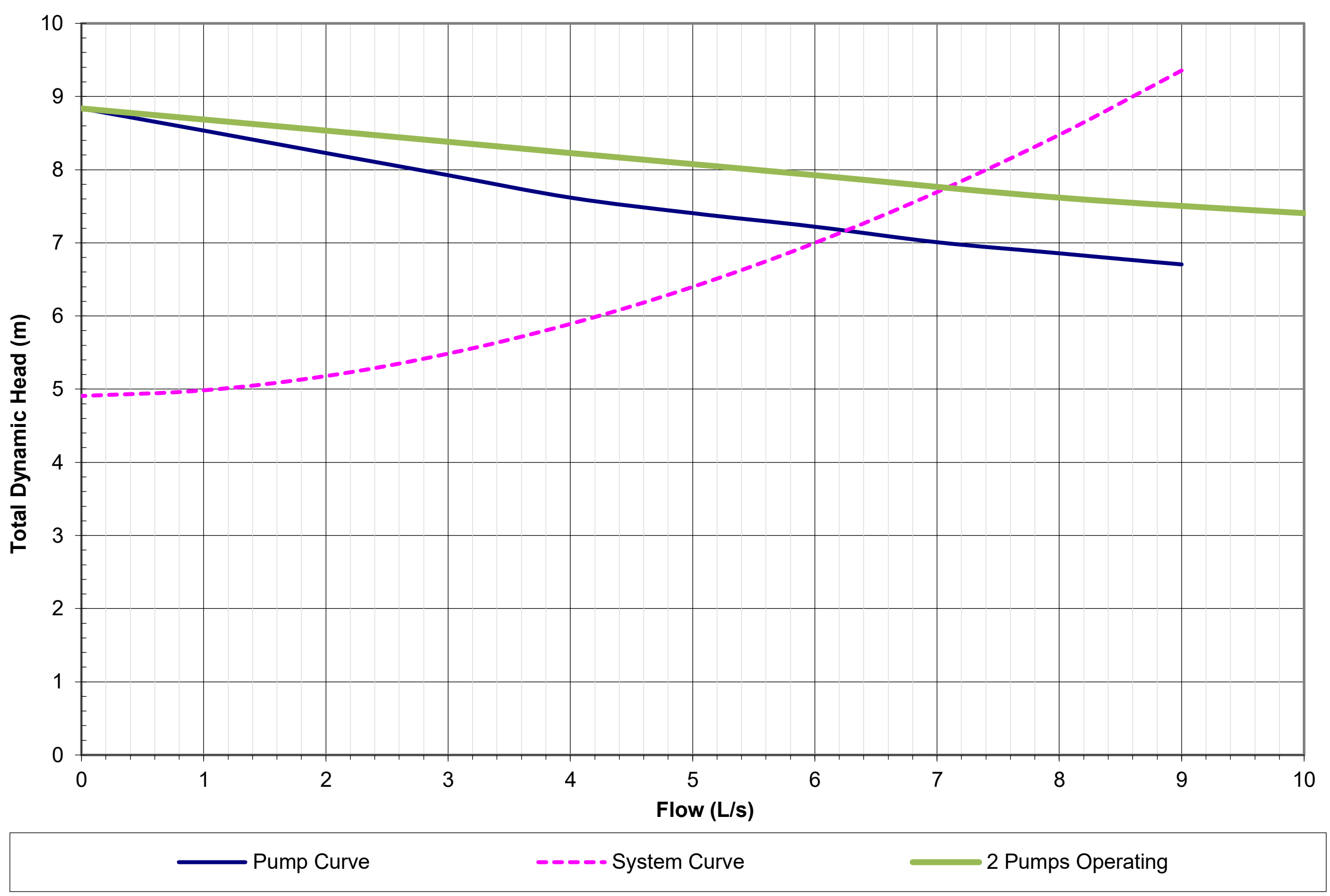
Bay Street, (former Simplex)

Koers File: 1863

Motor Details		Power Supply		Pump Curve Flow (l/s)	Head (m)	Hydaulic Efficieny %	System Curve (m)
Power (hp)	3 (2.2kw)	Volts	600	9	6.7	33%	9.4
Voltage	208	Phase	3	8	6.9	30%	8.5
Phase	3			7	7.0	28%	7.7
RPM	1050			6	7.2	27%	7.0
Amps	8.6			5	7.4	23%	6.4
Pump Details				4	7.6	20%	5.9
Manufacturer	Gorman-Rupp			3	7.9		5.5
Model	T3CSC-B-4			2	8.2		5.2
Impeller Dia.	8.75" (222 mm)			1	8.5		5.0
				0	8.8	0%	4.9

Forcemain Details						Duty Point Calculations	
C Value:	140	**Minor losses:**	**k**	**Minor losses:**	**k**	Flow:	6.25 L/s
Class & Type:	AC, Class 150	Bends, 90º:	0.13	Valve:	0.13	Pump off el.	14.7 m
Nominal Ø, mm:	100	45º:	0.07	Tee:	1.00	forcemain el.	19.61 m
Actual ø, mm:	100	22½º:	0.05	Check:	0.90	Static head:	4.91 m
Length, m:	300	11¼º:	0.03	Outlet:	1.00	friction:	2.13 m
Area, m²:	0.0079			Discharge:	0.25	minor:	0.13 m
	Number of Bends	90º	5	22½º	0	Head loss:	**7.17** m
		45º	2	11¼º	0	Velocty:	0.80 m/s

Pump Performance Curves



FRASER LANE

FLYGT	PERFORMANCE CURVE	PRODUCT CP3152.181	TYPE HT
DATE 2000-02-29	PROJECT District of Ucluelet-Chris Graha	CURVE NO 63-454-00-5360	ISSUE 2

	1/1-LOAD	3/4-LOAD	1/2-LOAD
MOTOR COS PHI	0.83	0.79	0.68
MOTOR EFFICIENCY	87.0 %	87.5 %	86.0 %
GEAR EFFICIENCY	---	---	---

MOTOR SHAFT POWER	20	Hp
STARTING CURRENT ...	121	A
RATED CURRENT ...	2060	A
RATED SPEED	1755	rpm
TOT.MOM.OF INERTIA ...	0.24	kgm2
NO. OF BLADES	1	

COMMENTS

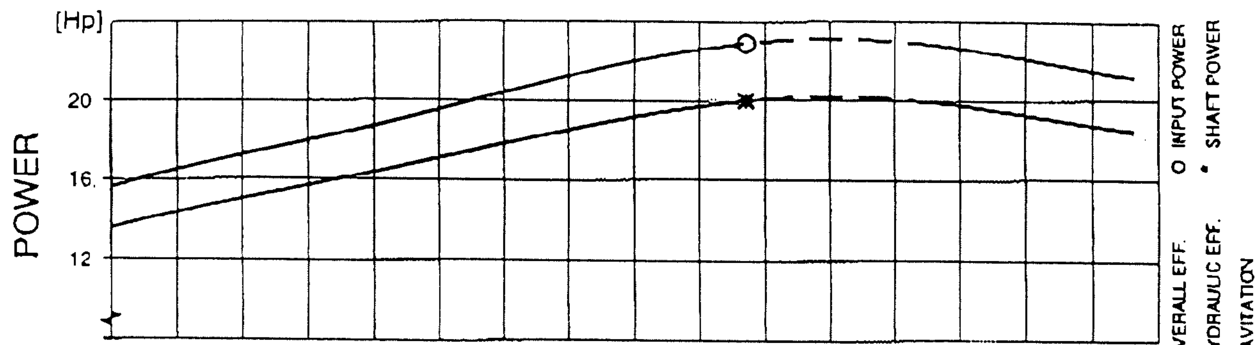
INLET/OUTLET	IMP. THROUGHLET
-/100 mm	76 mm

IMPELLER DIAMETER 275 mm

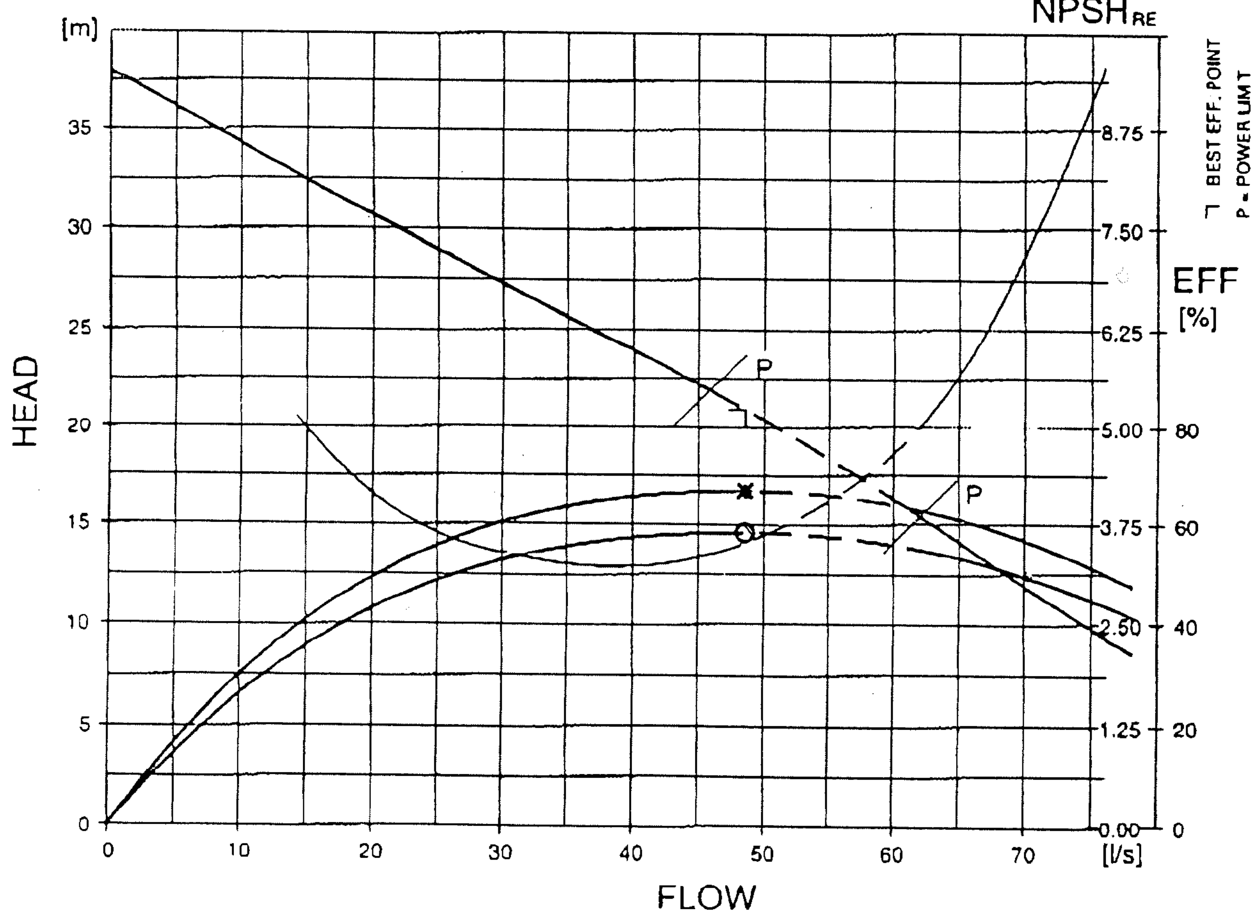
MOTORTYPE	STATOR	REV
25-15-4AA	52D	10

FREQ.	PHASES	VOLTAGE	POLES
60 Hz	3	600 V 208	4

GEARTYPE	RATIO



DUTY-POINT:	FLOW[l/s]	HEAD(m)	POWER[Hp]	EFF[%]	NPSH(m)	GUARANTY
B.E.P.:	48.54	20.92	22.90 (19.99)	58.3 (66.8)	3.51	



FLYPS 2.0 (1118)

Performance with clear water and rating data at 40 °C

FLYGT	CURVE

FROM : ITT FLYGT FAX NO. : 604 941 3659 02-01-00 12:10P P.05

KOERS & ASSOCIATES ENGINEERING LTD.
Consulting Engineers

Sewage Lift Station Details & Peformance Curves

Fraser Lane

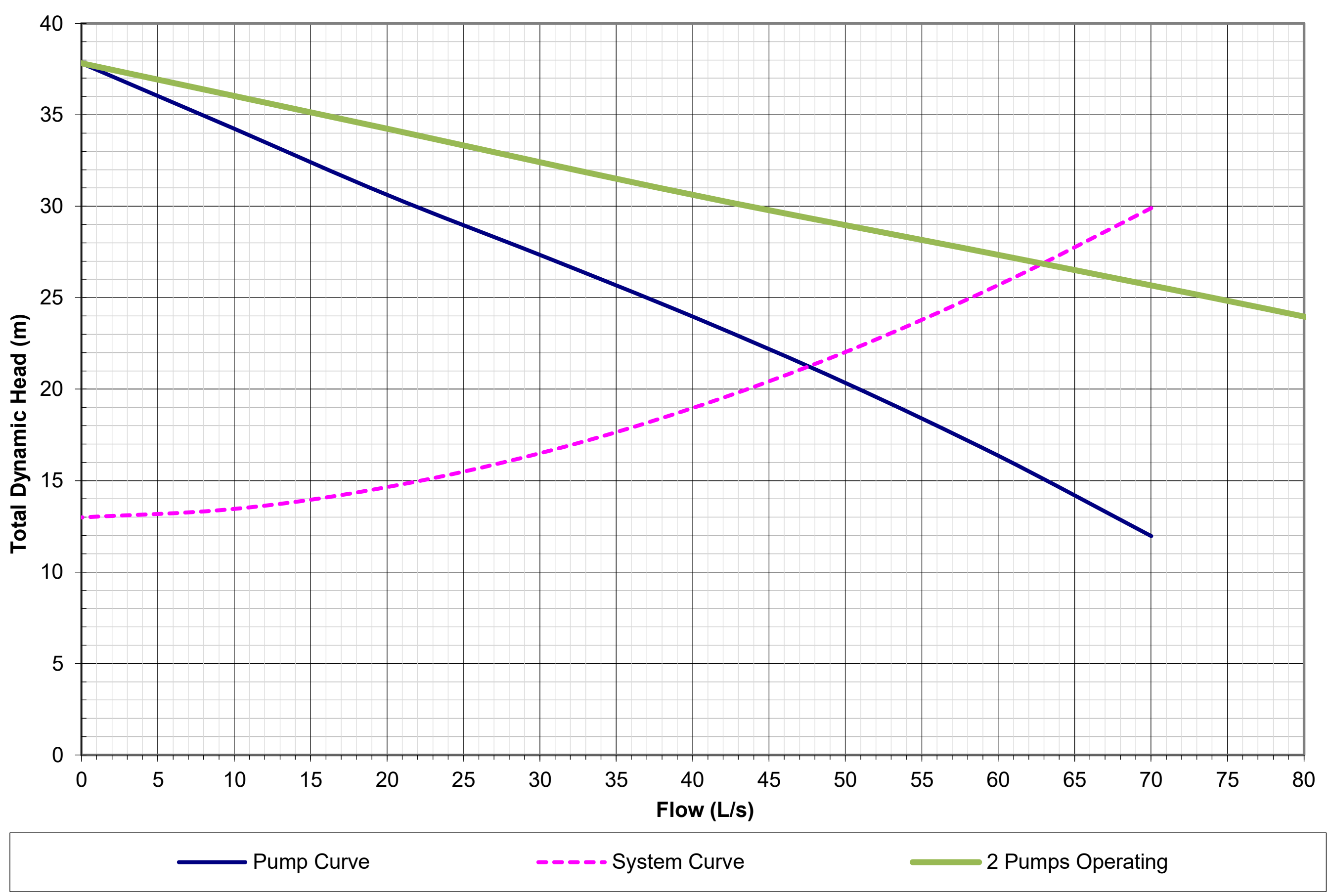
Koers File: 1863

Motor Details		Power Supply		Pump Curve Flow (l/s)	Head (m)	Hydaulic Efficieny %	System Curve (m)
Power (hp)	20 (15kw)	Volts	120/208	70	12.0	50.0	29.9
Voltage	208	Phase	single	60	16.4	56.0	25.7
Phase	three			50	20.4	57.0	22.0
RPM	1750			40	24.0	57.0	19.0
Amps	60			30	27.4	53.0	16.5
Pump Details		Serial Nos.		20	30.6	44.0	14.6
Manufacturer	Flygt	180-10024		10	34.2	26.0	13.5
Model	3152	180-8320056		0	37.8		13.0
Impeller Dia.	454						

Forcemain Details					
C Value:	120	Minor losses:	k	Minor losses:	k
Class & Type:	150 PVC	Bends, 90º:	0.13	Valve:	0.13
Nominal Ø, mm:	250	45º:	0.07	Tee:	1.00
Actual ø, mm:	200	22½º:	0.05	Check:	0.90
Length, m:	561	11¼º:	0.03	Outlet:	1.00
Area, m²:	0.0314			Discharge:	0.25
	Number of Bends	90º	6	22½º	3
		45º	4	11¼º	1

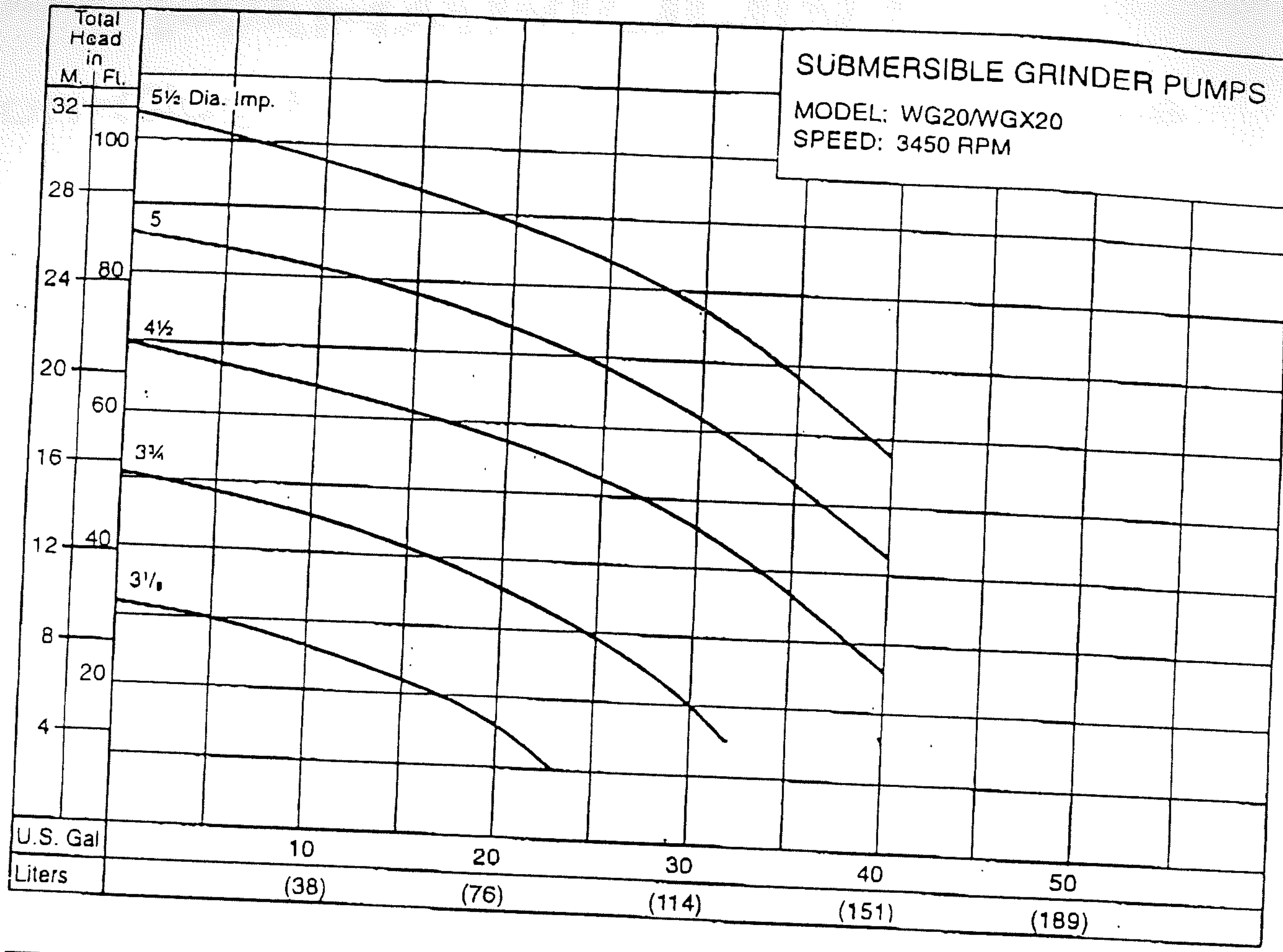
Duty Point Calculations		
Flow:	47.5	L/s
Static head:	13.00	m
friction:	7.70	m
minor:	0.51	m
Head loss:	**21.20**	m
Velocty:	1.51	m/s

Pump Performance Curves



52 STEPS

Pump Performance



Available Models		Motor Electrical Data									
Standard	Explosion Proof	HP	Volts	Phase	Start Amps	Run Amps	Run KW	Start KVA	Run KVA	NEC Code Letter	Service Factor
WG20-01-15	WGX20-01-15	2	200	1	50.0	15.0	2.8	10.0	3.0	F	1.25
WG20-21-15	WGX20-21-15	2	230	1	[illegible]	12.0	2.8	[illegible]	2.8	F	1.25
WG20-03-15	WGX20-03-15	2	200	3	30.0	9.5	2.9	10.4	3.3	F	1.25
WG20-23-15	WGX20-23-15	2	230	3	27.5	8.4	2.9	11.0	3.3	F	1.25
WG20-43-15	WGX20-43-15	2	460	3	13.8	4.2	2.9	11.0	3.3	F	1.25

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KOERS & ASSOCIATES ENGINEERING LTD.
Consulting Engineers

Sewage Lift Station Details & Peformance Curves

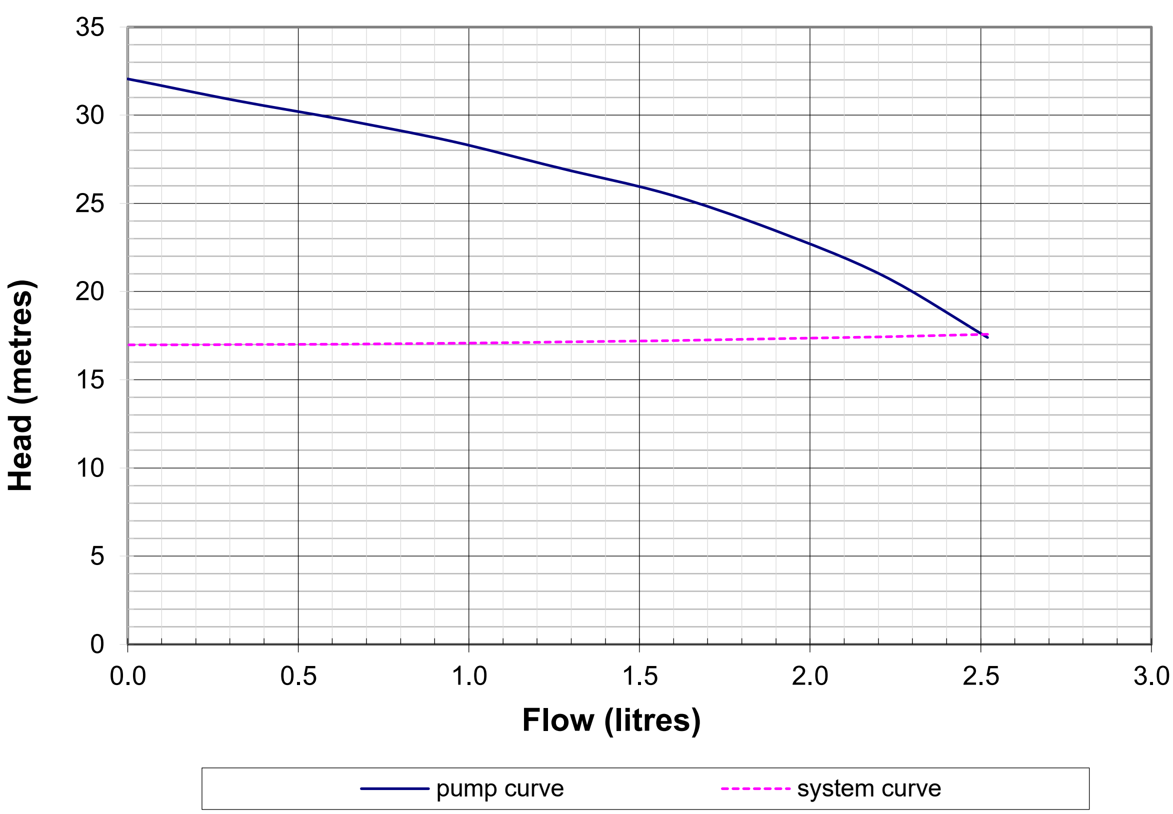
Imperial Lane (52 Steps)

Koers file: 1863

Motor Details		Power Supply		Flow (l/s)	Head (m)	overall η %	System Curve
Power (hp)	2 (1.49kw)						
Voltage	230	Volts	230	2.52	17.41	15.6	17.58
phase	single	Phase	single	2.21	20.94	16.4	17.45
rpm	3450			1.89	23.51	15.8	17.33
Amps	12			1.58	25.55	14.3	17.23
Type	Meyers			1.26	27.03	12.1	17.15
Model	WGL20-21			0.95	28.52	9.6	17.08
Serial No.	P2K2701E			0.63	29.75	6.7	17.03
Serial No.	?			0.32	30.83	3.5	17.00
impeller #	139.7mm	5 1/2"		0.00	32.07	0.0	16.99

Forcemain C	120	110	**Minor losses:**	**k**		**k**		Flow (l/s)	2.52
Class & Type	150 PVC		Bends:90˚	0.13	Valve	0.13		static	6.99
Nominal Ø mm	250	50	45˚	0.07	Tee	1.00		friction	0.287
Actual Ø mm	250	54.29	22½°	0.05	Check	0.90		minor	0.247
Length m	217	7	11¼°	0.03	Outlet	1.00		Head loss:	**17.58**
Section Area m²	0.0491	0.0023			Discharge	0.25		Vel, m/s:	0.05
Bends no. 90˚ 6		22½° 0	Vel m/s			sudden enlargement			0.055
45˚ 0		11¼° 1		0.05	1.09	pump pressure (Fraser)			10

Pump Performance Curves



FORBES ROAD

Performance Curve

FLYGT	Performance Curve	Product: NP3127.181	Type: HT
Date: 2019-06-27	Project:	Curve No: 63-489-00-2202	Issue: 4

	1/1-Load	3/4-Load	1/2-Load
Power Factor	0.87	0.84	0.76
Efficiency	83.5 %	84.0 %	82.5 %
Motor Data	---	---	---

Rated Power ...	7.5 (5.59 kW)	hp
Starting Current ...	46	A
Rated Current ...	7.4	A
Rated Speed ...	1740	rpm
Tot. Mom. of Inertia ...	0.044	kgm2
No. of Blades	2	

Impeller Diameter: 195 mm

Motor #	Stator	Rev
21-10-4AL	52D	11

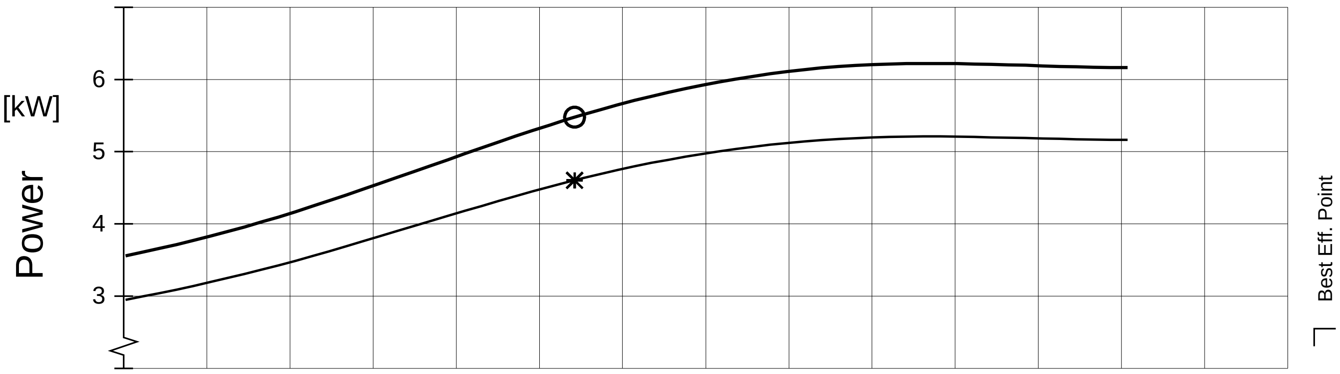
Freq.	Phases	Voltage	Poles
60 Hz	3	600 V	4

Geartype	Ratio
---	---

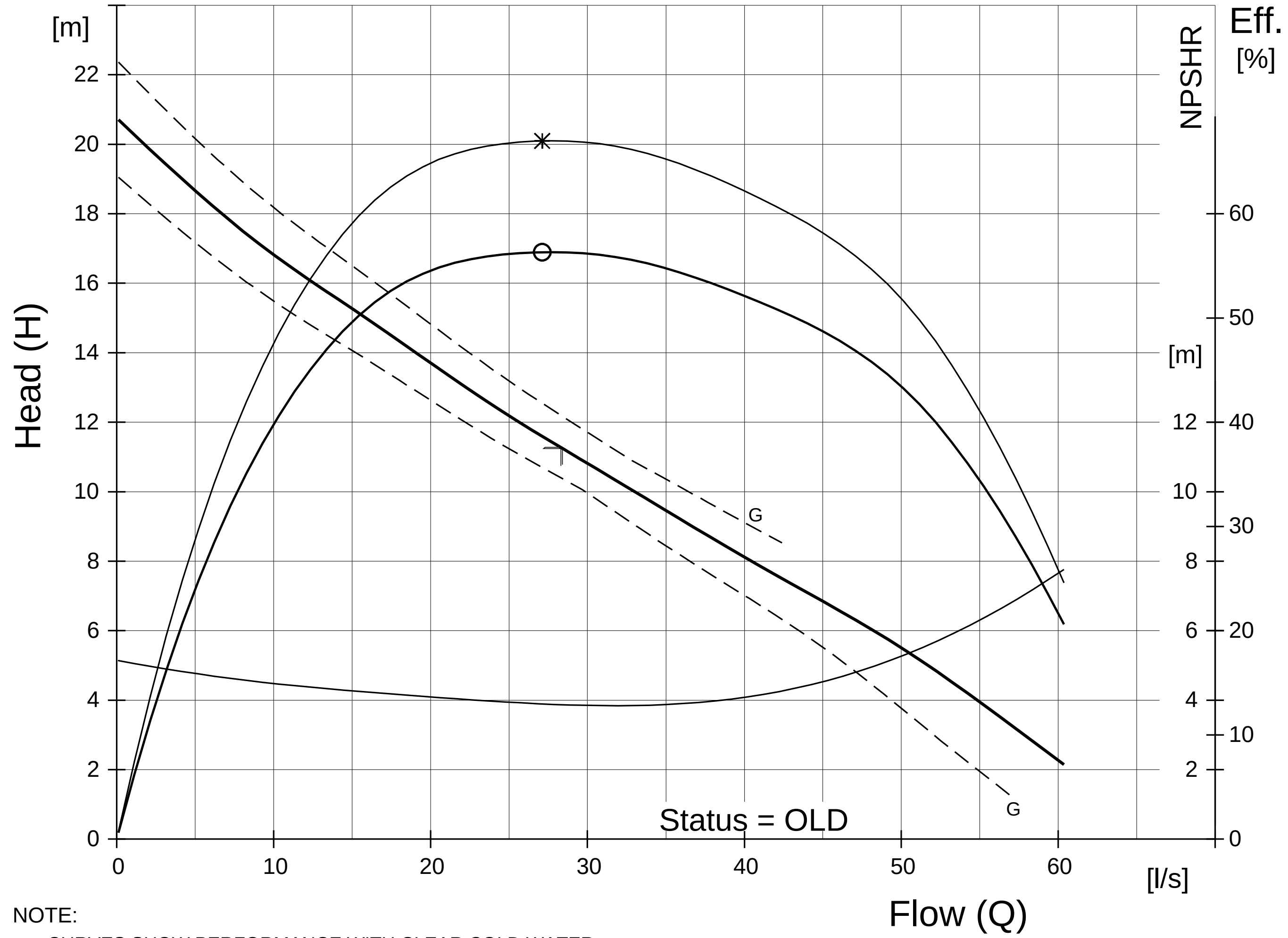
Comments

Inlet/Outlet: -/100 mm

Imp. Throughlet: ---



Duty-Point	Flow [l/s]	Head [m]	Power [kW]	Eff. [%]	NPSHR[m]
B.E.P.	27.1	11.6	5.48 (4.61) *	56.3 (67.0) *	3.9



NOTE:

CURVES SHOW PERFORMANCE WITH CLEAR COLD WATER

* : Pump EFFICIENCY/Shaft POWER

O : Overall EFFICIENCY/Input POWER

NPSHR = NPSH3 + min. operational margin

Guarantee between limits (G) acc. to

ISO 9906:2012 & ANSI/HI 11.6:2012 / <10kW

unix AUTHOR: XY81618 SACU (rev:8.1)

KOERS & ASSOCIATES ENGINEERING LTD.
Consulting Engineers

Sewage Lift Station Details & Peformance Curves

Forbes Road (Marine Drive)

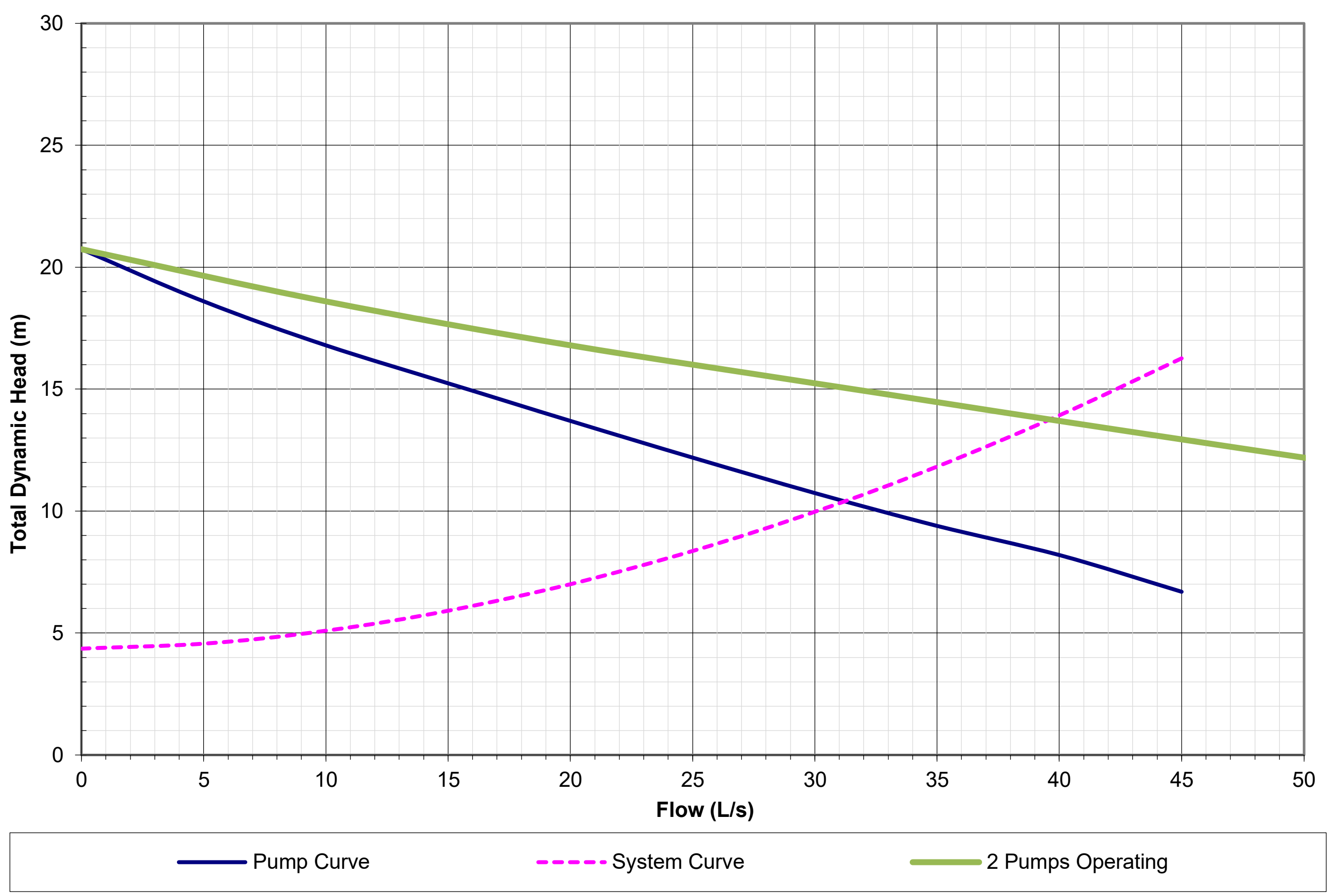
Koers File: 1863

Motor Details		Power Supply		Pump Curve			System Curve
				Flow (l/s)	Head (m)	Hydaulic Efficieny %	(m)
Power (hp)	7.5 (5.6kw)	Volts	600	45	6.7	49%	16.3
Voltage	600	Phase	3	40	8.2	52%	13.9
Phase	3			35	9.4	55%	11.8
RPM	1740			30	10.8	56%	10.0
Amps	46 / 7.4			25	12.2	56%	8.4
Pump Details				20	13.7	55%	7.0
Manufacturer	Flygt			15	15.3	50%	5.9
Model	NP3127.181 HT			10	16.8	40%	5.1
Impeller Dia.	195 mm			5	18.6	24%	4.6
				0	20.8	0%	4.4

Forcemain Details					
		Minor losses:	**k**	**Minor losses:**	**k**
C Value:	140	Bends, 90º:	0.13	Valve:	0.13
Class & Type:	HDPE, DR17	45º:	0.07	Tee:	1.00
Nominal Ø, mm:	200	22½º:	0.05	Check:	0.90
Actual ø, mm:	192	11¼º:	0.03	Outlet:	1.00
Length, m:	1,000			Discharge:	0.25
Area, m²:	0.0290				
	Number of Bends	90º	6	22½º	0
		45º	1	11¼º	

Duty Point Calculations		
Flow:	31.3	L/s
Static head:	4.37	m
friction:	5.82	m
minor:	0.25	m
Head loss:	**10.44**	m
Velocty:	1.08	m/s

Pump Performance Curves



BIG BEACH

Performance Curve

FLYGT	Performance Curve	Product: NP3127.181	Type: HT
Date: 2019-06-27	Project:	Curve No: 63-488-00-3702	Issue: 1

	1/1-Load	3/4-Load	1/2-Load
Power Factor	0.88	0.86	0.79
Efficiency	84.0 %	85.0 %	84.5 %
Motor Data	---	---	---

Rated Power ...	10 (7.46 kW)	hp
Starting Current ...	55	A
Rated Current ...	9.7	A
Rated Speed ...	1735	rpm
Tot. Mom. of Inertia ...	0.054	kgm2
No. of Blades	2	

Impeller Diameter: 215 mm

Motor #	Stator	Rev
21-12-4AL	52D	11

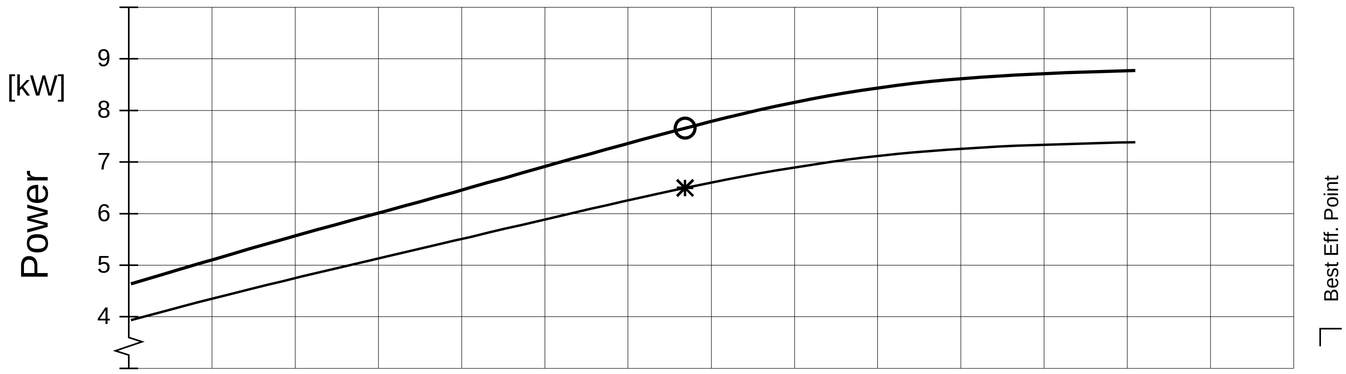
Freq.	Phases	Voltage	Poles
60 Hz	3	600 V	4

Geartype	Ratio
---	---

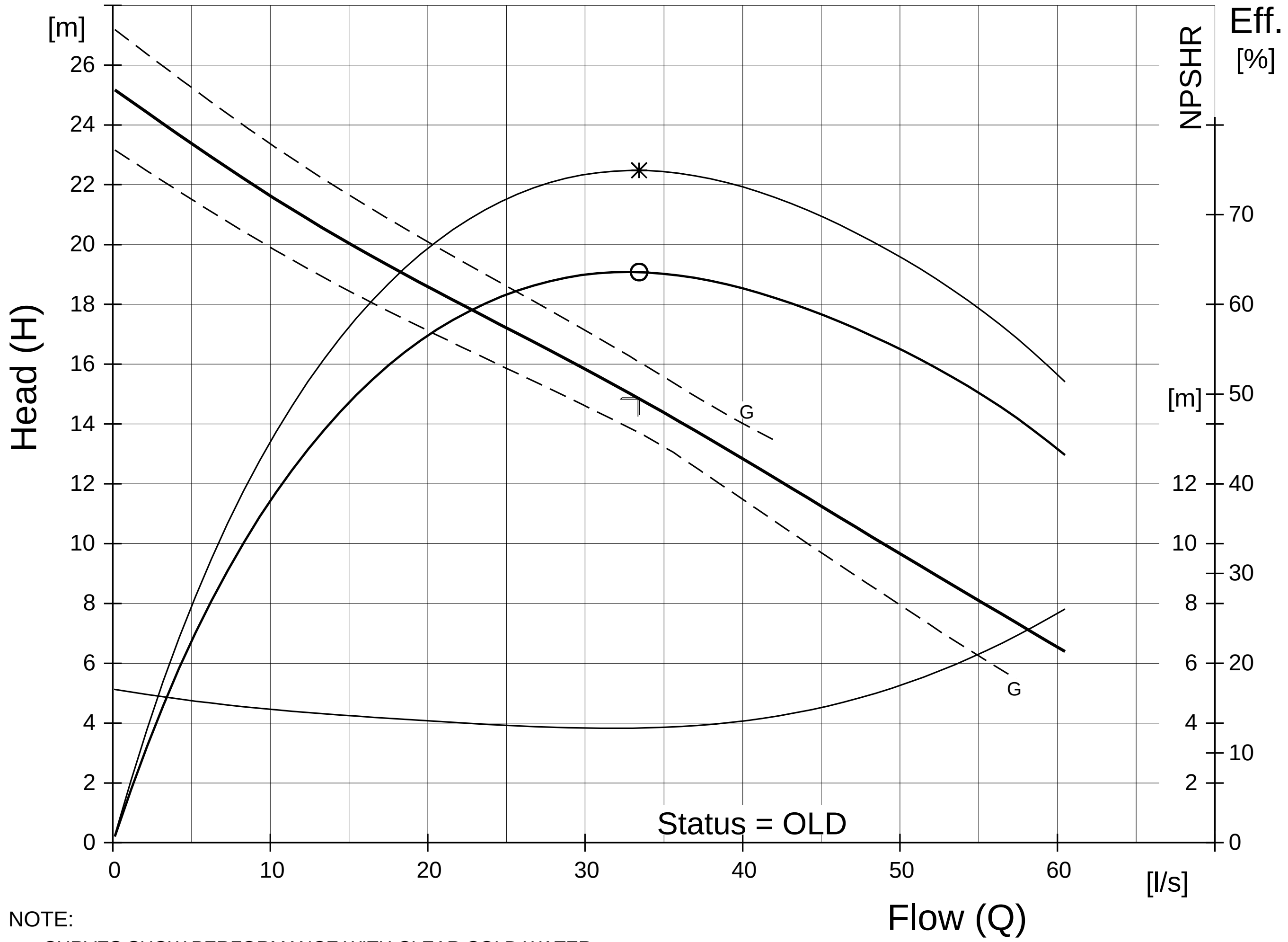
Comments

Inlet/Outlet: -/100 mm

Imp. Throughlet: ---



Duty-Point	Flow [l/s]	Head [m]	Power [kW]	Eff. [%]	NPSHR[m]
B.E.P.	33.4	14.8	7.66 (6.50) *	63.6 (74.9) *	3.9



NOTE:

CURVES SHOW PERFORMANCE WITH CLEAR COLD WATER

* : Pump EFFICIENCY/Shaft POWER

O : Overall EFFICIENCY/Input POWER

NPSHR = NPSH3 + min. operational margin

Guarantee between limits (G) acc. to

ISO 9906:2012 & ANSI/HI 11.6:2012 / <10kW

unix AUTHOR: XY81618 SACU (rev:8.1)

KOERS & ASSOCIATES ENGINEERING LTD. Consulting Engineers

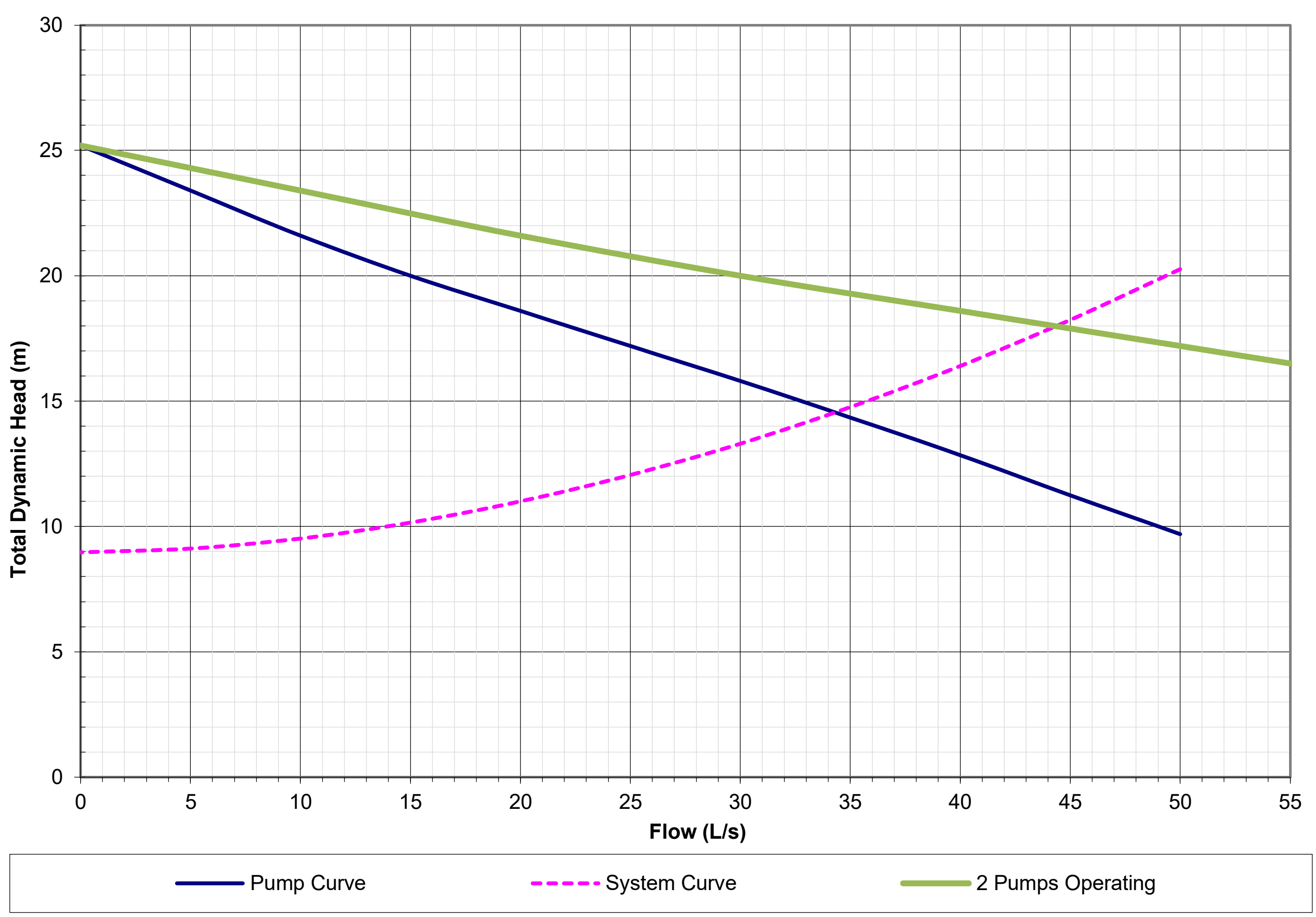
Sewage Lift Station Details & Peformance Curves

Big Beach

Koers File: 1863

Motor Details		Power Supply		Pump Curve			System Curve	
				Flow (l/s)	Head (m)	Hydaulic Efficieny %	1 Pump (m)	2 Pump (m)
Power (hp)	10 (7.5kw)	Volts	600	50	9.7	55%	20.3	20.3
Voltage	600	Phase	3	45	11.3	59%	18.2	18.3
Phase	3			40	12.9	62%	16.4	16.4
RPM	1735			35	14.4	63%	14.8	14.9
Amps	55 / 10			30	15.8	63%	13.3	13.3
Pump Details				25	17.2	61%	12.1	12.2
Manufacturer	Flygt			20	18.6	57%	11.0	15.0
Model	NP3127.181 HT			15	20.0	49%	10.2	10.3
Impeller Dia.	215 mm			10	21.6	38%	9.5	9.5
				5	23.4	23%	9.1	9.2
				0	25.2	0%	9.0	9.0

Forcemain Details						Duty Point Calculations	
C Value:	150	**Minor losses:**	**k**	**Minor losses:**	**k**	Flow:	34.4 L/s
Class & Type:	PVC, C900	Bends, 90º:	0.13	Valve:	0.13	Pump off el.	7.73 m
Nominal ø, mm:	150	45º:	0.07	Tee:	1.00	forcemain el.	16.7 m
Actual ø, mm:	150	22½º:	0.05	Check:	0.90	Static head:	8.97 m
Length, m:	237	11¼º:	0.03	Outlet:	1.00	friction:	4.813 m
Area, m²:	0.0177			Discharge:	0.25	minor:	0.798 m
	Number of Bends	90º	6	22½º	0	Head loss:	**14.58** m
		45º	1	11¼º	0	Velocty:	1.95 m/s



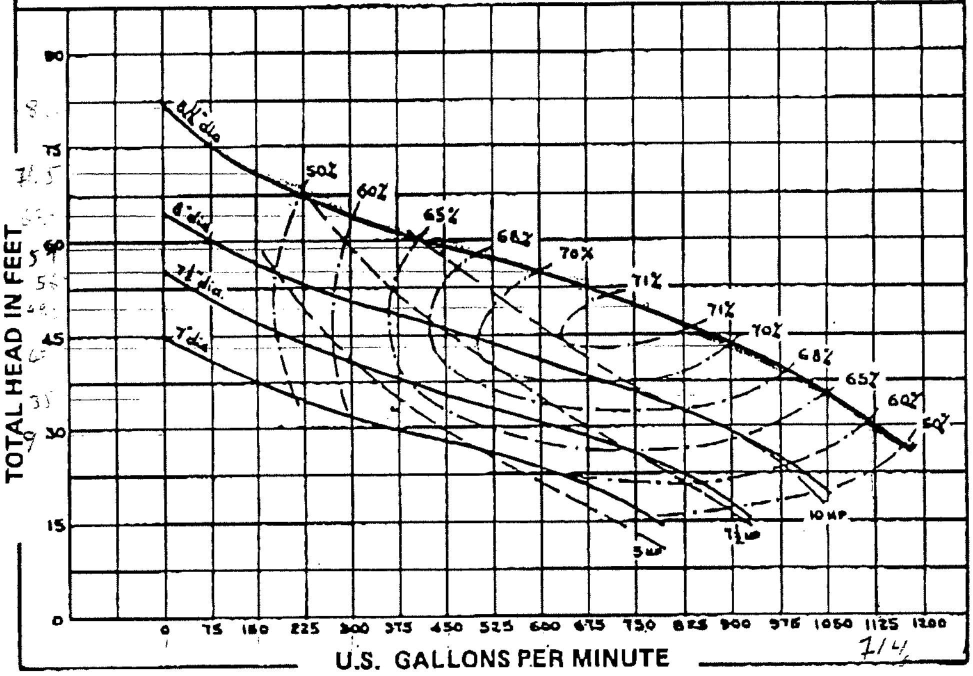
VICTORIA & ~~HEMLOCK (PRIOR TO MAY 5, 2009)~~

PARAMOUNT

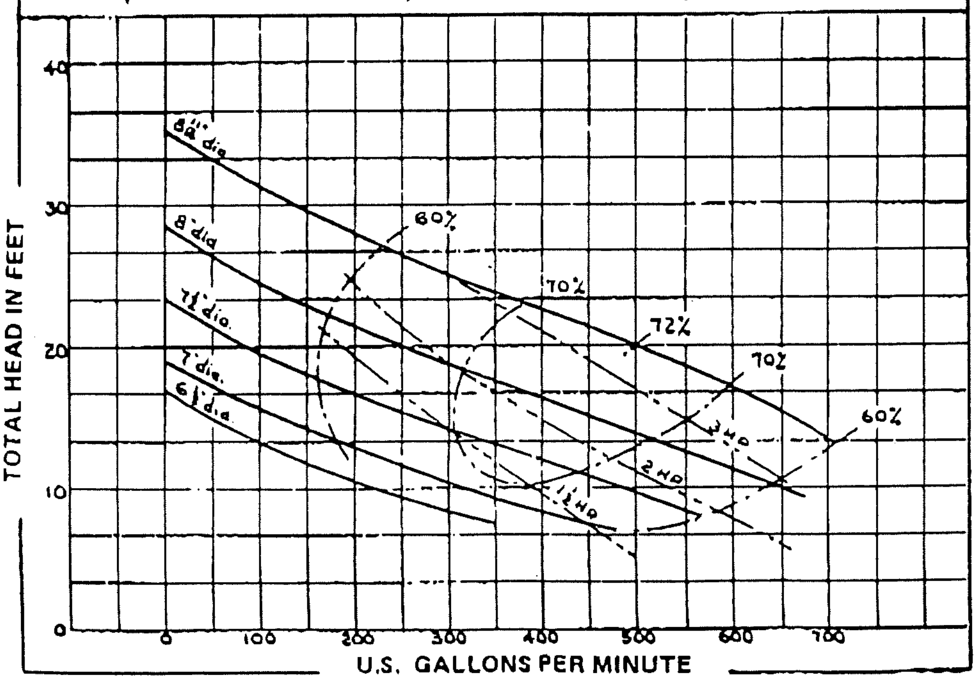
Non-Clog Sewage and Sump Pumps

8 11/16"

4LSVW, 4LSHD, 4LSVD, 4LSVDS, 4LSVWS, 4LSVCC	4" Suction, 4" Discharge, Passes 3" Sphere	Two Port Impeller operating at 1750 RPM,	CURVE No. 232-4-65-C



4LSVW, 4LSHD, 4LSVD, 4LSVDS, 4LSVWS, 4LSVCC	4" Suction, 4" Discharge, Passes 3" Sphere	Two Port Impeller operating at 1160 RPM,	CURVE No. 232-4-65-D



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KOERS & ASSOCIATES ENGINEERING LTD. Consulting Engineers

Sewage Lift Station Details & Peformance Curves

Victoria Road

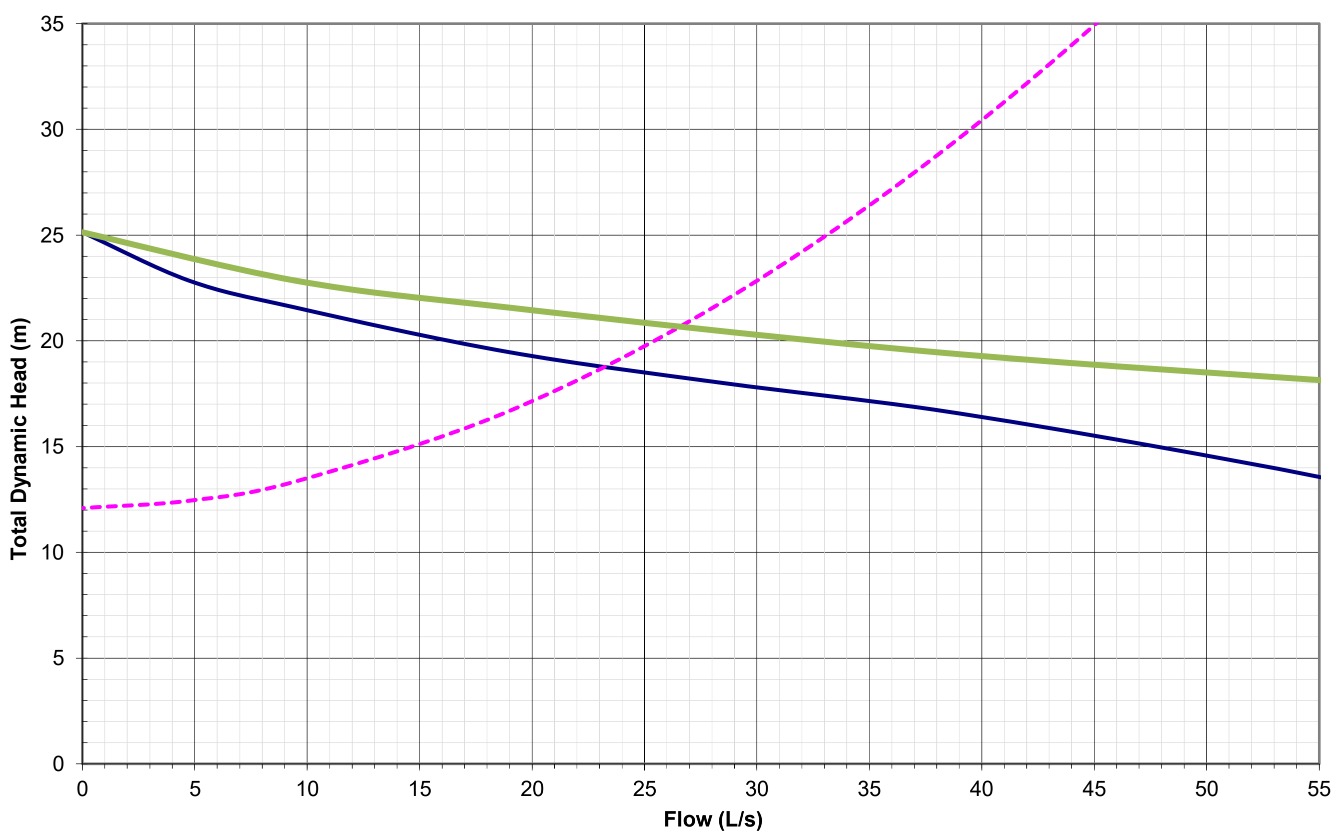
Koers File: 1863

Motor Details		Power Supply		Pump Curve Flow (l/s)	Pump Curve Head (m)	Pump Curve Hydaulic Efficieny %	System Curve (m)
Power (hp)	10 (7.5kw)	**Volts**	120/208	66.2	10.6	65.0	58.9
Voltage	208	**Phase**	single	56.8	13.2	70.0	47.3
Phase	three			47.3	15.1	71.0	37.2
RPM	1750			37.9	16.8	70.0	28.7
Amps	30			28.4	18.0	66.5	21.8
Pump Details		**Serial Nos.**		18.9	19.5	60.0	16.7
Manufacturer	Paramount	P2K2701E		9.5	21.6		13.4
Model	4L-SVWS	?		4.7	22.9		12.4
Impeller Dia.	220.7			0.0	25.1		12.1

Forcemain Details		Minor losses:	k	Minor losses:	k
C Value:	120				
Class & Type:	150 PVC	Bends, 90º:	0.13	Valve:	0.13
Nominal Ø, mm:	150	45º:	0.07	Tee:	1.00
Actual ø, mm:	155	22½º:	0.05	Check:	0.90
Length, m:	506	11¼º:	0.03	Outlet:	1.00
Area, m²:	0.0189			Discharge:	0.25
	Number of Bends	90º	2	22½º	0
		45º	3	11¼º	0

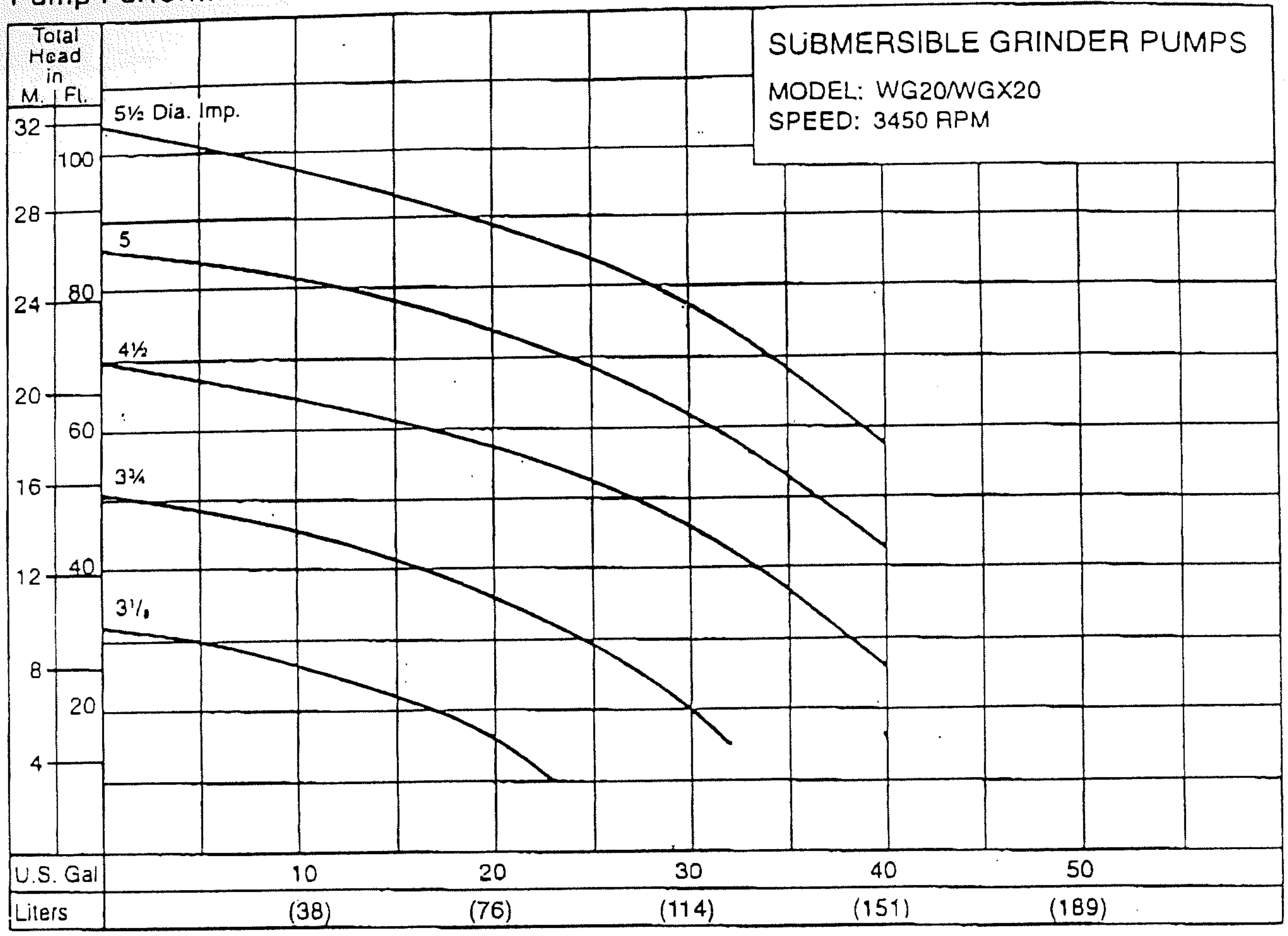
Duty Point Calculations		
Flow:	23.2	L/s
Static head:	12.09	m
friction:	6.39	m
minor:	0.29	m
Head loss:	**18.77**	m
Velocty:	1.23	m/s

Pump Performance Curves



MARINE DRIVE

Pump Performance



Available Models		Motor Electrical Data									
Standard	Explosion Proof	HP	Volts	Phase	Start Amps	Run Amps	Run KW	Start KVA	Run KVA	NEC Code Letter	Service Factor
WG20-01-15	WGX20-01-15	2	200	1	50.0	15.0	2.8	10.0	3.0	F	1.25
WG20-21-15	WGX20-21-15	2	230	1	44.0	12.0	2.8	10.1	2.8	F	1.25
WG20-03-15	WGX20-03-15	2	200	3	30.0	9.5	2.9	[illegible]	[illegible]	F	1.25
WG20-23-15	WGX20-23-15	2	230	3	27.5	8.4	2.9	11.0	3.3	F	1.25
WG20-43-15	WGX20-43-15	2	460	3	13.8	4.2	2.9	11.0	3.3	F	1.25

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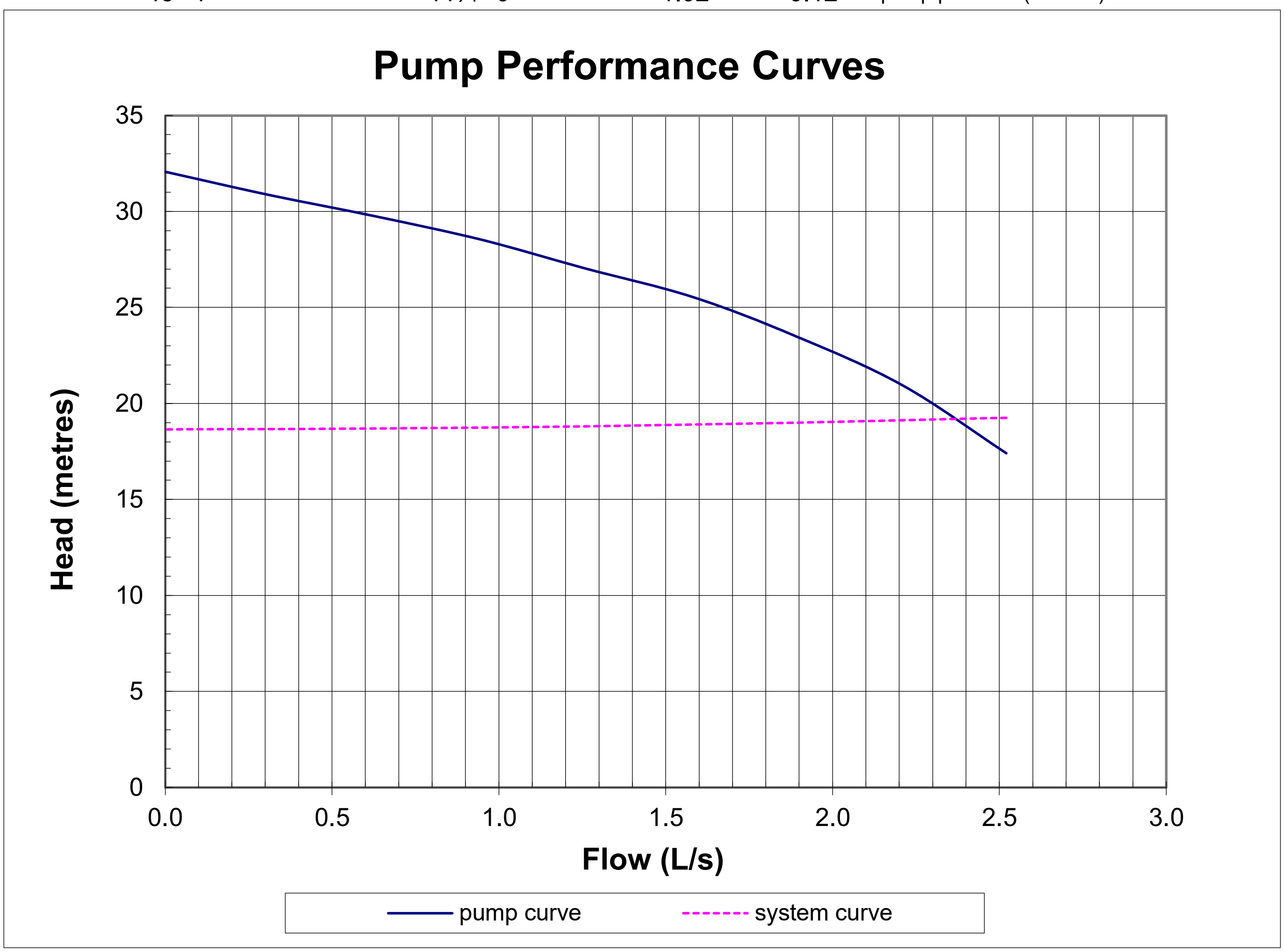
Sewage Lift Station Details & Peformance Curves

Marine Drive

Koers file: 1863

Motor Details		Power Supply		Flow	Head	overall	System
Power (hp)	2 (1.49kw)			(l/s)	(m)	η %	Curve
Voltage	208	Volts	230	2.52	17.41	21.8	19.27
phase	three	Phase	three	2.21	20.94	22.9	19.13
rpm	3450			1.89	23.51	22.1	19.01
Amps	9.5			1.58	25.55	20.0	18.91
Type	Meyers			1.26	27.03	16.9	18.82
Model	WGL20-21			0.95	28.52	13.4	18.75
Serial No.	680 1190			0.63	29.75	9.3	18.70
Serial No.	?			0.32	30.83	4.8	18.67
impeller #	139.7mm	5 1/2"		0.00	32.07	0.0	18.66

Forcemain C	120	110	**Minor losses:**	**k**		**k**	Flow (l/s)	2.35
Class & Type	150 PVC		Bends:90˚	0.13	Valve	0.13	static	8
Nominal Ø mm	150	50	45˚	0.07	Tee	1.00	static max	18.66
Actual Ø mm	155	54.29	22½°	0.05	Check	0.90	friction	0.293
Length m	242.5	7	11¼°	0.03	Outlet	1.00	minor	0.196
Section Area m²	0.0189	0.0023			Discharge	0.25	Head loss:	**19.19**
Bends no. 90˚ 3		22½° 0		Vel. m/s			sudden enlargement	0.040
45˚ 1		11¼° 0		1.02	0.12		pump pressure (Victoria)	



EDGE

PERFORMANCE CURVE

FLYGT	PERFORMANCE CURVE	PRODUCT CP3127.180	TYPE HT
DATE 2000-02-29	PROJECT District of Ucluelet-Chris Graha	CURVE NO 63-481-00-3755	ISSUE 2

	1/1-LOAD	3/4-LOAD	1/2-LOAD
MOTOR COS PHI	0.86	0.86	0.79
MOTOR EFFICIENCY	84.0 %	85.0 %	84.5 %
GEAR EFFICIENCY	---	---	---

MOTOR SHAFT POWER	10.0	Hp
STARTING CURRENT ...	55	A
RATED CURRENT ...	9.7	A
RATED SPEED	1735	rpm
TOT.MOM.OF INERTIA ...	0.12	kgm2
NO. OF BLADES	1	

COMMENTS

INLET/OUTLET: - /100 mm

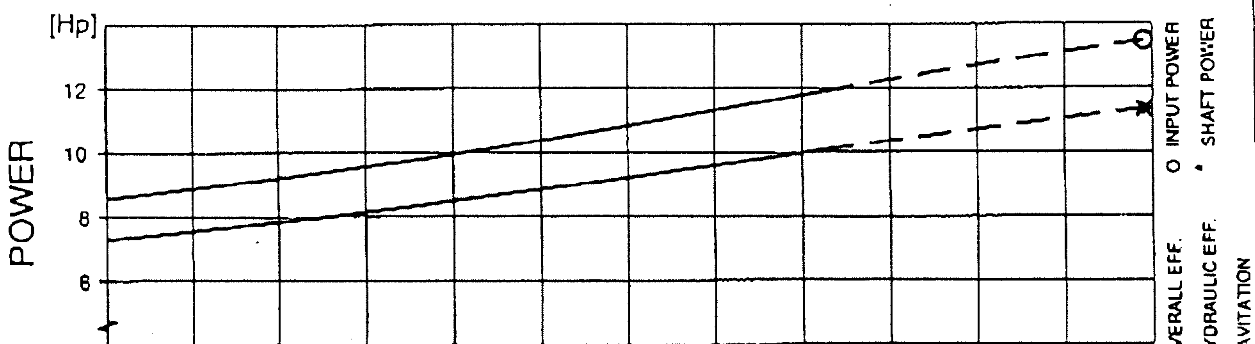
IMP. THROUGHLET: 76 mm

IMPELLER DIAMETER: 248 mm

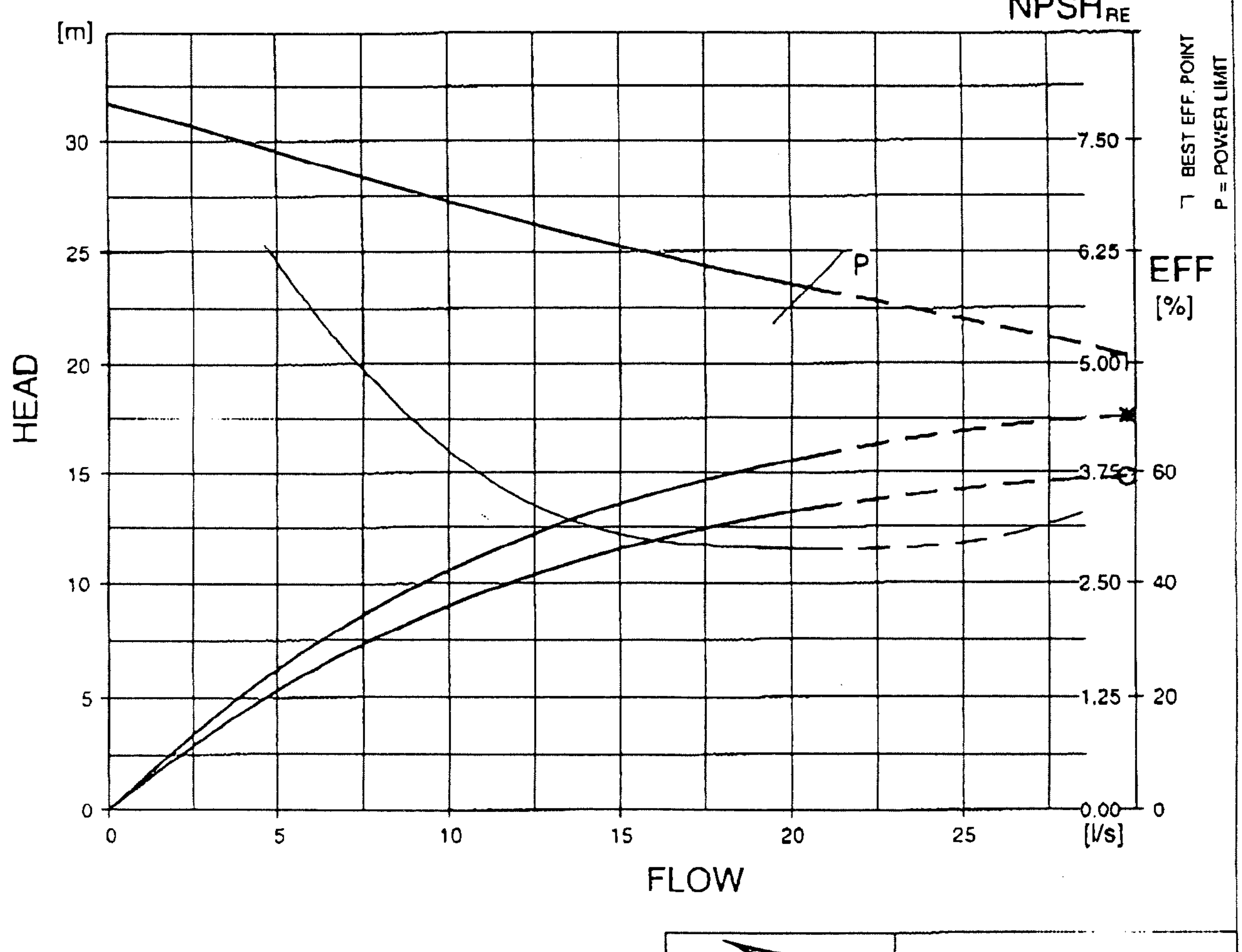
MOTORTYPE	STATOR	REV
21-12-4AL	52D	10

FREQ.	PHASES	VOLTAGE	POLES
60 Hz	3	~~600~~ V	4

GEARTYPE 230	RATIO
---	---



DUTY-POINT:	FLOW[l/s]	HEAD[m]	POWER[Hp]	EFF[%]	NPSH[m]	GUARANTY
B.E.P.:	29.75	20.39	13.49 (11.34)	59.1 (70.4)	--	



FLYPS 2.0 (1118)

Performance with clear water and rating data at 40 °C

FLYGT CURVE

FROM: ITT FLYGT FAX NO.: 604 941 3659 02-01-00 12:10P P.02

KOERS & ASSOCIATES ENGINEERING LTD.
Consulting Engineers

Sewage Lift Station Details & Peformance Curves

Edge (Kimoto Drive)

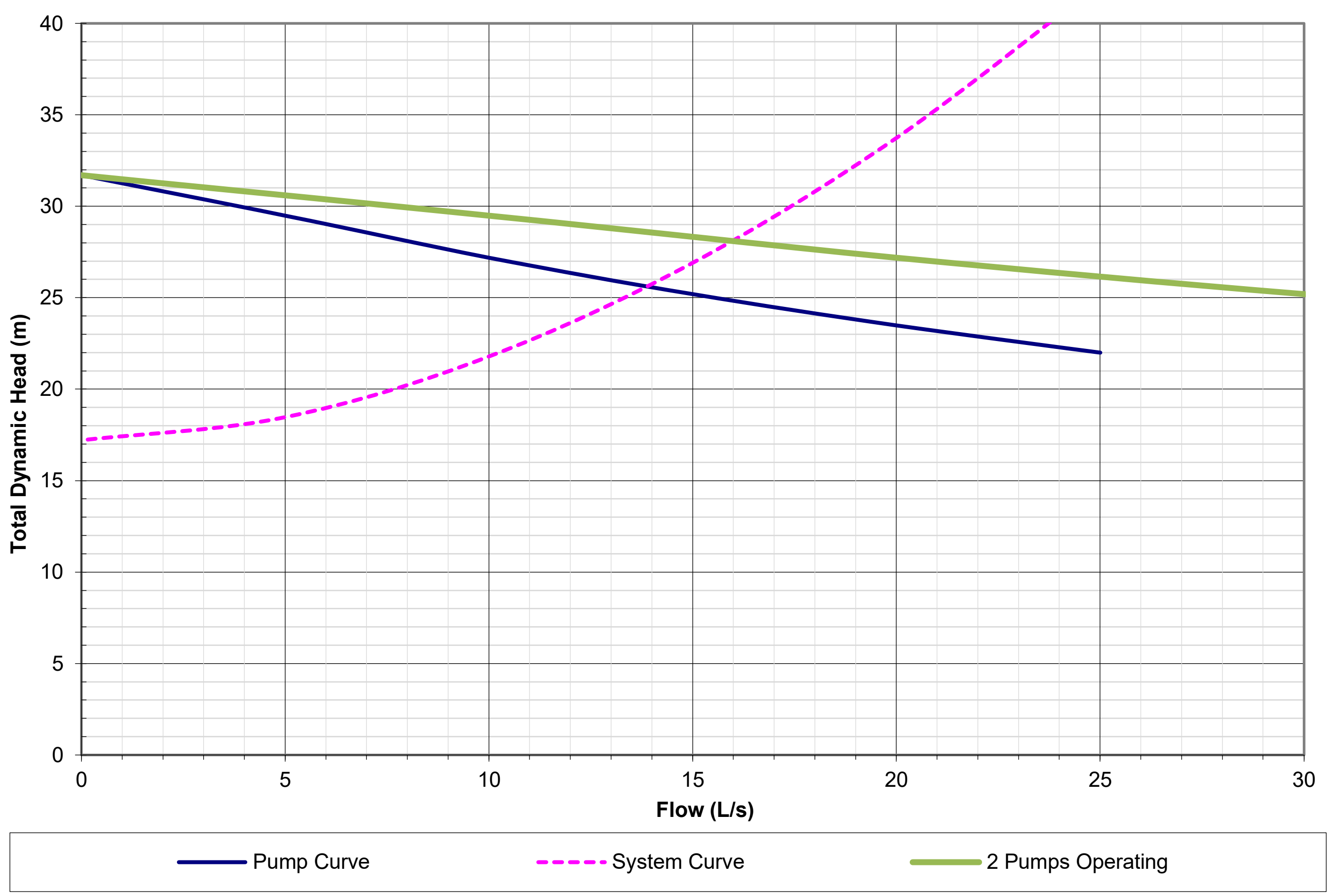
Koers File: 1863

Motor Details		Power Supply		Pump Curve Flow (l/s)	Head (m)	Hydaulic Efficieny %	System Curve (m)
Power (hp)	10 (7.5kw)	Volts	120/208				
Voltage	230	Phase	single				
Phase	single						
RPM	1735			25.0	22.0	57.0	42.2
Amps	30			20.0	23.5	53.3	33.7
Pump Details		Serial Nos.		15.0	25.2	46.0	26.9
Manufacturer	Flygt	180-958018		10.0	27.2	36.0	21.8
Model	CP 3127	180983010		5.0	29.5	20.0	18.5
Impeller Dia.	481.0			0.0	31.7		17.2

Forcemain Details		Minor losses:	k	Minor losses:	k
C Value:	120	Bends, 90º:	0.13	Valve:	0.13
Class & Type:	150 PVC	45º:	0.07	Tee:	1.00
Nominal Ø, mm:	150	22½º:	0.05	Check:	0.90
Actual ø, mm:	155	11¼º:	0.03	Outlet:	1.00
Length, m:	1,702			Discharge:	0.25
Area, m²:	0.0189				
	Number of Bends	90º	2	22½º	0
		45º	3	11¼º	0

Duty Point Calculations		
Flow:	14	L/s
Static head:	17.21	m
friction:	8.44	m
minor:	0.11	m
Head loss:	**25.75**	m
Velocty:	0.74	m/s

Pump Performance Curves



REEF POINT PUMP STATION

FLYGT	PERFORMANCE CURVE	PRODUCT CP3140.180	TYPE HT
DATE 2003-01-06	PROJECT	CURVE NO 63-480-00-3855	ISSUE 1

	1/1-LOAD	3/4-LOAD	1/2-LOAD
MOTOR COS PHI	0.85	0.81	0.72
MOTOR EFFICIENCY	84.0 %	84.5 %	83.0 %
GEAR EFFICIENCY	—	—	—

MOTOR SHAFT POWER	15	hp
STARTING CURRENT	85	A
RATED CURRENT	15	A
RATED SPEED	1745	rpm
TOT.MOM.OF INERTIA	—	
NO. OF BLADES	1	

COMMENTS

INLET/OUTLET: -/100 mm

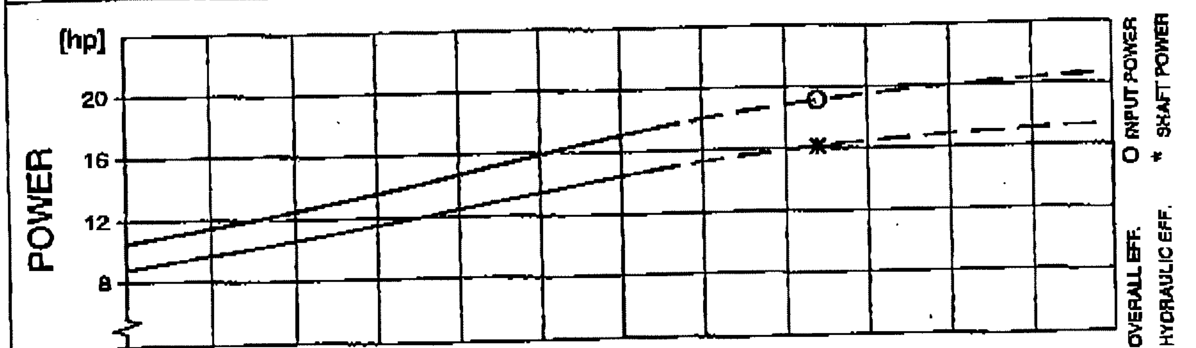
IMP. THROUGHLET: 76 mm

IMPELLER DIAMETER: 265 mm

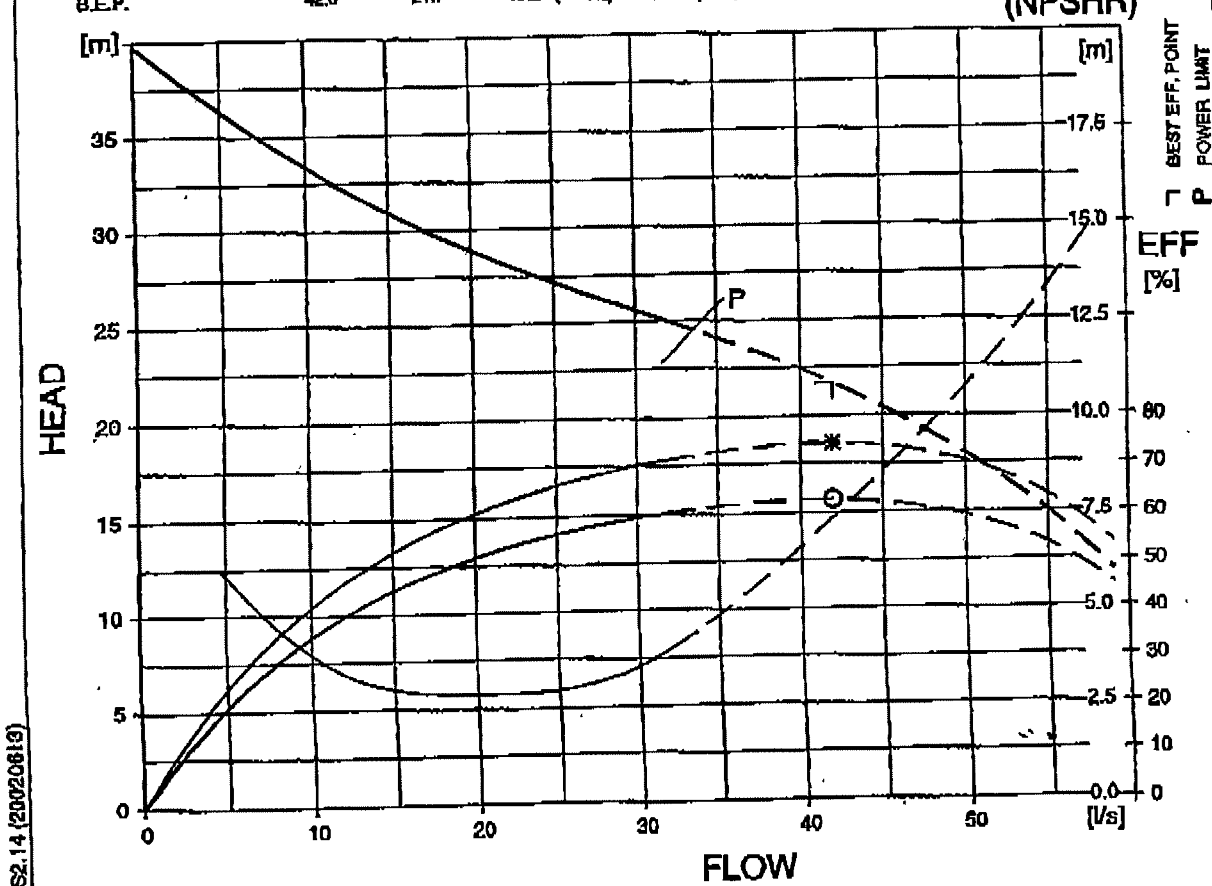
MOTORTYPE	STATOR	REV
25-11-4AA	52D	10

FREQ.	PHASES	VOLTAGE	POLES
60 Hz	3	600 V	4

GEARTYPE	RATIO
—	—



	FLOW [l/s]	HEAD [m]	POWER [hp]	EFF [%]	(NPSHR)[m]
DUTY-POINT	42.0	21.7	19.2 (16.2)	82.7 (74.3)	7.4
B.E.P.					



FLYPS2.14 (20020613)

(NPSHR) = (NPSH3) + margins

Performance with clear water and rating data at 40 °C

FLYGT | CURVE

KOERS & ASSOCIATES ENGINEERING LTD. Consulting Engineers

Sewage Lift Station Details & Peformance Curves

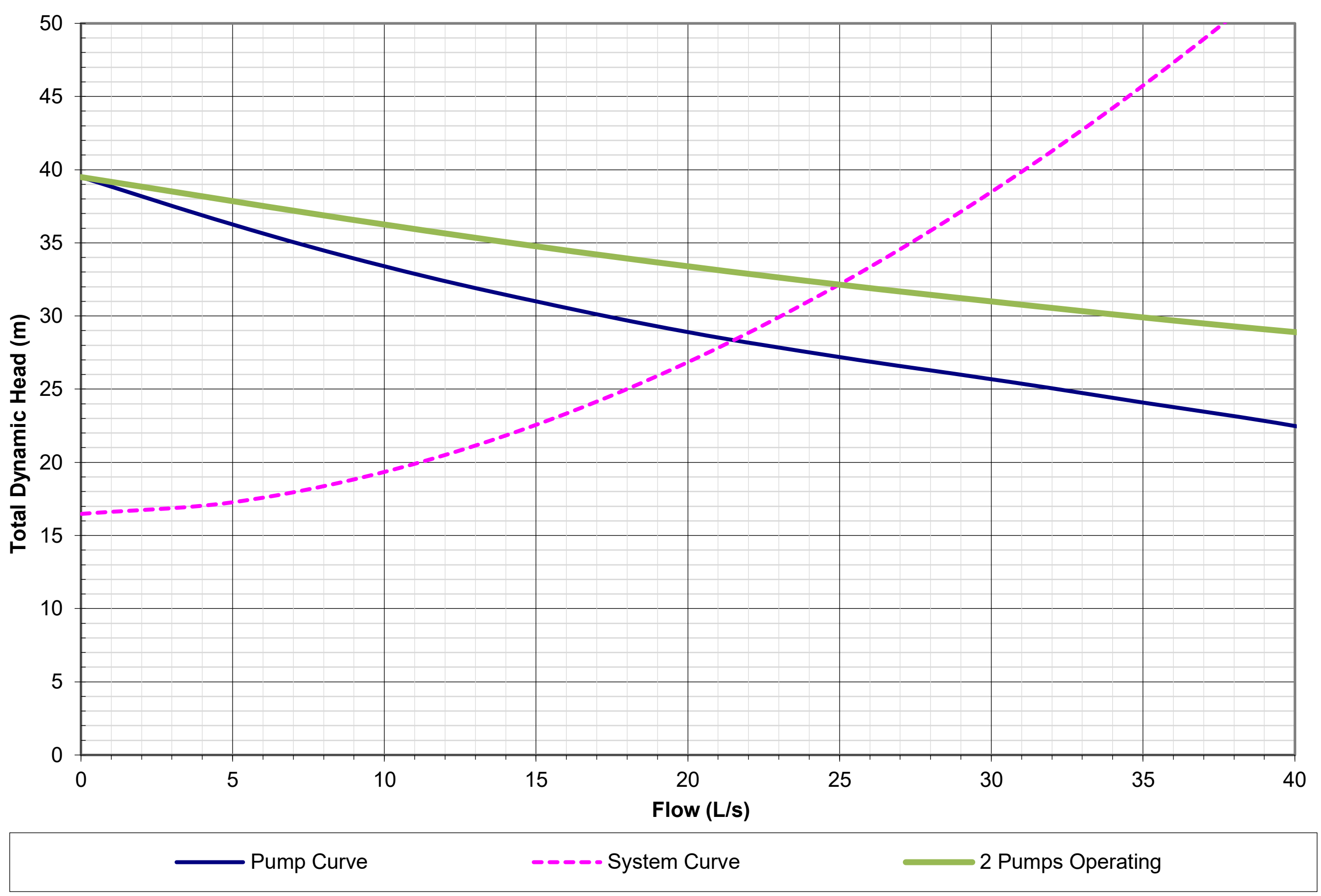
Reef Pt

Koers File: 1863

Motor Details		Power Supply		Pump Curve Flow (l/s)	Pump Curve Head (m)	Pump Curve Hydaulic Efficieny %	System Curve (m)
Power (hp)	15 (11.2kw)	**Volts**	600	45	20.5	62.0	63.1
Voltage	600	**Phase**	three	40	22.5	62.0	54.0
Phase	three			35	24.1	61.0	45.8
RPM	1750			30	25.7	60.0	38.5
Amps	15			25	27.2	57.0	32.2
Pump Details		**Serial Nos.**		20	28.9	51.0	26.9
Manufacturer	Flygt			15	31.0	45.0	22.6
Model	CP 3140			10	33.4	35.0	19.4
Impeller Dia.	485			5	36.3	20.0	17.3
				0	39.5	0.0	16.5

Forcemain Details						Duty Point Calculations	
C Value:	120	**Minor losses:**	**k**	**Minor losses:**	**k**	Flow:	21.5 L/s
Class & Type:	150 PVC	Bends, 90º:	0.13	Valve:	0.13	Pump off el.	2 m
Nominal Ø, mm:	150	45º:	0.07	Tee:	1.00	Forcemain el.	18.49 m
Actual ø, mm:	150	22½º:	0.05	Check:	0.90	Static head:	16.49 m
Length, m:	900	11¼º:	0.03	Outlet:	1.00	friction:	11.58 m
Area, m²:	0.0177			Discharge:	0.25	minor:	0.29 m
	Number of Bends	90º	4	22½º	0	Head loss:	**28.35** m
		45º	0	11¼º	0	Velocty:	1.22 m/s

Pump Performance Curves



HELEN RD

ITT Water & Wastewater

PERFORMANCE CURVE

PRODUCT	TYPE
NP3301.180	MT

DATE	PROJECT	CURVE NO	ISSUE
2009-05-15	Helen Road PS	63-634-00-3130	2

	1/1-LOAD	3/4-LOAD	1/2-LOAD
MOTOR COS PHI	0.76	0.70	0.58
MOTOR EFFICIENCY	91.0 %	91.0 %	90.0 %
GEAR EFFICIENCY	---	---	---

MOTOR SHAFT POWER	85	hp
STARTING CURRENT ...	580	A
RATED CURRENT ...	88	A
RATED SPEED	1185	rpm
TOT.MOM.OF INERTIA ...	1.3	kgm2
NO. OF BLADES	2	

IMPELLER DIAMETER: 404 mm

MOTORTYPE	STATOR	REV
35-29-6AA	04D	11

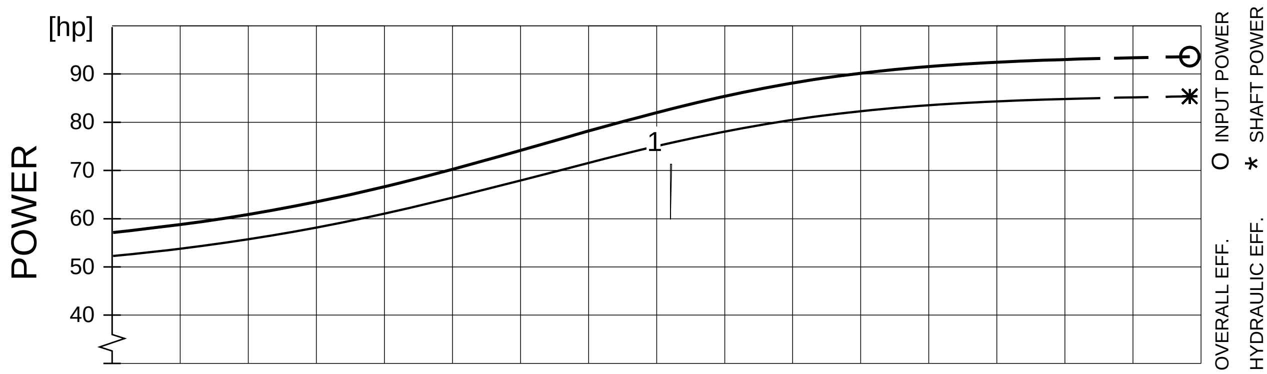
FREQ.	PHASES	VOLTAGE	POLES
60 Hz	3	600 V	6

GEARTYPE	RATIO
---	---

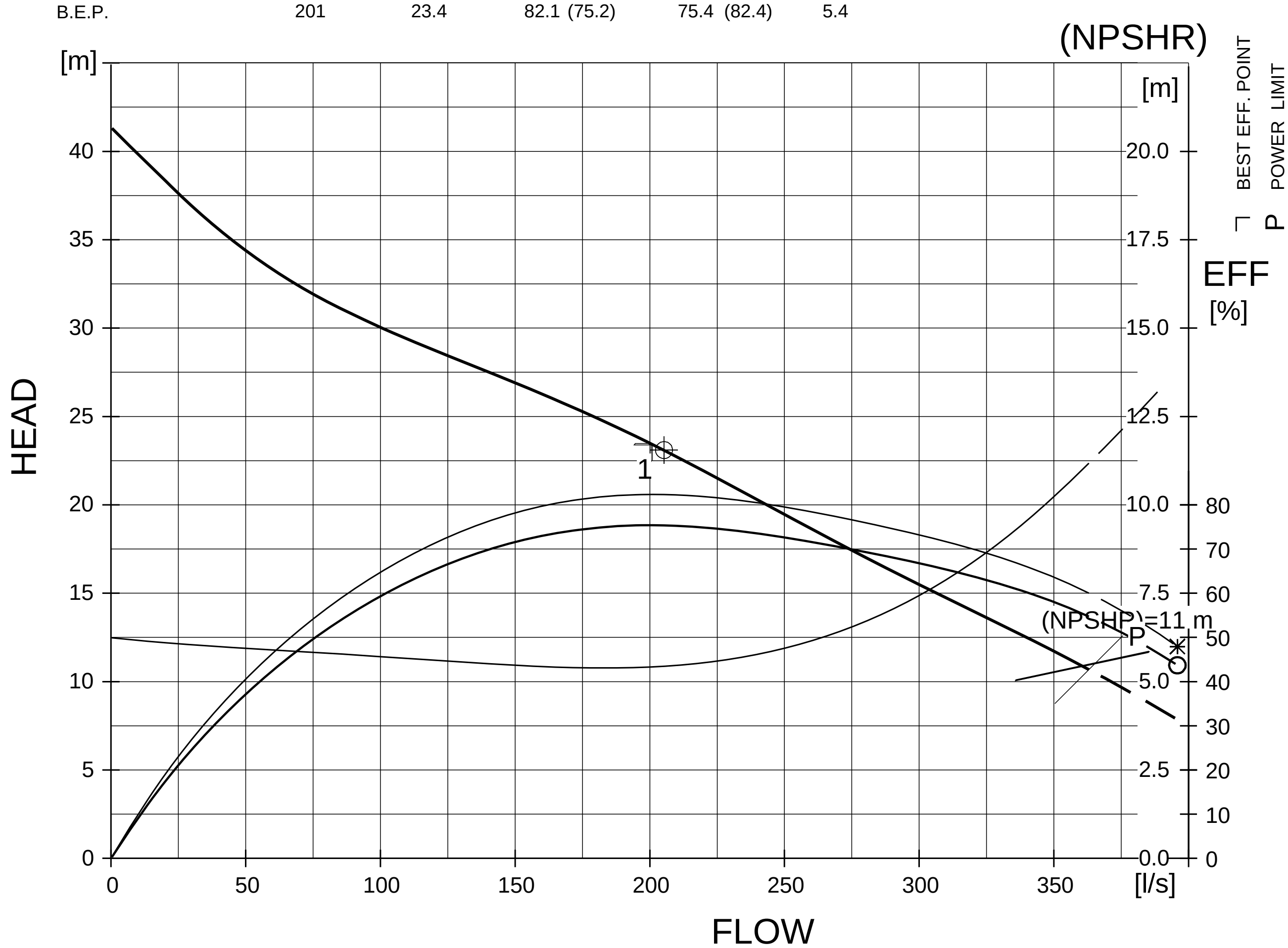
COMMENTS

INLET/OUTLET: -/250 mm

IMP. THROUGHLET: ---



DUTY-POINT	FLOW [l/s]	HEAD [m]	POWER [hp]	EFF [%]	(NPSHR)[m]
1	205	23.1	82.8 (75.8)	75.3 (82.3)	5.4
B.E.P.	201	23.4	82.1 (75.2)	75.4 (82.4)	5.4



FLYPS3.1.6.4 (20081110)

(NPSHR) = (NPSH3) + margins

Performance with clear water and rating data at 40 °C

FLYGT CURVE

KOERS & ASSOCIATES ENGINEERING LTD.
Consulting Engineers

Sewage Lift Station Details & Peformance Curves

Helen Road

Koers File: 1863

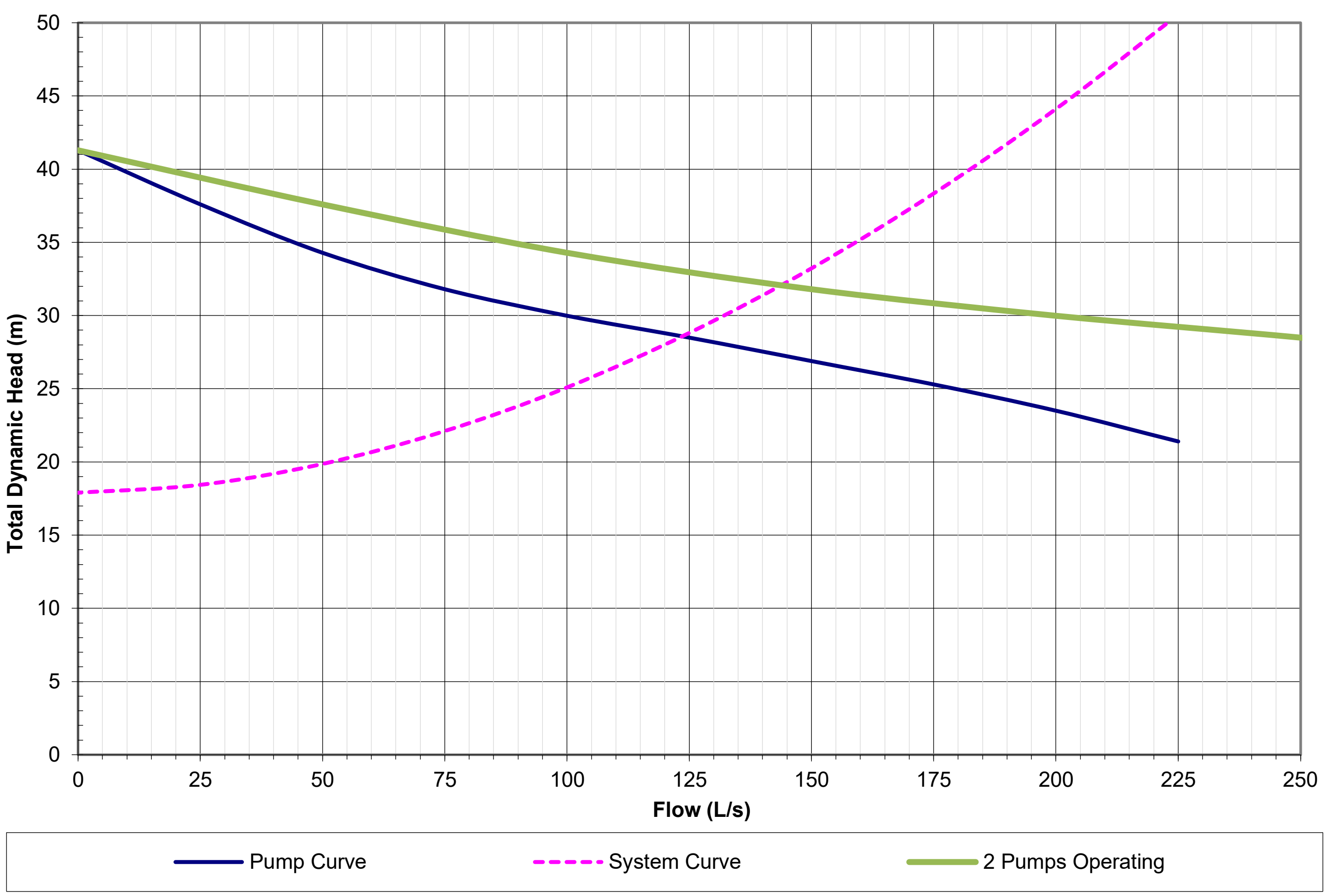
Motor Details		Power Supply	
Power (hp)	85 (63.4kw)	**Volts**	600
Voltage	600	**Phase**	3
Phase	3		
RPM	1185		
Amps	580 / 88		
Pump Details			
Manufacturer	Flygt		
Model	NP3301.180 MT		
Impeller Dia.	404 mm		

Pump Curve			System Curve (m)
Flow (l/s)	**Head (m)**	**Hydaulic Efficieny %**	
225	21.4	75%	50.6
200	23.5	75%	44.1
175	25.3	75%	38.3
150	26.9	72%	33.2
125	28.5	67%	28.8
100	30.0	60%	25.1
75	31.8	50%	22.1
50	34.3	38%	19.9
25	37.6	22%	18.4
0	41.3	0%	17.9

Forcemain Details					
C Value:	120	**Minor losses:**	**k**	**Minor losses:**	**k**
Class & Type:	HDPE, Series 60	Bends, 90º:	0.13	Valve:	0.13
Nominal ø, mm:	300	45º:	0.07	Tee:	1.00
Actual ø, mm:	297	22½º:	0.05	Check:	0.90
Length, m:	838	11¼º:	0.03	Outlet:	1.00
Area, m²:	0.0695			Discharge:	0.25
	Number of Bends	90º	12	22½º	6
		45º	6	11¼º	6

Duty Point Calculations	
Flow:	124 L/s
Static head:	17.90 m
friction:	9.83 m
minor:	0.86 m
Head loss:	**28.59** m
Velocty:	1.78 m/s

Pump Performance Curves

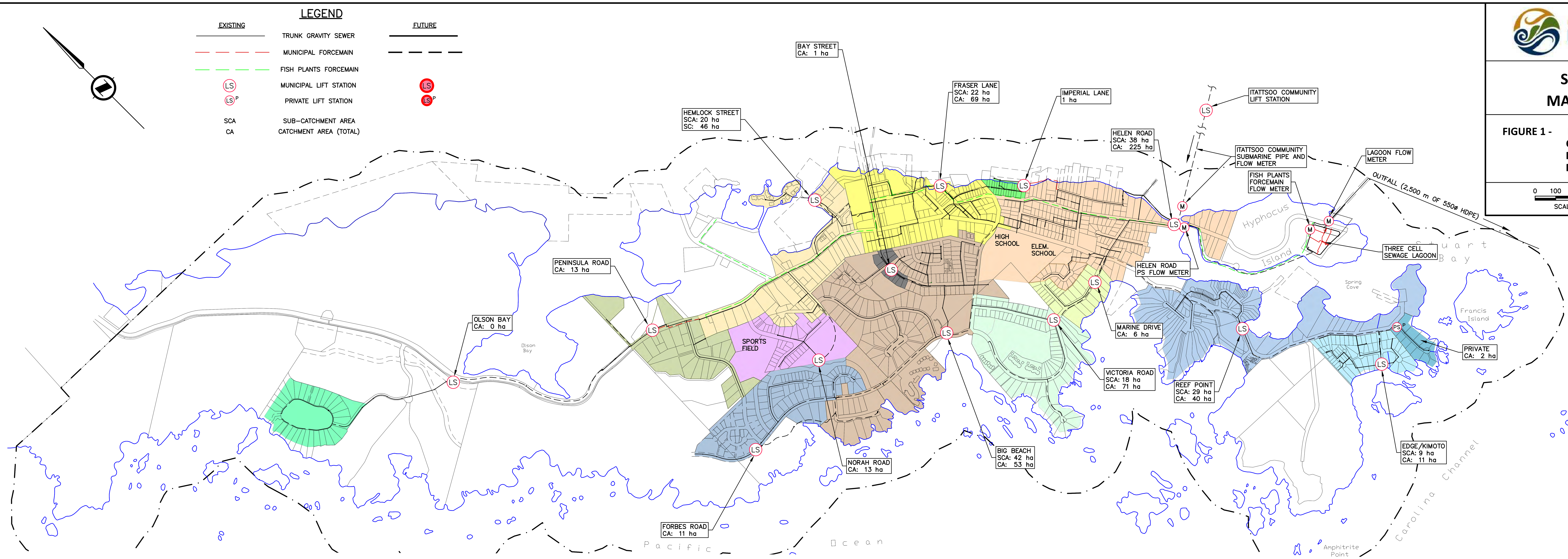


DISTRICT OF UCLUELET

SANITARY MASTER PLAN

FIGURE 1 - LIFT STATION CATCHMENT AREAS, EXISTING CONDITIONS & FUTURE BUILD-OUT

0 100 200 300 400 500m
SCALE 1:10,000



EXISTING CONDITIONS

FUTURE- BUILD-OUT

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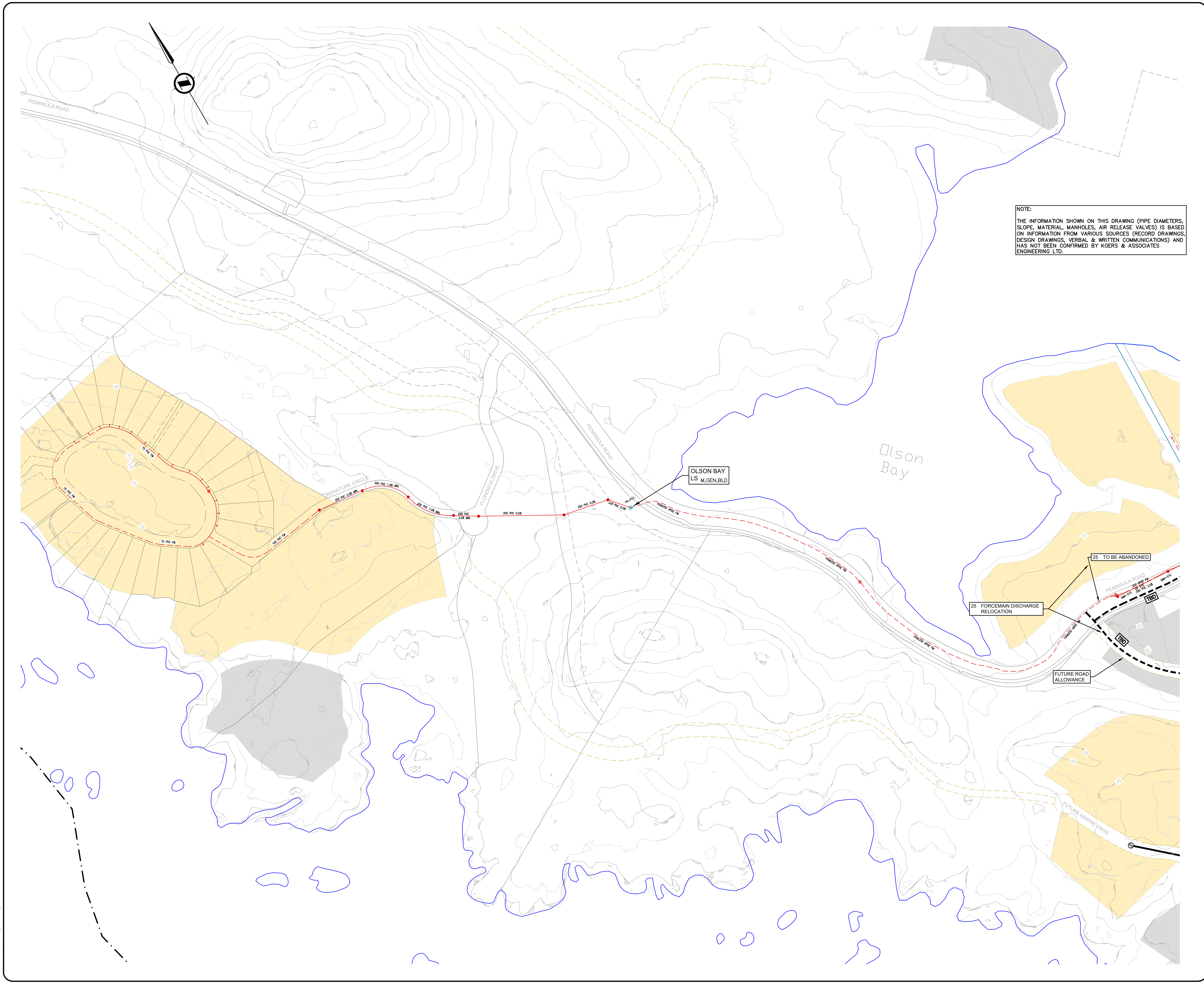
DATE: JUNE 2023



NOTE:

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DISTRICT OF UCLUELET

PROJECT No. & DESCRIPTION (SEE TABLES 19 & 20 IN REPORT)

23 FORCEMAIN DISCHARGE RELOCATION

LEGEND

EXISTING		FUTURE
	SANITARY (GRAVITY)	375 ● 0.5%
	TABLE 20 (PROJECT 18)	150/200
	SANITARY (FORCEMAIN)	
	MANHOLE	
	LIFT STATION	
	FORCEMAIN (FISH PLANT)	
	PIPE DIAMETER AND SLOPE TO BE DETERMINED	TBD
LS M	LIFT STATION FLOW METER	
GEN	LIFT STATION GENERATOR	
BLD	LIFT STATION ELECTRICAL / CONTROL BUILDING	
	SUB-CATCHMENT BOUNDARY	
	FUTURE RESIDENTIAL DEVELOPMENT	
	FUTURE NON-RESIDENTIAL DEVELOPMENT	

1:2,500 0 50 150m

SEAL

PERMIT TO PRACTICE No. 1001658

PROJECT NO.	1863
DRAWN	RC
DESIGNED	
CHECKED	CH
APPROVED	CD
DATE	JUNE 2023
SCALE	1:2500

CLIENT

DISTRICT OF UCLUELET

PROJECT

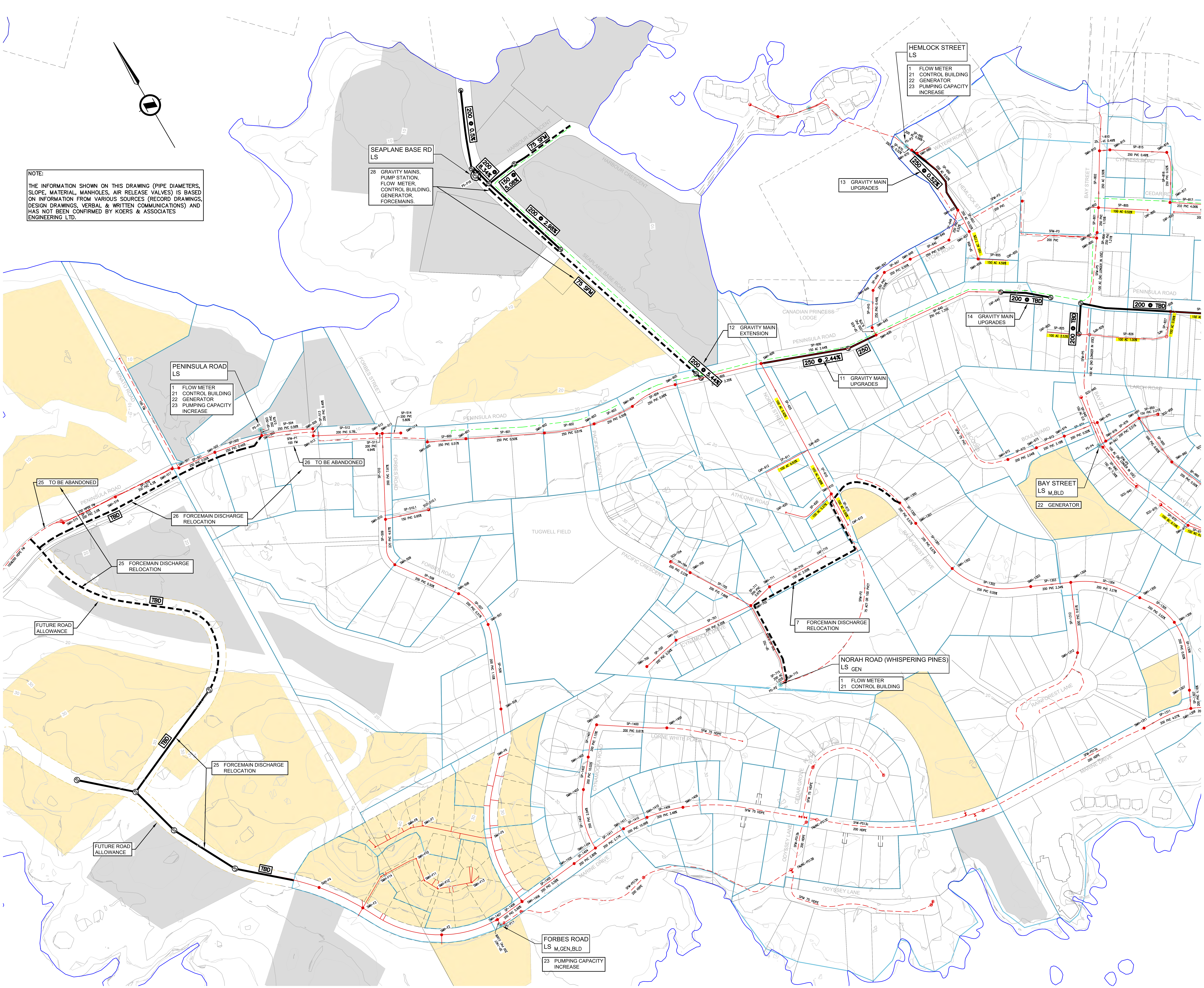
SANITARY MASTER PLAN

TITLE

SANITARY SEWER NETWORK EXISTING & PROPOSED

DRAWING No.	REV.	SHEET
1863-SAN-1		1/4

File: Report Figures.dwg Plot Time: Jun 29, 2023 - 11:37am User: rcove



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DISTRICT OF UCLUELET

PROJECT No. & DESCRIPTION (SEE TABLES 19 & 20 IN REPORT)
23 FORCEMAIN DISCHARGE RELOCATION

LEGEND

EXISTING		FUTURE
SP-648 200 PVC 0.50%	SANITARY (GRAVITY)	375 @ 0.5%
SP-611 100 AC 6.6%	TABLE 20 (PROJECT 18)	150/200
SFM-P5	SANITARY (FORCEMAIN)	
SMH-975	MANHOLE	
PS-P3	LIFT STATION	
	FORCEMAIN (FISH PLANT)	
	PIPE DIAMETER AND SLOPE TO BE DETERMINED	TBD
LS M	LIFT STATION FLOW METER	
GEN	LIFT STATION GENERATOR	
BLD	LIFT STATION ELECTRICAL / CONTROL BUILDING	
	SUB-CATCHMENT BOUNDARY	
	FUTURE RESIDENTIAL DEVELOPMENT	
	FUTURE NON-RESIDENTIAL DEVELOPMENT	

1:2,500 — 0 — 50 — 150m

SEAL

PERMIT TO PRACTICE No. 1001658

PROJECT NO.	1863
DRAWN	RC
DESIGNED	
CHECKED	CH
APPROVED	CD
DATE	JUNE 2023
SCALE	1:2500

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DISTRICT OF UCLUELET

PROJECT

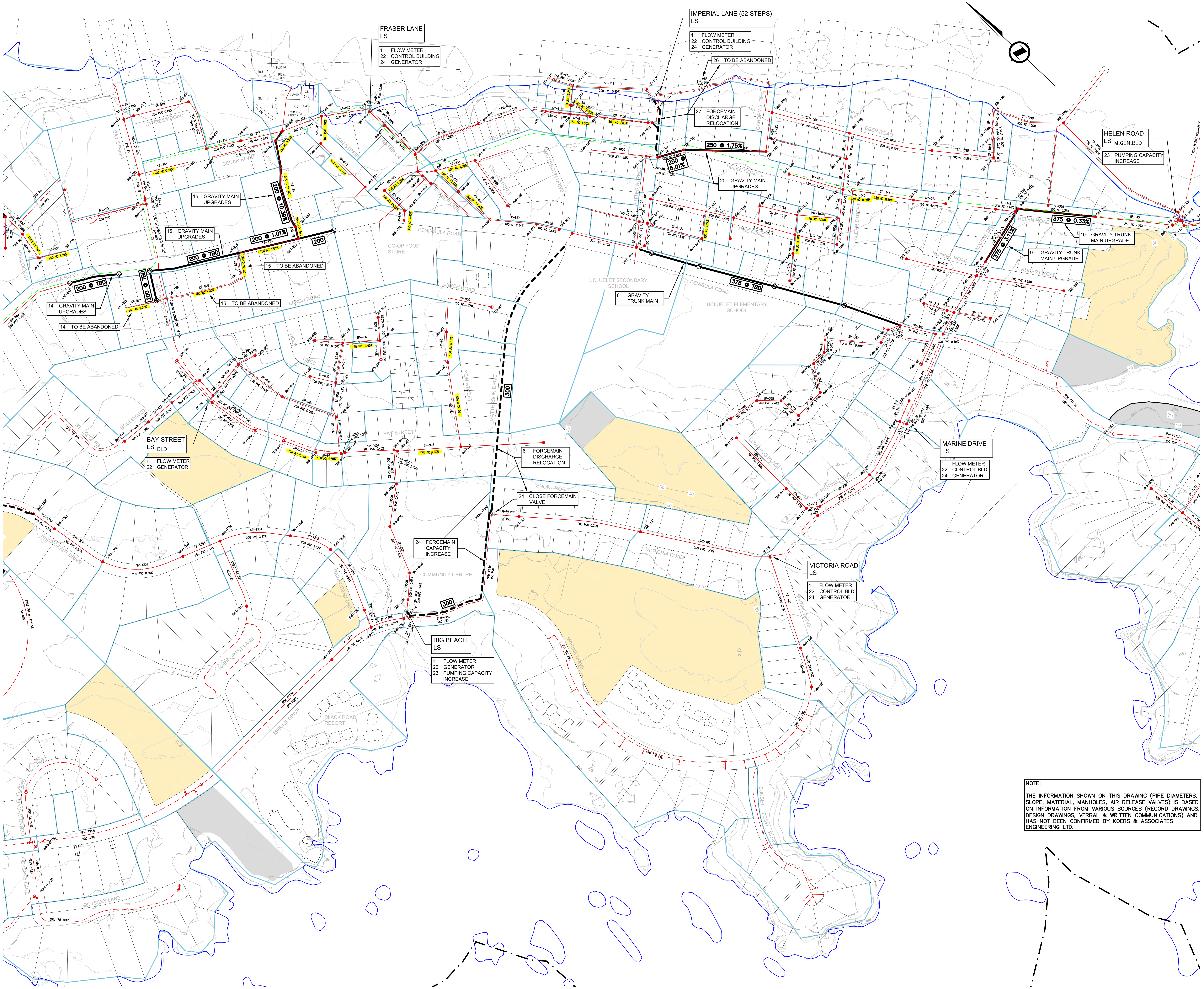
SANITARY MASTER PLAN

TITLE

SANITARY SEWER NETWORK EXISTING & PROPOSED

DRAWING No.	REV.	SHEET
1863-SAN-2		2/4

File: Report Figures.dwg Plot Time: Jun 29, 2023 - 11:37am User: rcove



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DISTRICT OF UCLUELET

PROJECT No. & DESCRIPTION (SEE TABLES 19 & 20 IN REPORT)
23 FORCEMAIN DISCHARGE RELOCATION

LEGEND

EXISTING		FUTURE
SP-646 200 PVC 0.50%	SANITARY (GRAVITY)	375 @ 0.5%
SP-611 100 AC 0.6%	TABLE 20 (PROJECT 18)	150/200
SFM-P5	SANITARY (FORCEMAIN)	
SMH-975	MANHOLE	
PS-P3	LIFT STATION	
	FORCEMAIN (FISH PLANT)	
	PIPE DIAMETER AND SLOPE TO BE DETERMINED	TBD
LS M	LIFT STATION FLOW METER	
GEN	LIFT STATION GENERATOR	
BLD	LIFT STATION ELECTRICAL / CONTROL BUILDING	
	SUB-CATCHMENT BOUNDARY	
	FUTURE RESIDENTIAL DEVELOPMENT	
	FUTURE NON-RESIDENTIAL DEVELOPMENT	

1:2,500 — 0 50 150m

SEAL

PERMIT TO PRACTICE No. 1001658

PROJECT NO.	1863
DRAWN	RC
DESIGNED	
CHECKED	CH
APPROVED	CD
DATE	JUNE 2023
SCALE	1:2500

CLIENT

DISTRICT OF UCLUELET

PROJECT

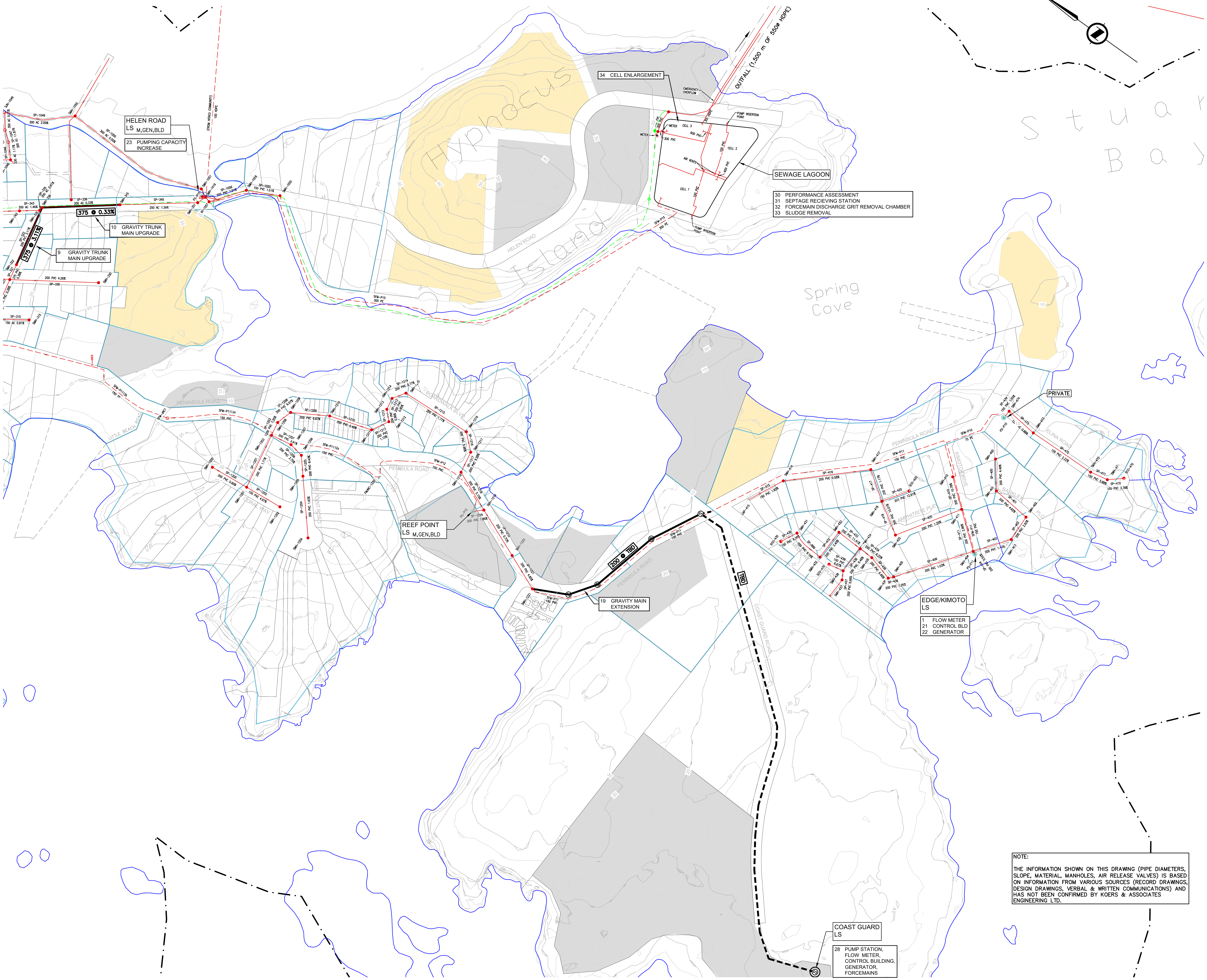
SANITARY MASTER PLAN

TITLE

SANITARY SEWER NETWORK EXISTING & PROPOSED

DRAWING No.	REV.	SHEET
1863-SAN-3		3/4

File: Report Figures.dwg Plot Time: Jun 29, 2023 - 11:37am User: rcove



NOTE:
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DISTRICT OF UCLUELET

PROJECT No. & DESCRIPTION (SEE TABLES 19 & 20 IN REPORT)

23 FORCEMAIN DISCHARGE RELOCATION

LEGEND

EXISTING		FUTURE
SP-648 250 PVC 0.50%	SANITARY (GRAVITY)	375 @ 0.5%
SP-611 100 AC 8.6%	TABLE 20 (PROJECT 18)	150/200
SFM-P5	SANITARY (FORCEMAIN)	
SMH-975	MANHOLE	
PS-P3	LIFT STATION	
	FORCEMAIN (FISH PLANT)	
	PIPE DIAMETER AND SLOPE TO BE DETERMINED	TBD
LS M	LIFT STATION FLOW METER	
GEN	LIFT STATION GENERATOR	
BLD	LIFT STATION ELECTRICAL / CONTROL BUILDING	
	SUB-CATCHMENT BOUNDARY	

FUTURE RESIDENTIAL DEVELOPMENT

FUTURE NON-RESIDENTIAL DEVELOPMENT

1:2,500 — 0 50 150m

SEAL

PERMIT TO PRACTICE No. 1001658

PROJECT NO.	1863
DRAWN	RC
DESIGNED	
CHECKED	CH
APPROVED	CD
DATE	JUNE 2023
SCALE	1:2500

CLIENT

DISTRICT OF UCLUELET

PROJECT

SANITARY MASTER PLAN

TITLE

SANITARY SEWER NETWORK EXISTING & PROPOSED

DRAWING No.	REV.	SHEET
1863-SAN-4		4/4

File: Report Figures.dwg Plot Time: Jun 29, 2023 - 11:38am User: rcove