COWICHAN VALLEY REGIONAL DISTRICT

DEVELOPMENT PERMIT

REGISTERED PROPERTY OWNER(S):

Raven Point Project GP Ltd.

c/o Stefan Crucil, of FMC Holding Inc.,

1890 SchoolHouse Rd.

Nanaimo BC V9X 1T4

CVRD FILE NO.: **DP24H04**

DATE ISSUED: **MARCH 3, 2025**

1. This Development Permit is issued and is subject to compliance with all of the bylaws of the Regional District applicable thereto, except as specifically supplemented by this Permit.

2. This Development Permit applies to and only to those lands within the Regional District described below:

LOT A SECTION 2 OYSTER DISTRICT PLAN VIP86097 (PID: 027-772-900)
4760 Brenton Page Road

3. Authorization is hereby given for site redevelopment including a new temporary laundry/bathroom building, an service building, an expanded parking area and revised layout of existing parking areas, an asphalt marina access pathway, tree removal, and landscaping, subject to the following requirements:

   a. Development shall occur in accordance with Schedules A-H of the Development Permit;
   b. A landscape security shall be provided to the CVRD in the amount of $31,020;
   c. Install silt fencing during construction according to the Erosion & Sediment Control Plan in Schedule B;
   d. Adhere to environmental protection measures according to the Environmental Assessment in Schedule E.
   e. This Development Permit only approves development on the subject property.

4. The following Schedules are attached to and form a part of this permit:

   Schedule A – Subject Property Map

   Schedule B – Site Plans, Cascara Consulting Engineers Ltd., February 5, 2025

   Schedule C – Hydrogeologic Assessment, Hy-Geo Consulting, February 5, 2025

   Schedule D – Addendum to Hydrogeologic Assessment, Hy-Geo Consulting, December 17, 2024

   Schedule E – Environmental Assessment, Aquaparian Environmental Consulting Ltd., December 5, 2025

   Schedule F – Rain Water Management Plan, Cascara Consulting Engineers Ltd., February 18, 2025

Schedule G - Geo-technical Hazard Assessment, Lewkowich Engineering Associates Ltd., February 20, 2025

Schedule H – Landscape Plan, LADR Landscape Architects, February 21, 2025

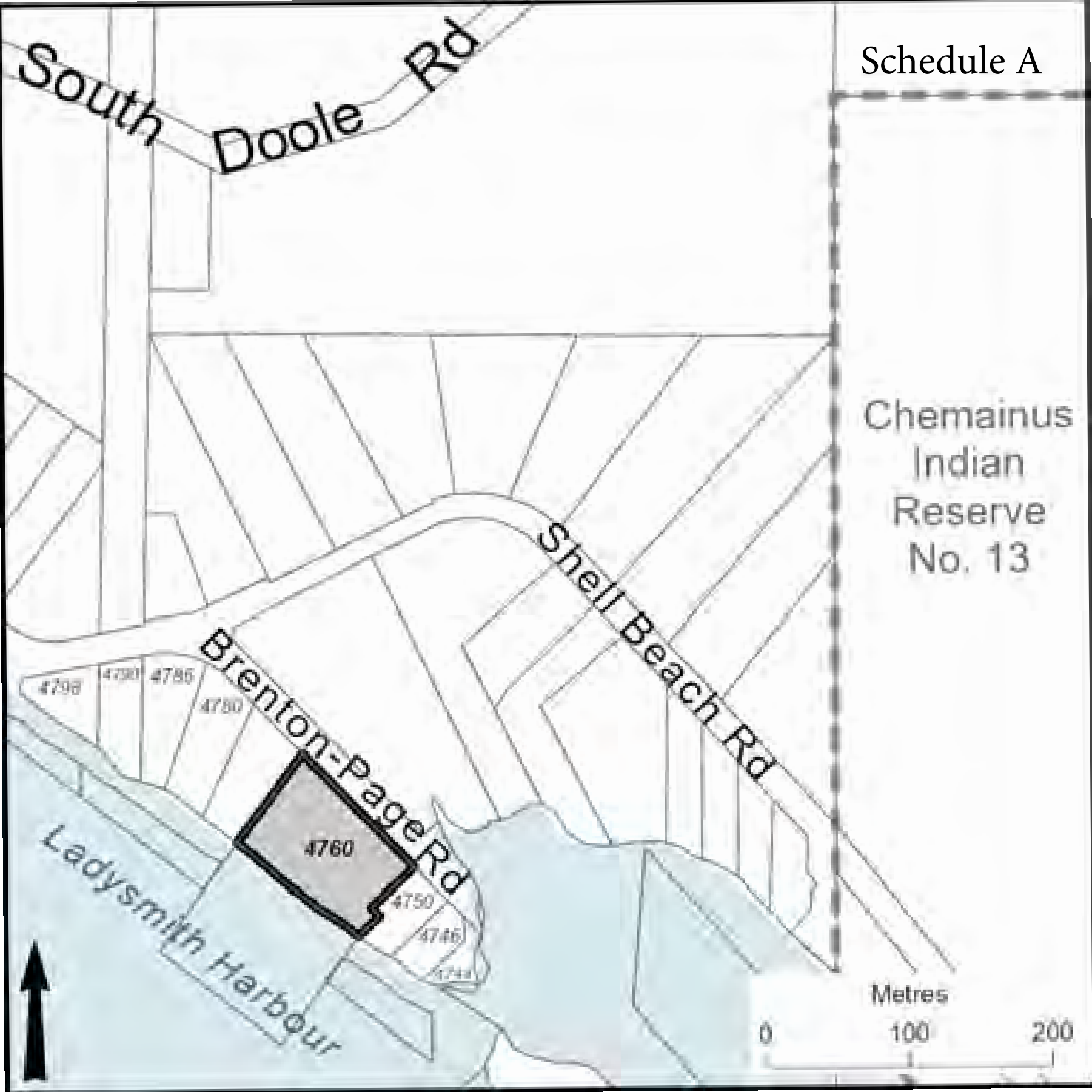
5. The land described herein shall be developed in substantial compliance with the terms and provisions of this Permit and any plans and specifications attached to this Permit shall form a part thereof.

6. Subject to the terms of this Permit, if the holder of this Permit does not substantially start construction within 2 years of its issuance, this Permit will lapse.

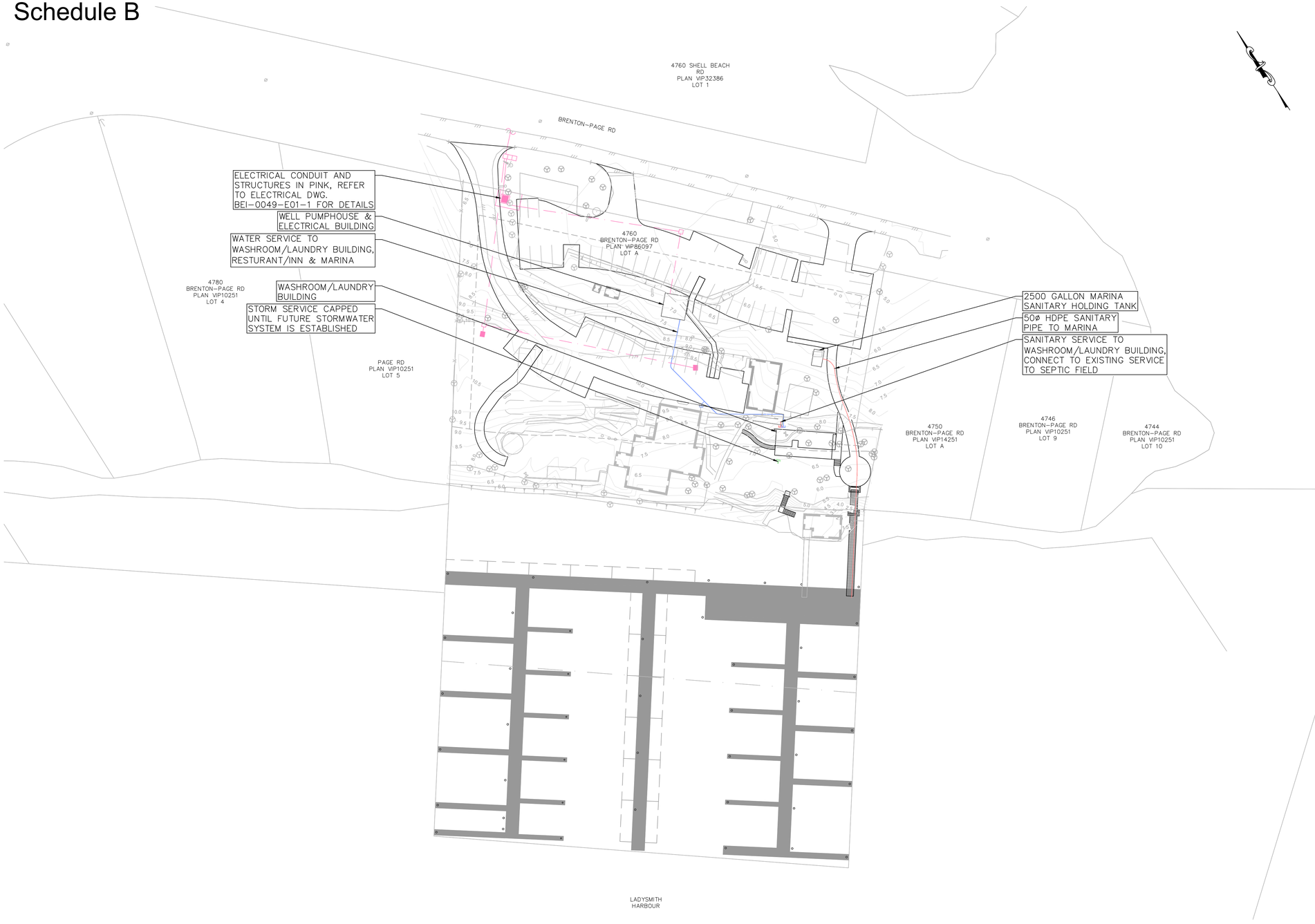
Ann Kjerulf, General Manager
Land Use Services Department

This permit has been issued by the General Manager of Land Use Services Department in accordance with Section 7 of CVRD Bylaw No. 4483 – Development Application Procedures Bylaw, 2023.

This Permit is <u>not</u> a Building Permit nor does it replace any Federal or Provincial approval requirements. Where applicable, no occupancy certificate or final subdivision approval shall be issued until all items of this Development Permit have been complied with to the satisfaction of the Land Use Services Department.


Schedule A
South Doole Rd
Chemainus Indian Reserve No. 13
Shell Beach Rd
Brenton-Page Rd
4798
4790
4786
4780
4760
4750
4746
4744
Ladysmith Harbour
Metres
0
100
200

Schedule B



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NOTES:

1. REFER TO DRAWING NUMBER C01 FOR GENERAL NOTES.

CLIENT

FMC HOLDINGS LTD.

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E	05FEB2025	DL	REVISED PER CVRD COMMENTS	CR
D	17DEC2024	DL	REVISED PER CVRD COMMENTS	CR
C	24OCT2024	DL	REVISED FOR COORDINATION	CR
B	31JULY2024	DL	REVISED PER CVRD COMMENTS	CR
A	08JULY2024	DL	ISSUED FOR REVIEW	CR

RAVEN POINT MARINA

LADYSMITH, BC

DRAWING TITLE:

UPLANDS & MARINA
PHASE 1
SERVICING PLAN

CASCARA CONSULTING ENGINEERS LIMITED
EGBC PERMIT No. 1000784
#203-335 WESLEY STREET NANAIMO, BC V9R 2T5
TEL: 250.591.7364 EMAIL: info@cascara.ca

DESIGN BY: DL	CHECKED BY: CR
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	DATE: 05FEB2025 | SHEET: 4 OF 10
	ENG. FILE NUMBER:
	CITY DWG #: | PROJECT #: 1055-011
	DRAWING NUMBER: C04 | REV: D

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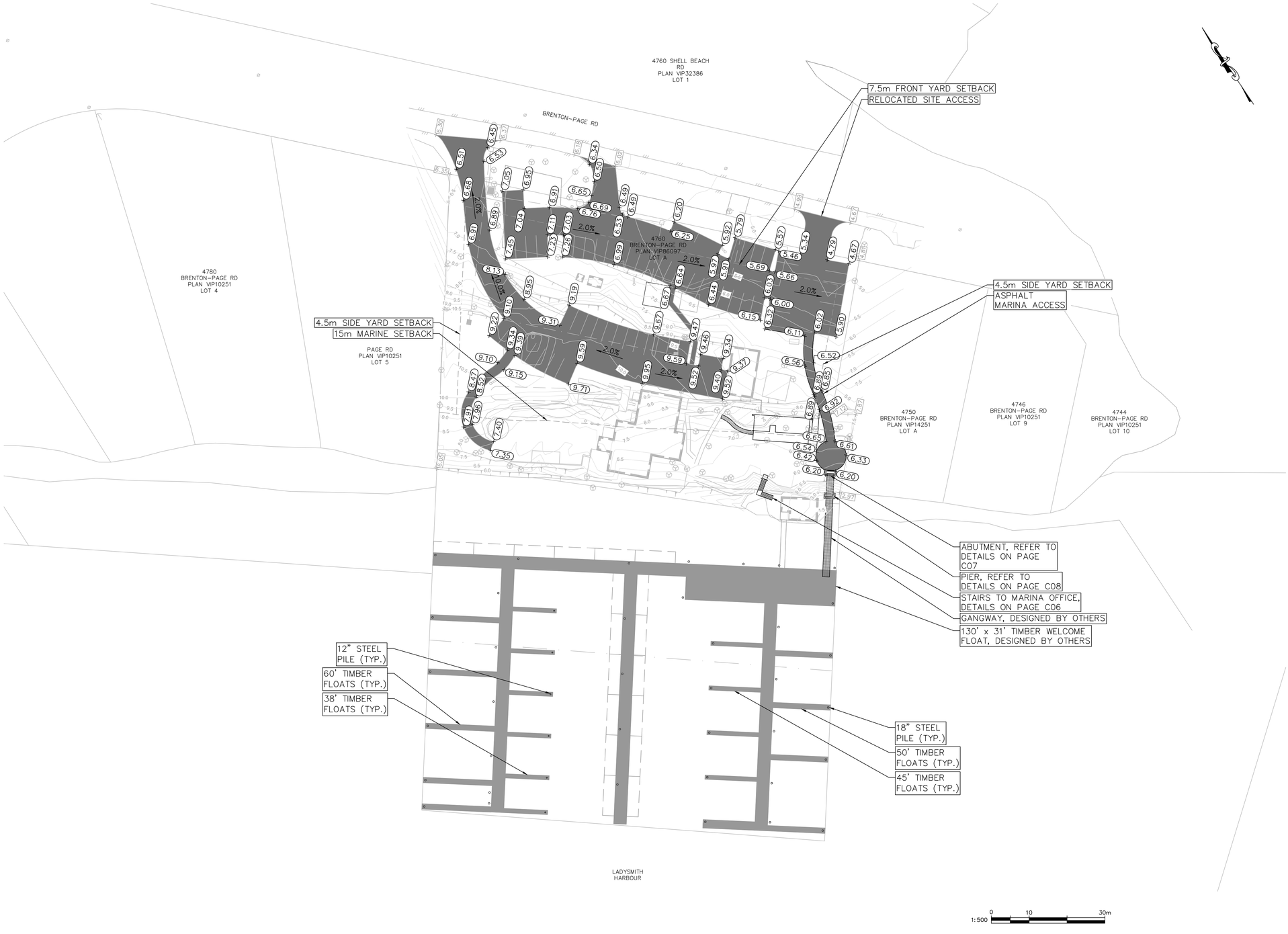
2.12.2025



NOTES:

1. REFER TO DRAWING NUMBER C01 FOR GENERAL NOTES.
2. FLOATS AND PILES ARE DESIGNED BY OTHER.

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12.16.2024

CLIENT

FMC HOLDINGS LTD.

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A	08JULY2024	DL	ISSUED FOR REVIEW	CR

RAVEN POINT MARINA

LADYSMITH, BC

DRAWING TITLE:

UPLANDS & MARINA PHASE 1 GRADING PLAN

CASCARA CONSULTING ENGINEERS LIMITED
EGBC PERMIT No. 1000784
#203-335 WESLEY STREET NANAIMO, BC V9R 2T5
TEL: 250.591.7364 EMAIL: info@cascara.ca

DESIGN BY: DL	CHECKED BY: CR
DRAWN BY: DL	APPROVED BY: CR

SEAL:

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA C. D. DAVIS 35747

EGBC Permit 1000784

2024-12-17

SCALE: HORIZ: SHOWN VERT: ----

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CITY DWG #: | PROJECT #: 1055-011

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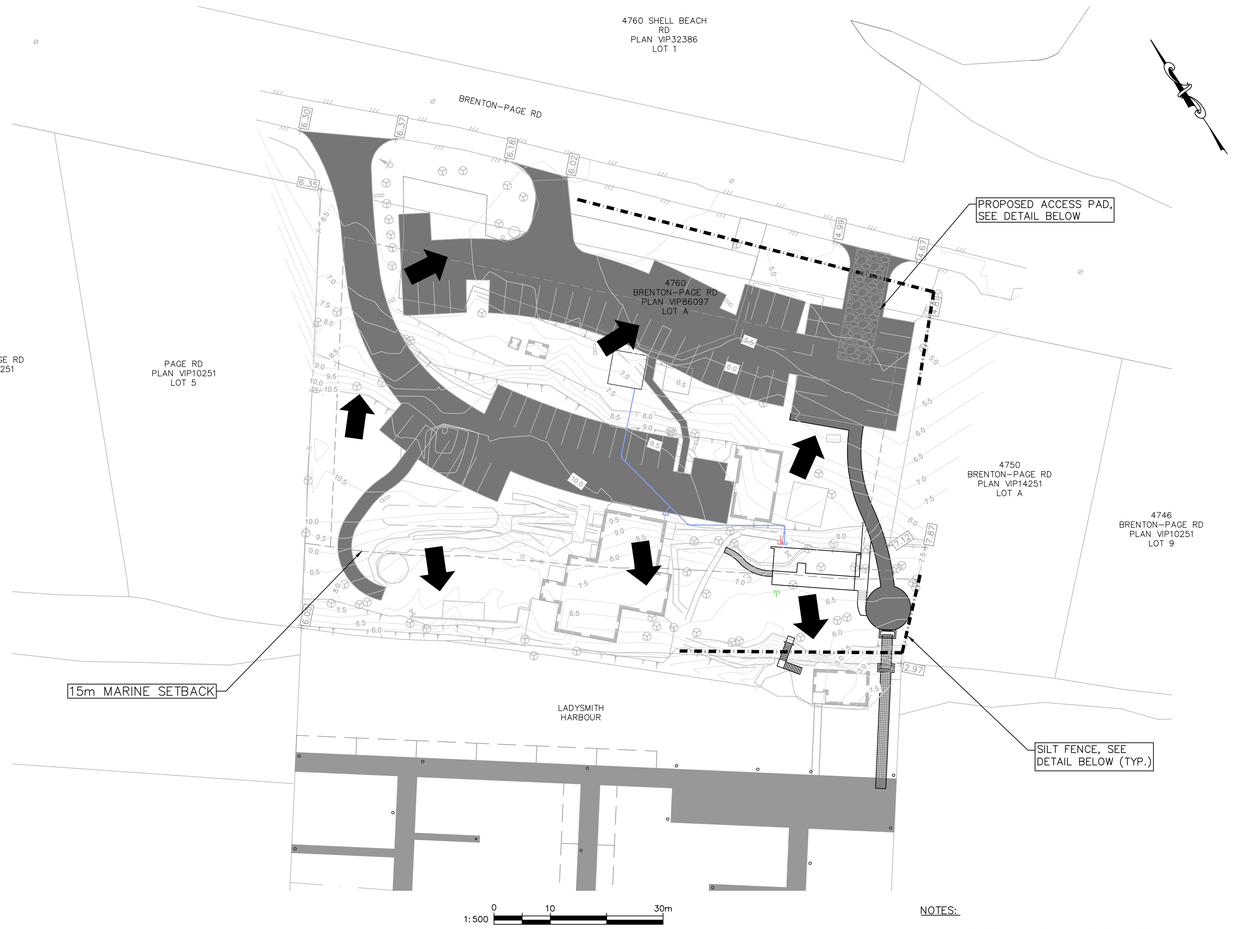


NOTES:

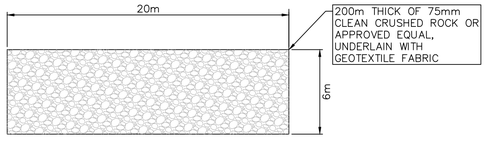
1. REFER TO DRAWING NUMBER C01 FOR GENERAL NOTES.

EROSION & SEDIMENT CONTROL NOTES:

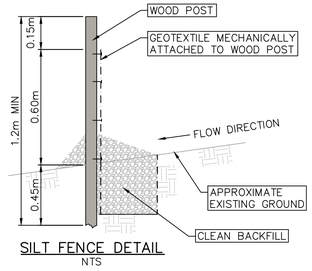
1. EROSION AND SEDIMENT CONTROL FOR THIS PROJECT WILL BE AS OUTLINED IN THE FISHERIES AND OCEANS CANADA & MINISTRY OF WATER, LANDS AND AIR PROTECTION HANDBOOK ENTITLED "LAND DEVELOPMENT GUIDELINES FOR THE PROTECTION OF THE AQUATIC HABITAT, SEPTEMBER 1993" AND "ENVIRONMENTAL BEST MANAGEMENT PRACTICES FOR URBAN AND RURAL LAND DEVELOPMENT IN BRITISH COLUMBIA, JUNE 2004". IT IS INCUMBENT UPON THE CONTRACTOR TO ACQUIRE THESE GUIDELINES AND BE FAMILIARIZED WITH THE REQUIREMENTS WITHIN.
2. THE EROSION AND SEDIMENT CONTROL PLAN (ESCP) IS DEEMED TO BE A MINIMUM LEVEL OF EROSION AND SEDIMENT CONTROL FOR THIS PROJECT. THE CONTRACTOR SHALL INSTALL ADDITIONAL MEASURES, AS REQUIRED, TO SUIT THEIR CONSTRUCTION ACTIVITY.
3. THE CONSULTANT ASSUMES NO RESPONSIBILITY FOR DAMAGES RESULTING FROM IMPROPER EROSION AND SEDIMENT CONTROL MEASURES UNDERTAKEN BY THE CONTRACTOR.
4. ANY DIRECTION GIVEN BY THE CONSULTANT OR MUNICIPALITY TO THE CONTRACTOR FOR EROSION AND SEDIMENT CONTROL AND NOT FOLLOWED BY THE CONTRACTOR IS TO BE REPORTED TO THE MUNICIPALITY IMMEDIATELY.
5. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO ENSURE NO MUD, DIRT, SOIL, SILT OR ANY OTHER SUBSTANCES ARE SPILLED, DROPPED, WASHED OR TRACKED ONTO PUBLIC RIGHTS OF WAY, OR AREAS THAT LEAD TO CATCH BASINS CONNECTED TO PUBLIC SYSTEMS. THE CONTRACTOR IS TO CLEAN ANY SUCH MATERIAL IMMEDIATELY. i.e. STREETS ARE TO BE SWEPT WITH A VACUUM STREET SWEEPER AFTER WORK STOPPAGE EACH DAY.
6. PRIOR TO CONSTRUCTION, INSTALL A TEMPORARY GRAVEL CONSTRUCTION ENTRANCE/EXIT PAD TO LIMIT TRACKING OF SITE SOILS ONTO OFFSITE ROADWAYS. THE WIDTH OF THE PAD SHOULD NOT BE LESS THAN THE FULL WIDTH OF POINT OF INGRESS OR EGRESS IN ANY CASE SHOULD NOT BE LESS THAN 6m WIDE WITH A LENGTH OF THE PAD NOT LESS THAN 20m AND HAVING A MINIMUM THICKNESS OF 200MM (8") OF COARSE GRANULAR MATERIAL. COARSE GRANULAR MATERIAL SUCH AS 75mm PLUS SHOT ROCK OR FRACTURED DRAIN ROCK UNDERLAIN WITH GEO–TEXTILE FABRIC IS RECOMMENDED.
7. THE ENTRANCE SHOULD BE MAINTAINED FOR THE DURATION OF OF CONSTRUCTION IN A CONDITION THAT WILL PREVENT THE TRACKING OF SEDIMENT ONTO PUBLIC RIGHT–OF–WAY, OR, AREAS THAT LEAD TO CATCH BASINS CONNECTED TO PUBLIC SYSTEMS. THIS MAY REQUIRE PERIODIC TOP DRESSING WITH ADDITIONAL MATERIAL AS CONDITIONS AS DEMAND. THE PAD MAY BE REMOVED ONCE PERMANENT PAVEMENTS ARE IN PLACE AT THE SITE. A WHEEL WASH MAY BE REQUIRED OF THE TEMPORARY GRAVEL PAD IS NOT WORKING."
8. CONTRACTOR TO STAGE CONSTRUCTION OPERATIONS TO LIMIT DISTURBANCE. STRIP AND GRUB ONLY THOSE AREAS NECESSARY FOR THE CURRENT CONSTRUCTION. DO NOT STRIP ANY AREA UNTIL REQUIRED.
9. CONTRACTOR TO GRADE WORK AREAS AWAY FROM ADJACENT PROPERTIES.
10. SILT FENCING IS TO BE INSTALLED AROUND ALL STOCK/SPOIL PILES, OR PILES ARE TO BE OTHERWISE COVERED TO LIMIT EROSION AND SEDIMENT GENERATION.
11. ROUTINE INSPECTION AND MAINTENANCE OF THE SYSTEM COMPONENTS WILL BE THE RESPONSIBILITY OF THE CONTRACTOR. THE CONTRACTOR SHOULD DESIGNATE AN ON–SITE PERSON TO BE RESPONSIBLE FOR DAY–TO–DAY MANAGEMENT OF THE ESCP. AT A MINIMUM, INSPECT ALL BMP'S WEEKLY TO ENSURE PROPER FUNCTION WITH INSPECTION REPORTS PROVIDED TO THE ENGINEER FOR REVIEW.
12. DURING AND/OR FOLLOWING EACH SIGNIFICANT STORM EVENT, THE DESIGNATED SITE PERSON SHOULD OBSERVE THE SYSTEM TO CONFIRM THAT TURBID WATERS FROM SOURCES ASSOCIATED WITH CONSTRUCTION ARE NOT ENTERING THE STORM DRAINAGE SYSTEM. TAKE IMMEDIATE CORRECTIVE ACTION IF INSPECTION INDICATES A PROBLEM. RECORD INSPECTION DATES, ANY SIGNIFICANT OBSERVATIONS, AND ACTIONS TAKEN, THEN INFORM THE CONSULTANT IN CHARGE AND THE MUNICIPALITY OF NORTH COWICHAN.

LEGEND

- SILT FENCE
- APPROX. OVERLAND FLOW DIRECTION



ACCESS PAD PLAN VIEW
NTS



SILT FENCE DETAIL
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CLIENT

FMC HOLDINGS LTD.

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D	17DEC2024	DL	REVISED PER CVRD COMMENTS	CR
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RAVEN POINT MARINA

LADYSMITH, BC

DRAWING TITLE:

EROSION & SEDIMENT CONTROL PLAN

CASCARA CONSULTING ENGINEERS LIMITED
EGBC PERMIT No. 1000784
#203–335 WESLEY STREET NANAIMO, BC V9R 2T5
TEL: 250.591.7364 EMAIL: info@cascara.ca

DESIGN BY: DL
DRAWN BY: DL
CHECKED BY: CR
APPROVED BY: CR

SEAL:

EGBC Permit 1000784

2024-12-17

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PROJECT #: 1055-011
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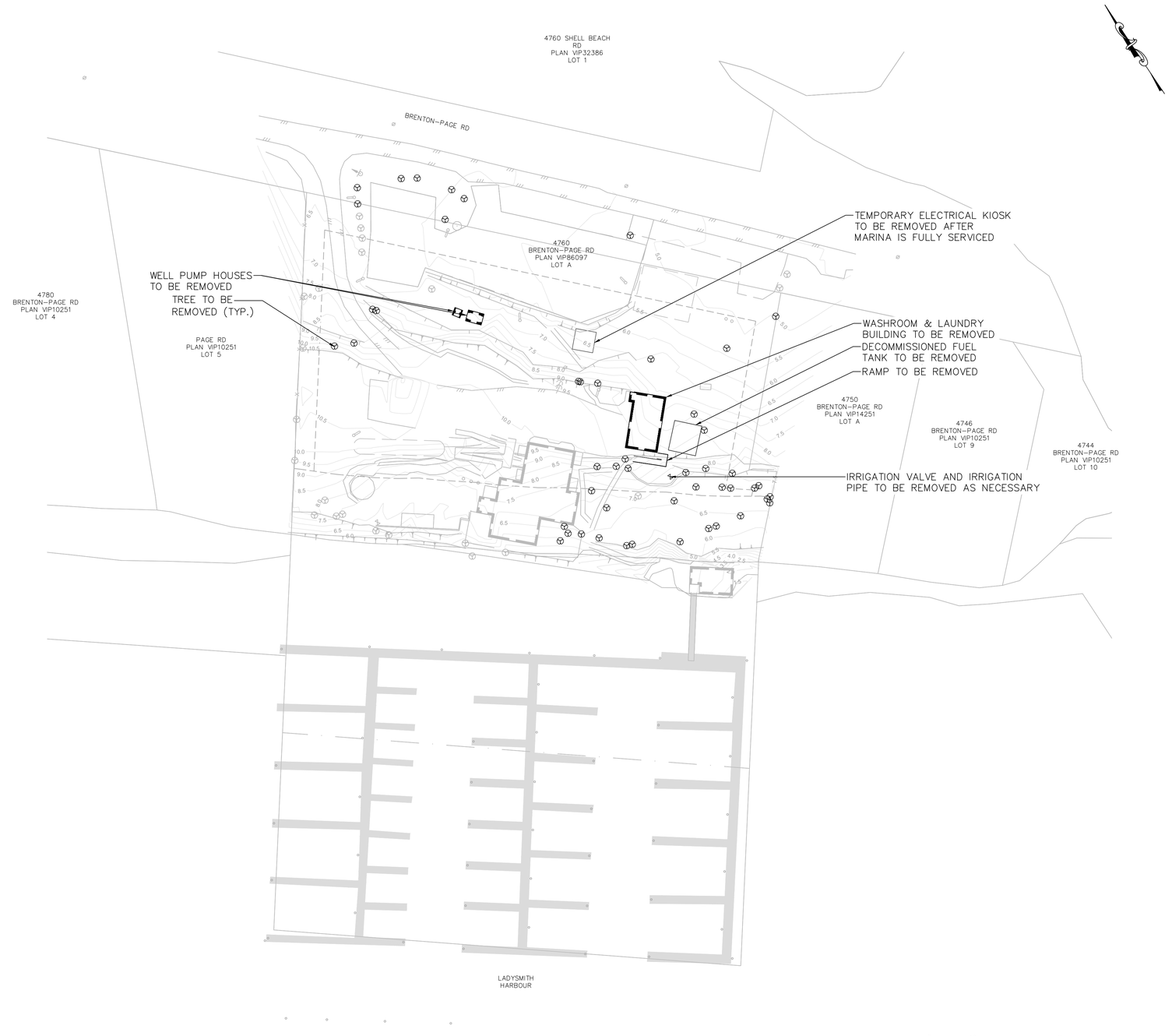
12.16.2024



NOTES:

1. REFER TO DRAWING NUMBER C01 FOR GENERAL NOTES.

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A	08JULY2024	DL	ISSUED FOR REVIEW	CR

RAVEN POINT MARINA

LADYSMITH, BC

DRAWING TITLE:

REMOVALS

CASCARA
CONSULTING ENGINEERS LIMITED
EGBC PERMIT No. 1000784
#203-335 WESLEY STREET NANAIMO, BC V9R 2T5
TEL: 250.591.7364 EMAIL: info@cascara.ca

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	CITY DWG #: | PROJECT #: 1055-011
	DRAWING NUMBER: C02 | REV: D

File: 2407221

February 5, 2025

Cascara Consulting Engineers Limited
#203-335 Wesley Street
Nanaimo, BC V9R 2T5

Attention: Charles Ramos. P.Eng., P.E.

Re: Revised Hydrogeologic Assessment of Water Supply System at Raven Point Marina 4760 Brenton-Page Road, Ladysmith. British Columbia

As requested, Hy-Geo Consulting has completed a preliminary assessment of the water supply system at the Raven Point Marina to support a Development Permit that meets the requirements of DPA 4 – Aquifer Protection Area for the Cowichan Valley Regional District. Raven Point Marina is planning to upgrade the use of their property, designated as PID 027-772-900, Lot A Section 2 Oyster District Plan VIP8609. The proposed redevelopment of the Raven Point Inn & Marina involves renovations to the existing inn and restaurant building, a new laundry/shower/washroom building, and improvements to the existing water system.

Location

The subject waterfront property, 7481 m^2 in area, is located along the north shore of Ladysmith Harbour approximately 1.5 km north of the Town of Ladysmith (Figure 1). The property lies within 20 m of sea level along the eastern base of the Woodley Range that rises to elevations just above 220 m to the northwest.

Geology and Aquifer Setting

The property and neighbouring region including the Woodley Range is underlain by fractured sedimentary rocks of the Nanaimo Group of Cretaceous age comprised principally of conglomerate and sandstone of the De Courcey Formation, and interbedded shale, siltstone and sandstone of the Cedar District Formation (Muller and Jeletzky, 1970).

Groundwater is found primarily in open fractures in the bedrock formations. These fractures constitute the major zones for groundwater storage and movement. Woodley Range and environs is part of **Aquifer 162** that has been identified, classified and mapped by the province in the region. **Aquifer 162** is a large 84.km^2 regional bedrock aquifer that has been classified as being moderate to heavily developed and highly vulnerable to contamination from surface sources of pollution (Province of British Columbia, 2024a). Waterline Resources Inc (2017) has compiled and reviewed available hydrogeological information in the region to assess water supply options for the Woodley Range Subdivision.

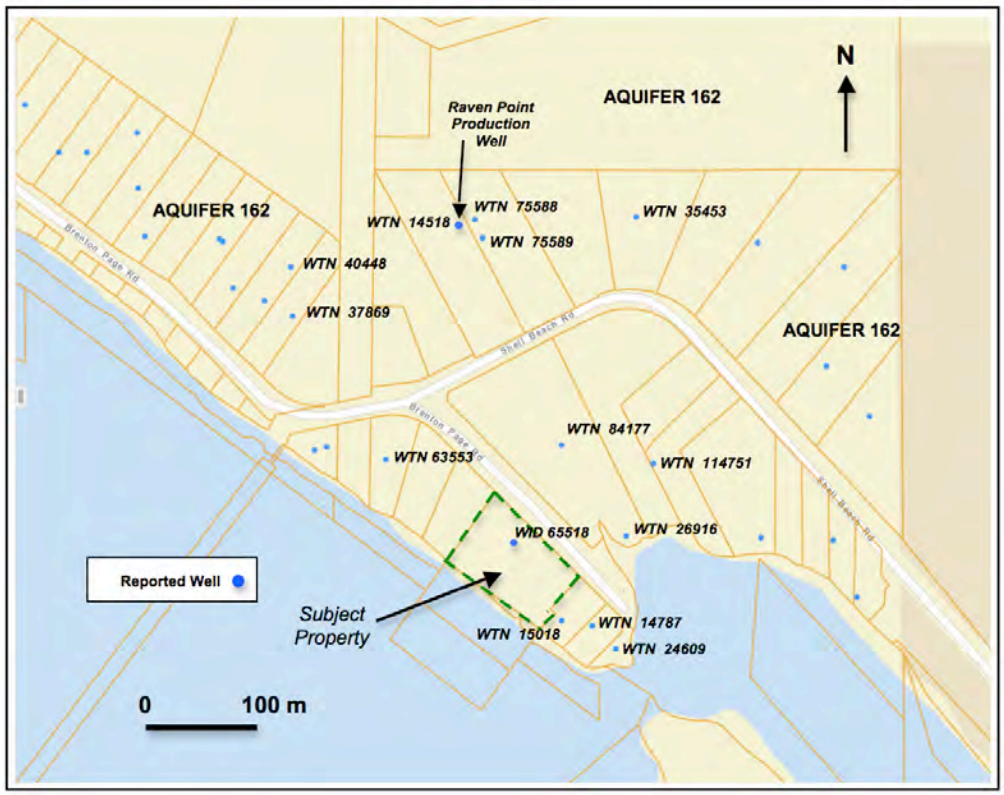

Figure 1. Location of subject property and reported nearby well locations. Well locations are approximate and have not been verified in all cases. Basemap from Province of British Columbia (2024a).

Figure 1 shows the location of reported water wells at and in the vicinity of the subject property. Table 1 provides a summary of information available for the labeled wells shown in Figure 1. Figure 2 shows an exposure of the De Courcey Formation along Brenton-Page Road, 1.2 km northwest of the subject property.

Figure 2. Exposure of relatively massive sandstone of De Courcey Formation looking north along north side of Brenton-Page Road, October 22, 2024. Note hat for scale by arrow.

Table 1. Summary of water wells at and in vicinity of subject property.

Well Tag No. (WTN)	Well Identification Plate No. (WID)	Depth Drilled or Dug (feet)	Depth Well Drilled (m)	Diameter (inches)	Diameter (cm)	Driller's Estimated Yield Value(Usgpm)	Water Depth (feet)	Water Depth (m)	Depth to Bedrock (feet)	Depth to Bedrock (m)	Construction Completion Date	General Remarks	Legal Plan	Lot No.	Section	Owner When Constructed	Well Purpose	Comments
14518		46	14.02	6	15.24	10	15	4.57	19	5.79	Mar-55	completed in mixed sandstone and shale, water at 42 feet			2	Manana Lodge	Water Supply	Manana Park Water Co Op
14787		30	9.14	6	15.24	10 ?	6	1.83	9	2.74	Mar-56	3 gpm at 25 feet, 7 gpm at 30 feet, completed in sandstone			2	Mr.. Smith	Private Domestic	Site of spring
15018		60	18.29			0.4	17	5.18	0	0	Jan-57	completed in sandstone, water at 18 feet			2	Jack Davie	Private Domestic	
24609		75	22.86	6	15.24	2	12.5	3.81	1	0.30	Mar 11-1971	completed in sandstone, 2 gpm at 26 feet, 69 feet	14251	Lot A	2	Ted Boggs	Private Domestic	
26916		60	18.29	6	15.24	2.5	14	4.27	8	2.44	Sept 7-1972	completed in shaley sandstone, 20 gph at 15 feet, 1 gpm at 26 feer, 1 gpm at 31 feet, 20 gph at 46 feet				Victor Duffhues	Private Domestic	
35453		70	21.34	6	15.24	1	9	2.74	7	2.13	Aug 5-1976	completed in sandstone,. 0.5 gpm at 39 feet, 0,5 gpm at 52 feet	24048	6	2	Mr. C.F. Little	Private Domestic	
37869		65	19.812	6	15.24	20			17	5.1816	Aug 8-1977	completed in sandstone with shale lenses	24217	16	2	Marv Bradshaw	Private Domestic	owner reports flows in winter, water level 20 feet in summer
40448		105	32.004	6	15.24	0.5	20	6.10	15	4.572	Aug 25-1978	completed in sandstone with shale lenses, 0.5 gpm ay 35 feet	24217	15	2	Rick Irvin	Private Domestic	water quality good, quality has remained constant over 7 year period (Oct 85) sulphur smell develops during dry spells
63553		305	92.96	6	15.24	2	10	3.05	10	3.05	Feb 3-1992	completed in shale with sandstone layers, 1.75 gpm at 25 feet, 2 gpm at 65 feet, 2gpm at 165 feet, 2 gpm at 245 feet, 2 gpm at 305 feet	10251	3	2	Curtis Peck	Private Domestic	
75588		14	4.27			27						Too much wafar in winter when they run about 150 gpm.Well water has iron and maganese. No sediment noted.		3			Private Domestic	data from CENAM well inventory, dug well
75589		130	39.62			7								3			Private Domestic	data from CENAM well inventory, well used for irrigation
84177		87	26.52	6	15.24	15 to 20	14	4.27	25	7.62	May 14-2004	completed in sandstone and shalle, 3 gpm at 47 feet, 7-8 gpm st 67 feet, 15-20 gpm at 87 feet	32386	1	2	Bob Wall	Private Domestic	
114751	19919	60	18.29			15	12	3.66	30	9.14	July 1-2015 ?	completed in sandstone, 5 gpm at 27 feet, 15 gpm at 55 feet				Dan Carr	Private Domestic	
	65518	160	48.768	6	15.24	2	21.4	6.52	12	3.66	Nov 2-2023	completed in sandstone, 0.5 gpm at 22-36 feet in shale. 2 gpm at 106 to 118 feet in shale	VIP86097	A	2	Raven Point Inn & Marina	Water Supply	Pump tested briefly on August 19, 2024, initial reported well yield could not be sustained.

Data from Province of British Columbia, 2024a and 2024b, and Red Williams Well Drilling Ltd.

Amenities at the Subject Property

The property has historically hosted:

(a) A private marina with 65 slips and 1044 m of wharf space that can accommodate vessels ranging from 8 to 30 metres in length.

(b) A 100 seat restaurant.

(c) An inn with 6 small suites having ensuite bathrooms.

(d) A two-bedroom cabin.

(e) A marina office building.

(f) An out building with toilets, showers and laundry.

(g) A pump house with water supply, treatment and distribution system reliant on a bedrock well source designated WTN 14518 that is situated on another property (PID 002-966-956).

(h) A sewerage treatment system.

Water Supply System and Source

The *Manana Park Water Co Op* historically supplied the marina, inn, small cabin and 3 residential properties east of the marina property along Brenton-Page Road (Figure 3). A copy of the Operating Certificate for the water system issued by Island Health is provided in Appendix A.

The current water supply system on the subject property consists of a main pump house with below ground water storage (concrete tank with capacity of 6540 L (1728 USgals) and adjacent small building with below ground storage concrete tank with capacity of 3185 L (841 USgals). This facility will be replaced with a new pump house and 2000 USgal storage tank. The current pump house also includes an ozone treatment system, pressure tanks and in-line cartridge filter. Water is sourced from bedrock Well WTN 14518 (WID 13313) situated on parcel PID 002-966-956 off Shell Beach Road as shown in Figure 3. The land parcel and well is owned by the *Manana Park Water Co Op* and has been supplying the marina and inn with water for several decades. The well is equipped with a pump that is controlled from a small building on PID 002-966-956 that houses a small pressure tank and pump controller. Pumping of the well is activated when water level drops below a certain point in the storage tanks on the marina property. There are four water meters on site: one in the main pumphouse, one on the line servicing the inn and marina dock, one servicing the three residential properties, and one servicing the cabin. Historic metered water consumption records are available for the 13 year period from October 15, 2009 until December 8, 2022. **Bacteriological sampling data for the water system is available from Island Health for 27 years between October 1998 and October 2024 (Island Health, 2024).**

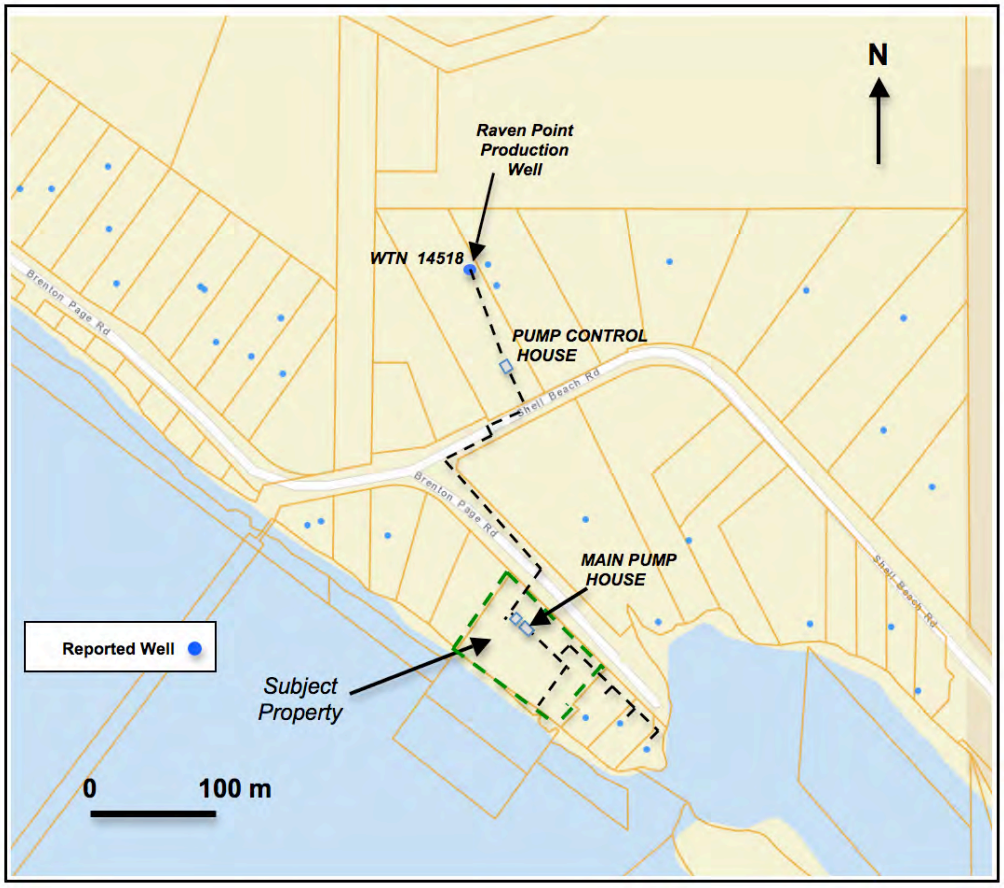

Figure 3. Location of *Manana Park Water Co Op* water system components. Distribution lines and well locations are approximate and have not been verified in all cases. Basemap from Province of British Columbia (2024a).

Historic Water Usage

Metered water consumption records available for the period 13 year period from October 15, 2009 until December 8, 2022 are summarized in Table 2. For the entire 13 year period average continual use amounted to a rate of 7513 Litres/day, equivalent to a continuous pumping rate of 1.38 USgpm. The maximum average use recorded during the 751 day period from November 17, 2020 to December 8, 2022 was 9563 Litres/day, equivalent to 1.75 US gpm on a continuous basis. For various monitoring periods, residential use ranged from 36 to 68 % of total use (averaging 48 %) and the inn and marina accounted for 32 to 64% of total use (averaging 52 %). It has been reported (pers.comm. Wayne Smith, October 30, 2024) that on a few occasions in the past, water needed to be trucked in to support the marina when hoses had been left on at the marine while the residential properties were not affected.

Table 2. Metered water usage for *Manana Park Water Co Op* from October 15, 2009 to December 8, 2020.

Period	Number of Days	Lodge/Marina (USgals)	Residential Properties (USgals)	Total (USgals)	Average (Usgpm)	Average (Litres/day)	Lodge/Marina (% of Total)	Residential Properties (% of Total)
Oct 15 to Nov 3/2009	19	11,350	11190	22,540	0.82	4491	50	50
Nov 3/2009 to May 10/2010	188	114738	82403	197,141	0.73	3969	58	42
May 10/2010 to June 30/2011	416	457112	433017	890,129	1.49	8100	51	49
June 30/2011 to Apr 12/2012	287	287660	264600	552,260	1.34	7284	52	48
Apr 12/2012 to Dec 11/2012	243	302040	288610	590,650	1.69	9201	51	49
Dec 11/2012 to Dec 15/2013	369	421700	336170	757870	1.43	7775	56	44
Dec 15/2013 to October 3/2014	292	307420	296310	603730	1.44	7827	51	49
Oct 3/2014 to July 7/2017	1008	831240	939530	1770770	1.22	6650	47	53
July 7/2017 to Sept 12/2018	432	216870	465240	682110	1.10	5977	32	68
Sept 12/2018 to Nov 17/2020	797	780030	786650	1566680	1.37	7441	50	50
Nov 17/2020 to Dec 8/2022	751	1208460	688700	1897160	1.75	9563	64	36
Totals:	4802	4938620	4592420	9531040				
Average:					1.38	7513	52	48

Existing Well Source WTN 14518 (WID 13313)

According to the well record on file with the province, Well WTN 14518 was drilled for Manana Lodge in March 1955 by Pacific Water Wells to a depth of 46 feet (14.0 m) and completed in mixed sandstone and shale, underlying 15 feet (4.6 m) of silty clay and 4 feet (1.2 m) of topsoil. The well was completed with 22 feet (6.7 m) of 6 inch (15.2 cm) diameter steel casing set into the bedrock. Water was encountered at a depth of 42 feet (12.8 m) with the water level reported at 15 feet (4.6 m). Yield of the well was reported at 10 gpm. A copy of the well record on file with the province is provided in Appendix B.

The well was completed prior to introduction of the *Groundwater Protection Regulation* under the *Water Sustainability Act* in 2016. While the well is completed with a steel surface casing set in bedrock it is unlikely that it has a surface seal around the casing to a depth of 5 m. As the well was likely completed using the cable-tool method in 1955 by driving the casing, the minimal length of surface seal required would be 1 m in accordance with Section 23 (1b) of the *Groundwater Protection Regulation*.

Between November 6 and 9, 2024, Red Williams Well Drilling Ltd., excavated around the well casing and installed a surface seal with a minimum thickness of 2.54 cm around the casing to a depth of 1.2 m (4 feet), in compliance with the *Groundwater Protection Regulation.* Red Williams Well Drilling Ltd., also installed a new pump in the well, and a new pressure tank in the pump house, complete with a water meter and sediment filter unit. A water level sounding tube was also installed in the well.

The well is currently plotted at the eastern end of Breton-Page Road, in error at the *BC Water Resources Atlas* (Province of British Columbia, 2024a). The correct location is shown in Figure 1. Current output of the well source is estimated to be 5 USgpm (pers.comm. Wayne Smith, October 30, 2024). After installation of the new well pump in early November 2024, Red Williams Well Drilling Ltd., tested the well at 11 USgpm for one hour. **The well, however. has not been pump tested following current standards (Province of British Columbia, 2020) to verify the long-term well capacity.**

The well is situated at an elevation of approximately 15 m (49 feet) above sea level, which would preclude any risks of water levels being drawn down below sea level during pumping and causing sea water intrusion into the aquifer. The potential capture zone for the well (Figure 4), is situated upslope towards a wooded upland region of the Woodley Range where there are no reported wells. The closest reported wells, within 30 m of WTN 14518 to the east are WTN 75588 and WTN 75589. They have reported well yields of 27 and 7 USgpm respectively.

A comprehensive water quality analysis is available for a sample taken from a water tap on the property in January, 2020. A copy of the analysis is provided in Appendix C. The water is low in overall mineralization with a Total Dissolved Solids (TDS) level of 180 mg/L and conductivity of 320 µS/cm. The laboratory results indicate the water quality of the subject well met or exceeded the *Guidelines for Canadian Drinking Water-Summary Tables* (Health Canada, 2022) for all parameters analyzed except for elevated levels of: Total coliforms at 4.0 CFU/100mL, Turbidity at 2.8 NTU, Colour at 15 Col. Unit and Total Manganese at 268 µg/L. The elevated levels of turbidity and colour do not pose a health hazard and are only of aesthetic concern. Manganese above 20 µg/L is of aesthetic concern and may result in staining of laundry and/or toilet fixtures. Manganese in water above 120 µg/L is a health concern and can cause effects on neurological development and behaviour deficits in memory, attention, and motor skills and pose a risk to infants if used to prepare formula. These parameters may decrease with time as the well is pumped and may be partly reduced with conventional filtering and other on site treatment systems.

During inspection of the well on October 22, 2024 a pumped water sample taken from the well showed a conductivity of 342 µS/cm., similar to the January 2020 results. The water also had a faint hydrogen sulphide (H_2S) odour.

A recent laboratory analysis of a pumped water sample taken from the well on November 7, 2024 (Appendix C) showed no total coliforms, fecal or E.coli bacteria. Total manganese was reported at 430 µg/L similar to previous levels observed in 2020.

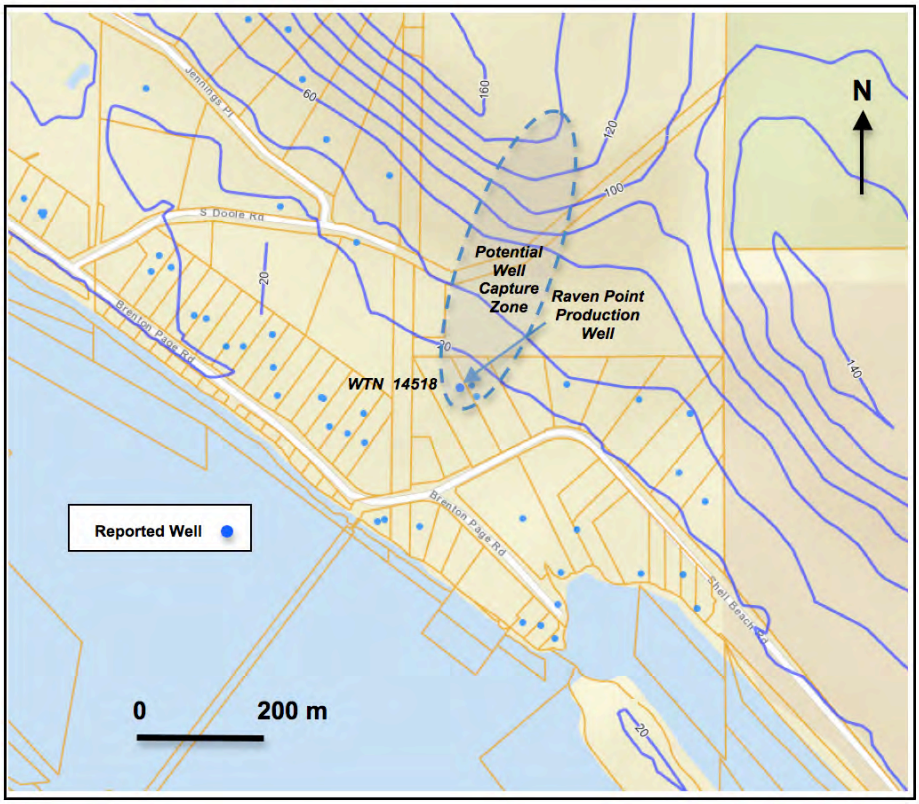

Figure 4. Potential capture zone for well WTN 14518. Wells locations are approximate and have not been verified in all cases. Basemap from Province of British Columbia (2024a), contour interval = 20 m.

Historic Water Demand

Based on the historic metering it is evident that the well has been able to meet a maximum average daily demand (ADD) up to 9573 Litres/day, equivalent to a continuous pumping rate of 1.75 USgpm. The Maximum Day Demand (MDD) would likely have exceeded the average day demand (ADD) by a peaking factor of 2 to 3 times. Maximum Day Demand (MDD) is the single highest total 24-hour daily water consumption occurring over a one-year period based on the *Design Guidelines for Rural Residential Community Water Systems* (Ministry of Forests, Lands & Natural Resource Operations, 2012). This would suggest that the well source needed to yield perhaps 3.5 to 5.25 USgpm (19,078 to 28,618 L/day) for short periods of time to meet the peak demand. Current output of the well source is estimated to be 5 USgpm (pers.comm. Wayne Smith, October 30, 2024).

The Maximum Day Demand (MDD) in Litres/day may be estimated based on the following:

MDD = Indoor Demand + Outdoor Demand + Water Losses + Irrigation Demand

Indoor demand includes the 3 residential properties, the inn, restaurant, washrooms and laundry facilities. The two-bedroom cabin will not operational.

Outdoor demand would include the marina, e.g. filling of water tanks and boat washing.

Water losses include leaks from the water system.

Irrigation demand includes watering of lawns and gardens on the subject property.

While the water demands of the individual facilities are not known, a preliminary estimate may be made as indicated in Table 3.

Table 3. Preliminary estimate of Maximum Daily Demand (MDD) for the Manana Park Water Co Op.

Area of Demand	Facility	MDD Demand (L/day)	Reference
Indoor Demand	3 Residential Properties	6825	based on 2275 L/day per parcel x 3
	Inn		
	Restaurant		
	Washrooms with Showers	6825	based on 50% of total Average Day Demand, as observed from historic metered data
	Laundry		
Outdoor Demand	Marina		
Water Losses	Leaking Pipes	unknown	
Irrigation Demand		minimal	
	Total:	13650	

Table 3 indicates that the minimum MDD could be 13650 L/day, equivalent to a continuous pumping rate of 2.5 USgpm.

Future Water Demand

Upgrading the washroom, shower and laundry facilities of the subject property and water fixtures for the inn and restaurant will not likely increase the peak water demand as fixtures will be replaced with low-flow and more water-efficient units. Assuming that there are no leaks in the water system, residential and marina demands would remain essentially unchanged and irrigation demands would be minimal.

Based on *Design Guidelines for Rural Residential Community Water Systems* (Ministry of Forests, Lands & Natural Resource Operations, 2012), the storage required to balance the difference between instantaneous demands and the average demands should be a minimum 25% of the MDD (13650 L/day). Therefore, the minimum volume requirement for balancing storage would need to be 3413 L (902 USgals). It would appear that the existing storage capacity of the water system at 2569 USgals and replacement storage tank of 2000 USgals would be sufficient. Depending upon how the existing storage system is activated, adding additional storage capacity would provide a greater safety factor for the water system.

Under the *Water Sustainability Act* a water licence would be required to operate the well for commercial purposes. On December 2, 2024, the *Manana Park Water Co Op* submitted an application for use of the well to FrontCounter BC in Nanaimo through the website https://portal.nrs.gov.bc.ca/web/client/home

Potential Impacts on Aquifer 162

Under the guidelines for Development Permit Area 4: Aquifer Protection (Cowichan Valley Regional District, 2024) the objectives for aquifer protection are to:

- protect subsurface aquifers from contamination by land use and development activities; and

- avoid depletion of aquifer water supplies, maximize their recharge and promote the efficient use of water to ensure a stable and sustainable hydrologic system.

Potential impacts of the marina and inn upgrade on the aquifer are discussed as follows:

Physical Location of Subject Property

The waterfront property is situated at the edge of bedrock **Aquifer 162** in an area where groundwater is naturally discharging towards the ocean and is not situated in an upland recharge area. Unconsolidated deposits consisting of 9 feet of clay and 3 feet of sand and gravel overlie the bedrock on the property as evidenced in well WID 65519. There are no plans to use Well WID 65519 as a water supply source due to its very low yield. These conditions minimize any potential risks of aquifer contamination.

On Site Storage of Hazardous Materials

There are no plans to store gasoline or bulk oil on the property to service the inn and marina. The marina does not have a pump-out for sewerage from boats. All garbage and refuse generated at the property will be regularly transported to a permitted off-site recycling and storage facility. These conditions minimize any potential risks of aquifer contamination.

Existing Sewerage Septic Systems

There are two reported sewerage system disposal fields located on the marina property as shown in Figure 5 at sites A and B.

Site A covers an area of approximately 25 m^2 and is situated at an elevation close to 6.5 m above sea level. It services the Inn and laundry/showers building. Infiltration at this location likely seeps down into the underlying surficial deposits and then down slope in an easterly direction.

Site B cover an area of approximately 150 m^2 and is situated at an elevation close to 9.0 m above sea level. It services a caretaker suite and the restaurant at the inn. Infiltration at

this location likely seeps down into the underlying surficial/fill deposits and then down slope in a southwesterly direction towards the ocean.

The historic use of water at the inn and marina for the 13 year period from October 15, 2009 until December 8, 2022 amounted to an average continual use 7513 Litres/day, equivalent to a continuous pumping rate of 1.38 USgpm. For various monitoring periods, the inn and marina accounted for 32 to 64% of total use (averaging 52 %). The remaining water use was for the three adjacent residential properties. Based on these figures the total loading rate on the two septic field systems on the marina property would have averaged less than 52% x 1.38 USgpm or approximately 0.72 USgpm. This relatively low rate of discharge and apportioned between the two disposal sites would pose insignificant quantity or quality risks to the underlying bedrock **Aquifer 162.**

The marina/inn property is also situated at the edge of bedrock **Aquifer 162** in an area where deep groundwater in the aquifer is naturally discharging towards the ocean and is not situated in an upland recharge area. Unconsolidated deposits consisting of 9 feet of clay and 3 feet of sand and gravel overlie the bedrock along the northern portion of the property as evidenced in well WID 65519 (Appendix B). There are no plans to use Well WID 65519 as a water supply source due to its very low yield. These conditions minimize any potential risks of aquifer or well contamination.

The existing sewerage system, servicing the inn, and outbuilding with washrooms, showers and laundry may be upgraded in the future in compliance with the *Sewerage System Regulation* under the *Public Health Act.*

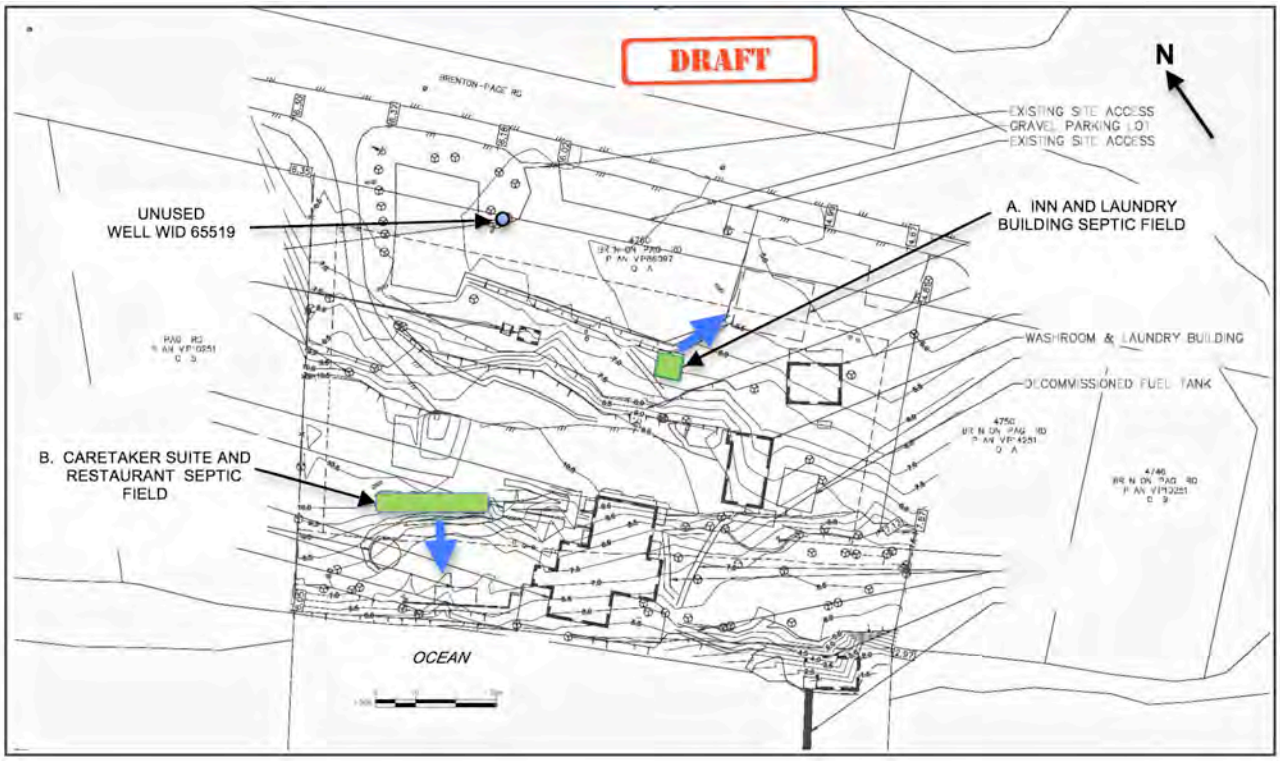

Figure 5. Location of septic disposal fields on Raven Point Marina property. Blue arrows show direction of inferred down slope seepage. Figure adapted from Cascara Consulting Engineers Limited (2024).

Proposed Tree Cutting

Campbell and Zamora (2024) have prepared an environmental assessment for the Raven Point Inn and recommend removal of 40 Douglas fir trees ranging in size between 25-85cm DBH. Other trees to be removed include six arbutus (10-35cm DBH), five bigleaf maple (25-160cm DBH), two grand fir (53cm and 85cm DBH), two black cottonwood (40cm and 60cm DBH) and one apple (40cm DBH). The total number of trees to be removed is 56 trees. Appendix D adapted from Turner & Associates (2024) outlines the areas of tree removal on the property. The majority of the trees are located in the southeast corner of the property east of the main inn building.

Tree removal will reduce evapotranspiration from the area during the spring-summer growing season and likely lead to increased surface water runoff during the fall and winter rainy period. As the marina/inn property is situated at the edge of bedrock **Aquifer 162** in an area where deep groundwater in the aquifer is naturally discharging towards the ocean, risks to the quantity and quality of groundwater in the aquifer would not be significant. Tree removal, however, may result in the potential for increased bank erosion down slope of this portion of the property.

Well WTN 14518 Construction

Since the well was completed prior to introduction of the *Groundwater Protection Regulation* under the *Water Sustainability Act* in 2016, it is unlikely that the well was completed with a surface seal around the casing to a depth of 5 m. The well, however, was likely completed using the cable-tool method in 1955 by driving the casing and the minimal length of surface seal required would be 1 m in accordance with Section 23 (1b) of the *Groundwater Protection Regulation*. On November 6, 2024, Red Williams Well Drilling Ltd., excavated around the well casing and installed a surface seal with a minimum thickness of 2.54 cm around the casing to a depth of 1.2 m (4 feet), in compliance with the *Groundwater Protection Regulation.* The bedrock aquifer at the well site is also protected by overlying, low permeability layers comprised of 15 feet (4.6 m) of silty clay and 4 feet (1.2 m) of clayey topsoil. The wellhead also has a commercially manufactured well cap and 30.5 cm (1 foot) stickup in compliance with the *Groundwater Protection Regulation* and is not situated in an area subject to flooding.

Water Supply from Well WTN 14518

It is anticipated that pumping from the well on parcel PID 002-966-956 for the inn, transient toilet/laundry facilities, restaurant and marina will not increase over the historic pumping rate of the well. Residential use of the well is not likely to increase. The *Manana Park Water Co Op* submitted a water licence application for use of the well to FrontCounter BC in Nanaimo on December 2, 2024.

As the well has been operating successfully over the past 26 years with no significant issues reported, the potential impacts of pumping are not expected to be significant and lead to any local aquifer depletion issues or deterioration in water quality. Pump testing the well for 72 hours duration in accordance with current guidelines (Province of British Columbia, 2020) and monitoring water levels in one or more neighbouring wells would verify the long-term well capacity and any potential impacts on the aquifer and other nearby water users.

Potential Capture Zone for Well WTN 14518

The potential capture zone for Well WTN 14518 extends upslope into a wooded upland on Woodley Range where there are currently no reported wells. The closest reported wells, within 30 m of WTN 14518 to the east, are WTN 75588 and WTN 75589 that have reported well yields of 27 and 7 USgpm respectively. The potential risks for any significant well interference and groundwater contamination are considered very low.

Well WID 65518

The recently 2023. drilled Well WID 65518 on the property was constructed in compliance with the *Groundwater Protection Regulation* and will need to be decommissioned in compliance with Part 9 of the *Groundwater Protection Regulation* if it is not in service for a period of 5 years. Alternatively the well could be used possibly as a monitor well or geo-exchange well. The well is not subject to flooding conditions and does not pose any risk to the aquifer.

Sea Water Intrusion

Given that the elevation of WTN 14518 Well is approximately 15 m (49 feet) above sea level and the well is 14 m (46 feet) deep would preclude any risks of water levels being drawn down below sea level during pumping and causing sea water intrusion into the aquifer. Existing 2020 water quality information for the well indicates that the well water is low in total dissolved mineral content (TDS= 180 mg/L) indicative of freshwater recharge. Further water quality sampling can be conducted when the well is pump tested to confirm these conditions.

Metering Water Consumption

Continued metering of water consumption on the subject property will promote the efficient use of water, water conservation efforts, and detection of water system leaks to ensure a stable and sustainable hydrologic system. An additional water meter located in the pump control building near the well was installed on November 7, 2024 and will be beneficial to detect any leaks in the water system. The toilet/laundry building, inn and restaurant will also be utilizing low-flow water fixtures and water-efficient appliances to conserve water.

Sensitive Ecosystems

No sensitive ecosystems have been identified on the subject property or in the well source area according to available sensitive ecosystem mapping in the region (Canadian Wildlife Service and BC Ministry of Environment, 2004).

Conclusions

Based on the above report information the following conclusions can be made:

1. Historic operation of the existing well source (WTN 14518) for the inn, marina and neighbouring properties for several decades has not caused any known issues to water availability or water quality in the aquifer.

2. A preliminary hydrogeological assessment of the water supply system and planned redevelopment of the Raven Point Inn and Marina indicates that water use would not exceed historic use levels and not likely to have any significant negative impacts upon the available quantity and quality of groundwater in **Aquifer 162.**

3. The subject property does not host any potential sources of contamination such as gasoline or bulk oil storage, that if not contained, might adversely impact the aquifer.

4. The potential for sea water intrusion by operation of the well (WTN 14518) is remote due to the elevation and safe depth of the well.

5. The marina does not provide a sewerage pump out and disposal system for boats.

6. No sensitive ecosystems have been identified on the subject property or in the well source area.

7. The property conditions and water supply meet the objectives for aquifer protection under the guidelines for Development Permit Area 4: Aquifer Protection (Cowichan Valley Regional District, 2024). These conditions also comply with Section 3.7.2 Water Quality and Quantity guidelines under the Develop with Care: Environmental Guidelines for Urban and Rural Land Development in British Columbia (Government of British Columbia, 2014).

8. There are two reported sewerage system disposal fields located on the marina property (Sites A and B). Site A services the Inn and Laundry/Showers building and Site B services a caretaker suite and the restaurant at the inn.

9. From historic water use figures, the total loading rate on the two septic field systems on the marina property would have averaged approximately 0.72 USgpm. This relatively low rate of discharge and apportioned between the two disposal sites would have insignificant quantity or quality effects on the underlying bedrock aquifer. The marina/inn property is also situated at the edge of bedrock **Aquifer 162** in an area where deep groundwater in the aquifer is naturally discharging towards the ocean and is not situated in an upland recharge area.

10. A significant number of trees are planned for removal with the majority situated in the southeast corner of the property. Tree removal will reduce evapotranspiration from the area during the spring-summer growing season and likely lead to increased surface water runoff during the fall and winter rainy period. Potential quantity and quality impacts on **Aquifer 162** would not be significant.

11. Tree removal may result in the potential for increased bank erosion down slope of the southeastern portion of the property.

Recommendations

The following recommendations are suggested for consideration:

1. Install a datalogger in well WTN 14518, periodically, to monitor fluctuations of the water level with time in conjunction with weekly recording of US gals pumped. This information would enable assessment of well performance with time, recharge effects of rainfall and potential well interference effects from and on any neighbouring wells.
2. Conduct a 72 hour constant rate pumping test on well WTN 14518 at a minimum rate of 3 USgpm to assess the long-term well capacity. Monitoring of water levels in one or more neighbouring wells should also be undertaken during the test to assess any potential effects on other water users of the aquifer.
3. Sample the water quality near the end of the pumping test for laboratory analyses of bacteriological and chemical parameters including dissolved metals. The results could assist in determining any water treatment modifications for the water system.
4. Following tree removal, monitor and improve the surface drainage conditions along the southeastern bank of the property to minimize any potential erosion concerns.

Closure

This report was prepared in accordance with generally accepted engineering, hydrogeological and consulting practices. It is intended for the prime use of Cascara Consulting Engineers Limited in connection with its purpose as outlined under the scope of work for this project. This report is based on data and information available to the author from various sources at the time of its preparation and the findings of this report may therefore be subject to revision. Data and information supplied by others has not been independently confirmed or verified to be correct or accurate in all cases. Any errors, omissions or issues requiring clarification should be brought to the attention of the author. The author retains full copyright of the material contained in the report. The author and Hy-Geo Consulting accept no responsibility for damages suffered by any third party as a result of any unauthorized use of this report.

Respectfully submitted,

Alan P. Kohut P.Eng
Principal and Senior Hydrogeologist

HY-GEO CONSULTING
Permit to Practice Number: 1001034

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APPENDIX A

Operating Certificate for *Manana Park Water Co Op*

island health

Environment
201 - 771 Ver
Victoria, BC V

April 1, 2024

Manana Park Water Co Op
Manana Park Water Co Op
24760 Brenton Page Road
Ladysmith BC V9G 1L7

Dear Operator:

Re: Health Operating Permit April 1, 2024 to March 31, 2025

Facility Type: **Drinking Water-2-14 Connections**
Facility Number: **1313650**
Facility Name: **Manana Park Water Co Op**

Enclosed please find your April 2024 – March 2025 validation decal #0686 for your **water facility permit**.

This decal should be affixed to your Permit to Operate and displayed in a conspicuous place and is not transferable.

If your facility has been sold or closed, please advise your local Environmental Public Health (EPH) office and return the permit/decal to the appropriate office.

Please contact your local EPH office at the number below if you have any questions.

Thank you,

Environmental Public Health

Victoria EPH
Gateway Village Health Unit
201-771 Vernon Ave
Victoria, BC V8X 5A7
(250) 519-3401

Nanaimo EPH
3rd Floor
6475 Metral Dr
Nanaimo, BC V9T 2L9
(250) 755-6215

Duncan EPH
202-6425 Norcross Rd
Duncan, BC V9L 6C5
(250) 737-2010

Campbell River EPH
200-1100 Island Hwy
Campbell River, BC V9W 8C6
(250) 850-2111

Port Alberni EPH
4201 6th Ave
Port Alberni, BC V9Y 4N1
(250) 731-1355

Parksville EPH
OHC 489 Alberni Hwy
Parksville, BC V9P 1J9
(250) 947-8222

Port Hardy EPH
7070 Market St
Port Hardy, BC V0N 2P0
(250) 902-6071

Courtenay EPH
355 11th St
Courtenay, BC V9N 1S4
(250) 331-8518

APPENDIX B

Well Records

WTN 14518

WID 65518

092G 001.2.2.2

MERIDIAN	TENS	UNITS	TENS	UNITS	QUARTER	TENS	UNITS
	RANGE		SECTION		NE SE SW NW	LAND DISTRICT	8

WATER RIGHTS BRANCH, DEPT. OF LANDS AND FORESTS, VICTORIA, B.C. (X2, Y6)

6 ✓ 6 ✓

LOCATION S2 Oyster District
(COMPLETE LEGAL DESCRIPTION)

OWNER'S NAME Manana Lodge ADDRESS 47-- Shell Beach Road, North Oyster ~~Brentwood, Ladysmith~~, B.C. WTN 14518

DRILLER'S NAME Pacific Water Wells ADDRESS Nanaimo, B.C. DATE OF COMPLETION May 1955

DEPTH 46' ELEVATION OF COLLAR 40 (108) CASING DIAM. 6" LENGTH 22' TYPE

METHOD OF DIGGING Drilled SCREEN ☐ SIZE LENGTH TYPE

PERFORATED CASING ☐ LENGTH SIZE OPENINGS DEVELOPED ☐ DESCRIBE

GRAVEL PACK ☐ LENGTH DIAM. SIZE GRAVEL, ETC.

PUMP ☐ TYPE POWER

CAPACITY OTHER DATA

COSTS WELL PUMP PUMP HOUSE, ETC.

MAINTENANCE

DISTANCE TO WATER FROM TOP OF CASING 15' ☐ ESTIMATED ☑ MEASURED ELEVATION FLUCTUATION

HIGH WATER MONTH LOW WATER MONTH OBSERVATION DATA ☐ FILE No.

WATER USE Waterworks

MAX. RATE WITHDRAWAL ☐ ESTIMATED ☐ MEASURED

TEMPERATURE PUMPS SAND ☐

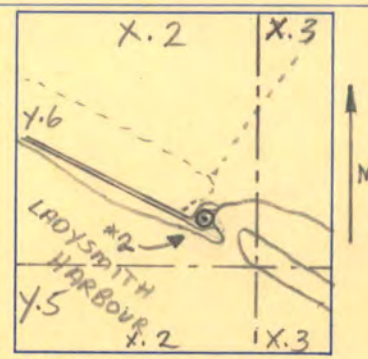
CLOGS SCREEN ☐ TYPE DEPOSIT AQUIFER DATA

Sandstone & Shale

LICENSE No. DATE LICENSE AMOUNT

DATE APPLICATION USE

Well Location - On terrace north of Lodge



LOCATION SKETCH—INDICATE NORTH

WATER QUALITY: ANALYSIS; SOFT; HARD; HIGH IRON; HIGH SULPHUR; SALTY; ALKALINE; SALINE; POLLUTED; INADEQUATE QUALITY

CAPACITY GPD: DRY HOLE; INADEQUATE QUANTITY; PUMPING TEST; $0 - 10^3$; $10^3 - 10^4$; $10^4 - 10^5$; $10^5 - 10^6$; $> 10^6$

METHOD: DUG; DRIVEN; DRILLED; JETTED; BORED

DEPTH: 0 — 25; 25 — 50; 50 — 100; 100 — 200; 200 — 400; >400

OBSERVATION; ABANDONED; DEVELOPED; SCREEN*; PERF. CASING; GRAVEL ENV.; PUMP

TYPE WELL: FLOWING; NON-FLOW ARTESIAN; WATER TABLE; PART CONFINED

SUPPLY AQUIFER		OTHER AQUIFER PRESENT		OTHER AQUIFER PRESENT		CHARACTER OF SUPPLY AQUIFER			WATER USE							RELIABILITY OF DATA		
TENS	UNITS	TENS	UNITS	TENS	UNITS	SAND	GRAVEL	TILL	HOUSEHOLD	GARDEN	STOCK	COOLING	IRRIGATION	INDUSTRIAL	WATERWORKS	GOOD	FAIR	POOR

SYSTEMS EQUIPMENT LIMITED. VICTORIA—CANADA O 1065 SYSTEMSORT

LOG

FROM	TO	DESCRIPTION	NAME
0	4	Topsoil	
4	19	Silty Clay	
19	46	Mixed Sandstone & Shale	
(B)		Water @ 42'	

SAMPLE No. _____ DATE _____

LAB. _____

COLIFORM ORGANISMS _____

TOTAL BACTERIA _____

COLOUR _____ ODOUR _____

TASTE _____

PUMPING TEST SUMMARY

TEST BY _____

DATE _____ FILE No. _____

SPECIFIC CAPACITY _____ PERMIABILITY _____

STORAGE COEFF _____ POROSITY _____

REMARKS _____

Yield - 10 g.p.m.

ANALYSIS

	PPM
Total Hardness	
Carbonate Hard	
Magnesium Hard	
Fe	
SO_2	
Ca	
Mg	
Na	
K	
HCO_3	
CO_3	
Cl	
SO_4	
NO_3	
B	
E	
Total Dis-solids	
Total Alkalinity	
Suspended Solids	
Ph	

OTHER DATA

SIZE ANALYSIS. ETC. _____

CARD BY J.C. DATE Nov. 62

SOURCES INFORMATION G.S.C.

BRITISH COLUMBIA

☒ Well Construction Report
☐ Well Alteration Report

RED WILLIAMS WELL DRILLING LTD
980 PRATT RD QUALICUM BEACH BC V9K 1W5
(250) 248-5552

Ministry Well ID Plate Number: 65518
Where ID Plate is attached: CASING
Ministry Well Tag Number: _____

See reverse for notes & definitions of abbreviations

Well Class: Class of well (see note 2): WATER SUPPLY **Sub-class of well:** DOMESTIC

Water supply wells: indicate intended water use: ☐ private domestic ☐ water supply system ☐ irrigation ☒ commercial or industrial ☐ other (specify): _____

Start date of work (YYYY/MM/DD): 2023/11/02 **End date of work** (YYYY/MM/DD): 2023/11/02

Person Responsible for Work (print clearly): **Name (first, last)** (see note 3): TRAVIS JOHNSON

Person who completed the work: TRAVIS JOHNSON **Registration no.** (see note 4): WD 0604190

Consultant (if applicable; name and company): _____

DECLARATION: Well construction, well alteration or well decommission, as the case may be, has been done in accordance with the requirements in the Water Sustainability Act and the Ground Water Protection Regulation.

Signature of Person Responsible PER TRAVIS JOHNSON

Owner name: RAVEN POINT PROJECT GP

Mailing address: 2965 NORMAN RD Town NANAIMO Prov. BC Postal Code V9X 1R1

Well Location (see note 6): Address: Street no. 4760 Street name BRENTON PAGE RD Town LADYSMITH

(or) **Legal description:** Lot A Plan VIP86097 D.L. _____ Block _____ Sec. 2 Twp. ___ Rg. ___ Land District ___

(or) **PID:** 027-772-900 (and) **Description of well location (attach sketch, if nec.):** WITHIN PROPERTY BOUNDAR

Well Location:

NAD 83: Zone: 10 (see note 7) (and) **UTM Easting:** 439885.5 m **UTM Northing:** 5425145.8 m (or) **Latitude** (see note 8): _____ **Longitude:** _____

Method of drilling: ☒ air rotary ☐ dual rotary ☐ cable tool ☐ mud rotary ☐ auger ☐ driving ☐ jetting ☐ other (specify): _____

Orientation of well: ☒ vertical ☐ horizontal Ground elevation: 36' ft (asl) Method (see note 9): GPS/ACCURACY 12

Lithologic description (see notes 10-15)

From ft (bgl)	To ft (bgl)	Material Description	Moisture: Dry	Damp	Moist	Wet	Colour: Black	Blue	Brown	Green	Grey	Vari-coloured	Red	Tan	White	Hardness: Dense	Hard	Loose	Medium	Soft	Stiff	Very Hard	Very Soft	Observations (e.g. other geological materials (e.g. boulders), est. water bearing flow (USgpm))
0	3	SAND, GRAVEL																						
3	12	CLAY							✓															
12	15	SANDSTONE							✓															WEATHERED
15	22	SANDSTONE									✓													
22	36	SHALE																						
36	106	SANDSTONE									✓													
106	118	SHALE																						
118	160	SANDSTONE									✓													

Casing Details:

Type: ☐ Surface ☒ Production ☐ Open Hole ☐ Steel Removed

From ft (bgl)	To ft (bgl)	Dia in	Casing Material/Open Hole (see note 16)	Wall Thickness in	Drive Shoe
0	18'	6	STEEL	.219	—

Surface seal: Type: BENTONITE Depth: 18' ft

Method of installation: ☒ Poured ☐ Pumped Thickness: 2" in

Backfill: Type: _____ Depth: _____ ft

Liner: ☐ PVC ☐ Other (specify): _____

Diameter: _____ in Thickness: _____ in

From: _____ ft (bgl) To: _____ ft (bgl)

Perforated: From: _____ ft (bgl) To: _____ ft (bgl)

Screen details:

From ft (bgl)	To ft (bgl)	Dia in	Type (see note 17)	Slot Size

Intake: ☐ Screen ☐ Open bottom ☐ Uncased hole

Screen type: ☐ Telescope ☐ Pipe size

Screen material: ☐ Stainless steel ☐ Plastic ☐ Other (specify): _____

Screen opening: ☐ Continuous slot ☐ Slotted ☐ Perforated pipe

Screen bottom: ☐ Bail ☐ Plug ☐ Plate ☐ Other (specify): _____

Filter pack: From: _____ ft To: _____ ft Thickness: ____ in

Type and size of material: _____

Developed by: ☒ Air lifting ☐ Bailing ☐ Jetting ☐ Pumping ☐ Surging ☐ Other (specify): _____ Total duration: 2 hrs

Notes: _____

Well yield estimated by: ☐ Pumping ☒ Air lifting ☐ Bailing ☐ Other (specify): _____

Rate: 2 USgpm Duration: 2 hrs SWL before test: _____ ft (btoc) Drawdown: _____ ft (btoc)

Hydro-fracturing: ☐ Yes ☐ No Increase in Well Yield due to Hydro-fracturing: _____ USgpm

Water Quality: Water sample collected: ☐ Yes ☐ No

Date (YYYY/MM/DD) _____ Water quality odour: _____

Characteristics: ☐ Clear ☐ Cloudy ☒ Fresh ☐ Gas ☐ Salty ☐ Sediment ☐ Other (specify): _____

Colour: ☐ Black ☐ Black flecks ☐ Brown ☒ Clear/none ☐ grey ☐ Slight colour/milky ☐ Orange ☐ Other (specify): _____

Comments: _____

Final well completion data:

Total depth drilled: 160' ft Finished well depth: 160' ft (bgl)

Final casing stick up: 24" in Depth to bedrock: 12' ft (bgl)

SWL: _____ ft (btoc) Estimated well yield: 2 USgpm

Artesian flow: _____ USgpm, or Artesian pressure: _____ ft

Type of well cap: VERMIN PROOF Well disinfected: ☒ Yes ☐ No

☐ **Confirmation/alternative specs. attached**

☐ **Original well construction report attached**

PLEASE NOTE: The information recorded in this well report describes the works and hydrogeologic conditions at the time of construction or alteration, as the case may be. Well yield, well performance and water quality are not guaranteed as they are influenced by a number of factors, including natural variability, human activities and condition of the works, which may change over time.

white: Customer copy
canary: Driller copy
pink: Ministry copy

APPENDIX C

Water Quality Analyses

Well WTN 14518

Your C.O.C. #: 08476143

Attention: Daniel Maloney

Raven Point Landings
4760 Brenton Page Road
Ladysmith, BC
Canada V9G 1L7

Report Date: 2020/02/07
Report #: R2842547
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C006456
Received: 2020/01/30, 10:30

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity @25C (pp, total), CO3,HCO3,OH (1)	1	N/A	2020/01/31	BBY6SOP-00026	SM 23 2320 B m
Chloride/Sulphate by Auto Colourimetry (1)	1	N/A	2020/02/03	BBY6SOP-00011 / BBY6SOP-00017	SM23-4500-Cl/SO4-E m
Colour (True) by Kone Lab (1)	1	N/A	2020/01/31	BBY6SOP-00057	SM 23 2120 C m
Conductivity @25C (1)	1	N/A	2020/01/31	BBY6SOP-00026	SM 23 2510 B m
Fluoride (1)	1	N/A	2020/02/01	BBY6SOP-00048	SM 23 4500-F C m
Sulphide (as H2S) (2)	1	N/A	2020/02/04		Auto Calc
Hardness Total (calculated as CaCO3) (1, 3)	1	N/A	2020/02/03	BBY WI-00033	Auto Calc
Mercury (Total) by CV (1)	1	2020/02/03	2020/02/03	BBY7SOP-00015	BCMOE BCLM Oct2013 m
Heterotropic Plate Count (MF) in Water (1)	1	N/A	2020/01/30	BBY4SOP-00003	SM 23 9215
Iron Related Bacteria (1, 4)	1	N/A	2020/01/30	BBY4SOP-00004	BI BART User Manual
Na, K, Ca, Mg, S by CRC ICPMS (total) (1)	1	N/A	2020/02/03	BBY WI-00033	Auto Calc
Elements by CRC ICPMS (total) (1)	1	N/A	2020/02/01	BBY7SOP-00003 / BBY7SOP-00002	EPA 6020b R2 m
Nitrogen (Total) (1)	1	N/A	2020/02/05	BBY6SOP-00016	SM 23 4500-N C m
Ammonia-N (Total) (2)	1	N/A	2020/02/05	AB SOP-00007	SM 23 4500 NH3 A G m
Nitrate + Nitrite (N) (1)	1	N/A	2020/01/31	BBY6SOP-00010	SM 23 4500-NO3- I m
Nitrite (N) by CFA (1)	1	N/A	2020/01/31	BBY6SOP-00010	SM 23 4500-NO3- I m
Nitrogen - Nitrate (as N) (1)	1	N/A	2020/01/31	BBY WI-00033	Auto Calc
Nitrogen (Tot. Organic) Calculation (1)	1	N/A	2020/02/05	BBY WI-00033	Auto Calc
pH @25°C (1, 5)	1	N/A	2020/01/31	BBY6SOP-00026	SM 23 4500-H+ B m
Sat. pH and Langelier Index (@ 4.4C) (1)	1	N/A	2020/02/03	BBY WI-00033	Auto Calc
Sat. pH and Langelier Index (@ 60C) (1)	1	N/A	2020/02/03	BBY WI-00033	Auto Calc
Total Sulphide (2)	1	N/A	2020/02/04	AB SOP-00080	SM 23 4500 S2-A D Fm
Sulphate Reducing Bacteria (1, 4)	1	N/A	2020/01/30	BBY4SOP-00004	BI BART User Manual
Total Dissolved Solids (Filt. Residue) (1)	1	2020/02/01	2020/02/03	BBY6SOP-00033	SM 23 2540 C m
Total Coliform & E.Coli by MF-Chromocult (1)	1	N/A	2020/01/30	BBY4SOP-00143	Merck KGaA Version 1
Carbon (Total Organic) (2, 6)	1	N/A	2020/02/05	AB SOP-00087	MMCW 119 1996 m
Turbidity (1)	1	N/A	2020/01/31	BBY6SOP-00027	SM 23 2130 B m
UV absorbance @254nm-Unfiltered (2, 7)	1	N/A	2020/02/04	CAL SOP-00274	SM 23 5910B m
UV transmittance @254nm-Unfiltered (2)	1	N/A	2020/02/04		Auto-Calc

Your C.O.C. #: 08476143

Attention: Daniel Maloney

Raven Point Landings
4760 Brenton Page Road
Ladysmith, BC
Canada V9G 1L7

Report Date: 2020/02/07
Report #: R2842547
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C006456
Received: 2020/01/30, 10:30
Remarks:

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by BV Labs, unless otherwise agreed in writing. BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by BV Labs, results relate to the supplied samples tested.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) This test was performed by BV Labs Vancouver
(2) This test was performed by BV Labs Calgary Environmental
(3) "Total Hardness" was calculated from Total Ca and Mg concentrations and may be biased high (Hardness, or Dissolved Hardness, calculated from Dissolved Ca and Mg, should be used for compliance if available).
(4) Presence/Absence Method. Number is an estimate.
(5) The CCME method requires pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the CCME holding time. Bureau Veritas Laboratories endeavours to analyze samples as soon as possible after receipt.
(6) TOC present in the sample should be considered as non-purgeable TOC.
(7) Sample(s) analyzed using methodologies that have been subjected to Bureau Veritas Laboratories' standard validation process for the submitted matrix however it is not an accredited method.

Your C.O.C. #: 08476143

Attention: Daniel Maloney

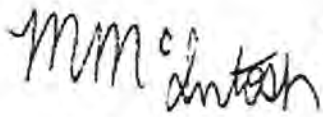
Raven Point Landings
4760 Brenton Page Road
Ladysmith, BC
Canada V9G 1L7

Report Date: 2020/02/07
Report #: R2842547
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C006456
Received: 2020/01/30, 10:30

Encryption Key



Melissa McIntosh
Project Manager
10 Feb 2020 11:28:10

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Customer Solutions, Western Canada Customer Experience Team
Email: customersolutionswest@bvlabs.com
Phone# (833) 282-5227

==========

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

BV Labs Job #: C006456
Report Date: 2020/02/07

Raven Point Landings

VIHA PKG, WELLS/SPRINGS - BURNABY (WATER)

BV Labs ID					XH6379		
Sampling Date					2020/01/30 03:15		
COC Number					08476143		
	UNITS	MAC	AO	OG	TAP RESULTS RAVEN POINT	RDL	QC Batch
ANIONS							
Nitrite (N)	mg/L	1	-	-	<0.0050	0.0050	9751074
Calculated Parameters							
Total Hardness (CaCO3)	mg/L	-	-	-	99.8	0.50	9748624
Nitrate (N)	mg/L	10	-	-	0.041	0.020	9749092
Total Organic Nitrogen (N)	mg/L	-	-	-	0.033	0.020	9749563
Sulphide (as H2S)	mg/L	-	0.05	-	<0.0020	0.0020	9748917
Transmittance at 254nm	%T/cm	-	-	-	97.0	N/A	9749499
Misc. Inorganics							
Conductivity	uS/cm	-	-	-	320	2.0	9750713
pH	pH	-	-	7.0:10.5	7.99	N/A	9750711
Total Organic Carbon (C)	mg/L	-	-	-	0.59	0.50	9753191
Total Dissolved Solids	mg/L	-	-	-	180	10	9751342
Anions							
Alkalinity (PP as CaCO3)	mg/L	-	-	-	<1.0	1.0	9750712
Alkalinity (Total as CaCO3)	mg/L	-	-	-	150	1.0	9750712
Bicarbonate (HCO3)	mg/L	-	-	-	180	1.0	9750712
Carbonate (CO3)	mg/L	-	-	-	<1.0	1.0	9750712
Dissolved Fluoride (F)	mg/L	1.5	-	-	0.28	0.050	9751413
Hydroxide (OH)	mg/L	-	-	-	<1.0	1.0	9750712
Total Sulphide	mg/L	-	0.05	-	<0.0018	0.0018	9753180
Dissolved Chloride (Cl)	mg/L	-	250	-	6.3	1.0	9751222
Dissolved Sulphate (SO4)	mg/L	-	500	-	11	1.0	9751222
MISCELLANEOUS							
True Colour	Col. Unit	-	15	-	<5.0	5.0	9750913
UV absorbance (254nm)	AU/cm	-	-	-	0.013	0.010	9753360
Nutrients							
Total Ammonia (N)	mg/L	-	-	-	0.048	0.015	9755845
Nitrate plus Nitrite (N)	mg/L	-	-	-	0.041	0.020	9751072
Total Nitrogen (N)	mg/L	-	-	-	0.123	0.020	9754977
Physical Properties							
Turbidity	NTU	see remark	see remark	see remark	2.8	0.10	9750949

No Fill	No Exceedance
Grey	Exceeds 1 criteria policy/level
Black	Exceeds both criteria/levels

RDL = Reportable Detection Limit
N/A = Not Applicable

Bureau Veritas Laboratories Courtenay: 27558 Moray Avenue V9N 8M9, Phone: (250) 338-7786. Toll free: (800) 665-8566

VIHA PKG, WELLS/SPRINGS - BURNABY (WATER)

BV Labs ID					XH6379		
Sampling Date					2020/01/30 03:15		
COC Number					08476143		
	UNITS	MAC	AO	OG	TAP RESULTS RAVEN POINT	RDL	QC Batch
Elements							
Total Mercury (Hg)	ug/L	1	-	-	<0.0020	0.0020	9752738
Total Metals by ICPMS							
Total Aluminum (Al)	ug/L	-	-	100	<3.0	3.0	9750349
Total Antimony (Sb)	ug/L	6	-	-	<0.50	0.50	9750349
Total Arsenic (As)	ug/L	10	-	-	<0.10	0.10	9750349
Total Barium (Ba)	ug/L	1000	-	-	214	1.0	9750349
Total Beryllium (Be)	ug/L	-	-	-	<0.10	0.10	9750349
Total Bismuth (Bi)	ug/L	-	-	-	<1.0	1.0	9750349
Total Boron (B)	ug/L	5000	-	-	121	50	9750349
Total Cadmium (Cd)	ug/L	5	-	-	<0.010	0.010	9750349
Total Chromium (Cr)	ug/L	50	-	-	1.0	1.0	9750349
Total Cobalt (Co)	ug/L	-	-	-	<0.20	0.20	9750349
Total Copper (Cu)	ug/L	2000	1000	-	30.8	0.20	9750349
Total Iron (Fe)	ug/L	-	300	-	11.1	5.0	9750349
Total Lead (Pb)	ug/L	5	-	-	0.63	0.20	9750349
Total Manganese (Mn)	ug/L	120	20	-	268	1.0	9750349
Total Molybdenum (Mo)	ug/L	-	-	-	<1.0	1.0	9750349
Total Nickel (Ni)	ug/L	-	-	-	<1.0	1.0	9750349
Total Selenium (Se)	ug/L	50	-	-	<0.10	0.10	9750349
Total Silicon (Si)	ug/L	-	-	-	10200	100	9750349
Total Silver (Ag)	ug/L	-	-	-	<0.020	0.020	9750349
Total Strontium (Sr)	ug/L	7000	-	-	428	1.0	9750349
Total Thallium (Tl)	ug/L	-	-	-	<0.010	0.010	9750349
Total Tin (Sn)	ug/L	-	-	-	<5.0	5.0	9750349
Total Titanium (Ti)	ug/L	-	-	-	<5.0	5.0	9750349
Total Uranium (U)	ug/L	20	-	-	<0.10	0.10	9750349
Total Vanadium (V)	ug/L	-	-	-	<5.0	5.0	9750349
Total Zinc (Zn)	ug/L	-	5000	-	43.9	5.0	9750349
Total Zirconium (Zr)	ug/L	-	-	-	<0.10	0.10	9750349
Total Calcium (Ca)	mg/L	-	-	-	28.7	0.050	9749435
Total Magnesium (Mg)	mg/L	-	-	-	6.80	0.050	9749435
Total Potassium (K)	mg/L	-	-	-	0.943	0.050	9749435
Total Sodium (Na)	mg/L	-	200	-	31.1	0.050	9749435
Total Sulphur (S)	mg/L	-	-	-	<3.0	3.0	9749435

No Fill	No Exceedance
Grey	Exceeds 1 criteria policy/level
Black	Exceeds both criteria/levels

RDL = Reportable Detection Limit

NDW .268 .192

Bureau Veritas Laboratories Courtenay: 2755B Moray Avenue V9N 8M9, Phone: (250) 338-7786. Toll free: (800) 665-8566

VIHA PKG, WELLS/SPRINGS - BURNABY (WATER)

BV Labs ID					XH6379		
Sampling Date					2020/01/30 03:15		
COC Number					08476143		
	UNITS	MAC	AO	OG	TAP RESULTS RAVEN POINT	RDL	QC Batch
Microbiological Param.							
Heterotrophic Plate Count	CFU/mL	-	-	-	2	1	9749976
Iron Bacteria	CFU/mL	-	-	-	<25	25	9749978
Sulphate reducing bacteria	CFU/mL	-	-	-	<75	75	9749979
Total Coliforms	CFU/100mL	0	-	-	**4.0**	N/A	9749977
E. coli	CFU/100mL	0	-	-	0	N/A	9749977
Calculated Parameters							
Langelier Index (@ 4.4C)	N/A	-	-	-	-0.299	N/A	9749564
Langelier Index (@ 60C)	N/A	-	-	-	0.742	N/A	9749565
Saturation pH (@ 4.4C)	N/A	-	-	-	8.29	N/A	9749564
Saturation pH (@ 60C)	N/A	-	-	-	7.25	N/A	9749565

No Fill	No Exceedance
Grey	Exceeds 1 criteria policy/level
Black	Exceeds both criteria/levels

RDL = Reportable Detection Limit
N/A = Not Applicable

Bureau Veritas Laboratories Courtenay: 2755B Moray Avenue V9N 8M9, Phone: (250) 338-7786. Toll free: (800) 665-8566

GENERAL COMMENTS

MAC,AO,OG: The guidelines that have been included in this report have been taken from the Canadian Drinking Water Quality Summary Table,June 2019.

Criteria A = Maximum Acceptable Concentration (MAC) / Criteria B = Aesthetic Objectives (AO) / Criteria C = Operational Guidance Values (OG)
It is recommended to consult these guidelines when interpreting your data since there are non-numerical guidelines that are not included on this report.

Turbidity Guidelines:
1. Chemically assisted filtration: less than or equal to 0.3 NTU in 95% of the measurements or 95% of the time each month. Shall not exceed 1.0 NTU at any time.
2. Slow sand / diatomaceous earth filtration: less than or equal to 1.0 NTU in 95% of the measurements or 95% of the time each month. Shall not exceed 3.0 NTU at any time.
3. Membrane filtration: less than or equal to 0.1 NTU in 99% of the measurements made or at least 99% of the time each calendar month. Shall not exceed 0.3 NTU at any time.
4. To ensure effectiveness of disinfection and for good operation of the distribution system, it is recommended that water entering the distribution system have turbidity levels of 1.0 NTU or less.
Measurement of Uncertainty has not been accounted for when stating conformity to the selected criteria, where applicable.

Results relate only to the items tested.

Bureau Veritas Laboratories Courtenay: 2755B Moray Avenue V9N 8M9, Phone: (250) 338-7786. Toll free: (800) 665-8566

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9750349	AA1	Matrix Spike	Total Aluminum (Al)	2020/01/31		100	%	80 - 120
			Total Antimony (Sb)	2020/01/31		102	%	80 - 120
			Total Arsenic (As)	2020/01/31		102	%	80 - 120
			Total Barium (Ba)	2020/01/31		98	%	80 - 120
			Total Beryllium (Be)	2020/01/31		98	%	80 - 120
			Total Bismuth (Bi)	2020/01/31		100	%	80 - 120
			Total Boron (B)	2020/01/31		97	%	80 - 120
			Total Cadmium (Cd)	2020/01/31		101	%	80 - 120
			Total Chromium (Cr)	2020/01/31		98	%	80 - 120
			Total Cobalt (Co)	2020/01/31		96	%	80 - 120
			Total Copper (Cu)	2020/01/31		99	%	80 - 120
			Total Iron (Fe)	2020/01/31		104	%	80 - 120
			Total Lead (Pb)	2020/01/31		100	%	80 - 120
			Total Manganese (Mn)	2020/01/31		99	%	80 - 120
			Total Molybdenum (Mo)	2020/01/31		102	%	80 - 120
			Total Nickel (Ni)	2020/01/31		99	%	80 - 120
			Total Selenium (Se)	2020/01/31		105	%	80 - 120
			Total Silicon (Si)	2020/01/31		103	%	80 - 120
			Total Silver (Ag)	2020/01/31		97	%	80 - 120
			Total Strontium (Sr)	2020/01/31		100	%	80 - 120
			Total Thallium (Tl)	2020/01/31		100	%	80 - 120
			Total Tin (Sn)	2020/01/31		99	%	80 - 120
			Total Titanium (Ti)	2020/01/31		100	%	80 - 120
			Total Uranium (U)	2020/01/31		99	%	80 - 120
			Total Vanadium (V)	2020/01/31		99	%	80 - 120
			Total Zinc (Zn)	2020/01/31		102	%	80 - 120
			Total Zirconium (Zr)	2020/01/31		103	%	80 - 120
9750349	AA1	Spiked Blank	Total Aluminum (Al)	2020/01/31		95	%	80 - 120
			Total Antimony (Sb)	2020/01/31		92	%	80 - 120
			Total Arsenic (As)	2020/01/31		92	%	80 - 120
			Total Barium (Ba)	2020/01/31		91	%	80 - 120
			Total Beryllium (Be)	2020/01/31		95	%	80 - 120
			Total Bismuth (Bi)	2020/01/31		96	%	80 - 120
			Total Boron (B)	2020/01/31		95	%	80 - 120
			Total Cadmium (Cd)	2020/01/31		92	%	80 - 120
			Total Chromium (Cr)	2020/01/31		94	%	80 - 120
			Total Cobalt (Co)	2020/01/31		91	%	80 - 120
			Total Copper (Cu)	2020/01/31		94	%	80 - 120
			Total Iron (Fe)	2020/01/31		100	%	80 - 120
			Total Lead (Pb)	2020/01/31		96	%	80 - 120
			Total Manganese (Mn)	2020/01/31		94	%	80 - 120
			Total Molybdenum (Mo)	2020/01/31		91	%	80 - 120
			Total Nickel (Ni)	2020/01/31		93	%	80 - 120
			Total Selenium (Se)	2020/01/31		93	%	80 - 120
			Total Silicon (Si)	2020/01/31		99	%	80 - 120
			Total Silver (Ag)	2020/01/31		91	%	80 - 120
			Total Strontium (Sr)	2020/01/31		93	%	80 - 120
			Total Thallium (Tl)	2020/01/31		96	%	80 - 120
			Total Tin (Sn)	2020/01/31		93	%	80 - 120
			Total Titanium (Ti)	2020/01/31		94	%	80 - 120
			Total Uranium (U)	2020/01/31		93	%	80 - 120
			Total Vanadium (V)	2020/01/31		93	%	80 - 120
			Total Zinc (Zn)	2020/01/31		93	%	80 - 120
			Total Zirconium (Zr)	2020/01/31		93	%	80 - 120
9750349	AA1	Method Blank	Total Aluminum (Al)	2020/01/31	<3.0		ug/L	

Bureau Veritas Laboratories Courtenay: 2755B Moray Avenue V9N 8M9, Phone: (250) 338-7786. Toll free: (800) 665-8566

A.B.C. Water Systems Ltd. S# - E
*A
#9 - 2180 S. Wellington Rd.
Nanaimo, BC
V9X 1V8
TEL: (250) 753-3333
office@abcwatersystems.ca

07Nov24 9:07a W183978
Source: Well
Type of Sample: Water
No. of Samples: 1
Arrival temp.: 8.0C
Sampler: Wayne Smith

Sample: Raven Point Marina - 4760 Brenton Page Rd

	Site Code	Date	Time	CFU/100 ml TC	T-NC	CFU/100 ml FC	F-NC	CFU/100 mL E.coli
1	Well Head	06Nov24	10:30	0	40400	0	18	0

TC = total coliform bacteria
FC = fecal coliform bacteria (aka thermotolerant coliforms)
NC = non-coliform bacteria
CFU/100 ml = colony forming units per 100 milli-litres

Results may be adversely affected if samples are submitted to the laboratory more than 24 to 30 hours after collection.

E. coli = Escherichia coli, FDA/BAM 9th ed, Oct 2020
Bergy's Manual of Systematic Bacteriology vol 1, AOAC 1984; J.Clin.Micro., J.Intern.Systm.Bact.

Comments:
For Interpretation of Results:
Total or Fecal Coliforms present greater than 0 CFU/100mL (0 CFU/mL):
IF Coliform numbers exceed safe limits for drinking water-
water is not suitable for drinking without treatment.

Total Non-coliform bacteria (=Lactose Fermentors) equal to or greater than 200 CFU/100mL (2.0 CFU/mL):
IF the number of organisms present exceed recommended guidelines for drinking water; treatment is strongly recommended.

- See following page for chemistry results -

W. Riggs
Sr. Microbiologist

M.B. LABS LTD
T: 250 656-1334 E: info@mblabs.com W: www.mblabs.com

E-MAILED 12Nov24 9:54B

A.B.C. Water Systems Ltd. S# - E
*A
#9 - 2180 S. Wellington Rd.
Nanaimo, BC
V9X 1V8
TEL: (250) 753-3333
office@abcwatersystems.ca

07Nov24 9:07a
Source: Well
Type of Sample: Water
No. of Samples: 1
Arrival temp.: 8.0C
Sampler: Wayne Smith

Sample: Raven Point Marina - 4760 Brenton Page Rd, - Well Head 06Nov24 10:30a

ELEMENTS		SAMPLE	UNITS	Maximum Limits In Drinking Water*
1) Aluminium	Al	<0.010	mg/L	no limit listed
2) Antimony	Sb	<0.500	ug/L	6.00 ug/L
3) Arsenic	As	<0.500	ug/L	10.0 ug/L
4) Barium	Ba	0.161	mg/L	2.00 mg/L
5) Beryllium	Be	<0.003	mg/L	no limit listed
6) Boron	B	<0.050	mg/L	5.00 mg/L
7) Cadmium	Cd	<0.010	ug/L	7.00 ug/L
8) Calcium	Ca	24.9	mg/L	200 mg/L
9) Chromium	Cr	<0.003	mg/L	0.050 mg/L
10) Cobalt	Co	<0.005	mg/L	no limit listed
11) Copper	Cu	<0.008	mg/L	1.00 mg/L
12) Gold	Au	<0.040	mg/L	no limit listed
13) Iron	Fe	<0.010	mg/L	0.300 mg/L
14) Lanthanum	La	<0.020	mg/L	no limit listed
15) Lead	Pb	2.52	ug/L	5.00 ug/L
16) Magnesium	Mg	5.35	mg/L	50.0 mg/L
17) Manganese	Mn	0.430	mg/L	0.120 MAC 0.020 AO
18) Mercury	Hg	<0.010	ug/L	1.00 ug/L
19) Molybdenum	Mo	<0.005	mg/L	no limit listed
20) Nickel	Ni	<0.004	mg/L	no limit listed
21) Phosphorus	P	0.088	mg/L	no limit listed
22) Potassium	K	1.02	mg/L	no limit listed
23) Scandium	Sc	<0.050	mg/L	no limit listed
24) Selenium	Se	<0.500	ug/L	5.0 ug/L
25) Silicon	Si	18.8	mg/L	no limit listed
26) Silver	Ag	<0.010	mg/L	no limit listed
27) Sodium	Na	37.2	mg/L	200 mg/L
28) Strontium	Sr	0.380	mg/L	no limit listed
29) Tin	Sn	<0.020	mg/L	no limit listed
30) Titanium	Ti	<0.010	mg/L	no limit listed
31) Tungsten	W	<0.050	mg/L	no limit listed
32) Vanadium	V	<0.010	mg/L	no limit listed
33) Zinc	Zn	<0.001	mg/L	5.00 mg/L
Hardness (mg/L $CaCO_3$)		84.2	mg/L	75-150 mg/L = moderately hard
pH		7.41	units	7.0 to 10.5

* As per Canadian or B.C. Health Act Safe Drinking Water Regulation BC Reg 230/92, & 390 Sch 120, 2001. Task Force of the Canadian Council of Resource and Environment Ministers - Guidelines for Canadian Drinking Water Quality, 2020.

Comments:
Manganese: high amounts can cause staining of laundry, porcelain & plumbing fixtures & an undesirable tastes. Not considered toxic-caution children under 6 months

R. Bilodeau
Analytical Chemist

H. Hartmann
Sr.Analytical Chemist

RB

APPENDIX D

Topographic Site Plan Showing Areas of Planned Tree Removal

N

5
Plan 10251

Brenton-Page Road

Edge of Pavement

Sign

FIR ø=0.75

LS

FIR ø=0.40

FIR ø=0.60

FIR ø=0.60

FIR ø=0.80

SPRUCE ø=0.80

FIR ø=1.0

MAPLE ø=1.0

SPRUCE ø=1.1

ø=0.60

ø=0.75

WELL

New Well
Location Surveyed
May 27, 2024

FIR ø=0.55

MAPLE ø=1.25

FIR ø=0.65

MAPLE ø=0.50

FIR ø=1.2

ARBUTUS ø=0.90

FIR ø=0.45

Bottom of Bank

Top of Bank

72.83

MAPLE ø=1.8

PARKING AREA

Accessory Building

Edge of Gravel

110.47

Plan VIP86097

A

MAPLE ø=0.40

FIR ø=0.60

FIR ø=0.60

Updated Survey Data
May 27, 2024

Edge of Pavement

FIR ø=0.50

FIR ø=0.70

FIR ø=0.50

FIR ø=0.50

Formwork

Retaining Walls

Retaining Wall

Access Ramp

Septic Tank

Stairs

Deck

Concrete Patio

Main Building
Basement Floor Elev.(at sill)=7.66
Roof Peak Elev.=13.99
Roof Peak Elev.=13.99

Retaining Wall

Top of Bank

Natural Boundary
per Plan VIP86097

ø=0.40

FIR ø=0.40

Formwork

FIR ø=0.40

FIR ø=0.80

FIR ø=0.80

FIR ø=.70

FIR ø=0.50

FIR ø=0.50

FIR ø=0.70

Concrete Path

Ramp

Accessory Building

Fuel Tank

Septic Tank

Septic Lids

Cabin

Deck

MAPLE ø=0.50

FIR ø=0.80

FIR ø=0.70

FIR ø=0.70

ICV

Retaining Wall

Top of Bank

Bottom of Bank

FIR ø=0.80

FIR ø=0.80

FIR ø=0.65

FIR ø=0.65

FIR ø=0.70

FIR ø=0.70

FIR ø=0.70

FIR ø=0.70

FIR ø=0.60

FIR ø=0.80

FIR ø=0.80

FIR ø=0.65

ARBUTUS ø=0.55

ARBUTUS ø=0.60

ARBUTUS ø=0.3

FIR ø=0.60

FIR ø=0.60

Top of Bank

Path

Deck

Office Building

Post

Ramp to Docks

Natural Boundary
per DL 290 Survey Plan

DL 290 & 2055
BLOCK D

DL 290
BLOCK B

DL 290
BLOCK B

A
Plan 14251

Ladysmith Harbour

10.90

10.79

21.49

10.09

43.04

14.94

6.37

RED OUTLINED AREAS OF PLANNED TREE REMOVAL AS INDICATED BY CASCARA CONSULTING ENGINEERING LIMITED, DECENBER 12 2024

Legend

×5.0	Denotes Spot Elevation
⊕ UP	Denotes Utility Pole
↑ ANC	Denotes Pole Anchor
◉ LS	Denotes Lamp Standard
⧫ ICV	Denotes Irrigation Control Valve
☒ WELL	Denotes Well
	Denotes Coniferous Tree
	Denotes Deciduous Tree
ø	Denotes Tree Trunk Diameter
⬟	Denotes Sign
–x–x–x–	Denotes Fenceline
●	Denotes Standard Iron Post Found

NOTE:
THE REGISTERED TITLE OF THIS PROPERTY IS AFFECTED BY THE FOLLOWING LEGAL NOTATIONS AND REGISTERED CHARGES, LIENS AND INTERESTS:
UNDER SURFACE RIGHTS 52524G, 58763G, L48628 & SRW CA7844400.
SEE REGISTERED TITLE FOR DESCRIPTION OF LEGAL NOTATIONS.
THIS SITE PLAN DOES NOT VERIFY COMPLIANCE WITH THE ABOVE NOTED DOCUMENTS.

TOPOGRAPHIC SITE PLAN OVER:
LOT A, SECTION 2,
OYSTER DISTRICT, PLAN VIP86097.

Client: RAVEN POINT PROJECT GROUP
Civic Address: 4760 BRENTON-PAGE ROAD, CVRD
File: 23-044 | Scale: 1:300 | Drawn by: DRW
Property Zoning: C4

0 10 15 20 25
SCALE 1:300
DISTANCES AND ELEVATIONS ARE IN METRES.
GEODETIC ELEVATIONS ARE DERIVED FROM GNSS OBSERVATIONS (CGVD28BC DATUM).

DATE:	ISSUE:
MAY 24, 2023	TOPOGRAPHIC SURVEY-PREPARE SITE PLAN
MAY 27, 2024	UPDATED TOPOGRAPHIC SURVEY-SEE CLOUDED AREA

Certified correct this 27th day of May, 2024

B.C.L.S.

Turner & Associates
land surveying
250.753.9778
435 Terminal Avenue North
Nanaimo, BC V9S 4J8
www.turnersurveys.ca

Hy-Geo Consulting
www.hy-geo.com
Tel: (250) 744-7859 Victoria, British Columbia Canada V8Z 2M9

File: 2407221

December 17, 2024

Cascara Consulting Engineers Limited
#203-335 Wesley Street
Nanaimo, BC V9R 2T5

Attention: Charles Ramos. P.Eng., P.E.

Re: Addendum to Kohut (2024) report titled: Hydrogeologic Assessment of Water Supply System at Raven Point Marina 4760 Brenton-Page Road, Ladysmith. British Columbia

As requested, Hy-Geo Consulting has prepared the following supplementary information to address questions regarding the potential impacts of existing sewerage septic systems and proposed tree cutting on bedrock Aquifer 162.

Potential Impacts on Aquifer 162

Existing Sewerage Septic Systems

There are two reported sewerage system disposal fields located on the marina property as shown in Figure 5 at sites A and B.

Site A covers an area of approximately 25 m^2 and is situated at an elevation close to 6.5 m above sea level. It services the Inn and Laundry/Showers building. Infiltration at this location likely seeps down into the underlying surficial deposits and then downslope in an easterly direction.

Site B cover an area of approximately 150 m^2 and is situated at an elevation close to 9.0 m above sea level. It services a caretaker suite and the restaurant at the inn. Infiltration at this location likely seeps down into the underlying surficial/fill deposits and then downslope in a southwesterly direction towards the ocean.

The historic use of water at the inn and marina for the 13 year period from October 15, 2009 until December 8, 2022 amounted to an average continual use 7513 Litres/day, equivalent to a continuous pumping rate of 1.38 USgpm. For various monitoring periods, the inn and marina accounted for 32 to 64% of total use (averaging 52 %). The remaining water use was for the three adjacent residential properties. Based on these figures the total loading rate on the two septic field systems on the marina property would have averaged less than 52% x 1.38 USgpm or approximately 0.72 USgpm. This relatively low rate of discharge and apportioned between the two disposal sites would pose insignificant quantity or quality risks to the underlying bedrock **Aquifer 162.**

The marina/inn property is also situated at the edge of bedrock **Aquifer 162** in an area where deep groundwater in the aquifer is naturally discharging towards the ocean and is not situated in an upland recharge area. Unconsolidated deposits consisting of 9 feet of clay and 3 feet of sand and gravel overlie the bedrock along the northern portion of the property as evidenced in well WID 65519. There are no plans to use Well WID 65519 as a water supply source due to its very low yield. These conditions minimize any potential risks of aquifer or well contamination.

The existing sewerage system, servicing the inn, and outbuilding with washrooms, showers and laundry may be upgraded in the future in compliance with the *Sewerage System Regulation* under the *Public Health Act.*

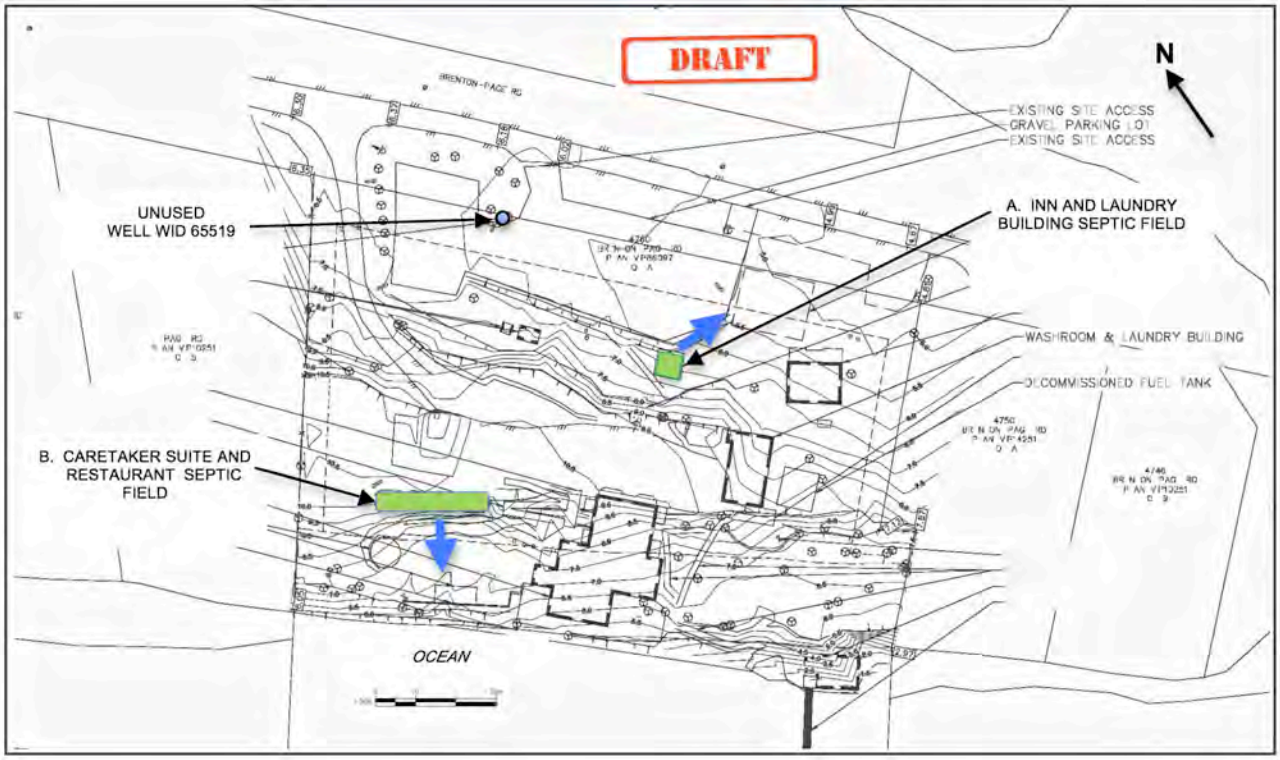


Figure 5. Location of septic disposal fields on Raven Point Marina property. Blue arrows show direction of inferred downslope seepage. Figure adapted from Cascara Consulting Engineers Limited (2024).

Proposed Tree Cutting

Campbell and Zamora (2024) have prepared an environmental assessment for the Raven Point Inn and recommend removal of 40 Douglas fir trees ranging in size between 25-85cm DBH. Other trees to be removed include six arbutus (10-35cm DBH), five bigleaf maple (25-160cm DBH), two grand fir (53cm and 85cm DBH), two black cottonwood (40cm and 60cm DBH) and one apple (40cm DBH). The total number of trees to be removed is 56 trees. Appendix D adapted from Turner & Associates (2024) outlines the areas of tree removal on the property. The majority of the trees are located in the southeast corner of the property east of the main inn building.

Tree removal will reduce evapotranspiration from the area during the spring-summer growing season and likely lead to increased surface water runoff during the fall and winter rainy period. As the marina/inn property is situated at the edge of bedrock **Aquifer 162** in an area where deep groundwater in the aquifer is naturally discharging towards the ocean, risks to the quantity and quality of groundwater in the aquifer would not be significant. Tree removal, however, may result in the potential for increased bank erosion downslope of this portion of the property.

Additional Note

On December 2, 2024, The *Manana Park Water Co Op* completed the submission of a water licence application for use of their water supply well WTN 14518 to FrontCounter BC in Nanaimo.

Conclusions

Based on the above information the following additional conclusions can be made:

8. There are two reported sewerage system disposal fields located on the marina property (Sites A and B). Site A services the Inn and Laundry/Showers building and Site B services a caretaker suite and the restaurant at the inn.

9. From historic water use figures, the total loading rate on the two septic field systems on the marina property would have averaged approximately 0.72 USgpm. This relatively low rate of discharge and apportioned between the two disposal sites would have insignificant quantity or quality effects on the underlying bedrock aquifer. The marina/inn property is also situated at the edge of bedrock **Aquifer 162** in an area where deep groundwater in the aquifer is naturally discharging towards the ocean and is not situated in an upland recharge area.

10. A significant number of trees are planned for removal with the majority situated in the southeast corner of the property. Tree removal will reduce evapotranspiration from the area during the spring-summer growing season and likely lead to increased surface water runoff during the fall and winter rainy period. Potential quantity and quality impacts on Aquifer 162 would not be significant.

11. Tree removal may result in the potential for increased bank erosion downslope of the southeastern portion of the property.

Recommendations

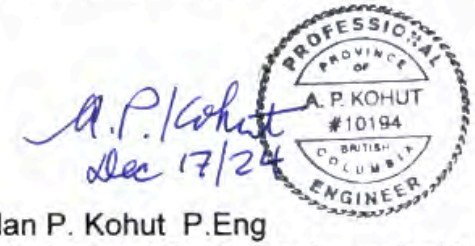
The following additional recommendation is suggested for consideration:

4. Following tree removal, monitor and improve the surface drainage conditions along the southeastern bank of the property to minimize any potential erosion concerns.

Closure

This report was prepared in accordance with generally accepted engineering, hydrogeological and consulting practices. It is intended for the prime use of Cascara Consulting Engineers Limited in connection with its purpose as outlined under the scope of work for this project. This report is based on data and information available to the author from various sources at the time of its preparation and the findings of this report may therefore be subject to revision. Data and information supplied by others has not been independently confirmed or verified to be correct or accurate in all cases. Any errors, omissions or issues requiring clarification should be brought to the attention of the author. The author retains full copyright of the material contained in the report. The author and Hy-Geo Consulting accept no responsibility for damages suffered by any third party as a result of any unauthorized use of this report.

Respectfully submitted,



A.P. Kohut
Dec 17/24

Alan P. Kohut P.Eng
Principal and Senior Hydrogeologist

HY-GEO CONSULTING
Permit to Practice Number: 1001034

References

Campbell, C., and C. Zamora. 2024. *Environmental Assessment Raven Point Inn, Ladysmith, BC.* Report prepared for Cascara Consulting Engineers Limited, Aquaparian Environmental Consulting Ltd., Revision December 5, 2024.

Cascara Consulting Engineers Limited. 2024. *Existing Conditions*. Draft drawing number C02, Rev. D.

Kohut, A.P. 2024. *Hydrogeologic Assessment of Water Supply System at Raven Point Marina 4760 Brenton-Page Road, Ladysmith. British Columbia.* Report prepared for Cascara Consulting Engineers Limited, Hy-Geo Consulting File: 2407221, November 25, 2024.

Turner & Associates. 2024. Topographic Site Plan Over: Lot A, Section 2, Oyster District, Plan VIP86097.

APPENDIX D

Topographic Site Plan Showing Areas of Planned Tree Removal

N

5
Plan 10251

Brenton-Page Road

Edge of Pavement

Sign

FIR ø=0.75

LS

FIR ø=0.40

FIR ø=0.60

FIR ø=0.60

FIR ø=0.80

SPRUCE ø=0.80

FIR ø=1.0

MAPLE ø=1.0

SPRUCE ø=1.1

ø=0.60

ø=0.75

WELL

New Well
Location Surveyed
May 27, 2024

FIR ø=0.55

MAPLE ø=1.25

FIR ø=0.65

MAPLE ø=0.50

FIR ø=1.2

ARBUTUS ø=0.90

FIR ø=0.45

Bottom of Bank

Top of Bank

72.83

MAPLE ø=1.8

PARKING AREA

Accessory Building

Edge of Gravel

110.47

Plan VIP86097

A

MAPLE ø=0.40

FIR ø=0.60

FIR ø=0.60

Updated Survey Data
May 27, 2024

Edge of Pavement

FIR ø=0.50

FIR ø=0.70

FIR ø=0.50

FIR ø=0.50

Formwork

Retaining Walls

Retaining Wall

Access Ramp

Septic Tank

Stairs

Deck

Concrete Patio

Main Building
Basement Floor Elev.(at sill)=7.66
Roof Peak Elev.=13.99
Roof Peak Elev.=13.99

Retaining Wall

Top of Bank

Natural Boundary
per Plan VIP86097

ø=0.40

FIR ø=0.40

Formwork

FIR ø=0.40

FIR ø=0.80

FIR ø=0.80

FIR ø=.70

FIR ø=0.50

FIR ø=0.50

FIR ø=0.70

Concrete Path

Ramp

Accessory Building

Fuel Tank

Septic Tank

Septic Lids

Cabin

Deck

MAPLE ø=0.50

FIR ø=0.80

FIR ø=0.70

FIR ø=0.70

ICV

Retaining Wall

Top of Bank

Bottom of Bank

FIR ø=0.80

FIR ø=0.80

FIR ø=0.65

FIR ø=0.65

FIR ø=0.70

FIR ø=0.70

FIR ø=0.70

FIR ø=0.70

FIR ø=0.60

FIR ø=0.80

FIR ø=0.80

FIR ø=0.65

ARBUTUS ø=0.55

ARBUTUS ø=0.60

ARBUTUS ø=0.3

FIR ø=0.60

FIR ø=0.60

Top of Bank

Path

Deck

Office Building

Post

Ramp to Docks

Natural Boundary
per DL 290 Survey Plan

DL 290 & 2055
BLOCK D

DL 290
BLOCK B

DL 290
BLOCK B

A
Plan 14251

Ladysmith Harbour

10.90

10.79

21.49

10.09

43.04

14.94

6.37

RED OUTLINED AREAS OF PLANNED TREE REMOVAL AS INDICATED BY CASCARA CONSULTING ENGINEERING LIMITED, DECENBER 12 2024

Legend

×5.0	Denotes Spot Elevation
⊕ UP	Denotes Utility Pole
↑ ANC	Denotes Pole Anchor
◉ LS	Denotes Lamp Standard
⧫ ICV	Denotes Irrigation Control Valve
☒ WELL	Denotes Well
	Denotes Coniferous Tree
	Denotes Deciduous Tree
ø	Denotes Tree Trunk Diameter
⬟	Denotes Sign
–x–x–x–	Denotes Fenceline
●	Denotes Standard Iron Post Found

NOTE:
THE REGISTERED TITLE OF THIS PROPERTY IS AFFECTED BY THE FOLLOWING LEGAL NOTATIONS AND REGISTERED CHARGES, LIENS AND INTERESTS:
UNDER SURFACE RIGHTS 52524G, 58763G, L48628 & SRW CA7844400.
SEE REGISTERED TITLE FOR DESCRIPTION OF LEGAL NOTATIONS.
THIS SITE PLAN DOES NOT VERIFY COMPLIANCE WITH THE ABOVE NOTED DOCUMENTS.

TOPOGRAPHIC SITE PLAN OVER:
LOT A, SECTION 2,
OYSTER DISTRICT, PLAN VIP86097.

Client: RAVEN POINT PROJECT GROUP
Civic Address: 4760 BRENTON-PAGE ROAD, CVRD
File: 23-044 | Scale: 1:300 | Drawn by: DRW
Property Zoning: C4

0 10 15 20 25
SCALE 1:300
DISTANCES AND ELEVATIONS ARE IN METRES.
GEODETIC ELEVATIONS ARE DERIVED FROM GNSS OBSERVATIONS (CGVD28BC DATUM).

DATE:	ISSUE:
MAY 24, 2023	TOPOGRAPHIC SURVEY-PREPARE SITE PLAN
MAY 27, 2024	UPDATED TOPOGRAPHIC SURVEY-SEE CLOUDED AREA

Certified correct this 27th day of May, 2024

B.C.L.S.

Turner & Associates
land surveying
250.753.9778
435 Terminal Avenue North
Nanaimo, BC V9S 4J8
www.turnersurveys.ca

SCHEDULE E

AQUAPARIAN
Environmental Consulting Ltd.

August 8, 2024
Revision December 5, 2024

Dawson Link, EIT
Cascara Consulting Engineers Ltd
#203-335 Wesley Street
Nanaimo, BC, V9R 2T5
343-333-7277

Via Email: dlink@cascara.ca

Re: ENVIRONMENTAL ASSESSMENT
RAVEN POINT INN, LADYSMITH, BC

1.0 INTRODUCTION

Aquaparian Environmental Consulting Ltd. (Aquaparian) was retained to complete an environmental assessment for a proposed redevelopment of the Raven Point Inn & Marina located at 4760 Brenton Page Road in Ladysmith, BC. The property is waterfront to Ladysmith Harbour. The parcel is zoned Tourist Recreational Commercial (C-4) and is located in Electoral Area 'H' of the Cowichan Valley Regional District (CVRD). The legal description of the parcel is as follows:

- Lot A, Section 2, Oyster District, Plan VIP86097 (PID: 027-772-900).

The Raven Point Inn & Marina (formerly Page Point Inn) property offers small inn accommodation, marina with moorage and offices, a washrooms/shower/laundry building, a restaurant with outdoor patio, parking areas and a small residential cabin. The proposed redevelopment involves renovations to the existing inn and restaurant building, new temporary laundry/shower/washroom building, removal of cabin and old structures, new water well, electrical and well pumphouse building, new driveway access and marina parking area, new asphalt marina access pathway, new marina abutment, pier and gangway, new expanded marina floating docks and piles and tree removals and landscaping.

As understood, Area 'H' of the CVRD is not subject to a Marine DPA; however, according to Section 5.13 of the Electoral Area H Zoning Bylaw No. 1020, "Notwithstanding any other provisions of this bylaw, no habitable building shall be located within 15 metres of the high-water

mark of a watercourse, lake or the sea." Additionally, the property is subject to DPA 4 – Aquifer Protection. There are no freshwater watercourses within the subject property. An unnamed stream is located to the northeast of the property and across the Brenton Page Road. Onsite measurements confirm that the top of bank of this watercourse is over 30m away from the proposed development and so the CVRD Riparian Protection DPA 1 does not apply to this project and likely tidally influenced where is fronts the development.

A separate Marine Habitat Assessment & Impact Determination report was completed by Aquaparian in March 2024 and was submitted as part of a Crown Water Lease Application for the proposed marina upgrades and development within the foreshore lease area. Aquaparian is providing this environmental assessment of the proposed upland redevelopment project to detail the existing site conditions and to provide recommendations for environmental protection during construction as well as provide an invasive vegetation management plan for the property.

In preparation of this report, Aquaparian reviewed the CVRD Area 'H' Official Community Plan and area maps, government databases and completed a site assessment of the property on November 8, 2023 and a subsequent visit on August 1, 2024. A site location map has been included as Figure 1 and a site survey plan provided by Turner & Associates Land Surveying is included as Figure 2. A selection of site photographs taken during the site assessment has been included in Appendix A. Engineering drawings of the proposed development provided by Cascara Consulting Engineers Ltd is included as Appendix B.

2.0 SITE DESCRIPTION

The subject parcel is approximately 1.8 acres in size. The parcel is bound by Brenton Page Road to the northeast with an undeveloped parcel on the opposite side of the road, Ladysmith Harbour to the southwest, and residential properties to the northwest and southeast. The property is mostly developed for commercial use with some stands of mature trees remaining. The parcel is terraced from the road up to where the main building is located and then a vertical foreshore bluff faces the shoreline. A gravel parking area fronts the road and a cabin is located in the northeast portion of the parcel with a lawn area between the cabin and the road. A sloped gravel driveway access from the northern corner of the lot leads up to a second asphalt parking lot on a bench of land in the central area of the parcel. The main building with inn and restaurant is located in the central area at the top of the foreshore / sandstone bluff. A wooden deck extends from the restaurant out over the bluff. To the west of the main building is a fence at the top of bank with lawn area above and two concrete pads. Concrete stairs and wheelchair ramp are on the west side of the main building. The high point of land is in the western portion of the lot where a graveled area overlooks the ocean. A laundry/shower/washroom building is located to the east of the main building. A marina office building and deck is located in the southern corner of the parcel

extending out over the shoreline on piles and connected to the marina floating docks via a gangway. Several footpaths and stairs connect between buildings and facilities. Landscaped garden beds and vegetated slopes are throughout the terraced property.

The vegetation of the subject property is mostly remaining stands of mature trees consisting of Douglas fir (*Pseudotsuga menziesii*) with some arbutus (*Arbutus menziesii*) and bigleaf maple (*Acer macrophyllum*). Other trees identified include black cottonwood (*Populus trichocarpa*), apple (*Malus* sp.) and grand fir (*Abies grandis*). Understorey vegetation was very limited with patches of Indian plum (*Omleria cerasiformis*), oceanspray (*Holodiscus discolor*), snowberry (*Symphoricarpos albus*), Nootka rose (*Rosa nutkana*), sword fern (*Polystichum munitum*), dull-Oregon grape (*Mahonia nervosa*), ornamental garden species, grass and moss species. Invasive species were prevalent within the property and included spurge laurel (*Daphne laureola*), periwinkle (*Vinca* sp.), Scotch broom (*Cytisus scoparius*), English ivy (*Hedera helix*), morning glory (*Convolvulus arvensis*), Himalayan blackberry (*Rubus armeniacus*), Aaron's beard (*Hypericum calycinum*) and common holly (*Ilex aquifolium*). The soils are mostly dry, thin soils overlying bedrock. Along the foreshore slope the following species were identified: oceanspray, Scotch broom, Indian plum, Aaron's beard and periwinkle. Sea asparagus (*Salicornia pacifica*) was identified on the bedrock bench at the shoreline.

The shoreline is characterized by a small sandstone bluff that is near vertical and higher at the southwest end of the lot (~5m high) and lower at the southeast end (~1m high) where the gangway to the marina is located. The bluff is vegetated at the top of bank with shrub and groundcover vegetation and a few Douglas fir trees and one arbutus. At the bottom of the bedrock bluff are large chunks of fractured sandstone within the shallow waters.

According to the provincial Wildlife Tree Stewardship Atlas and Great Blue Heron Atlas, there are no mapped eagle or heron nests within or in vicinity of the subject property. No raptor nests were identified during the site assessment. Additionally, no rare plant or animal species were identified during the site assessment or in the provincial iMap database. The Sensitive Ecosystem Inventory (SEI): East Vancouver Island (1998) and the CVRD Sensitive Ecosystems map does not identify any mapped sensitive ecosystems within the subject property.

3.0 REGULATORY REVIEW

The following federal and provincial *Acts* and regulations may apply to the current property use and / or proposed development of the parcel:

Federal *Fisheries Act* Section 35: Fish and fish habitat protection provisions, as well as some of the regulations that support these provisions include the following:

- No person shall carry on any work, undertaking or activity, other than fishing, that results in the death of fish; and,
- No person shall carry on any work, undertaking or activity that results in the harmful alteration, disruption or destruction of fish habitat. The definition of harmful alteration, disruption or destruction of fish habitat is any temporary or permanent change to fish habitat that directly or indirectly impairs the habitat's capacity to support one or more life processes of fish.

Federal *Fisheries Act* Section 36: Environment and Climate Change Canada administers Section 36 of the *Fisheries Act*, the key pollution prevention provision, prohibiting the deposit of deleterious substances into waters frequented by fish, unless authorized by regulations under the *Fisheries Act* or other federal legislation. A deleterious substance can be any substance that, if added to any water, would degrade or alter its quality such that it could be harmful to fish, fish habitat or the use of fish by people.

Federal *Species-at-Risk Act*. The *Act* is a key federal government commitment to prevent wildlife species from becoming extinct and secure the necessary actions for their recovery. It provides for the legal protection of wildlife species and the conservation of their biological diversity. For most extirpated, endangered and threatened species, the *Species at Risk Act* (SARA) applies automatically only on federal lands. This includes national parks, national marine conservation areas, national historic sites and other protected heritage areas administered by Parks Canada. SARA also applies automatically on provincial and territorial lands and waters for species also protected under the *Migratory Birds Convention Act*, or aquatic species as defined in the *Fisheries Act*. Under SARA, provincial and territorial governments are given the first opportunity to protect species and critical habitat found on non-federal lands. However, the Governor in Council on the recommendation of the Minister of the Environment, may order that certain SARA restrictions apply on provincial or territorial lands. Critical habitat of species is protected after it has been identified in a recovery strategy or action plan.

Federal *Migratory Birds Convention Act, 1994*. Most species of birds in Canada are protected under this act. "Migratory birds" are defined by Article I of the Convention which names the families and sub-families of birds protected, and provides some clarification of the species included. In general, birds not falling under federal jurisdiction within Canada include grouse, quail, pheasants, ptarmigan, hawks, owls, eagles, falcons, cormorants, pelicans, crows, jays, kingfishers, and some species of blackbirds. Timing for vegetation clearing will be provided in the recommendations section to avoid impacts to migratory birds.

Section 34 of the Provincial *Wildlife Act*, states that a person commits an offence if the person, except as provided by regulation, possesses, takes, injures, molests or destroys:

(a) a bird or its egg,
(b) the nest of an eagle, peregrine falcon, gyrfalcon, osprey, heron or burrowing owl, or
(c) the nest of a bird not referred to in paragraph (b) when the nest is occupied by a bird or its egg.

Heritage Conservation Act. All archaeological sites, recorded or not, are protected under the Heritage Conservation Act and must not be altered or damaged without a site alteration permit from the Archaeology Branch. If evidence of an archaeological site is encountered during development, activities must be halted immediately and the Archaeological Branch contacted at 250-953-3334 for guidance. No further clearing or excavation should occur until an Archaeological Assessment is completed by a Professional Archaeologist.

4.0 IMPACT ASSESSMENT

The property has been operating as an resort inn and marina for several decades. The project involves demolition and removal of buildings, construction of buildings, renovations of existing buildings, asphalt paving for parking lot and pathway, and concrete pouring for new marina gangway abutment/pier and slab for temporary accessory building. Trees and understory vegetation removal within upland areas are required for the proposed development. Some trees to be removed due to existing impacts from roots on the foundation of buildings. Some trees adjacent to buildings and deck seating areas require limbing. Soil disturbance and excavations will be required. The following is a list of proposed tree removals and selective limbing for this project:

Tree	Species	DBH (cm)	Location	Prescription
Within 15m from the shoreline				
Douglas fir	*Pseudotsuga menziesii*	31	Along the top of foreshore bank	Limbing
Douglas fir	*Pseudotsuga menziesii*	32	Along the top of foreshore bank	Limbing
Douglas fir	*Pseudotsuga menziesii*	30	Along the top of foreshore bank	Limbing
Douglas fir	*Pseudotsuga menziesii*	50	Along the top of foreshore bank	Limbing
Douglas fir	*Pseudotsuga menziesii*	70	Along the top of foreshore bank	Limbing
Douglas fir	*Pseudotsuga menziesii*	39	Restaurant deck	Remove
Douglas fir	*Pseudotsuga menziesii*	45	Restaurant deck	Remove
Douglas fir	*Pseudotsuga menziesii*	47	Restaurant deck	Remove
Douglas fir	*Pseudotsuga menziesii*	56	Restaurant deck	Remove
Douglas fir	*Pseudotsuga menziesii*	47	Between inn and marina office	Remove
Douglas fir	*Pseudotsuga menziesii*	49	Between inn and marina office	Remove
Douglas fir	*Pseudotsuga menziesii*	48	Between inn and marina office	Remove
Douglas fir	*Pseudotsuga menziesii*	48	North of marina office	Remove

Douglas fir	*Pseudotsuga menziesii*	60	North of marina office	Remove
Douglas fir	*Pseudotsuga menziesii*	65	North of marina office	Remove
Arbutus	*Arbutus menziesii*	25	North of marina office	Remove
Douglas fir	*Pseudotsuga menziesii*	45	Southeast property boundary	Remove
Arbutus	*Arbutus menziesii*	45	Southeast property boundary	Remove
Douglas fir	*Pseudotsuga menziesii*	45	Southeast property boundary	Remove
Douglas fir	*Pseudotsuga menziesii*	58	Between inn and washrooms	Remove
Douglas fir	*Pseudotsuga menziesii*	58	Between inn and washrooms	Remove
Douglas fir	*Pseudotsuga menziesii*	65	Between inn and washrooms	Remove
Douglas fir	*Pseudotsuga menziesii*	62	Washroom building footprint	Remove
Arbutus	*Arbutus menziesii*	13	South of washroom building footprint	Remove
Outside of 15m from the shoreline				
Arbutus	*Arbutus menziesii*	13	Washroom building footprint	Remove
Douglas fir	*Pseudotsuga menziesii*	63	Washroom building footprint	Remove
Douglas fir	*Pseudotsuga menziesii*	55	Washroom building footprint	Remove
Douglas fir	*Pseudotsuga menziesii*	45	Washroom building footprint	Remove
Douglas fir	*Pseudotsuga menziesii*	65	Washroom building footprint	Remove
Douglas fir	*Pseudotsuga menziesii*	60	Washroom building footprint	Remove
Douglas fir	*Pseudotsuga menziesii*	60	Washroom building footprint	Remove
Douglas fir	*Pseudotsuga menziesii*	55	Washroom building footprint	Remove
Arbutus	*Arbutus menziesii*	10	Between inn and washrooms	Remove
Douglas fir	*Pseudotsuga menziesii*	57	Between inn and washrooms	Remove
Douglas fir	*Pseudotsuga menziesii*	65	Between inn and washrooms	Remove
Douglas fir	*Pseudotsuga menziesii*	55	Between inn and washrooms	Remove
Douglas fir	*Pseudotsuga menziesii*	65	Between inn and washrooms	Remove
Douglas fir	*Pseudotsuga menziesii*	70	North side of inn	Remove
Douglas fir	*Pseudotsuga menziesii*	62	North side of inn	Remove
Douglas fir	*Pseudotsuga menziesii*	25	North side of inn	Remove
Douglas fir	*Pseudotsuga menziesii*	70	North side of inn	Remove
Douglas fir	*Pseudotsuga menziesii*	75	East of fuel tank	Remove
Bigleaf maple (3 stem)	*Acer macrophyllum*	25	East of fuel tank	Remove
Grand fir	*Abies grandis*	53	Slope to north of washrooms	Remove
Douglas fir	*Pseudotsuga menziesii*	47	Slope to north of washrooms	Remove
Bigleaf maple (8 stem)	*Acer macrophyllum*	40	Northwest of cabin	Remove
Douglas fir	*Pseudotsuga menziesii*	85	Parking lot footprint east of cabin	Remove
Douglas fir	*Pseudotsuga menziesii*	70	Southeast property boundary	Remove
Bigleaf maple	*Acer macrophyllum*	160	Slope in northern portion of property	Remove

Arbutus	*Arbutus menziesii*	35	Slope in northern portion of property	Remove
Douglas fir	*Pseudotsuga menziesii*	70	Slope in northern portion of property	Remove
Douglas fir	*Pseudotsuga menziesii*	35	Slope in northern portion of property	Remove
Bigleaf maple	*Acer macrophyllum*	40	Slope in northern portion of property	Remove
Douglas fir	*Pseudotsuga menziesii*	30	Boulevard fronting Brenton-Page Rd	Remove
Douglas fir	*Pseudotsuga menziesii*	70	Boulevard fronting Brenton-Page Rd	Remove
Douglas fir	*Pseudotsuga menziesii*	85	Boulevard fronting Brenton-Page Rd	Remove
Bigleaf maple (3 stem)	*Acer macrophyllum*	40	Boulevard fronting Brenton-Page Rd	Remove
Grand fir	*Abies grandis*	85	Boulevard fronting Brenton-Page Rd	Remove
Black cottonwood	*Populus trichocarpa*	60	Boulevard fronting Brenton-Page Rd	Remove
Black cottonwood	*Populus trichocarpa*	40	Boulevard fronting Brenton-Page Rd	Remove
Apple	*Malus* sp.	40	Boulevard fronting Brenton-Page Rd	Remove

A total of 40 Douglas fir trees ranging in size between 25-85cm DBH are proposed to be removed for the development and five Douglas fir trees are proposed to be limbed. Other trees to be removed include six arbutus (10-35cm DBH), five bigleaf maple (25-160cm DBH), two grand fir (53cm and 85cm DBH), two black cottonwood (40cm and 60cm DBH) and one apple (40cm DBH). The total number of trees to be removed is 56 trees. Figure 3 includes a tree location map of the property where trees are proposed to be removed. Recent windstorms in November 2024 and 2023 have resulted in the braking of several limbs from large maples and cottonwoods on site resulting in damage to small outbuildings and vehicles.

A new driveway access and additional parking area is also proposed within the eastern corner of the property and covering a 355m^2 area. The footprint to also include the removal of an old cabin located within a lawn area. A proposed new asphalt pathway connecting the new parking lot to the marina access gangway is approximately 157m^2. The new gangway will be supported by a concrete abutment and a concrete pier. The existing washroom/laundry building (85m^2) will remain in place until a temporary modular washroom building will be brought to site supported by piers with concrete slab poured on grade. The structure will be connected to existing sanitary lines connecting to existing septic field. The footprint of the new washroom/laundry building including decking and connecting pathways is approximately 120m^2. New asphalt pathways connecting to the washroom building will be constructed. Future plans for the development include redeveloping the existing washroom building. A new well pump and electrical building (30m^2) will be constructed on the sloped area between the existing lower and upper parking areas.

As understood, the new modular washroom/laundry building with decking will be partially within

the 15m watercourse setback for habitable buildings, but since the structure is considered "temporary" it is allowable (Agreement with CVRD).

Removal of 56 native second-growth trees in the upland area of the waterfront property will result in a loss of wildlife habitat. Nineteen of these trees are located within 15m of the shoreline. The trees that are located closest to the top of bank of the foreshore slope are mostly to remain except for four Douglas fir trees that are to be removed in the middle of the existing restaurant deck due to their roots encroaching into the building's foundations and limbs that may pose a danger to the public. The trees to remain at the top of bank will continue to provide perching habitat for birds and fish habitat value in the form of shade, leaf litter, insect drop and large woody debris functions. If any tree limbs pose a risk to buildings or decking then they will require limbing.

Some landscaping has occurred in the northwest portion of the property surrounding the existing parking lot and seating area to the northwest of the main building. Invasive plant species are prevalent in areas that have not been landscaped especially along the foreshore slope and in the southeast half of the parcel along property boundaries. Morning glory was observed along the northeast property fronting Brenton-Page Road and growing up one of the apple trees. In the eastern corner, a swath of English ivy is covering the ground in a 30m long x 3m wide area and growing up black cottonwood trees. Some spurge laurel was also observed in this area. Along the southeast fenceline is mostly English ivy with some spurge laurel and a small amount of Himalayan blackberry. The ivy is growing up cottonwood, Douglas fir and bigleaf maple trees. A groundcover of periwinkle covers the southern property boundary and cascades over the top of bank of the retaining wall that leads down to the marina office. The periwinkle covers an area of approximately 45m long x 3m wide. A small amount of spurge laurel was also observed. A groundcover of invasive Aaron's beard is located along the slope above and below the pathway along the southwest boundary that leads down to the marina office. English ivy is growing at the corner of the upper parking lot along the retaining wall between the deck and staircase. Morning glory is covering the slope below the bathroom building and to the staircase. A common holly tree is located along this slope. Invasive plant species found along the slope between the upper parking lot and the lower parking lot include spurge laurel, morning glory, Himalayan blackberry and variegated periwinkle. Scotch broom is growing along the top of bank and along the foreshore slope of the western portion of the lot to the northwest of the main building. A map showing the locations of invasive species is included as Figure 4.

Aquaparian recommends removing invasive plant species from the property and incorporating as many native plants that are suitable to the site conditions as possible in landscape plans. Re-establishment of native vegetation especially in the riparian buffer zone of the marine foreshore is important for long-term habitat value and ecological functioning of the shoreline and associated upland buffer zone. Riparian vegetation is a vital component to support fish and wildlife values.

5.0 INVASIVE SPECIES MANAGEMENT PLAN

The *CVRD Invasive Plant Species Strategy* identifies nine invasive plant species as requiring priority attention. Two of these species are found within the subject property including Scotch broom and Spurge laurel. Aquaparian recommends removal of these invasive species as well as other invasive species including English ivy, Himalayan blackberry, and morning glory. The periwinkle and aaron's beard groundcover that has established along the slope leading down to the foreshore should remain since removal would likely destabilize this slope and may lead to sedimentation to the marine environment. These species should be controlled from spreading from the current areas.

Spurge laurel that is found mainly along the southeast property boundary and some plants along the top of bank of the southwest corner should be removed carefully including the roots. The berries, seeds and leaves are highly poisonous. If touched, the plant can cause skin to become irritated. Use protective clothing during removal and do not compost. Properly dispose of plants according to the CVRD Invasive Species webpage for Daphne/Spurge-Laurel (Appendix C).

English ivy should be removed including their roots. Ensure English ivy is also removed from the base of trees as the ivy spreading up the trees can damage the tree. The site will need to be checked annually to remove re-growth. Himalayan blackberry has not spread substantially, but emerging plants should be removed including the roots so that this invasive species does not become established. Morning glory that has spread along the southeast fenceline and along the centre slope behind the parking lot should be removed including the underground rhizomes. An Invasive Species Council of Metro Vancouver factsheet for morning glory removal is included in Appendix C. This species will also require continual checking and removal of re-growth. The Scotch broom along the foreshore slope should be removed where it is safe to access plants. Plants can be cut at the ground when broom is in bloom before seed maturity (refer to Appendix C).

Native vegetation plantings are recommended to be incorporated into landscape plans to enhance the existing vegetation and to stabilize areas where invasive plants have been removed and soils have been disturbed. The following is a list of native plants that may be suitable to the site:

<u>Foreshore slope</u>

- Beach pea (*Lathyrus japonicus*)
- Seashore lupin (*Lupinus littoralis*)

- Sea blush (*Plectritis congesta*)
- Oceanspray (*Holodiscus discolor*)
- Broadleaf stonecrop (*Sedum spathulifolium*)

Upland areas

- Douglas fir (*Pseudotsuga menziesii*)
- Bigleaf maple (*Acer macrophyllum*)
- Nootka rose (*Rosa nutkana*)
- Snowberry (*Symphoricarpos albus*)
- Red-flowering currant (*Ribes sanguineum*)
- Sword fern (*Polystichum munitum*)
- Salal (*Gaultheria shallon*)
- Dull Oregon grape (*Mahonia nervosa*)
- Kinnikinnick (*Arctostaphylos uva-ursi*)
- Coastal strawberry (*Fragaria chiloensis*)
- Yarrow (*Achillea millefolium*)
- Pearly everlasting (*Anaphalis margaritacea*)
- Woolly sunflower (*Eriophyllum lanatum*)
- Broadleaf stonecrop (*Sedum spathulifolium*)

6.0 ENVIRONMENTAL PROTECTION RECOMMENDATIONS

This report is intended to support the proposed redevelopment of the Raven Point Inn & Marina. The following section identifies environmental protection recommendations for the upland construction phase of the project.

- Complete excavation work during the dry season if possible or with minimal rain forecast. Heavy equipment working on site is to be clean and free of leaks and have a stocked spill kit on board.

- Install silt fencing between construction zones (i.e. the bathroom building, marina pathway and gangway abutments) and the top of bank of the foreshore slope and between the new parking area and the road prior to earthworks to prevent potential runoff and sedimentation to the foreshore or to roadways.

- Ensure no sediments or other deleterious substances enter any catch basins or other off-site drainages adjacent to construction zones.

- Cover exposed soils or temporary soil stockpiles with tarps or plastic-sheeting (weighed

down to prevent blowing off) to prevent runoff during rain events.

- Stage construction to limit disturbance. Strip and grub only those areas necessary for the current construction. Invasive plant removal along the foreshore to be done manually and in summer months to avoid soil erosion.

- Do not allow any sediment track-out to roadways. Prior to construction, a temporary gravel entrance/exit pad is to be installed at the access to the proposed new parking area. Use a vacuum street sweeper to remove any sediments from the road.

- Concrete wash water from cast-in-place concrete works (within the first 72hrs) shall not enter the marine environment or any surface water, storm water at or near the worksite. Concrete pouring should not be performed if significant precipitation events are expected within 72 hours. Uncured concrete works for concrete abutments or building slab may need to be covered with tarps or poly-sheeting to prevent contact with rain and to prevent runoff from being released to the marine environment. Ensure concrete forms are tight with no leakage or overtopping. Do not wash concrete trucks or tools on site.

- **Removal of trees should be completed outside the migratory bird nesting season (March 15 - Aug 15) or have a suitable qualified professional complete a nesting survey within a few days prior to the proposed clearing to determine if there are any active nests present.** Trees also to be checked for the presence of Pileated woodpecker nest cavities. Active cavity nesting trees are protected under the Federal Migratory Bird Protection Act.

- Trees to remain adjacent to construction areas should be protected from damage of their structure including root systems. Install plastic snow-fencing around the drip line to prevent compaction of root systems by heavy equipment. Retain tree stumps (3-5m tall) wherever possible to provide habitat value and slope stability.

- Remove invasive plant species including the roots from the property including Himalayan blackberry, English ivy, Spurge laurel, Morning glory and Scotch broom. Check seasonally and remove any invasive species re-growth as soon as possible.

- Incorporate native plantings into the landscape plan as per the recommended native species list provided. Install plants during the early spring or fall to optimize survival and irrigate through the first 2-3 summer seasons as necessary.

- All archaeological sites, recorded or not, are protected under the Heritage Conservation Act and must not be altered or damaged without a site alteration permit from the

Archaeology Branch. If archaeological artifacts are found during development, halt construction and contact the Archaeology Branch for guidance (**250-953-3334**).

7.0 CONCLUSION

The Raven Point Inn & Marina (formerly Page Point Inn) has been in use for several decades and is waterfront to northeast side of the Ladysmith Harbour. This Environmental Assessment is for the proposed redevelopment of the property including tree removals, soil grading and landscaping, removal and construction of accessory buildings and pathways, renovations of the main inn and restaurant building, and construction of a new parking area. Environmental protection recommendations have been provided for the construction phase of the project and an invasive plant species management plan has also been provided. If all mitigation and restoration measures are implemented as recommended in this report, the risk of negative impacts to the marine environment will be minimized.

8.0 CLOSURE

This report has been based on a site assessment of the subject property, past project experience working on similar development projects and in accordance with generally accepted biological practices. No other warranty is made, either expressed or implied. Aquaparian trusts that the information provided in this report meets your requirements. Any questions regarding information provided in this document, please contact the undersigned at (250) 591-2258.

Sincerely,

AQUAPARIAN ENVIRONMENTAL CONSULTING LTD.

Prepared by:

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Environmental Technician

Reviewed/Revised by:

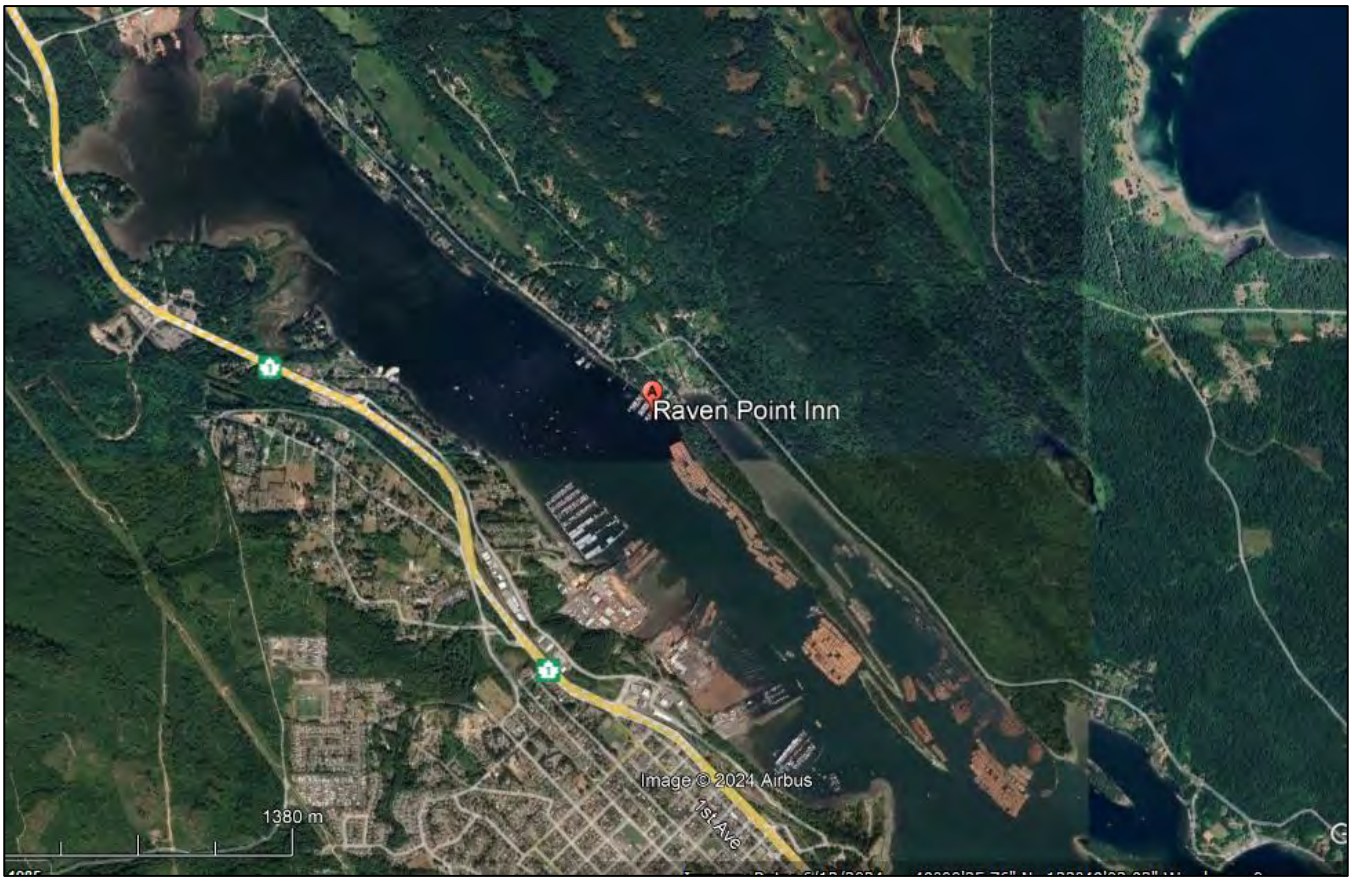
Chris Zamora B.Sc., R.P.Bio
Senior Biologist / Principal

https://netorg5387218.sharepoint.com/sites/Shared/Shared Documents/Documents/Projects/Projects/N1117 Raven Point Inn Development/Upland EA/Raven Point Inn Environmental Assessment - Revised Dec 3, 2024.docx

FIGURE 1

SITE LOCATION MAP

Figure 1. Site Location Map
Raven Point Inn & Marina



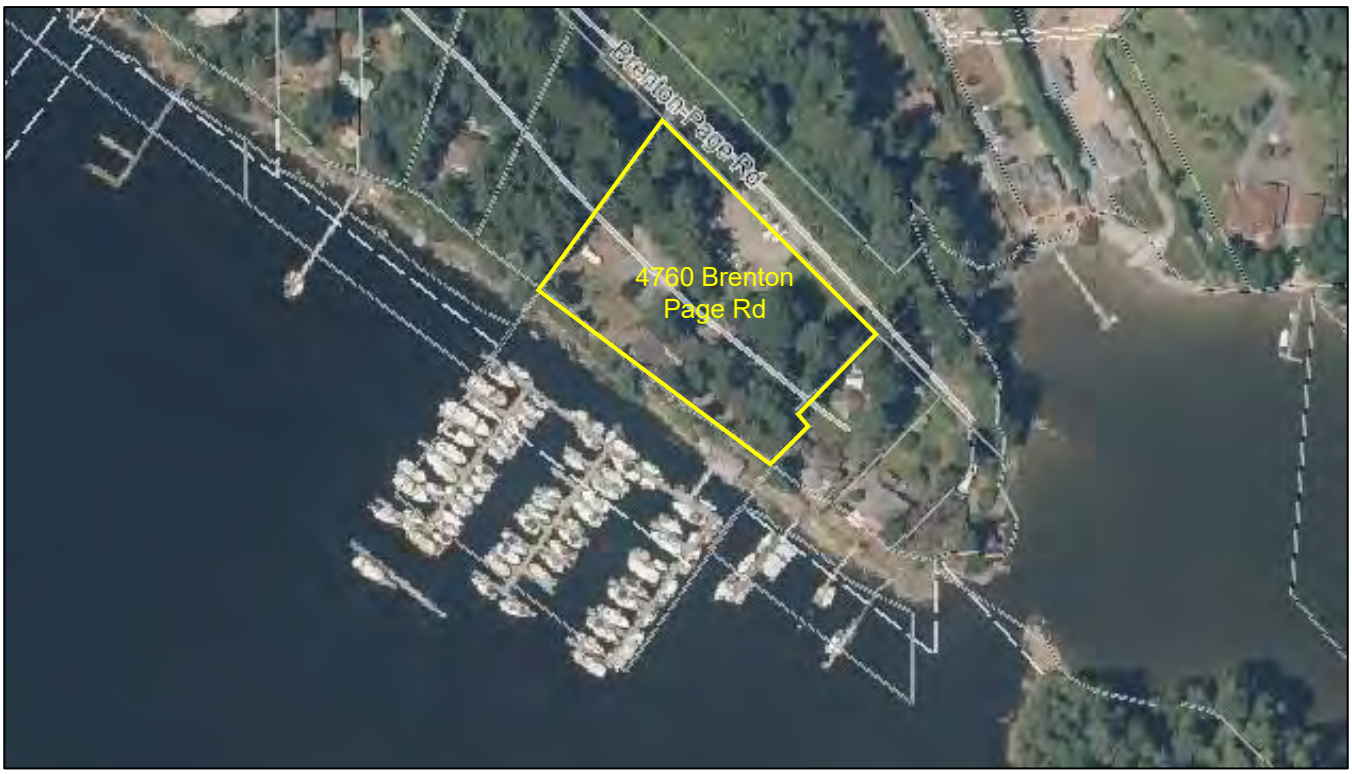


FIGURE 2

SITE PLAN

(TURNER & ASSOCIATES LAND SURVEYING)

N

Brenton–Page Road

5
Plan 10251

A
Plan VIP86097

A
Plan 14251

DL 290
BLOCK B

DL 290 & 2055
BLOCK D

DL 290
BLOCK B

Ladysmith Harbour

Natural Boundary per Plan VIP86097

Natural Boundary per DL 290 Survey Plan

Edge of Pavement

Edge of Gravel

Top of Bank

Bottom of Bank

Retaining Wall

Concrete Walkway

Concrete Path

Concrete Patio

Deck

Ramp

Ramp to Docks

Stairs

Access Ramp

Septic Tank

Septic Lids

Formwork

PARKING AREA

Updated Survey Data
May 27, 2024

New Well
Location Surveyed
May 27, 2024

Main Building
Basement Floor Elev (at sill)=7.66
Roof Peak Elev=13.99
Roof Peak Elev=13.99

Accessory Building

Cabin

Fuel Tank

Office Building

WELL

Sign

72.83

110.47

10.90

10.79

21.49

40.98

43.04

6.37

14.94

FIR ø=0.75
FIR ø=0.40
FIR ø=0.60
FIR ø=0.60
FIR ø=0.80
FIR ø=1.0
MAPLE ø=1.0
SPRUCE ø=0.80
SPRUCE ø=1.1
ø=0.60
ø=0.75
FIR ø=0.55
MAPLE ø=1.25
FIR ø=0.65
MAPLE ø=0.50
FIR ø=0.45
FIR ø=1.2
ARBUTUS ø=0.90
MAPLE ø=1.8
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FIR ø=0.80
FIR ø=0.70
FIR ø=0.70
FIR ø=0.80
FIR ø=0.80
FIR ø=0.65
FIR ø=0.65
FIR ø=0.70
FIR ø=0.80
FIR ø=0.80
FIR ø=0.65
ARBUTUS ø=0.55
ARBUTUS ø=0.60
ARBUTUS ø=0.3
FIR ø=0.60
FIR ø=0.60
FIR ø=0.50
FIR ø=0.55
ø=0.55
MAPLE ø=0.50
MAPLE ø=0.40
ø=1.0
ø=0.50
FIR ø=0.70
FIR ø=1.0
MAPLE
Septic Tank
ANC
UP
LS
ICV
Post
Accessory Building
Accessory Building

Legend

×5.0	Denotes Spot Elevation
⊕ UP	Denotes Utility Pole
↑ ANC	Denotes Pole Anchor
◉ LS	Denotes Lamp Standard
⧫ ICV	Denotes Irrigation Control Valve
☒ WELL	Denotes Well
	Denotes Coniferous Tree
	Denotes Deciduous Tree
ø	Denotes Tree Trunk Diameter
⬟	Denotes Sign
–x–x–x–	Denotes Fenceline
●	Denotes Standard Iron Post Found

NOTE:
THE REGISTERED TITLE OF THIS PROPERTY IS AFFECTED BY THE FOLLOWING LEGAL NOTATIONS AND REGISTERED CHARGES, LIENS AND INTERESTS:
UNDER SURFACE RIGHTS 52524G, 58763G, L48628 & SRW CA7844400.
SEE REGISTERED TITLE FOR DESCRIPTION OF LEGAL NOTATIONS.
THIS SITE PLAN DOES NOT VERIFY COMPLIANCE WITH THE ABOVE NOTED DOCUMENTS.

TOPOGRAPHIC SITE PLAN OVER: LOT A, SECTION 2, OYSTER DISTRICT, PLAN VIP86097.

Client: RAVEN POINT PROJECT GROUP
Civic Address: 4760 BRENTON–PAGE ROAD, CVRD
File: 23–044 | Scale: 1:300 | Drawn by: DRW
Property Zoning: C4

0 10 15 20 25
SCALE 1:300
DISTANCES AND ELEVATIONS ARE IN METRES.
GEODETIC ELEVATIONS ARE DERIVED FROM GNSS OBSERVATIONS (CGVD28BC DATUM).

DATE:	ISSUE:
MAY 24, 2023	TOPOGRAPHIC SURVEY–PREPARE SITE PLAN
MAY 27, 2024	UPDATED TOPOGRAPHIC SURVEY–SEE CLOUDED AREA

Certified correct this 27th day of May, 2024

B.C.L.S.

Turner & Associates
land surveying
250.753.9778
435 Terminal Avenue North
Nanaimo, BC V9S 4J8
www.turnersurveys.ca

FIGURE 3

TREE REMOVAL PLAN

N

5
Plan 10251

A
Plan VIP86097

A
Plan 14251

DL 290
BLOCK B

DL 290 & 2055
BLOCK D

DL 290
BLOCK B

Ladysmith Harbour

Brenton-Page Road

Edge of Pavement

Edge of Gravel

Top of Bank

Bottom of Bank

Retaining Wall

Concrete Path

Deck

Ramp

Ramp to Docks

Stairs

Access Ramp

Septic Tank

Septic Lids

Fuel Tank

Cabin

Office Building

Accessory Building

Main Building
Basement Floor Elev (ot elb)7.86
Roof Peak Elev15.99
Roof Peak Elev15.99

Formwork

Sign

WELL

New Well
Location Surveyed
May 27, 2024

Updated Survey Data
May 27, 2024

PARKING AREA

Natural Boundary
per Plan VIP86037

Natural Boundary
per DL 290 Survey Plan

72.83

110.47

40.38

21.49

10.73

10.30

43.04

14.34

FIR ø=0.40
FIR ø=0.45
FIR ø=0.50
FIR ø=0.55
FIR ø=0.60
FIR ø=0.65
FIR ø=0.70
FIR ø=0.75
FIR ø=0.80
FIR ø=1.0
FIR ø=1.2
MAPLE ø=0.40
MAPLE ø=0.50
MAPLE ø=1.0
MAPLE ø=1.25
MAPLE ø=1.8
SPRUCE ø=0.80
SPRUCE ø=1.1
ø=0.60
ø=0.75
ø=0.50
ø=1.0
ARBUTUS ø=0.30
ARBUTUS ø=0.60
ARBUTUS ø=0.3

Legend

×5.0	Denotes Spot Elevation
⊕ UP	Denotes Utility Pole
ANC	Denotes Pole Anchor
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WELL	Denotes Well
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	Denotes Deciduous Tree
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	Denotes Sign
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SEE REGISTERED TITLE FOR DESCRIPTION OF LEGAL NOTATIONS.
THIS SITE PLAN DOES NOT VERIFY COMPLIANCE WITH THE ABOVE NOTED DOCUMENTS.

Proposed Tree Removal

Note: Tree diameters not to true size on plan

TOPOGRAPHIC SITE PLAN OVER:
LOT A, SECTION 2,
OYSTER DISTRICT, PLAN VIP86097.

Client: RAVEN POINT PROJECT GROUP		Civic Address: 4760 BRENTON-PAGE ROAD, CVRD
File: 23-044	Scale: 1:300	Drawn by: DRW
		Property Zoning: C4

0 10 15 20 25
SCALE 1:300
DISTANCES AND ELEVATIONS ARE IN METRES.
GEODETIC ELEVATIONS ARE DERIVED FROM GNSS OBSERVATIONS (CGVD28BC DATUM).

DATE:	ISSUE:
MAY 24, 2023	TOPOGRAPHIC SURVEY-PREPARE SITE PLAN
MAY 27, 2024	UPDATED TOPOGRAPHIC SURVEY-SEE CLOUDED AREA

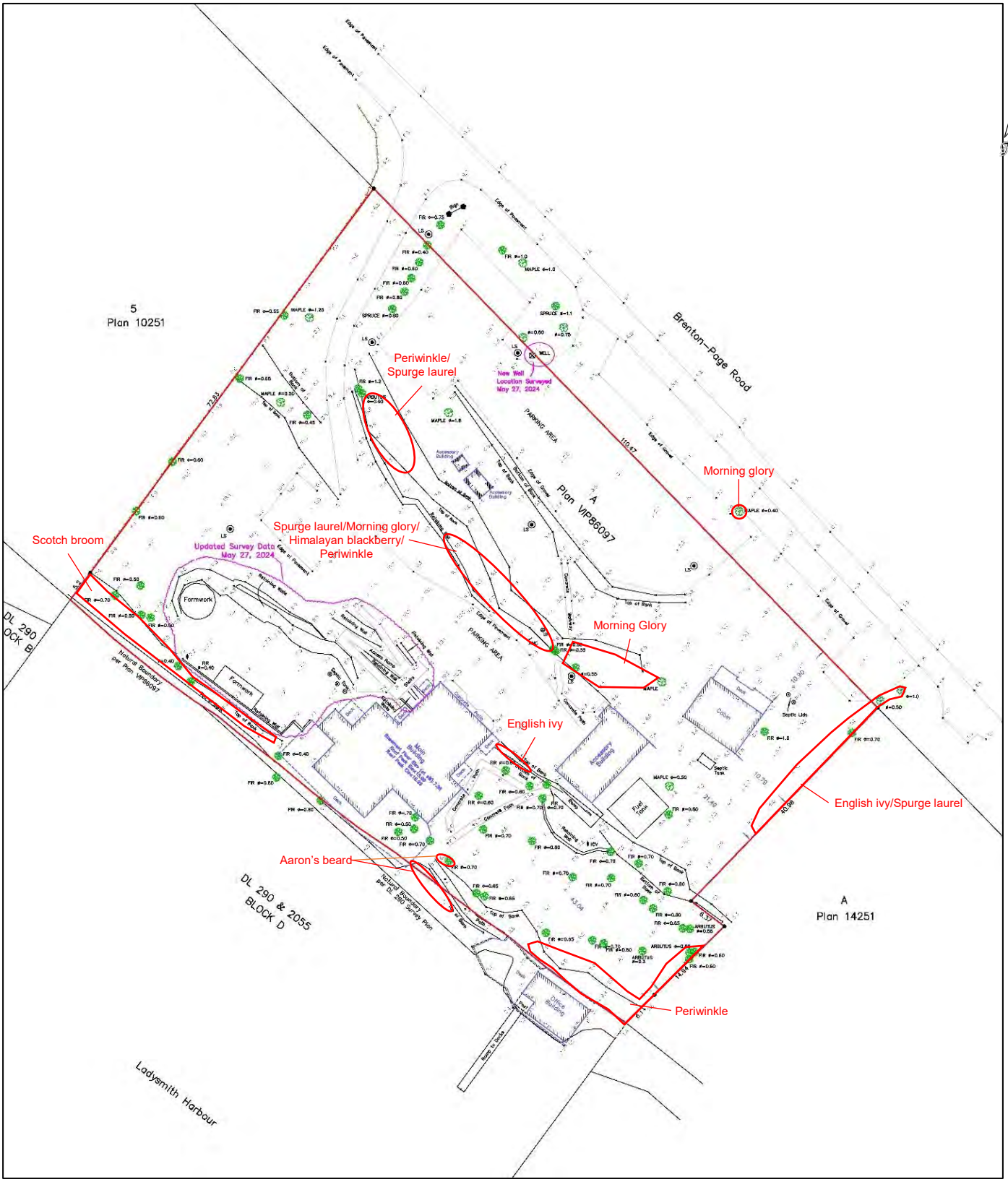
Certified correct this 27th day of May, 2024
Ryan Turner
QV82X6
Digitally signed by Ryan Turner QV82X6
Date: 2024.06.06 12:19:16 -07'00'
B.C.L.S.

Turner & Associates
land surveying
250.753.9778
435 Terminal Avenue North
Nanaimo, BC V9S 4J8
www.turnersurveys.ca

FIGURE 4

INVASIVE SPECIES LOCATION MAP

Figure 3 - Invasive Plant Species Location Map
Raven Point Inn & Marina



APPENDIX A

SITE PHOTOGRAPHS

Raven Point Inn & Marina Redevelopment Project
Photo Sheet 1

Photo 1. Raven Point Inn & Marina property at 4760 Brenton Page Road located in Ladysmith, BC within the Cowichan Valley Regional District (CVRD). The plan is to redevelop and upgrade the inn and marina. The lower gravel parking lot faces the road.

Photo 2. Showing the lower gravel parking area, the small cabin that is in the process of being removed, the upper washroom/laundry building and the main building above with inn and restaurant.

Photo Sheet 2

Photo 3. The property is waterfront to Ladysmith Harbour. The restaurant decking extends out towards the sandstone vertical shoreline slope.

Photo 4. The marina office in the southern corner of the property is on piers above the shoreline and a gangway leads out to the existing marina docks.

Photo 5. Another view of the shoreline with the inn and restaurant above and the pathway leading down to the decking off the marina office.

Photo 6. The frontage of the small inn with accommodations and asphalt upper parking area.

Photo Sheet 3

Photo 7. The existing accessory building with washrooms, laundry and shower facilities.

Photo 8. The side of the inn and restaurant building that is under renovation. Trees in the area to the southeast of this building are to be removed for new development.

Photo 9. Trees to be removed and the concrete block fuel tank structure to be removed.

Photo 10. The temporary washroom building to be placed in front of the existing accessory building.

Photo Sheet 4

Photo 11. The gravel driveway entrance and newly landscaped garden beds at the northern corner of the property.

Photo 12. Newly landscaped area to the northwest of the main building.

Photo 13. Invasive species including English ivy and spurge laurel along the southeast property boundary.

Photo 14. Periwinkle growing over the top of the bank in the southern corner above the marina office building.

Photo Sheet 5

Photo 15. Aaron's beard growing below the paved pathway that leads from the restaurant deck to the marina office.

Photo 16. Morning glory covering the slope above the lower gravel parking lot and to the east of the stairs.

Photo 17. Invasive species including Himalayan blackberry, spurge laurel, morning glory and periwinkle along the slope above the lower gravel parking lot.

Photo 18. Scotch broom along the foreshore slope along the southwest boundary.

CASCARA
CONSULTING ENGINEERS LIMITED

EGBC Permit No. 1000784

February 18, 2025 1055-011

Cowichan Valley Regional District
175 Ingram Street
Duncan, BC V9L 1N8

Attn: CVRD Planning

Re:
Raven Point Marina
Rainwater Management Plan

Dear CVRD:

The attached report has been issued in support of the revised development permit application to the Cowichan Valley Regional District (CVRD) for the development of the uplands and marina at 4760 Brenton-Page Road.

The items relating to the MOTI's specifications for rainwater management have been addressed within the report. These items include pre-and-post development flow rates, runoff calculations, and release measures.

The detailed site design will discharge the runoff from the site to the ocean. There is no need for onsite storage as the site is located directly adjacent to the ocean with insignificant capacity for groundwater recharge.

The post-development 100-year overland flow path matches the pre-development 100-year overland flow path through the grading on the onsite parking and landscaped areas.

Sincerely,

CASCARA CONSULTING ENGINEERS LIMITED

Dawson Link, EIT Charles D. Ramos, P.Eng.

Attachment: Raven Point Marina Rainwater Management Report

Rainwater Management Plan For:

Raven Point Marina

Ladysmith, BC

Prepared For:

Cowichan Valley Regional District

Attn:

CVRD Planning

Prepared By:

CASCARA CONSULTING ENGINEERS LIMITED

EGBC Permit No. 100078
#203-335 Wesley Street
Nanaimo, BC V9R 2T5
Phone: (250) 591-7364

CCEL Project Number: 1055-011
Submitted: February 18, 2025
Revision: 5

Prepared by:

Dawson Link, EIT

Reviewed by:

Charles Ramos, P.Eng.

REVISION TABLE			
Revision #	Rev. Date	By	Description
1	June 28, 2024	DL	RWMP Submission
2	July 23, 2024	DL	RWMP Revision per CVRD Comments
3	November 19, 2024	DL	RWMP Revision per MOTI Comments
4	February 5, 2025	CR	RWMP Revision per CVRD Comments
5	February 18, 2025	DL	RWMP Revision per CVRD Comments

Table of Contents

1.0 Introduction and Scope of Rainwater Management Plan (RWMP)

Cascara Consulting Engineers Limited (CCEL) has been retained by Raven Point Project GP Ltd. to prepare a RWMP in support of the development permit submission to the Cowichan Valley Regional District (CVRD).

The expected final use of the site includes developing the uplands and marina to accommodate a replacement marina with greater access and efficiency than the existing. This includes a new abutment, pier, jump-span and gangway as well as a new laundry & washroom building and new asphalt and gravel parking lots and an asphalt marina access. The existing cabin and laundry/washroom building will be removed during the development. This RWMP addresses expected design storm intensity per return period, expected pre-development flowrates and expected post-development flowrates related to the lot of 0.748 hectares. The RWMP is designed to the CVRD Bylaw 4331 – Electoral Areas Works and Servicing Bylaw, 2022, the Master Municipal Construction Document (MMCD), 2022, and Section 1000 of the BC Supplement to TAC Geometric Design Guide, 2019 3rd Edition.

The following have been prepared as part of this report:

- Rev. D Civil Design drawings
- A Summary table with the pre- and post-development catchment area runoff rate.

Analysis and calculations have been done to determine the following, in accordance with requirements and guidelines in Section 1000 of the BC Supplement to TAC Geometric Design Guide, 2019 3rd Edition:

- Pre- and post-development runoff rates with a return period of 100 years.

1.1 Site Description

The subject site is located at 4760 Brenton Page Road. The property contains a cabin, restaurant/inn, marina office and a marina with a gangway. The site is mostly developed, with undulating topography, exposed bedrock and steep drop to the ocean in front.

2.0 Components of a Rainwater Management Plan

A strong rainwater management plan protects the environment and infrastructure. The control of rainwater drainage helps to reduce erosion, wildlife habitat destruction, and property damage. A rainwater management plan is site specific and utilizes many different aspects to reduce the overland flows and downstream flows within a storm system. Some of these include rainwater detention and retention, erosion and sediment control, outlet control devices and lined watercourses, as discussed below.

Both rainwater detention and retention chambers and ponds collect site runoff to a single location and release it at a controlled rate to the rainwater system. The main difference between the two is that detention ponds and chambers are normally dry, without a permanent pool of water, and retention ponds

and chambers maintain a permanent pool of water. Both types of systems can release water through a control structure, infiltration, or both. Detention ponds are often designed as rain gardens, complete with suitable vegetation, while chambers generally consist of rock and or plastic module systems.

High runoff velocities and unprotected soils can greatly increase soil erosion and conveyance of sediment-laden runoff to streams, lakes, and ocean waters. Soil erosion can be mitigated by doing mass grading work in the dry season and phasing work to minimize the exposed area at any one time. Controlling site erosion reduces site damage, as well as the release of sediments to offsite waters. Some methods that can be adopted to control sediment are silt fences, compost berms, sediment traps, temporary gravel access pads, and curb inlet sediment bars.

Inlet/outlet structures, lined channels, mulching and seeding exposed areas, and covering loose stockpiled soils are other methods to minimize site erosion.

3.0 Rainwater Analysis

3.1 Hydrologic and Hydraulic Parameters and Assumptions

The RWMP was prepared using the following parameters and assumptions.

1. Pre-development refers to the undeveloped state prior to any modification. A fully treed site was used to model pre-developed rates for this report.
2. This site is directly on the ocean waterfront. As such, the value of infiltrating rainwater for groundwater recharge is essentially irrelevant, as the proximity of the ocean and saltwater subsurface ingress overwhelms infiltrated rainwater runoff.
3. We understand the site has not experienced previous rainwater drainage issues.
4. Rainfall intensity and duration data has been calculated in accordance with MMCD specs which states the IDF curve from the nearest location and/or a location that shares similar climate characteristics. Therefore, the Town of Ladysmith (ToL) IDF curve was used.
    a. The data for the IDF curve was measured at the City of Nanaimo Public Works Yard from 1980 to 2018, including adjustments made for projected climate change.
5. The runoff coefficient of any undeveloped portion of the site was assumed to be 0.35. The runoff coefficient of the developed site and the portion of the site to be developed was assumed to be 0.9.
6. The Rational Method was used to determine the runoff flow. The Rational Method is a frequently used, conservative procedure for smaller catchments such as this.

3.2 Minor and Major Storm Events

The site has been assessed assuming precipitation from a major storm event (100-year return period, per Section 1000 of the BC Supplement to TAC Geometric Design Guide, 2019 3rd Edition) that will be collected and conveyed off site. Major storm events such as the 100-year storm event will flow overland

as natural drainage. In general, site infrastructure for subdivisions and building lots within a municipality is designed to handle minor storm events, through a piped or ditched system. Major storm events, generally up to 100-year events, are not handled by the lot's onsite infrastructure, these events are conveyed overland following the topography and the municipalities major roads, major ditches, and major watercourses. In this case, designing conservatively, the site is designed to withstand major storm events by erosion-proofing site flow paths and by directing overland flows to minimize downstream impacts.

3.3 Rainwater Modelling

The Raven Point subject site has a total area of 7479 m^2 (0.748 ha). The MMCD Specs, 2022 identifies use of the Rational Method for design calculations.

The Rational method formula is: $Q_p = \frac{CiA}{360}$, where:

Q_p = Peak Flow, m^3/s
C = runoff coefficient
i = rainfall intensity = P/T_c, mm/hr
P = total precipitation, mm
T_c = time of concentration, hr
A = drainage area, ha
360 = conversion constant

The above formula can be simplified to: Q=CIA*2.78, where:
Q = peak flow, L/s
C = runoff coefficient
I = rainfall intensity, mm/hr
A = drainage area, ha
2.78 = Conversion constant

The 100-year return period was examined in the analysis and is shown in Appendix A.

To summarize, the following was done:

- The site was modeled to identify the peak pre-development runoff.
- Post development runoff volume has been determined as part of this report for the 100-year storm and is included in Appendix A

3.4 Runoff Calculations

A runoff coefficient of 0.9 was used for all impervious surfaces; 0.35, similar to the pre-development coefficient, is used for all pervious surfaces. Using the Rational Method, it was determined that the post-development runoff will increase by approximately 191% from the pre-development conditions.

The total runoff for the site of 0.748 hectares in size is summarized in Table 1 for a design storm based on the 100-year return period.

Rainwater Runoff Summary		
Event (Year)	Pre-Development Peak Flow (L/s)	Post Development Peak Flow (L/s)
100	57.51	78.81

Table 1 - Runoff Summary

3.5 Discharge of Rainwater

Due to the site being adjacent to the ocean, the rainwater that the site experiences does not have sufficient time to recharge the ground water and is directed to the ocean through overland flow or over the shallow bedrock present on site. Although it is standard to control the post-development flows to match the pre-development flows, in this case, such treatments would be unnecessary and add significant additional complexity to the project. It is our recommendation at this site that the rainwater from the rainwater leaders and perimeter drains be directed to the site surface, then conveyed to the ocean via surface swales or ditches. The runoff from development will either drain directly to the ocean through the site or towards Brenton Page Road where there is existing ditching along the road for a short distance before outletting to the ocean.

3.6 100-Year Overland Flow Path

The existing 100-year overland flow path onsite is directed to the ocean and ditches along Benton-Page Road. The water travels either to the northeast or southwest, depending on where the rain falls on the site. It is standard to grade a site to allow for the post-development 100-year overland flow path to match the pre-development 100-year overland flow path. It can be seen on the attached drawings that the grading of the onsite parking matches the pre-development grading and therefore satisfies the need to match the pre-development and post-development 100-year overland flow paths.

3.7 Water Quality

As recommended in MCCD design guidelines 2022, any paved parking lot(s) will have oil water separators to allow for pre-treatment of surface runoff to reduce TSS and hydrocarbons. Areas that are not paved will direct water to landscaped areas to allow for natural surface treatment prior to discharging into the ocean. The same surface treatment will be provided for runoff that is collected through perimeter drains and rainwater leaders.

4.0 Summary Discussion and Recommendations

The site is approximately 0.748ha or 7479m^2 and is relatively flat with moderate tree coverage. The anticipated impervious and pervious areas were determined from the current civil and architectural plans. The recommendation to manage post-development runoff for the new lots is to direct runoff water to the surface close to the ocean or frontage ditching, which will infiltrate into the ground and naturally filter any particulates and increase the water quality.

4.1 Response to CVRD Feb 3, 2025 Comments

On February 3, 2025, CVRD provided the following review comments:

1. *Please also update the rain water management report to assess impact of tree removal, as it recommends using existing vegetation for overland filtration.*
2. *Please clarify what surface materials will be used for the parking areas and driveways as shown on this plan:*

3. *Please update the rain water management plan to re-assess the post-development condition considering new hard surfaces.*

Response to these items follows:

4. The tree removals are not expected to impact the rainwater management for the site, as the vegetative ground cover and will still remain in place, irrespective of the tree removal. It was not expected that tree trunk or root systems would filtering runoff.

5. The marina access, northeast section of the lower parking lot, and the path from the marina access to the washroom building will be asphalt. The upper parking lot and remaining pathways will be gravel-surfaced. This will allow some minimal infiltration through the surface structure to reduce runoff.
6. All proposed development is included in the Rainwater Management Plan calculations, using appropriate runoff coefficients.

APPENDIX A – SWMP Calculations

STORMWATER MANAGEMENT PRE & POST DEVELOPMENT FLOW ANALYSIS - CALCULATION SHEET

Project	**1055-011 Raven Point Marina**
Engineering Company	Cascara Consulting Engineers Limited
Address	#203 - 335 Wesley Street Nanaimo BC
EGBC Permit No.	1000784
Engineer	Charles Ramos, P.Eng

Seal / Engineer's Stamp

Return Period: 100 Years

Date: February 18, 2025

Design By: Dawson Link, EIT

Rational Formula:
Q = C x I x A x 2.78

Rainfall Intensity:
R = A x T ^{B}

City of Nanaimo IDF Curve Data

A_{100}	**24.9**
B_{100}	**-0.570**

PRE-DEVELOPMENT CONDITIONS

Time of Concentration (min)	$T_{c\ (Pre)}$	7.91
Intensity (mm/hr)	I	79.0

Surface	Runoff Coeficient (C)	Area (ha) (A)
Forested/Rock	0.35	0.748
Weighted Average	0.350	
Total		0.748

Pre-development Outflow (L/s)	$Q_{(Pre)\ 100}$	57.51

POST-DEVELOPMENT CONDITIONS

Time of Concentration (min)	$T_{c\ (Post)}$	7.91
Intensity (mm/hr)	I	79

Surface	Runoff Coeficient (C)	Area (ha) (A)
Landscaping	0.35	0.386
Impervious	0.90	0.119
Gravel	0.50	0.243
Weighted Average	0.480	
Total		0.748

Post-development Outflow (L/s)	$Q_{(Post)\ 100}$	78.81

*** Includes 10% increse in rainfall due to climate change**

Duration (hr)	I (mm/hr)	Inflow (L/s)	Total Inflow Volume over Duration (L)	Total Outflow Volume over Duration (L)	Storage Required (m^3)
0.0833	103				
0.1	93				
0.1167	85				
0.1333	79				
0.15	73				
0.1667	69	68.955	41373.0	34505.8	6.87
0.25	55	54.726	49253.4	51758.8	-2.51
0.5	37	36.864	66355.9	103517.5	-37.16
1	25	24.832	89396.8	207035.0	-117.64
1.5	20	19.708	106424.4	310552.5	-204.13
2	17	16.728	120438.4	414070.1	-293.63
2.5	15	14.730	132567.3	517587.6	-385.02

$Q_{(Pre\ 100\text{-}year)}$	57.51 L/s

Max. Req'd Storage	6.87 m^3
Available Storage	0.00 m^3

CASCARA CONSULTING ENGINEERS LIMITED

GEOTECHNICAL HAZARD ASSESSMENT

Marina Development

4760 Brenton Page Road, Ladysmith, BC

Legal Address:
Lot A Section 2, Oyster District Plan, VIP86097, PID 027-772-900

Prepared For:
Raven Point Project LP
2965 Norman Road,
Nanaimo, BC V9X 1K5

Attention:
Mr. Stefan Crucil

February 20, 2025

File No.: E3577.01
Revision No.: 03
Prepared by: Louis Chapdelaine, P.Geo.
Reviewed by: Chris Hudec, M.A.Sc., P.Eng.

Lewkowich Engineering Associates Ltd.
1900 Boxwood Road
Nanaimo, BC, V9S 5Y2
250-756-0355 (Office)
250-756-3831 (Fax)
www.lewkowich.com
geotech@lewkowich.com

Permit to Practice Number: 1001802

Lewkowich Engineering Associates Ltd.

DISCLAIMER, ACKNOWLEDGMENTS AND LIMITATIONS

1. Lewkowich Engineering Associates Ltd. (LEA) acknowledges that this report, from this point forward referred to as "the Report," may be used by the Cowichan Valley Regional District (CVRD) as a precondition to the issuance of a development and/or building permit. It is acknowledged that Approving Officers and/or Building Officials of the CVRD may rely on this Report when making a decision on application for development of the land. It is acknowledged that this Report and any conditions contained in the Report may be included in a restrictive covenant under Section 56 of the Community Charter and registered against the title of the property at the discretion of the CVRD.
2. This Report has been prepared in accordance with standard geotechnical engineering practice solely for and at the expense of Raven Point Project LP. We have not acted for or as an agent of the CVRD in the preparation of this Report.
3. The conclusions and recommendations submitted in this Report are based upon information from relevant publications, a visual site-assessment of the property, anticipated and observed subsurface conditions, current construction techniques and generally accepted engineering practices. No other warrantee, expressed or implied, is made. If unanticipated conditions become known during construction or other information pertinent to the development becomes available, the recommendations may be altered or modified in writing by the undersigned.
4. Future construction shall be carried out within the requirements and recommendations of the Environmental Consultant (if applicable), any defined jurisdictional bylaws, or any existing restrictive covenants, whichever is more stringent. Any environmental setbacks and/or jurisdictional limitations may supersede the recommendations in this Report.
5. The comments and recommendations of this Report are current as of the date of this Report and speak to the condition of the subject property and adjacent/adjoining properties. If there are any circumstances, such as a change in elevation, topography or gradients within the subject property or properties in proximity to the subject lot, the comments and recommendations of this Report become void, and will require re-evaluation by the undersigned.
6. This Report was authored, to the best of our knowledge at the time of issuance, with considerations for local requirements specific to the Authority Having Jurisdiction (AHJ) and their standards for the preparation of such reports, the 2024 British Columbia Building Code (BCBC), and current engineering standards. Updates to municipal bylaws, policies, or requirements of the AHJ, or updates to the BCBC and/or professional practice guidelines, may impact the validity of this Report.
7. This Report has been prepared by Mr. Louis Chapdelaine, P.Geo., and reviewed by Mr. Chris Hudec, M.A.Sc, P.Eng. Messrs. Chapdelaine and Hudec are both adequately experienced and are also members in good standing with the Engineers and Geoscientists of British Columbia (EGBC).

EXECUTIVE SUMMARY

1. The following is a brief synopsis of the property, assessment methods, and findings presented in the Report. The reader must read the Report in its entirety; the reader shall not rely solely on the information provided in this summary.
2. The subject property, 4760 Brenton Page Road, Ladysmith, BC, from this point forward referred to as "the Property," is an oceanfront lot located on the east coast of Vancouver Island within the jurisdictional boundaries of the CVRD. The Property may be subject to coastal flooding under the intermediate sea level rise scenario as described by Northwest Hydraulic Consultants extreme conditions, in their Coastal Sea Level Rise: Strategic Climate Risk Assessment for the Cowichan Valley Regional District, 2019 report. The proposed development for the Property at the time of this Report consists of the construction of a new washroom and laundry facility along with a new marine gangway and abutment, additional parking structures and onsite utilities and civil services.
3. A site-specific hazard assessment was conducted to identify potential geotechnical hazards for the Property and proposed development. Coastal flooding and steep slopes are the only geotechnical hazards related to the proposed development.
4. In summary, the Report recommends a coastal Flood Construction Level (FCL) of 6.55m CGVD28 and a coastal setback of 15.0m from the FNB. The FNB is defined as the 2.15m CGVD28 contour line and concludes that the proposed development as planned will not be impacted by slope instability. See attached civil site plan for additional detail.
5. The findings confirm the land is considered safe for the use intended, provided the recommendations in this Report are followed.

List of Abbreviations Used in the Report

Abbreviation	Title
AEP	Annual Exceedance Probability
AHJ	Authority Having Jurisdiction
BCBC	British Columbia Building Code
CGVD	Canadian Geodetic Vertical Datum
CVRD	Cowichan Valley Regional District
EGBC	Engineers and Geoscientists of British Columbia
FCL	Flood Construction Level
FNB	Future Natural Boundary
LEA	Lewkowich Engineering Associates Ltd.
NHC	Northwest Hydraulic Consultants
PNB	Present Natural Boundary
SLS	Service Limit States
ULS	Ultimate Limit States

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 General

a. As requested, LEA has carried out a Geotechnical Hazard Assessment of the subject Property with respect to the proposed development. This Report provides a summary of our findings and recommendations.

1.2 Background

a. We (LEA) understand that the proposed development consists of the construction of a new washroom and laundry facility along with a new marine gangway and abutment, additional parking structures and onsite utilities and civil services. We expect the development will consist of conventional construction methods, including typical cast-in-place concrete foundations and wood-framed superstructures, with designs details regarding the proposed marine parking lot provided by the projects Civil Engineer.

b. The Property is within the jurisdictional limits of the CVRD. We understand the Property is subject to coastal flooding under NHC's intermediate sea level rise scenario. Therefore, a Geotechnical Assessment and report is required to assist in determining what conditions or requirements shall be included in the development permit so that the proposed development is protected from the identified natural hazards and no increase in hazard is posed to existing development on or near the Property.

1.3 Assessment Methodology

a. A subsurface geotechnical investigation was carried out on August 14, 2024, using a Case 303.5E2 excavator provided by the Client. A total of six (6) test pits (TP 24-01 to TP 24-06) were excavated within the property boundaries and within the proposed building (washroom/laundry facility) envelope. All test pits were backfilled upon completion of our investigation

b. A site plan showing the location of the test pits (Drawing E3577-01) is attached, following the text of this Report.

c. This assessment also included a desktop review of relevant background information, including applicable CVRD bylaws, available development plans, registered covenants on title, aerial photographs, and published geology, topography, and floodplain mapping. Please refer to the list of references at the end of this Report.

d. This assessment was prepared with consideration of the referenced EGBC Legislated Flood Assessments in a Changing Climate in BC[1] and Guidelines for Legislated Landslide Assessments for Proposed Residential Developments in BC.[2]

1.4 Covenant Review

a. As part of our assessment, we have reviewed the legal title of the Property, specifically relative to any restrictive covenants that may impact the conclusions or recommendations made in this Report.

b. At the time of this Report, there are no restrictive covenants related to geotechnical practice registered to the title of the Property.

2.0 SITE CONDITIONS

2.1 Physical Setting

a. The Property is an oceanfront lot located on the east coast of Vancouver Island within the community of Ladysmith. The Property is zoned Village Commercial Accommodation (C-4) and is immediately surrounded by Rural Village Residential (R2) properties and to the southwest by Ladysmith Harbour (ocean). Refer to Figure 2.1 below.

Figure 2.1: Property Location Highlighted Blue[3]

2.2 Terrain and Features

a. When traversing the Property from the northeast to the southwest, the Property moderate rises to the approximate center of the Property. From the approximate centre of the Property, the terrain gently declines towards the foreshore area, where it meets a short and steep bedrock bank, near the PNB of Ladysmith Harbour. Based on available contour information and our visual assessment, there is a total vertical relief of approximately 10.0m within the Property.

b. At the time of our assessment, the Property was developed with an existing small hotel, marina, washroom facility, several small outbuildings and hardscaping, including short retaining walls, patios and sidewalks. The Property is well landscaped with tiered gardens and level grass areas. The remainder of the Property is vegetated with matures trees and shrubs.

c. The PNB of the ocean is not clearly defined or easily recognized. The shoreline consists of an approximately 6.0m tall sandstone bank leading to a foreshore consisting of a natural, sandstone bedrock. Refer to Photo 2.2.1 below.

Photo 2.2.1: Foreshore area. Looking north.

2.3 Regional Bedrock Geology

a. Bedrock geology for the area[4] is classified as the Nanaimo Group, comprised of undivided sedimentary rocks from the Upper Cretaceous period, generally consisting of boulder, cobble and pebble conglomerate, coarse to fine sandstone, siltstone, shale, and coal.

2.4 Soil Conditions

a. Consistent soil strata were encountered during the test pitting investigation. Generally, these strata consisted of driveway crush comprised of compact, grey, crushed gravel with trace sand, underlain by a compact to dense, moist, brown, silty sand with some rock rubble and trace organics (roots), underlain by a dense, sedimentary bedrock.

b. Detailed descriptions of the subsurface conditions are provided on the attached test pit logs (TP 24-01 to TP 24-06).

c. Depths are referenced to the existing ground surface at the time of our field investigation. Soil classification terminology is based on the Modified Unified classification system. The relative proportions of the major and minor soil constituents are indicated by the use of appropriate Group Names as provided in ASTM D2488-93 and/or D2487 Figures 1a, 1b, and 2. Other descriptive terms generally follow conventions of the Canadian Foundation Engineering Manual.

2.5 Groundwater

a. No groundwater seepage was encountered in any of the advanced test pits.

b. No evidence of abnormal groundwater conditions observed during our site assessment of the Property. We expect drainage may appear as interflow over the sandstone bedrock.

c. Groundwater levels can be expected to fluctuate with tides and seasonally with cycles of precipitation. Groundwater conditions at other times and locations can differ from those observed at the time of our assessment.

d. If groundwater flows or conditions are different than those encountered during the test pitting investigation, additional measures may be required during construction. Contact our office immediately if unanticipated conditions are encountered at any point during construction.

3.0 COASTAL FLOOD COMPONENTS

3.1 General

a. Provincial flood hazard management guidelines[5] recommend two methods for determining a coastal FCL: the Combined Method or the Probabilistic Method. The Probabilistic Method was used for this site-specific assessment, where the water level at the shoreline is based on a probabilistic analysis of high tide and storm surge. As per provincial guidelines, a target 0.5% AEP (i.e., 200-year return period) was adopted for this assessment.

b. In 2019, the CVRD commissioned and published the Risk Assessment of Floodplains and Coastal Sea Level Rise: Strategic Climate Risk Assessment for the Cowichan Valley Regional District.[6] The report was prepared by NHC and includes costal flood maps for areas of Ladysmith Harbour and others for multiple sea level rise scenarios.

c. The subject sea level rise scenarios vary from Low which incorporates 0.3m of SLR to the year 2100 to extreme which incorporates 2.5m of SLR to the year 2100. We (LEA) have chosen to work with the intermediate SLR scenario of 1.0m as it aligns with existing provincial regulation. See section 3.4 of this report for additional details.

3.2 Vertical Datum

a. There are currently two vertical datums being used in Canada, the older CGVD of 1928 (CGVD28), and the newer CGVD of 2013 (CGVD2013). The FCLs presented in this Report are also in terms of CGVD28, unless otherwise stated.

b. The building designer and construction contractor should be aware of the reference vertical datum to ensure the correct FCL is being used for the project.

3.3 Tides

a. Tidal data is published by Fisheries and Oceans Canada. The nearest tidal station to the Property is Ladysmith (Tidal Station 07460). Refer to Table 3.3 for published tide heights.

Table 3.3 – Summary of Ladysmith Tide Heights, Station ID: 07460

Tidal Condition	Tide Height (Chart Datum)
HHWLT	4.07 m
HHWMT	3.67 m
MWL	2.53 m
LLWMT	0.96 m
LLWLT	-0.11 m

b. As per provincial flood hazard guidelines, the Higher High Water Large Tide (HHWLT) elevation should be used in the summation of a coastal FCL assessment.[5] HHWLT is commonly referred to as King Tide.

c. Tide heights are published in Chart Datum (CD), a local datum nominally referenced to a normal low tide. The published Mean Water Level (MWL) can be taken to equal 0.0m CGVD28 for the purpose of coastal flood assessments. Therefore, the HHWLT in CGVD28 is equal to:

   i. 4.07m HHWLT in CD – 2.53m MWL = 1.54m HHWLT in CGVD28.

3.4 Sea Level Rise

a. Information prepared by the provincial government in 2011 regarding policy for coastal floodplain mapping recommends assuming a 1.0m rise in sea level from the year 2000 to 2100 due to climate change.[5] See Figure 3.4.1 below.

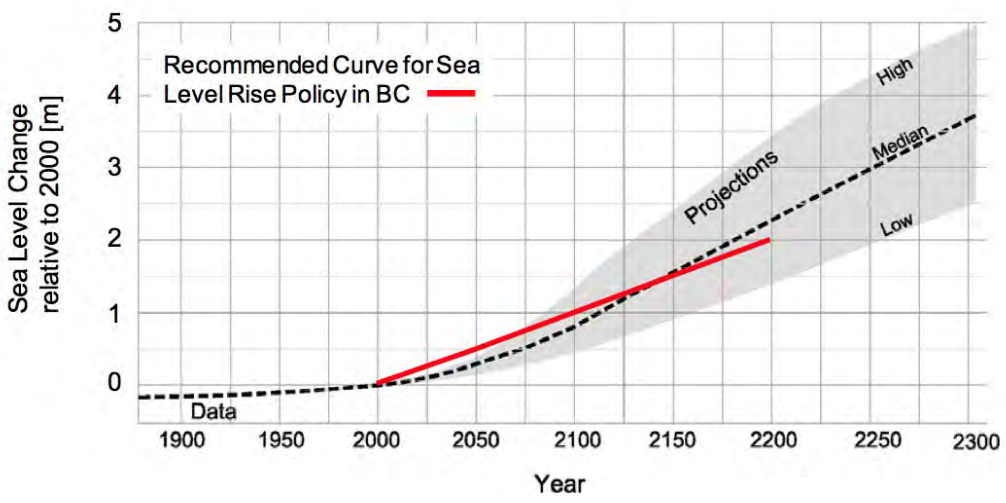


Figure 3.4 – Recommended SLR Curve for Planning and Design in BC

b. In accordance with current guidelines, 1.0 cm/year of SLR to the year 2100 was included in our assessment, for a total SLR of 0.76m.

c. The assumed amount of SLR was based on information available at the time of their study and will be revaluated in the future as more information becomes available. Forecasting this far into the future carries significant uncertainties. Monitoring changes of SLR is beyond the scope of this Report. We expect local authorities to remain informed to adjust their flood management plans/guidelines accordingly.

d. We have also reviewed the 2019 NHC report[6] that shows the Property is at risk for coastal flooding under the intermediate SLR scenario. See Figure 3.4.2 below.

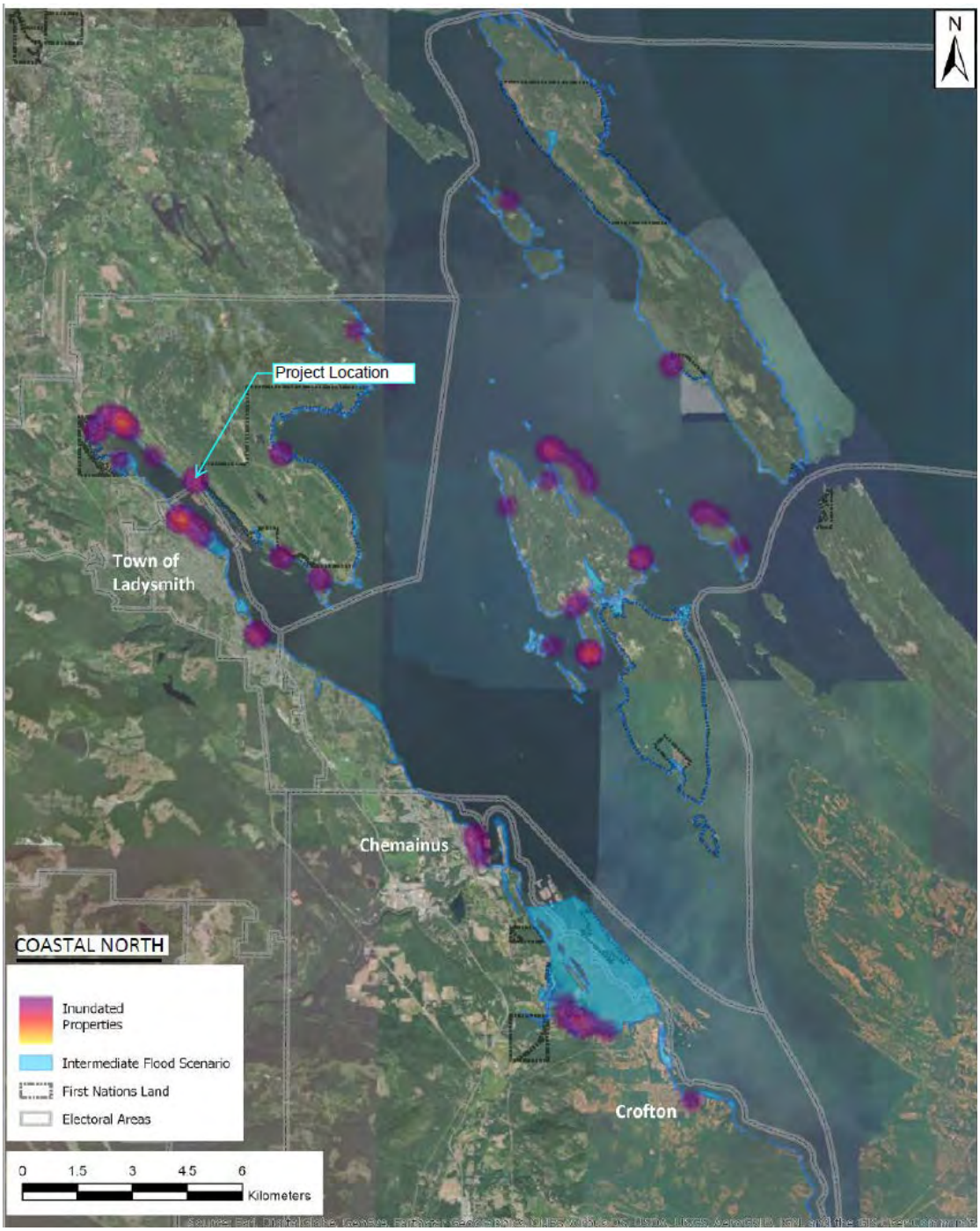


Figure 3.4.2 – NHC Property Vulnerability Coastal Intermediate Flood Scenario

3.5 Regional Adjustment – Isostatic Rebound

a. Future sea level is also affected by vertical land movement due to tectonic shifting (i.e., changes in the regional rebound or subsidence of the land surface). Areas where the land elevation is increasing (rebound) should decrease the allowance for SLR, while areas where the land elevation is decreasing (subsidence) should increase the allowance for SLR.

b. Based on current information, this area of Vancouver Island is rebounding at a rate of 2.0 mm/year, as measured at a GPS monitoring station in Chemainus.[7] Therefore, the land is expected to rebound by 0.15m by the year 2100. A rebound value of -0.15m was included in our assessment.

3.6 Storm Surge

a. Sea levels along the BC coast are not only affected by astronomical tide cycles, but also by storms. Storms may affect water levels due to changes in atmospheric pressure, strong winds acting on the water surface, and changes in ocean currents or temperature. The combined effect of all these factors is termed storm surge.

b. Storm surge is generally estimated by an extreme value analysis of the difference between measured water level and predicted tide level. In absence of this information, provincial guidelines[5] provide suggested storm surge values which can be safely used for FCL determination. Based on a 200-year designated storm, the suggested design storm surge for this area of Vancouver Island is 1.25m.

c. However, not all storms occur during a King Tide. The intent of the Probabilistic Method is to estimate the probability of a large storm occurring during a King Tide. We have used a designated 10-year event (i.e., 200-year x 5%) when calculating an FCL that coincides with a high tide. The report provides a storm surge value of 0.92m for the coincident 10-year storm event.

3.7 Wave Effect

a. Breaking waves during the design storm event must also be considered, as breaking waves may further increase the depth of water along the shoreline as well as increase the risk of runup and/or overtopping leading to flooding.

b. Wave effect is site specific and dependent on local wind conditions, bathymetry, the presence of shoreline structures (natural banks or slopes, revetments, dikes, sea walls, etc.), as well as water levels at the time of the designated storm, which all contribute to the estimated wave runup.

c. The Property consists of a natural shoreline bank, therefore wave runup was estimated using 1D calculation methods as described in the European Overtopping Manual (EurOtop, 2018).[8] By applying these methods, wave runup is calculated in terms of a 2% exceedance value ($R_{2\%}$).

d. The foreshore slope was determined for this specific Property based on available contour information, topographic surveys, and on-site measurements.

e. A wave effect value of 2.88m was used in our assessment.

3.8 Freeboard

a. A nominal freeboard value is typically added when calculating an FCL. The freeboard value accounts for uncertainties associated with value estimations used.

b. Provincial guidelines recommend a minimum freeboard value of 0.60m for the Probabilistic Method.[5]

3.9 Calculated FCL

a. Table 3.9 provides a summary of the site-specific coastal flood components used for the Probabilistic Method and the resulting FCL.

Table 3.9: Summary of Flood Components and FCL Calculation

HHWLT (CGVD28)	SLR	RA	SS	WE	FB	FCL (CGVD28)
1.54 m	0.76 m	-0.15	0.92 m	2.88 m	0.60 m	6.55 m

4.0 COASTAL FLOOD HAZARD ASSESSMENT

4.1 Coastal Setback

a. Floodplain setbacks are primarily established to keep development away from areas of potential erosion and to avoid restricting the floodway, as well as to protect structures from debris tossed onshore during storm events and to reduce weathering effects from salt spray.

b. The referenced provincial flood hazard guidelines[5] state building setback should be at least 15m from the estimated FNB. The FNB, defined as the natural boundary at the year 2100, can be reasonably estimated by summing the associated flood components, namely high tide (HHWLT), SLR, and regional adjustment to the year 2100. Based on this methodology, the FNB would equal:

   i. 1.54m HHWLT + 0.76m SLR – 0.15m RA = 2.15m CGVD28.

a. We recommend a coastal setback of 15.0m from the FNB, where the FNB is defined as the 2.15m CGVD28 contour line. This setback is adequate for the proposed development where the coastal flood hazard is mitigated through a combination of required FCL and setback.

b. The FNB and recommended coastal setback should be plotted on the development site plan and established on-site by qualified survey personnel.

4.2 Floodwater and Inundation

a. The recommended coastal FCL and setback applies to any Habitable Area; defined as any room or space within a building or structure which can be used for human occupancy, commercial sales, or the storage of goods, possessions, or equipment (including furnaces) which would be subject to damage if flooded.

b. The FCL establishes the minimum elevation of the underside of a wooden floor system or top of concrete slab for any Habitable Area. During construction, all footing and floor elevations shall be confirmed by qualified survey personnel to ensure the finished floor grade is at or above the recommended minimum FCL geodetic elevation.

c. Provided any construction within the Property satisfies the minimum recommended FCL and setback, we do not anticipate any damage to structures as a result of floodwater. However, anything constructed or stored below the recommended FCL, such as crawlspaces, basements, or storage rooms, could be subject damage from flooding. Following the best construction practices, areas below the FCL should not be used for the installation of furnaces, major electrical switchgear, or other fixed equipment susceptible to damage by floodwater.

4.3 Landfill and Site Grading

a. If structural fill materials are used for foundation support, and include structural fills placed above existing site grades, further assessment may be required. Structural fills placed above existing grades may require protective measures from scour and erosion.

b. Perimeter yard areas should be sloped to direct potential flood water away from the proposed building and preferably toward the foreshore area. Every effort must be made as to not direct surface water to neighbouring properties.

4.4 Shoreline Protection

a. The shoreline within the Property limits is currently defined by a near vertical bedrock bank. Given the strength and non-erodible nature of the foreshore substrate (bedrock), we expect the foreshore area and Property to remain protected from the effects of coastal erosion over the life of the proposed development. No shoreline protection measures are required at this time.

5.0 SLOPE STABILITY ANALYSIS

5.1 General

a. The subject slopes are in a stable condition with little surficial erosion due primarily to the nature of the bedrock in the area. There were no signs of potential global / full slope height instability. Therefore, slope movement would likely be confined to minor spalling of localized areas of the slope steeper than 45° from horizontal.

b. Based on slope geometries, bedrock conditions, interpreted mechanisms of slope movement and the proposed location of the subject structures, we (LEA) confirm that the location of the proposed structures (as seen on the attached development plan) are considered safe and suitable, as they are located well outside the 45° effective stable slope angle used for a conservative setback from the top of crest of the bedrock slope. Any changes to the location(s) of the proposed structures should be reviewed by the geotechnical consultant.

c. Ancillary structures such as gazebos and sheds may be located closer to the top of bank area with the understanding that they are not considered habitable space and are not structurally attached to any habitable structure (i.e., free-standing). Please note that the potential for loss or damage of these less critical structures due to slope failure increases as the distance to the top of bank diminishes. A minimum setback of 3.0m from top of bank should be considered for any ancillary structure. Ultimately it is at the discretion of the AHJ whether a specific ancillary structure is considered habitable space and be constructed in accordance with the BCBC. LEA can provide further recommendations for construction of ancillary structures closer to the top of the bank area upon request.

5.2 Slope Maintenance

a. It should be noted that landslides can occur due to human activity (i.e., excavation, placement of fill, removal of vegetation, etc.) or by failure of civil infrastructure (i.e. leakage/rupture of underground water and sewer mains, stormwater disposal from existing developments, etc.). Minimizing infiltration of water into the slope is essential to reducing the risk of slope movement. It is important that water does not pond near the top of bank. Surface water flow across the slope from precipitation events, collected stormwater or any other drainage system must be prevented from flowing in a concentrated manner down the slope. The concentrated discharge of collected stormwater can lead to erosion, earth movement, or slope failure.

b. Preserve a healthy natural vegetated buffer zone adjacent to cleared / landscaped areas for runoff attenuation which will assist in maintaining stability of surficial cover.

c. Tree removal does not impact global slope stability. Soil disturbed by tree removal should be stabilized with vegetation or other ground cover to prevent erosion.

d. Disposal of fills, yard waste, organic debris or excavation spoils shall not be discharged or dumped onto the slope or overload the top of bank area.

6.0 DESIGN PHASE

6.1 Foundation Design

a. Prior to construction, the foundation areas should be stripped to remove all unsuitable materials to provide an undisturbed natural subgrade for footing support.

b. Foundation loads should be supported on natural undisturbed mineral soil or structural fill, approved for use as a bearing stratum by our office, and may be designed using the following values:

   i. For foundations constructed on compact to dense, naturally deposited, inorganic subgrade, an SLS bearing pressure of 100 kPa and a ULS of 135 kPa may be used for design purposes. These values assume a minimum 0.45m footing embedment depth.

   ii. For foundations constructed on a minimum thickness of 0.65m of structural fill, as outlined in Section 6.2 of this Report, an SLS bearing pressure of 150 kPa and a ULS bearing pressure of 200 kPa may be used for design purposes. These values assume a minimum 0.45m footing embedment depth.

   iii. For foundations constructed on intact bedrock, an SLS bearing pressure of 300 kPa and a ULS bearing pressure of 400 kPa may be used for design purposes.

c. Exterior footings should be provided with a minimum 0.45m depth of ground cover for frost protection.

d. The Geotechnical Engineer should evaluate subsurface conditions at the time of construction to confirm that soil and/or groundwater conditions do not materially differ to those observed and inferred during the site reconnaissance and that footings are based on appropriate and properly prepared founding material.

e. Building and foundation design shall adhere to jurisdictional floodplain management regulations, applicable BCBC requirements, and/or structural requirements under the direction of a Structural Engineer.

6.2 Seismic Criteria

a. No liquefiable or sensitive soils were encountered during our site-specific assessment.

b. Based on the 2024 BCBC, Division B, Part 4, Table 4.1.8.4.-B, “Site Classes, S, for Site Designation Xs” the observed and inferred subsurface soil conditions would be classified as “Site Class C”.[8]

c. Seismic forces used reflect values from the 2015 National Building Code interpolated seismic hazard values for this Property which are 0.473g PGA (2% in 50 year probability) and 0.250g PGA (10% in 50-year probability.[9]

6.3 Lateral Earth Pressures

a. The lateral earth pressure coefficients (K) as outlined in Table 5.3.1 have been provided for the design of cast-in-place retaining walls or foundation walls. Any future retaining wall construction within the Property shall be reviewed by the Structural and/or Geotechnical Engineer(s).

b. It is assumed that there will be a level (0° from horizontal) backslope and no additional surcharge on the wall. It is noted that the methods employed are estimates and further analysis may be required after dimensions of the proposed structure have been determined.

c. An average soil friction angle of 27° has been used to calculate the lateral earth pressure coefficients. It is assumed that retained soils are free draining, well compacted, cohesionless sands and gravels, with a unit weight of 21 kN/m$^{3.}$

d. As previously stated, seismic forces used reflect values from the 2015 National Building Code interpolated seismic hazard values for this Property which are 0.473g PGA (2% in 50-year probability) and 0.250g PGA (10% in 50 year probability).

e. The Mononobe-Okabe Method has been used to calculate the seismic active lateral earth pressure coefficient (K_{aE}). The static active lateral earth pressure coefficient (K_a) has been calculated using Coulomb's theory. The static passive lateral earth pressure coefficient (K_p) has been calculated using Rankine's theory. See the following Table 6.3.1 for design values.

Table 6.3.1 – Lateral Earth Pressure Coefficients

Lateral Earth Pressure Condition	Earth Pressure Coefficient (K)	
Static Active	K_a	0.34
Static Passive	K_p	2.66
Seismic Active	K_{aE}	0.54

f. The thrust resulting from lateral earth pressures under each of the conditions outlined in Table 6.3.1 may be calculated using the relationship in Table 6.3.2. A minimum uniform static load of 20 kPa shall be considered for compaction forces.

Table 6.3.2 – Thrust from Lateral Earth Pressure Relationship

$P = 0.5 * K * \gamma * H^2$
P = Thrust (kN/m length of wall)
K = Lateral Earth Pressure Coefficient
γ = Soil Unit Weght (kN/m^3)
H = Height of Wall (m)

g. The seismic active coefficient provides a value that combines both static and dynamic forces to determine total active thrust (P_{aE}). The static component (P_a) acts through a point that is approximately H/3 above the toe of the wall. The dynamic component (ΔP_{aE}) acts through a point at approximately 0.6H above the toe of the wall. The total active thrust may then be considered to act at a height from the base of the wall using the following relationship in Table 6.3.3.

Table 6.3.3 – Height from Base of Wall for Total Active Thrust

$h = \frac{P_a * \left(\frac{H}{3}\right) + \Delta P_{aE} * (0.6H)}{P_{aE}}$
h = Height from Base of Wall for Total Active Thrust (m)
P_a = Static Active Thrust (kN/m)
P_{aE} = Total Active Thrust (kN/m)
$\Delta P_{aE} = P_{aE} - P_a$ = Dynamic Active Thrust (kN/m)
H = Height of Wall (m)

h. The presented earth pressure coefficients are based on fully drained backfill conditions, using free draining granular backfill and foundation drainage.

7.0 CONSTRUCTION PHASE

7.1 General Excavation – Future Building Sites

a. Prior to construction, all unsuitable materials within the proposed building envelope should be removed to provide a suitable base of support. Unsuitable materials include any non-mineral material such as vegetation, topsoil, peat, fill, or other materials containing organic matter, as well as any soft, loose, or disturbed soils.

b. Ground water ingressing into any excavations should be controlled with a perimeter ditch located just outside of the building areas, connected to positive drainage.

c. Prior to placement of concrete footings, any bearing subgrade that has been softened, loosened, or otherwise disturbed during the course of construction, should be removed or else compacted following our recommendations for structural fill. Compaction will only be feasible if the soil has suitable moisture content and if there is access to heavy compaction equipment.

d. The Geotechnical Engineer is to confirm the removal of unsuitable materials and approve the exposed competent inorganic subgrade, prior to placement of any structural fill.

7.2 Structural Fill

a. Where fill is required to raise areas that will support buildings or slabs, structural fill should be used. The Geotechnical Engineer should first approve the exposed subgrade in fill areas, to confirm the removal of all unsuitable materials.

b. Structural fill should be inorganic sand and gravel. If structural fill placement is to be carried out in the wet season, material with a fines content limited to 5% passing the 75µm sieve should be used, as such a material will not be overly sensitive to moisture, allowing compaction during rainy periods of weather.

c. Structural fill should be compacted to a minimum of 95% of Modified Proctor maximum dry density (ASTM D1557) in foundation and floor slab areas.

d. Structural fills under foundations should include the zone defined by a plane extending down and outward a minimum 0.5m from the outer edge of the foundation at an angle of 45 degrees from horizontal to ensure adequate subjacent support. This support zone is shown in Figure 7.2 below.

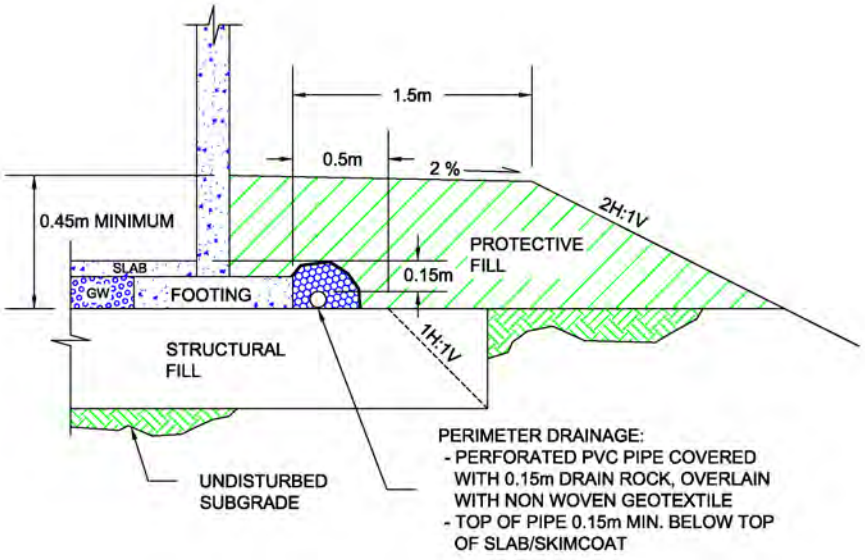


Figure 7.2 – Typical Section, Structural Fill

e. Compaction of fill should include moisture conditioning as needed to bring the soils to the optimum moisture content and compacted using vibratory compaction equipment in lift thicknesses appropriate for the size and type of compaction equipment used.

f. A general guideline for maximum lift thickness is no more than 100mm for light hand equipment such as a "jumping-jack," 200mm for a small roller, and 300mm for a large roller or heavy (>500 kg) vibratory plate compactor or a backhoe mounted hoe-pac or a large excavator mounted hoe-pac, as measured loose.

g. It should be emphasized that the long-term performance of buildings and slabs is highly dependent on the correct placement and compaction of underlying structural fills. Consequently, we recommend that structural fills be observed and approved by the Geotechnical Engineer. This would include approval of the proposed fill materials and performing a suitable program of compaction testing during construction.

7.3 Foundation Drainage

a. Our assessment did not identify any abnormal groundwater conditions that would necessitate special foundation drainage measures outside of Part 9 of the 2024 BCBC. Conventional requirements of the 2024 BCBC pertaining to building drainage are considered suitable at this site.

8.0 CONCLUSIONS

8.1 Local Government Conformance Statement

a. From a geotechnical point of view, and provided the recommendations in this Report are followed, the land is considered safe for the use intended (defined for the purposes of this Report as a new marina development following conventional construction methods), with the probability of a geotechnical failure resulting in property damage of less than:

i. 2% in 50 years for seismic events, including slope stability;

ii. 0.5% annual exceedance probability coastal flood event, including sea level rise to the year 2100;

iii. 10% in 50 years for all other geotechnical hazards.

8.2 Geotechnical and Quality Assurance Statement

a. The CVRD may request a Geotechnical Engineer to provide professional assurance services during the course of construction. Geotechnical Assurance services include review of the geotechnical components of the plans and supporting documents, and responsibility for field reviews of these components during construction.

9.0 CLOSURE

a. LEA appreciates the opportunity to be of service on this project. If you have any comments, or additional requirements at this time, please contact us at your convenience.

Respectfully Submitted,
Lewkowich Engineering Associates Ltd.

Reviewed By:

February 20, 2025

Louis Chapdelaine, P.Geo.
Project Geoscientist

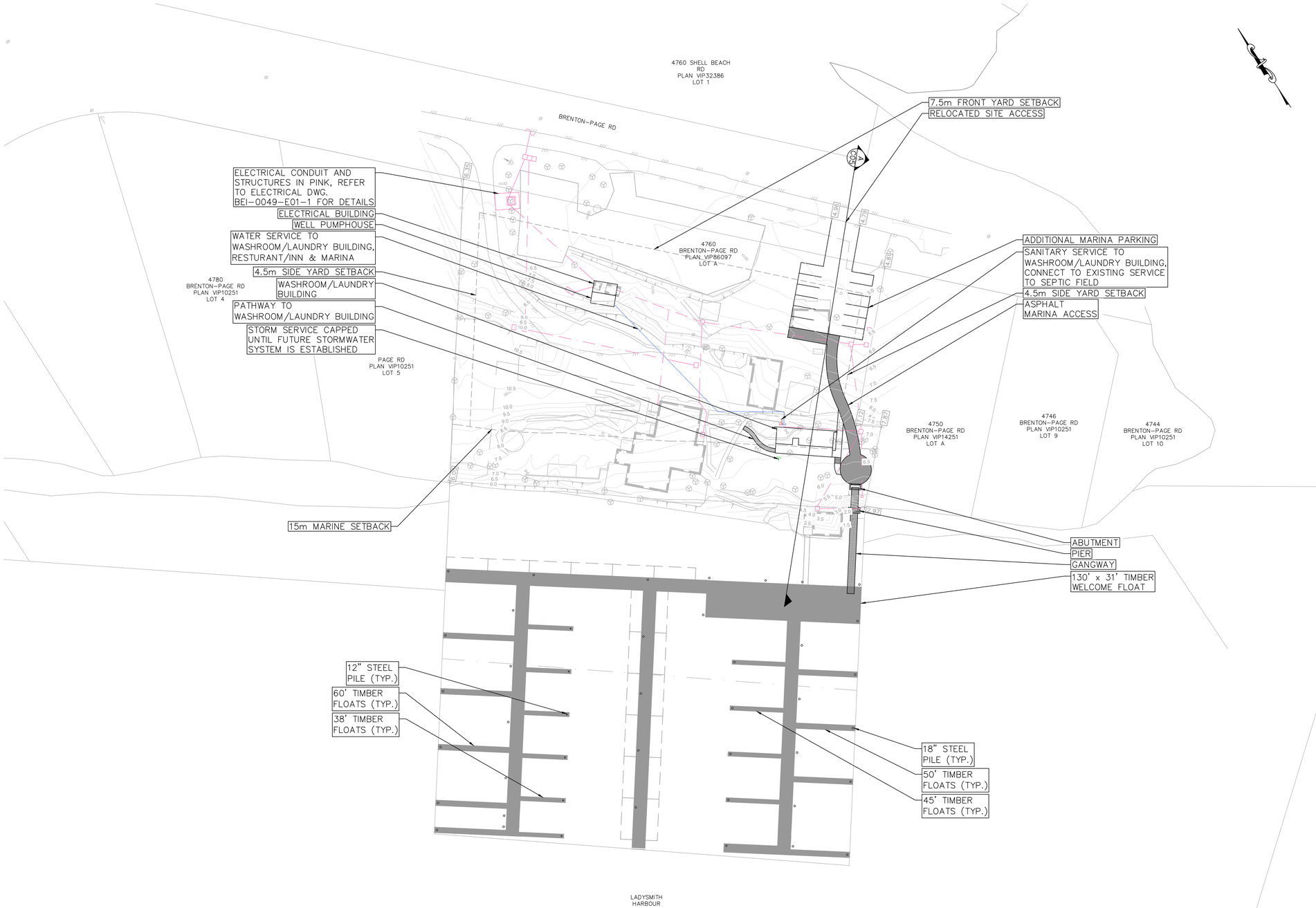
Chris Hudec, M.A.Sc., P.Eng.
Geotechnical Engineer

10.0 ATTACHMENTS

1. Cascara Consulting Engineers Ltd. Raven Point Marina. Site Plan.
2. LEA Drawing No. E3577-01 – Test Pit Location Plan.
3. LEA Test Pit Logs.
4. CVRD Natural Hazard Assurance Statement.

11.0 REFERENCES

1. EGBC, Professional Practice Guidelines – Legislated Flood Assessments in a Changing Climate in BC, Version 2.1, dated August 28, 2018.
2. EGBC, Professional Practice Guidelines – Landslide Assessments in British Columbia. Version 4.1, published March 1, 2023.
3. CVRD Webmap. Accessed September 12, 2024.
4. Province of BC, interactive web-map, *iMapBC*, accessed September 2024.
5. BC Ministry of Forests, Lands, Natural Resource Operations, *Coastal Floodplain Mapping – Guidelines and Specifications*, prepared by Kerr Wood Leidal Associates Ltd., dated June 2011.
6. Northwest Hydraulic Consultants. Risk Assessment of Floodplain and Coastal Sea Level Rise: Strategic Climate Risk Assessment for the Cowichan Valley Regional District – Final Report Rev. 1. May 2019.
7. BC Ministry of Environment, *Guidelines for Management of Coastal Flood Hazard Land Use*, prepared by Ausenco Sandwell, Proj No. 143111, dated January 27, 2011.
8. British Columbia Building Code 2024.
9. 2015-2005 National Building Code of Canada Seismic Hazard Values. Accessed September 2024.
10. BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development, *Flood Hazard Area Land Use Management Guidelines*, amended January 1, 2018.
11. EurOtop, 2018. Manual on wave overtopping of sea defenses and related structures. An overtopping manual largely based on European research, but for worldwide application. Van der Meer, J.W., Allsop, N.W.H., Bruce, T., De Rouck, J., Kortenhaus, A., Pullen, T., Schüttrumpf, H., Troch, P. and Zanuttigh, B., www.overtopping-manual.com.



NOTES:

1. REFER TO DRAWING NUMBER C01 FOR GENERAL NOTES.

CLIENT

FMC HOLDINGS LTD.

REV.	DATE	BY	DESCRIPTION	ENG
B	31JULY2024	DL	REVISED PER CVRD COMMENTS	CR
A	08JULY2024	DL	ISSUED FOR REVIEW	CR

RAVEN POINT MARINA

LADYSMITH, BC

DRAWING TITLE:

UPLANDS & MARINA PHASE 1

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DESIGN BY: DL	CHECKED BY: CR
DRAWN BY: DL	APPROVED BY: CR
SEAL:	SCALE: HORIZ: SHOWN VERT: ----
	DATE: 31JULY2024 | SHEET: 3 OF 6
	ENG. FILE NUMBER:
	CITY DWG #: | PROJECT #: 1055-011
	DRAWING NUMBER: C03 | REV: B

C:\USERS\DLINK\CASCARA CONSULTING ENGINEERS LIMITED\1055-011 RAVEN POINT - DOCUMENTS\04 - DRAWINGS\CIVIL DRAWINGS

7.31.2024

REV No.	DATE	BY	P.Eng.	REVISION DESCRIPTION
				TEST PIT No.

DRAWING TITLE
TEST PIT LOCATION PLAN

PROJECT NAME
4760 BRENTON PAGE ROAD
LADYSMITH, BC

LEGAL DESCRIPTION
LOT A SECTION 2 OYSTER DISTRICT
PLAN VIP86097

ENGINEER'S SEAL

EGBC PERMIT TO PRACTICE No.
1001802

PLOT DATE	DRAWN BY
2024-10-02	LC
REVIEWED BY	SCALE
LC	1:500
PROJECT No.	DRAWING No.
E3577	E3577-01

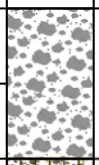
Lewkowich Engineering Associates Ltd.

Lewkowich Engineering Associates Ltd.

TEST PIT LOG

File Number: E3577 TP24-01
Client: Raven Point Project LP
Project: Raven Point Marina, 4760 Brenton Page Road
Location: Ladysmith, B.C.

Coordinates: 49.012255 N, -123.822869 W

Depth (m)	Soil Symbol	Description
0.0		Ground Surface
		0.0-0.2m Crushed gravel, trace sand, grey, compact, dry [Driveway Crush]
		0.2-0.8m Silty sand, some rock rubble, trace organics (roots), compact to dense, brown, moist
0.5		
		Refusal on bedrock at 0.80m. No groundwater seepage encountered.
1.0		
1.5		

Logged By: Spencer Woodward, GIT
Reviewed By: Louis Chapdelaine, P.Geo
Digging Method: Case 303.5E2 Excavator

Date: August 14, 2024
Page 1 of 1

1900 Boxwood Road,
Nanaimo, BC, V9S 5Y2
Phone: 250-756-0355
Fax: 250-756-3831
Email: geotech@lewkowich.com

Lewkowich Engineering Associates Ltd.

TEST PIT LOG

File Number: E3577 TP24-02
Client: Raven Point Project LP
Project: Raven Point Marina, 4760 Brenton Page Road
Location: Ladysmith, B.C.

Coordinates: 49.012139 N, -123.822845 W

Depth (m)	Soil Symbol	Description
		Ground Surface
0.0		0.0-0.2m Crushed gravel, trace sand, grey, compact, dry [Driveway Crush]
		0.2-0.5m Silty sand,trace gravel, dense, light brown, moist
0.5		0.5-1.35m Silty sand, some rock rubble, compact to dense, brown, moist
1.0		
1.5		Refusal on bedrock at 1.35m. No groundwater seepage encountered.

Logged By: Spencer Woodward, GIT
Reviewed By: Louis Chapdelaine, P.Geo
Digging Method: Case 303.5E2 Excavator

Date: August 14, 2024
Page 1 of 1

1900 Boxwood Road,
Nanaimo, BC, V9S 5Y2
Phone: 250-756-0355
Fax: 250-756-3831
Email: geotech@lewkowich.com

Lewkowich Engineering Associates Ltd.

TEST PIT LOG

File Number: E3577 TP24-03
Client: Raven Point Project LP
Project: Raven Point Marina, 4760 Brenton Page Road
Location: Ladysmith, B.C.

Coordinates: 49.012188 N, -123.822738 W

Depth (m)	Soil Symbol	Description
		Ground Surface
0.0		0.0-0.2m Crushed gravel, trace sand, grey, compact, dry [Driveway Crush]
		0.2-0.25m Silty sand, some rock rubble, compact to dense, brown, moist
		Refusal on bedrock at 0.25m. No groundwater seepage encountered.
0.5		
1.0		
1.5		

Logged By: Spencer Woodward, GIT
Reviewed By: Louis Chapdelaine, P.Geo
Digging Method: Case 303.5E2 Excavator

Date: August 14, 2024
Page 1 of 1

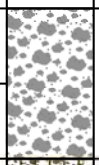
1900 Boxwood Road,
Nanaimo, BC, V9S 5Y2
Phone: 250-756-0355
Fax: 250-756-3831
Email: geotech@lewkowich.com

Lewkowich Engineering Associates Ltd.

TEST PIT LOG

File Number: E3577 TP24-04
Client: Raven Point Project LP
Project: Raven Point Marina, 4760 Brenton Page Road
Location: Ladysmith, B.C.

Coordinates: 49.012120 N, -123.8225266 W

Depth (m)	Soil Symbol	Description
		Ground Surface
0.0		0.0-0.2m Crushed gravel, trace sand, grey, compact, dry [Driveway Crush]
		0.2-0.6m Silty sand, some rock rubble, asphalt, compact to dense, brown, moist [FILL]
0.5		
		Refusal on bedrock at 0.60m. No groundwater seepage encountered.
1.0		
1.5		

Logged By: Spencer Woodward, GIT
Reviewed By: Louis Chapdelaine, P.Geo
Digging Method: Case 303.5E2 Excavator

Date: August 14, 2024
Page 1 of 1

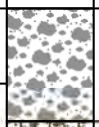
1900 Boxwood Road,
Nanaimo, BC, V9S 5Y2
Phone: 250-756-0355
Fax: 250-756-3831
Email: geotech@lewkowich.com

Lewkowich Engineering Associates Ltd.

TEST PIT LOG

File Number: E3577 TP24-05
Client: Raven Point Project LP
Project: Raven Point Marina, 4760 Brenton Page Road
Location: Ladysmith, B.C.

Coordinates: 49.0117549 N, -123.8218782 W

Depth (m)	Soil Symbol	Description
		Ground Surface
0.0		0.0-0.15m Crushed gravel, trace sand, grey, compact, dry [Driveway Crush]
		0.15-0.35m Silty sand, some rock rubble, compact to dense, brown, moist
		Refusal on bedrock at 0.35m. No groundwater seepage encountered.
0.5		
1.0		
1.5		

Logged By: Spencer Woodward, GIT
Reviewed By: Louis Chapdelaine, P.Geo
Digging Method: Case 303.5E2 Excavator

Date: August 14, 2024
Page 1 of 1

1900 Boxwood Road,
Nanaimo, BC, V9S 5Y2
Phone: 250-756-0355
Fax: 250-756-3831
Email: geotech@lewkowich.com

Lewkowich Engineering Associates Ltd.

TEST PIT LOG

File Number: E3577 TP24-06
Client: Raven Point Project LP
Project: Raven Point Marina, 4760 Brenton Page Road
Location: Ladysmith, B.C.

Coordinates: 49.0116306 N, -123.8219429 W

Depth (m)	Soil Symbol	Description
		Ground Surface
0.0		0.0-0.15m Silty sand, some organics, compact, dark brown, dry
		0.15-0.75m Silty sand, some rock rubble, compact to dense, brown, moist
0.5		
		Refusal on bedrock at 0.75m. No groundwater seepage encountered.
1.0		
1.5		

Logged By: Spencer Woodward, GIT
Reviewed By: Louis Chapdelaine, P.Geo
Digging Method: Case 303.5E2 Excavator

Date: August 14, 2024
Page 1 of 1

1900 Boxwood Road,
Nanaimo, BC, V9S 5Y2
Phone: 250-756-0355
Fax: 250-756-3831
Email: geotech@lewkowich.com

Geohazard Assurance Statement

For Development Approvals and Building Permits

Please complete this form in its entirety. If fields are left blank or responses are inconsistent, the form will be returned.

A. Project Information

Date February 20, 2025 CVRD File No. _____

Property Information

Project Name & Description Ravine Point Marina

Legal Description Lot A Section 2, Oyster District Plan, VIP 86097

Site Address 4760 Brenton Page, Ladysmith, BC PID 027-772-900

Client Information

Name Raven Point Project LP

Role (check on or more) ☑ Property Owner ☐ Developer ☐ Other _____

Client Address 2965 Norman Road, Nanaimo, BC, V9X 1K5

Qualified Professional

Name Louis Chapdelaine, P.Geo

EGBC Designation(s) ☐ P.Eng. ☑ P. Geo. ☐ Eng.L ☐ Geo.L

Firm Name[1] Lewkowich Engineering Associates Ltd.

Email Address lchapdelaine@lewkowich.com

Phone Number(s) 250-756-0355

Mailing Address 1900 Boxwood Road, Nanaimo, BC V9S 5Y2

Geophysical Hazard Risk Assessment Report Reference (the Report)

Title Geotechnical Hazard Assessment - E3577.01r01 Date October 2, 2024

1. The Qualified Professional is a representative of the firm, and submits this Assurance Statement on behalf of the firm.

B. Assurance

Based on the contents of this Assurance Statement and the Report, I hereby give assurance that *(check as applicable)*:

☑ **Development Permit:**	The Report will "assist the local government in determining what conditions or requirements under [Section 920] subsection (7.1) it will impose in the permit", as required by the Local Government Act (Sections 488 and 489).
☑ **Building Permit:** ☐ Community Charter ☐ Seismic Slope	"The land may be used safely for the use intended" , as required by the Community Charter (Section 56), The Report addresses the requirements of the BC Building Code 2006, 4.1.8.1.6 (8) and 9.4.4.4 (2), as detailed in the BC Building & Safety Policy Branch Information Bulletin B10-01, Jan 18, 2010
☐ **Floodplain Management Bylaw Exemption:**	"The land may be used safely for the use intended", as required by the Local Government Act (Section 524).
☐ **Subdivision**	The land may be used safely for the use intended", as required by the Land Title Act (Section 86).
☐ **Other:** *(e.g. Zoning Bylaw Amendment Official Community Plan Amendment Temporary Use Permit, etc.)*	Insert statement as appropriate:

C. EGBC Professional Practice Guidelines

The Report and this Assurance Statement were completed in accordance with the current version of one or both of the following Professional Practice Guidelines issued by the Engineers and Geoscientists of BC (EGBC):

- *2018 Legislated Flood Assessments in a Changing Climate in BC, and*
- *2010 Legislated Landslide Assessments for Proposed Residential Development in British Columbia" ("EGBC Landslide Guidelines").*

These two documents are collectively referred to as the "EGBC Guidelines". The italicized words in this Assurance Statement are defined in the EGBC Guidelines.

The Report has been prepared pursuant to the following EGBC Guidelines *(check one or both as applicable)*.

☑ EGBC Flood Guidelines

☑ EGBC Landslide Guidelines

D. Background Information

Qualified Professionals **must** confirm and check that each item is included in the Report.

☑ 1. Property location map — 8.5 x 11 size, *Show the spatial extent of hazard assessment zones.*

☑ 2. Development proposal site plan — 8.5 x 11 size. *Show the spatial extent of the study area, the hazard area and locations of mitigative features, where applicable. If a subdivision, show the parent parcel and all lots to be created, including any remainder.*

☑ 3. Description of the proposed development project (including building use) to the extent this is known at the time of Report preparation. *Specify ALL that apply.*

- ☑ residential
- ☐ industrial
- ☑ commercial
- ☐ institutional
- ☐ other _____

If the Report deviates materially from the appropriate EGBC Guidelines, please explain.

E. Technical Requirements

Qualified Professionals must review, confirm and check completed items (as pertinent).

Report Content

The Report contains the following items:

☑ 4. Relevant information pertaining to the Property and pertinent potential hazards from appropriate background sources, including the CVRD online library.

☑ 5. Complete listing of previous reports and other relevant information that has been reviewed in preparing the Report, including that from the CVRD online library.

☑ 6. Maps, illustrations and diagrams to illustrate areas referred to in the Report.

☑ 7. Description of field work conducted on and, if required, beyond the Property.

☐ 8. Contact and consultation with the Cowichan Valley Regional District. Provide name and title of contact:

_____

☑ 9. Review of relevant CVRD bylaws and other statutory requirements.

☑ 10. Restrictive covenants registered against the Property title that pertain to geohazards (if registered, the Report provides relevant information about the covenants).

☑ 11. Notation of any visibly apparent geohazards identified in background reports, which are not identified and addressed in the Report.

○ Yes ◉ No

Comment: All identified natural hazards addressed.

☑ 12. Does the Report rely on one or more Supporting Reports, each of which is independently reviewed, signed and sealed.

○ Yes ◉ No

If yes, have the supporting reports been reviewed by:

○ staff of the Report author's company; or

○ a third party?

☐ 13. For subdivision approval, the Report addresses geohazards for:

☐ the parent parcel prior to subdivision; and

☐ any lots to be created (including any remainder)

☐ adjacent properties representing a source of hazard, or are relevant to include in assessment of risk transfer with the proposed lot

Geohazard Assessment, Risk Acceptability and Risk Transfer

☑ 14. In considering the above-noted potential hazards that may affect the property, I have:

- ☑ reviewed and characterized the potential hazard(s);
- ☑ estimated the potential frequency and magnitude of the potential hazard(s);
- ☐ relied on Supporting Report(s) as noted above;
- ☐ relied on a pre-existing assessment of hazard frequency and magnitude;
- ☑ considered the potential effects of climate change in the context identified in the Report;
- ☑ considered the potential effects of changed future conditions (upstream watershed changes, forestry activity, land use changes, sea level rise, etc.) in the context identified in the Report.

☑ 15. This Assurance Statement pertains to all geohazards that are assessed in the Report and any Supporting Reports, and accurately reflects the contents of those documents.

☑ 16. The CVRD has adopted 'Natural Hazard Life Loss Policy", which provides a specific level of geohazard risk tolerance. I have included a geohazard risk tolerance table in the form presented in Section H, and which:

- ☑ lists all of the potential hazards addressed by the Report and any Supporting Reports;
- ☑ provides an annualized loss of life frequency and acceptability threshold classification (ALARP/ Unacceptable) for the unmitigated condition;
- ☐ proposes mitigative measures to appropriately reduce the geohazard risk if the quantified geohazard risk exceeds thresholds considered intolerable by the CVRD; and
- ☐ provides an annualized loss of life frequency and acceptability threshold classification (ALARP/Unacceptable) for the mitigated condition (the residual risk).

☐ 17. Following consultation with the CVRD, the Report proposes an alternative approach to risk reduction.

☑ 18. The Report describes the potential transfer of geohazard risk to other properties or infrastructure as a result of the proposed project *(including any proposed structural mitigation works)* and:

- ☑ considered the potential for transfer of geohazard risk;
- ☑ concludes that there is no transfer of geohazard risk;
- ☐ identifies the potential transfer of geohazard risk and proposes measures to offset such risk transfer.

Mitigation and Design Recommendations

The Report contains the following items:

☑ 19. Clearly identified building locations which are acceptable according to risk tolerance standards, ancillary structures, and onsite utility services (as applicable, such as a septic field) out of the geohazard area as a preferred development alternative.

☐ 20. Implementation steps for the identified mitigation works (in terms of design, construction and approval).

☐ Not Applicable

☐ 21. Commentary on the effectiveness of proposed mitigation works in terms of risk reduction and identify residual risks, and identification of any residual risk.

☑ 22. Proposed Flood Construction Level (FCL) for future development, including specification of an appropriate technique of achieving the FCL.

☑ 23. Proposed watercourse or marine shoreline setback, which is clearly referenced from the natural boundary, top of bank or high tide line.

☐ Not Applicable

☐ 24. A reference to proposed operation and maintenance actions that will be necessary in order for the level of safety to be maintained in the future, with indication of who should be responsible for those actions and when.

Riparian Area Regulation (if applicable)

☑ 25. If a Riparian Area Regulation assessment has been completed for the property, and it has been reviewed to identify and avoid conflict with Report recommendations for hazard mitigation.

○ Yes ○ No ○ Uncertain

Reviewer

☑ 26. The Report has received appropriate technical review which is consistent with the EGBC Professional Practice Guidelines, and the name of the reviewer is noted in the Report and below (insert name and professional designation):

Name Chris Hudec, M.A.Sc., P.Eng.

EGBC Designation(s) ☑ P.Eng. ☐ P. Geo. ☐ Eng.L ☐ Geo.L

F. CVRD Supplemental Requirements

The following points are understood by the Qualified Professional when submitting a Report:

- [x] 27. Permission is granted to the CVRD to use the Report in considering approval of the proposed development on the Property, provided that such permission is limited only to the proposed development project for which the Report was prepared.
- [x] 28. Methodology used in the Report is described in sufficient detail to facilitate a review of the study by CVRD staff or qualified third party professionals when necessary.
- [x] 29. This Assurance Statement may be relied upon for permitting purposes for a period of one year after submittal or until major earthworks or drainage diversions take place in the study area, whichever comes first. Beyond that time, CVRD should contact the QP for an updated Assurance Statement if needed.
- [x] 30. Professional liability insurance coverage of at least $1 million per claim is carried by the QP.
- [x] 31. Third party review or supplemental information may be required at the discretion of the CVRD.
- [ ] 32. Permission is granted to the CVRD to include the Report in the online CVRD geohazard report library (as background information, not for other parties to rely on).

H. Geohazard Summary Table

This geohazard risk assessment covers: (check one or both) ◉ Individual Risk Assessment ○ Group Risk Assessment

The geohazard report and/or any supporting reports addresses the following hazard types:

TYPE	YES	NO	NOT RE-VIEWED	SUPPORTING REPORT (have other reports pertaining to this property been referenced in the development of this assessment?) NO	SUPPORTING REPORT YES	If YES Report: Name, Date & Author	RISK TOLERANCE THRESHOLDS Annual Risk of Fatality - Unmitigated	Acceptability Threshold Classification – Unmitigated: Unacceptable	Acceptability Threshold Classification – Unmitigated: ALARP	Proposed Mitigation Measures: YES	Proposed Mitigation Measures: NO	Annual Risk of Fatality – Mitigated	Acceptability Threshold Classification – Mitigated: Unacceptable	Acceptability Threshold Classification – Mitigated: ALARP
LANDSLIDE PROCESSES														
Rock Fall	☐	☑	☐	☐	☐			☐	☐	☐	☐		☐	☐
Rock Slide	☑	☐	☐	☑	☐		2% in 50 years	☐	☑	☐	☑		☐	☐
Rock Avalanche	☐	☑	☐	☐	☐			☐	☐	☐	☐		☐	☐
Debris Flow	☐	☑	☐	☐	☐			☐	☐	☐	☐		☐	☐
SNOW AVALANCHES														
Dry	☐	☑	☐	☐	☐			☐	☐	☐	☐		☐	☐
Wet	☐	☑	☐	☐	☐			☐	☐	☐	☐		☐	☐
FLUVIAL PROCESSES														
Inundation by Floodwaters	☐	☑	☐	☐	☐			☐	☐	☐	☐		☐	☐
Bank Erosion and Scour	☐	☑	☐	☐	☐		0.5% annu. exceedance	☐	☑	☐	☑		☐	☐
Sediment Deposition	☐	☑	☐	☐	☐			☐	☐	☐	☐		☐	☐
Surface Erosion	☐	☑	☐	☐	☐			☐	☐	☐	☐		☐	☐
MARINE PROCESSES														
Coastal Flooding	☑	☐	☐	☐	☑	NHC 2019.		☐	☐	☐	☐		☐	☐
Coastal Shoreline Erosion	☐	☑	☐	☐	☐			☐	☐	☐	☐		☐	☐
Tsunami – Earthquake Induced	☐	☑	☐	☐	☐			☐	☐	☐	☐		☐	☐
Tsunami – Submarine Landslide-Induced	☐	☑	☐	☐	☐			☐	☐	☐	☐		☐	☐
Tsunami – Subaerial Landslide-Induced	☐	☑	☐	☐	☐			☐	☐	☐	☐		☐	☐
EARTHQUAKE														
Ground Shaking	☐	☑	☐	☐	☐			☐	☐	☐	☐		☐	☐
Ground Rupture	☐	☑	☐	☐	☐			☐	☐	☐	☐		☐	☐
Liquefaction	☐	☑	☐	☐	☐			☐	☐	☐	☐		☐	☐
Ridgetop Spreading	☐	☑	☐	☐	☐			☐	☐	☐	☐		☐	☐
Co-seismic Landslides	☑	☐	☐	☑	☐		2% in 50 years	☐	☑	☐	☑		☐	☐

G. Qualified Professional (QP)

Prepared by: (QP of Record)

Name Louis Chapdelaine, P.Geo

Designation ☐ P.Eng. ☑ P. Geo. ☐ Eng.L ☐ Geo.L

Reviewed by:

Name Chris Hudec, M.A.Sc., P.Eng.

Designation ☑ P.Eng. ☐ P. Geo.

Professional Seal, Signature and Date:

☑ I am a Qualified Professional as defined in the EGBC Guidelines, and I fulfill the education, training and experience requirements as outlined in the EGBC Guidelines

☑ I have signed, sealed, dated and thereby certify, this Assurance Statement and the attached report.

INVASIVE SPECIES TABLE

1. Scotch Broom (CVRD Invasive Plant Species Strategy)
2. Spurge Laurel (CVRD Invasive Plant Species Strategy)
3. English Ivy
4. Himalayan Blackberry
5. Morning Glory
6. Periwinkle (to be retained as it helps secure the foreshore slope)
7. Aaron's Beard (to be retained as it helps secure the foreshore slope)

LANDSCAPE LEGEND

- Approximate Areas of Disturbance
- Areas of Retained Vegetation (Invasive Species Removed)
- Areas of Documented Invasive Species
- Retained Tree
- Removed Tree

Recommended Nursery Stock

Trees
Total: 19

Botanical Name	Common Name	Size
Acer macrophyllum	Big Leaf Maple	6cm cal.
Pseudotsuga menziesii	Douglas Fir	2M Ht.

Large Shrubs
Total: 183

Botanical Name	Common Name	Size
Holodiscus discolor	Oceanspray	#5 pot
Oemleria cerasiformis	Indian Plum	#5 pot
Ribes sanguineum	Red Flowering Currant	#3 pot
Rosa nutkana	Nootka Rose	#5 pot
Vaccinium ovatum	Evergreen Huckleberry	#5 pot

Medium Shrubs
Total: 110

Botanical Name	Common Name	Size
Mahonia aquifolium	Tall Oregon Grape	#5 pot
Symphoricarpos albus	Snowberry	#2 pot

Small Shrubs
Total: 177

Botanical Name	Common Name	Size
Gaultheria shallon	Salal	#1 pot
Mahonia nervosa	Low Oregon Grape	#1 pot

Perennials, Annuals and Ferns
Total: 161

Botanical Name	Common Name	Size
Achillea millefolium	Common Yarrow	#1 pot
Anaphalis margaritacea	Pearly Everlasting	#1 pot
Eriophyllum lanatum	Wooly Sunflower	#1 pot
Polystichum munitum	Sword Fern	#1 pot

Notes:
1. All work to be completed to current CSLA Landscape Standards
2. All soft landscape to be irrigated with an automatic irrigation system

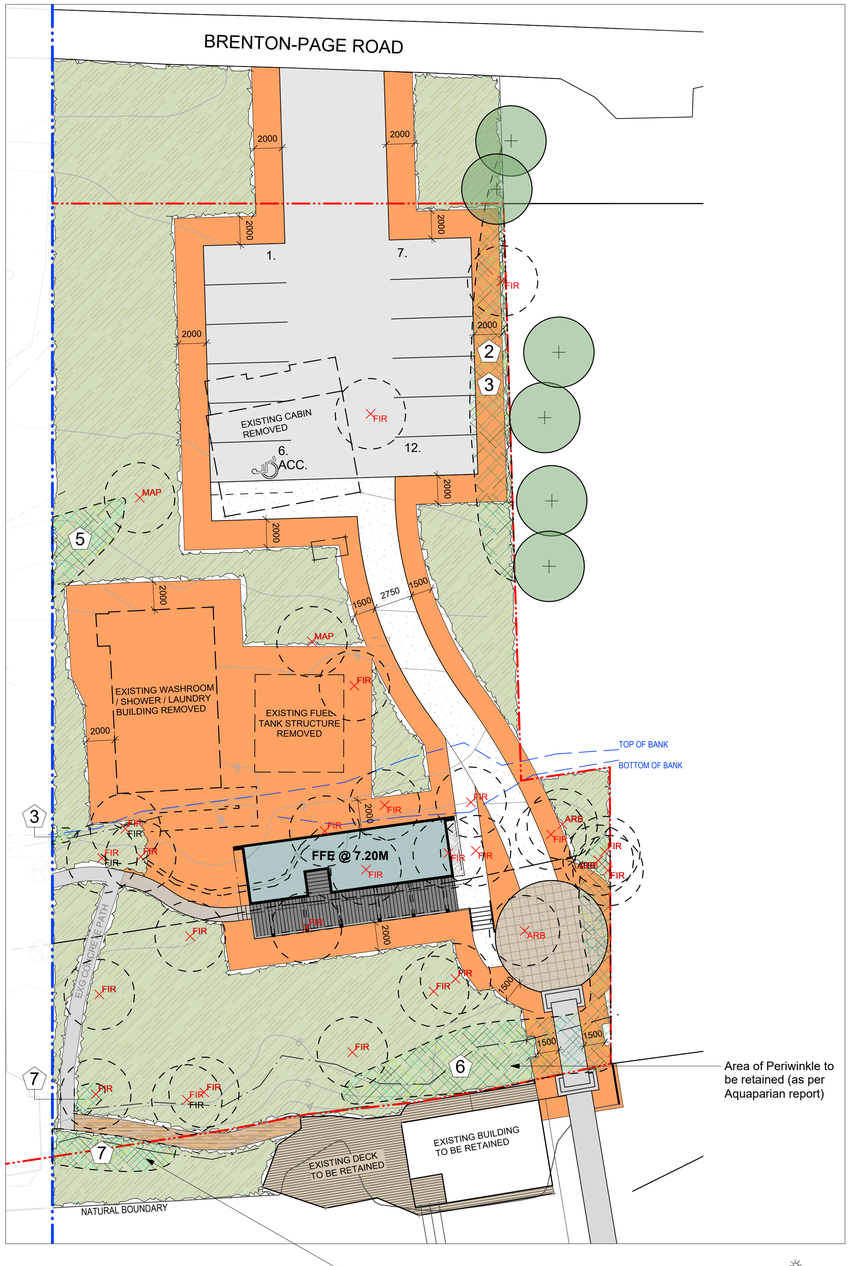
SUGGESTED NATIVE SPECIES LIST (PROVIDED BY AQUAPARIAN)

FORESHORE

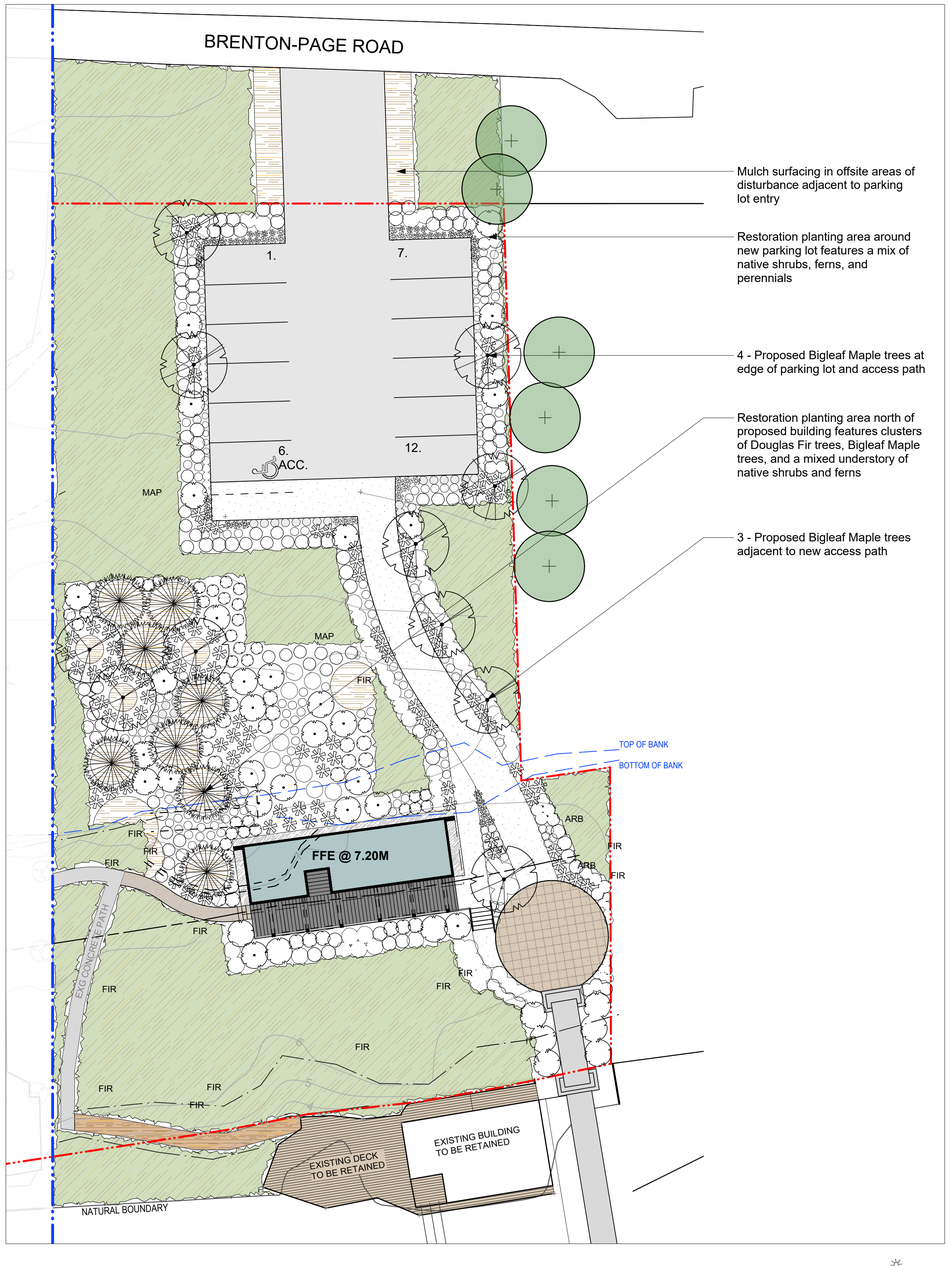
1. Beach pea (*Lathyrus japonicus*)
2. Seashore lupin (*Lupinus littoralis*)
3. Sea blush (*Plectritis congesta*)
4. Oceanspray (*Holodiscus discolor*)
5. Broadleaf stonecrop (*Sedum spathulifolium*)

UPLAND

1. Douglas fir (*Pseudotsuga menziesii*)
2. Bigleaf maple (*Acer macrophyllum*)
3. Nootka rose (*Rosa nutkana*)
4. Snowberry (*Symphoricarpos albus*)
5. Red-flowering currant (*Ribes sanguineum*)
6. Sword fern (*Polystichum munitum*)
7. Salal (*Gaultheria shallon*)
8. Dull Oregon grape (*Mahonia nervosa*)
9. Kinnikinnick (*Arctostaphylos uva-ursi*)
10. Coastal strawberry (*Fragaria chiloensis*)
11. Yarrow (*Achillea millefolium*)
12. Pearly everlasting (*Anaphalis margaritacea*)
13. Woolly sunflower (*Eriophyllum lanatum*)
14. Broadleaf stonecrop (*Sedum spathulifolium*)



1 Areas of Disturbance & Invasive Species
1:200



2 Landscape Concept Plan
1:200

SCHEDULE H

2	Feb 21-25	Reissued for Submission
1	Sept 5-24	Issued for Submission

REVISIONS

LADR LANDSCAPE ARCHITECTS
#3-864 Queens Ave. Victoria B.C. V8T 1M5
Phone: (250) 598-0105

PROJECT

Raven Point Marina
4760 Brenton Page Road
Ladysmith, BC

TITLE

Landscape Concept Plan

SCALE As Shown

DRAWN CW

CHECKED

PROJECT No.

DATE Sept 5-24

L1 of 1
SHEET