

**TECHNICAL ASSESSMENT FOR A NEW USE
GROUNDWATER LICENCE APPLICATION - LOT A,
SECTION 5, GABRIOLA ISLAND NANAIMO
DISTRICT, PLAN 21876 BRITISH COLUMBIA
_REV 1**

Submitted To:



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1.0 INTRODUCTION

1.1 Background

Silva Bay Resort and Marina (1167433 BC Ltd; the Client) is planning to expand their tourist commercial (TC-1) business, located on Lot A, Section 5, Gabriola Island Nanaimo District, Plan 21876 (the Site; Figure 1). An additional water supply is needed to supplement existing use from an unregistered/unlicensed groundwater well with Well Identification Number (WIN) 13370, located 500 m northwest of the Site on Lot 2, Section 5, Gabriola Island Nanaimo District, Plan 23322 (Figure 2).

In June 2019, the Client retained Waterline Resources Inc. (Waterline) to perform a Phase 1 groundwater assessment (Waterline, 2019), to determine if additional groundwater supply was available on the Site. Waterline identified WIN 25324, as a possible new use groundwater source at the Site.

Under the BC Water Sustainability Act (WSA; Government of BC, 2022), the Client is required to submit a new use groundwater licence application to the Ministry of Forests through Front Counter BC to obtain permission for diversion. In support of the application for groundwater use in British Columbia, a pumping test and desktop assessment are required to meet the Guidelines for Technical Assessment (Todd et.al, 2016). Waterline was retained by the Client to complete a pumping test at WIN 25324 and complete a desktop technical assessment to support the new use licence application.

1.2 Objective and Scope of Work

The objective was to determine the long-term safe yield of the water supply well and the potential for hydraulic connection to surface water sources or other groundwater users. To meet this objective, Waterline completed the following scope of work:

- Conducted a field verification survey of local land parcels near the Site to confirm the number of groundwater users in the area.
- Conducted a pre-pumping test at WIN 25324 to determine a suitable pumping rate for the subsequent constant rate pumping test.
- Conducted a 70-hour constant rate pumping test at WIN 25324 to confirm the sustainable well yield.
- Collected groundwater quality samples from WIN 25324 and an adjacent observation well with well tag number (WTN) 22523 for analytical testing.
- Monitored in situ field chemistry parameters at WIN 25324 during the constant rate pumping test to determine if groundwater conditions were changing with pumping.
- Analyzed the data obtained from the 70-hour constant rate pumping test to estimate aquifer hydraulic properties and predict the distance drawdown effects from the proposed groundwater diversion point.
- Reviewed the analytical data results to determine water types.

- Evaluated the potential for hydraulic connection between the water supply well and the local surface water features.
- Prepared this report summarizing the results of the technical assessment.

2.0 SETTING

2.1 Physiography

The Site is situated on the east end of Gabriola Island, and 8.5 km northeast of the municipality of Nanaimo (Figure 1). The Site consists of two marine-based lots (PID 359551 & 759740) and one land-based lot (PID 3354059; Figure 2). The land-based lot is 18.9 hectares and extends roughly 200 m inland from the shoreline. Ground topography gently slopes downward from west (South Rd) to east (Silva Bay shoreline), with relief of 33 m (Figure 2; Photographs A1 and A2 of Appendix A).

Land cover at the Site consists of grassed and forested areas including Douglas fir, Arbutus, and Western Red Cedars. The closest surface water body to the Site is a seasonal creek (Dick Brook - indefinite) located 900 m northwest of the Site. Dick Brook is within a different sub watershed from the Site and is separated from the Site by a ridge (40 metres above sea level; masl) which trends north to south. Dick Brook originates inland 3 km west of the Site and flow towards the north end of the island (Figure 2).

Gabriola Island is part of Vancouver Island East - Gulf Island watershed. Based on Environment Canada monitoring data obtained from the BC Ministry of Environment (ENV, 2019a) Water Tool, historical (date range of 1967 to 2011) average maximum temperatures for Gabriola range from 6.0°C (January) to 23.2°C (July). The historical monthly median precipitation ranges from 136 mm (December) to 22 mm (July).

2.2 Surficial and Bedrock Geology

Mapping by the province (ENV, 2013) indicates that the surficial sediment at the Site consists of glaciomarine deposits. Driller's log for registered groundwater wells onsite (see logs included in Appendix B), indicate that surficial sediments range from a veneer (<1 m) to blanket (>1 m) and are comprised of till and clay.

Bedrock exposures are seen along the shoreline and at inland locations where the soil cover is thin to nonexistent. Bedrock is mapped as the Upper Cretaceous Nanaimo Group (Gabriola Formation) comprised of pebble conglomerate, coarse- to fine-sandstone, siltstone, shale, and coal (Cui et. al. 2017; Figure 3).

2.3 Hydrogeology

A fractured bedrock aquifer (Aquifer reference #709) underlies the Site and extends across Gabriola Island (Figure 3). A summary of the aquifer details as referenced from Groundwater Wells and Aquifer database (GWELLS; ENV, 2019b), is included in Table 1.

Table 1: Description of Aquifer 709

Aquifer Information	Bedrock
Aquifer Name	Bedrock (Aquifer #709)
Aquifer Type	Partially Confined
Aquifer Material and Environment	Gabriola Formation
Aquifer Area (km ²)	46.8
Productivity	Low
Mean Depth to Groundwater (mbgl)	5.6
Mean Well Completion Depth (mbgl)	32.9
Mean Well Yield (m ³ /d)	20.7
Aquifer Vulnerability	High
Aquifer Use	Domestic
Comments	Bedrock exposures have been observed. The mean thickness of the confining layer is 2.4m. There are no well licences issued within the aquifer boundary.

Notes: mean is the Geometric mean value; mbgl is metres below ground level

Bedrock groundwater flow is controlled by regional pressure gradients that depend on the frequency and continuity of fractures (secondary porosity). Recharge to the aquifer is expected to be from precipitation where these fractures are exposed to surface. Aquifer vulnerability is rated as high due to the potential for seawater intrusion and the absence of a regionally continuous confining layer above bedrock.

Groundwater levels for Aquifer 709 are monitored at Provincial Groundwater Observation Wells (OW), with the closest monitoring locations being OW 197 and OW 316 (Figure 3). Data shows seasonal fluctuations between the winter (high piezometric head) and the summer (low piezometric head; ENV, 2019c). Manual groundwater levels recorded at WIN 25324 for the period of June to September 2019, range from 1.4 to 10.5 metres below ground level (mbgl), confirming seasonal changes (9.1 m) from the late spring to end of summer.

2.4 Local Groundwater and Surface Water Users

2.4.1 Registered Water Users within a 1-km Radius of WIN 25324

Waterline searched the GWELLS database to determine the number of registered groundwater wells and surface water users within a 1 km radius of WIN 25324. Search results returned 145 water wells and 3 surface water users. Two of the surface water users are registered to the same location (Figure 4). A summary of the results, with relevant well usernames, is provided in Table C1 of Appendix C. Of the 148 registered water users:

- 144 are listed as domestic use or unknown with only one well, WTN 5449, listed for commercial use (Page's Store). WTN 5449 is located 400 m southeast of WIN 25324 and is not licensed.
- Of the three surface water licenses, only one (C065734) is reported to be active, drawing water from Dick Brook.

3.0 METHODOLOGY

3.1 Field Verification Survey

The provincial water well database is known to be inaccurate since submission of well logs by water well drillers was voluntary prior to enactment of the WSA in 2016. In addition, the original property owner may have sold their property, but the wells database does not get updated with new owner's name. Wells listed in the database may have also been abandoned. For these reasons, field verification of wells is needed.

The Technical Assessment Guidelines (Todd et. al, 2016) suggest that the field verification survey for domestic users should include well owners within a 1-km radius of the proposed point of diversion (WIN 25324). However, considering the nature of the bedrock aquifer with fractures being randomly oriented and discontinuous over short distances, and the large number of well owners near the Site, Waterline exercised professional judgement and reduced the search area to surrounding properties only. This provided a realistic assessment of wells that could be affected by pumping at WIN 25324.

3.2 Well Testing Program

Waterline completed the well testing program at WIN 25324 (Photograph A3) in September (dry season). An electrical submersible pump was used for the testing (Photograph A4). Flow was redirected from the well through a 38.1 mm flexible hose. Flow rates were controlled with a ball valve and measured with using a 20 L pail (Photograph A5). The pumped water was discharged to ground in a wooded area 15 m downslope of the well casing (Photograph A6).

To monitor changes in groundwater levels during testing, a Solinst transducer with data logger was deployed in the pumping well (WIN 25324). Changes in groundwater levels were also monitored in an observation well (WTN 22523), located 25 m southwest of WIN 25324 (Figure 2). The data loggers at both wells were programmed to record readings at 1-minute intervals and were downloaded regularly throughout the test. Manual water level measurements were routinely recorded to verify the transducer data collected during the test.

The logger installed at WIN 25324 was a Solinst LTC logger capable of recording pressure, temperature, and electrical conductivity (EC). Having the ability to record EC, allowed Waterline to monitor the potential increases in salinity to determine if groundwater was under the influence of seawater given its proximity to the shoreline.

3.2.1 Pre-Pumping Test

Waterline completed a short duration pumping test at WIN 25324 to assess a reasonable pumping rate for the planned constant rate test. The pre pumping test was initiated at 12:20 on August 20, 2019, with the flow control valve open allowing for a constant flow rate of 54.5 m³/d. The pump was shut down at 12:48 on August 20, 2019, after 28-minutes of continuous flow. The pressure transducer was left in the well to monitoring recovery for 152-minutes, until groundwater levels reached near pre-pumping conditions.

3.2.2 Constant Rate Pump Test

The constant-rate test at WIN 25324 was initiated at 16:00 on September 3, 2019, with a constant flow rate of 14.2 m³/d (~25% of the pre pumping test rate). The pump was shut down on September 6, 2019, at 13:30 after 69.5-hours of continuous flow. Pressure transducers were left in the wells to monitor aquifer recovery for 141 hours (5.9-days) after pumping was stopped and until the groundwater level in WIN 25324 had reached greater than 90% of pre-pumping level.

3.3 Water Quality Sampling

Water quality samples were collected from WIN 25324 before, and at the end of, the constant-rate test to characterize changes in groundwater quality. All water samples were submitted to CARO Analytical Services in Richmond for analysis of the following parameters:

- Routine analysis including major ions;
- Total and dissolved metals; and
- Microbiological parameters.

3.4 Pumping Test Data Analysis

Waterline analyzed the pumping test data using the AQTESOLV, Version 4.50 Professional, Aquifer Test Design and Analysis Computer Software (HydroSOLVE, 2007). Assessment of the long-term sustainable yield of the well was completed using the modified Moell Q_{20} method (1975) as modified by Maathuis and van der Kamp (2005). This method allows for an assessment of the sustainable yield of the well over 20 years of pumping. Further details on the methodology for the above analyses are presented in Appendix D.

4.0 RESULTS

4.1 Field Verification Survey

Waterline personnel completed a field-verified survey of 23 residential properties that had a total of 30 documented water wells. A summary of locations visited, with information gathered is included in Table 2, with the verified well location identified on Figure 4.

Table 2: Results of Field-Verified Survey

Parcel Identification Number	Registered Well Tag Number(s)	Date Visited	Comment
30792606 (The Site)	13742, 22522, 122424, 22523, 21160	04/06/2019 16:00	Of the five wells identified onsite only three were identified and the others have been decommissioned
3081613	64284	04/06/2019 13:00	Well in good condition, no water issues
3347311	39667, 31803	04/06/2019 13:30	WTN 39667 only in use
3081621	23122	04/06/2019 14:20	Well in good condition, no water issues. Silva Bay existing use well.
3701859	28148	04/09/2019 14:10	No answer. Assumed ongoing water use
3701832	48475	04/09/2019 14:09	No answer. Assumed ongoing water use
3701867	91506	04/09/2019 14:05	No answer. Assumed ongoing water use
1386841	45043	04/09/2019 14:18	Well in good condition, goes dry in August
3701816	106526	04/09/2019 14:25	No answer. Assumed ongoing water use
3701875	49732, 64223	04/09/2019 14:02	No answer. Assumed ongoing water use
762199	91669	04/09/2019 14:27	No answer. Assumed ongoing water use
3701808	38657	04/09/2019 14:30	Well not in use
3701930	64407	04/09/2019 14:35	No answer. Assumed ongoing water use
3701751	51828	04/09/2019 14:39	No answer. Assumed ongoing water use
3701956	46723	04/09/2019 14:41	No answer. Assumed ongoing water use
3654508	69466	04/09/2019 14:42	No answer. Assumed ongoing water use
3654494	106566	04/09/2019 14:48	Well in good condition, no water issues
3701981	55705	04/09/2019 14:48	Well in use, information obtained for neighbor across the street
6100708	14865	05/09/2019 13:40	Commercial business is active, water system registered with VIHA. Assume well is in use
5844916	13864	05/09/2019 13:45	No answer. Assumed ongoing water use
24340987	32266	05/09/2019 13:55	No answer. Assumed ongoing water use
5843367	64224	05/09/2019 14:45	Well in good condition, no water issues
3641007	5435, 123444	05/09/2019 16:00	WTN 123444 only in use

The status of 17 wells was confirmed as part of this field verification survey. Well conditions varied from not in use, decommissioned, or in use. Only WTN 45043 had reported water quantity issues during the summer months.

4.2 Well Construction Details

A driller's log for WTN 22523, the observation well for the pumping test, is provided in Appendix B, however, there is no registered log for WIN 25324, the proposed water supply well. Waterline reached out to the registered drilling contractor identified by the Client (Windecker Water Well Drilling) to verbally document the well construction details and construction method. A summary of the drilling and completion details for WIN 25324 (pumping well) and WTN 22523 (observation well) are presented below in Table 3.

In completing the pre-pumping test to assess pumping rates for the constant rate test, Waterline was able to indirectly document the fracture network at WIN 25324 based on the well response

during pumping and recovery. This allowed the identification of the main water bearing fracture. An overview of the testing results and the mapped fractures are presented on Figure 5.

Table 3: Construction Details for Pumping and Observation Wells

Well Name		Pumping Well	Observation Well
Well Tag Number (WTN)		122424	22523
Well Plate ID Number (WIN)		25324	-
Completion Date (MMM-YYYY)		August - 1969	July - 1969
Drilling Contractor		Windecker Water Wells	
Land Parcel Identifier (PID)		30792606	
Location Relative to Pumping Well		-	28 m southwest
Location Relative to the Shoreline		170 m west	180 m west
UTM Coordinates (Zone 10)	Easting	448819	448811
	Northing	5444347	5444319
Aquifer Name		Aquifer 709	
Casing Inside Diameter (mm)		152	
Screen Type		Open Hole	
Borehole Total Depth (mbgl)		61.80	33.50
Casing Stick-up (magl)		0.35	0.00
Ground Elevation (masl)		31.00	30.00
NPWL (masl)*		20.46	20.59
Main Water Bearing Fracture (masl)		-10.87	2.56
Available Drawdown (m)		31.33	18.03

Notes: 'masl' means metres above sea level; 'magl' means metres above ground level; 'mbgl' means metres below ground level; NPWL means non-pumping water level * indicated NPWL measured on September 3, 2019; Available Drawdown is the distance from the non-pumping water level to the main water bearing fracture

4.3 Pumping Test Results

The water levels measured at WIN 25324 and WTN 22523 throughout the constant rate pumping test are shown on an overview plot (semi-log), included as Figure 6. At the end of pumping, the groundwater level at WIN 25324 was 2.1 masl, representing 18.1 m of drawdown from the start of the test or 58% of the total available head above the main water bearing fracture. After 6-days of non pumping, WIN 25324 had recovered to within 99% of pre pumping conditions (Figure 6).

Aquifer responses that were observed during the pumping and recovery periods include:

- During the drawdown portion of the test, steady-state conditions were observed at WIN 25324 during the first 100-minutes, corresponding to the draining of the uppermost water bearing fracture (elevation of 18.7 masl; Figure 6). During the recovery period at 5000-minutes, a similar response was observed as the fracture filled (Figure 6).
- At the 24-hour mark (1440-minutes) groundwater levels recovered at WIN 25324 and WTN 25223, potentially due to an unknown positive boundary (Figure 6). Pumping rates remained constant throughout this period.

- At the 48-hour mark (2880-minutes) when drawdown at WIN 25324 reached the depth of main water bearing fracture for WTN 22523 (2.6 masl; Table 3) there was a sudden change in groundwater elevations at both wells as the fracture was partially drained (Figure 6).
- Nearing the 72-hour mark (4,320-minutes) drawdown was reaching the middle water bearing fracture elevation of 0.8 masl (Figure 6). The lowermost and main water bearing fracture mapped at -10.9 masl was not encountered during the constant rate test (Figure 6).

4.3.1 Aquifer Parameter Estimates

The pumping test and recovery test data from WIN 25324 was used to determine representative aquifer characteristics. The results are presented in Table 4 and model plots are provided for reference in Appendix E (Figure E1 to E4).

Table 4: Summary of Aquifer Parameters

Figure Number	Solution	Pumping or Recovery Cycle	Aquifer Parameter	
			Transmissivity (m ² /d)	Specific yield (unitless)
Figure E1	Cooper-Jacob – Mid Time	Pumping Data	0.42	-
Figure E2	Cooper-Jacob – Late Time		0.82	
Figure E3	Cooper-Jacob (Agarwal)	Recovery Data	0.98	
Figure E4	Moench	Pumping Data	0.42	0.3

Notes: m²/d means square meter per day

The Cooper-Jacob (1946) and Agarwal (1980) solutions for an unconfined aquifer were used to estimate the aquifer transmissivity. Waterline assessed the middle and late-time pumping responses, and recovery data from WIN 25324, to document a range in aquifer transmissivities values, assuming infinite acting radial flow, not influenced by wellbore storage (see Table 4). The middle time pumping data was found to be the most representative of aquifer conditions based on the best overall fit (see Figure E1). However, as the response to pumping from WIN 25324 was generally uncorrelated at WTN 22523 (observation well) due to the muted hydraulic connection, a realistic specific yield value could not be estimated during the evaluation of aquifer parameters.

For further verification of the aquifer hydraulic properties, the pumping test data was also analysed using the Moench solution (1997; Table 4).

4.4 Sustainable Well Yield (Q₂₀) Calculation

The Modified Moell method (1975) developed by van der Kamp and Maathuis (2005) was applied to estimated aquifer parameters to predict the long-term sustainable yield (Q₂₀) for the water supply well. Using the forward solution in Aqtesolv (Figure E5), the theoretical drawdown at the tested rate was predicted for 100-minutes (S_{100mins theor}) and 20-years (S_{20yrs theor}). Table 5 summarizes the input parameters, and the calculation indicates that the water supply well could sustain continuous pumping at a rate of 9 m³/d or 3,285 cubic meter per year (m³/y), over a 20-year period, pumping 24 hours per day, 365 days per year.

Table 5: Q₂₀ Calculation Input Parameters

Parameter	Unit	WIN 25324
Tested pumping rate (Q)	m ³ /d	14.2
Available drawdown (Ha)	m	31.3
Measured drawdown after 100 minutes (S _{100mins})	m	3.7
Theoretical drawdown after 100 minutes (S _{100 mins theor})	m	6.6
Theoretical drawdown after 20 years (S _{20yrs theor})	m	37.7
Transmissivity	m ² /d	0.42
Theoretical 20-year sustainable yield (Q₂₀)	m³/d	9.0

Notes: m²/d means square meter per day; m³/d means cubic metres per day; Available Drawdown indicates the distance from the non-pumping water level to the main water bearing fracture

4.5 Predicted Distance Drawdown Calculations

Using the forward solution in Aqtesolv (Figure E6), drawdown in the aquifer was conceptualized at various distances (25 m, 50 m, 75 m, and 100 m) from WIN 25324 (pumping center) using the Q₂₀ rate of 9.0 m³/d (Table 6). These estimates of drawdown are conservative and do not consider annual recharge, known to occur throughout the wet season. The simulated distances were chosen to help understand impacts to adjacent groundwater users identified during the field verified survey.

Table 6: Distance Drawdown Results from Pumping at WIN 25324

Distance (m)	Drawdown After 20-year of Pumping at the Requested Rate of 9 m ³ /d (m)
0.1 (Pumping Center)	23.9
25	4.1
50	1.7
75	0.3
100	0.0

4.6 Groundwater Chemistry

4.6.1 Laboratory Results

Key groundwater quality results from WIN 25324, collected before and at the end of the aquifer testing program are presented in Table 7. Complete groundwater quality tables (Table F1 to F5) and the laboratory reports are included in Appendix F.

The water quality results are compared with the Guideline for Canadian Drinking Water Quality (GCDWQ, Health Canada, 2019) to provide the reader with a reference to gauge its potability. The GCDWQ set standards based on aesthetic objectives (AOs) and on maximum acceptable concentrations (MACs).

Table 7: Summary of Groundwater Quality

Sample Location	Units	Guidelines		WIN 25324	
Sample Date		GCDWQ AO	GCDWQ MAC	2019-08-21	2019-09-06
Lab ID				9082105-01	9090600-01
General Chemistry					
Colour	TCU	15	-	51	10
Conductivity (EC)	µS/cm	-	-	415	450
Total Dissolved Solids	mg/L	500	-	240	248
Turbidity	NTU	0.1	-	115	4.38
pH		7-10.5	-	7.57	8.04
Major Ions					
Bicarbonate (HCO3)	mg/L	-	-	195	194
Carbonate (CO3)	mg/L	-	-	<0.600	<0.600
Calcium (Ca)	mg/L			3.95	4.37
Chloride (Cl)	mg/L	250	-	31.6	39.6
Hydroxide (OH)	mg/L			<0.340	<0.340
Magnesium (Mg)	mg/L			1.62	1.88
Potassium (K)	mg/L			0.18	0.24
Sodium (Na)	mg/L	200	-	92.9	90.8
Sulphate (SO4)	mg/L	500	-	12.2	13.7
Microbiology					
E. coli	CFU or	-	0	<10	<1.1
Total Coliform	MPN/100 mL	-	0	<10	<1.1

Notes: Guidelines - Health Canada, June 2019, Guidelines for Canadian Drinking Water Quality (GCDWQ); **Yellow highlight** - Value exceeds the Maximum Acceptable Concentration (MAC); **Violet highlight** - Value exceeds the Aesthetic Objectives (AO); 'TCU' means true color units; 'NTU' means Nephelometric Turbidity Units; 'µS/cm' means micro siemens per centimetre; 'mg/L' means milligram per litre; 'CFU' means colony conforming unit; 'MPN' means most probable number

Based on the analytical chemistry results from WIN 25324:

- Turbidity remained above the AO during testing, while color improved meeting the GCDWQ guidelines and the end of the test (Table 7). As both turbidity and color improved during testing, this is indication that initial sample results are more characteristic of wellbore conditions.
- Groundwater is characterized as a sodium-bicarbonate type with an average total dissolved solids (TDS) concentration of 244 milligram per litre (mg/L; Table 7).
- As seen on the Piper plot of the major ions (Figure 7), the groundwater chemistry remained consistent throughout the aquifer testing program, with a slight increasing shift in the percentage of the chloride ion. The groundwater type at WIN 25324 was compared with water samples collected from WIN 13370, located 500 m northwest of the Site on Lot 2, Section 5, Gabriola Island Nanaimo District, Plan 23322 (Figure 2). Both groundwater types are similar, providing some indication that groundwater flow regimes for this area are similar.
- Concentration for E. coli and total coliform bacteria from before and after testing indicated that bacteria could exist at WIN 25324 (Table 7)

4.6.2 Field Chemistry Results

During the constant rate pumping test, field chemistry parameters including temperature, EC and pH were measured at WIN 25324 using a handheld EC/pH meter (Hanna Pen). Continuous EC measurements were also collected using the Solinst LTC logger. A summary of the manual measurements is included in Table F6 of Appendix F. The EC measurements from the manual and continuous readings plotted graphically on Figure 8.

Results of the field chemistry monitoring indicate:

- Some variation in electrical conductivity (EC) was noted during the constant rate pump test (Figure 8). Manual values ranged from 390 to 431 micro-Siemens per centimetre ($\mu\text{S}/\text{cm}$) while continuous measurements ranged from 255 to 291 $\mu\text{S}/\text{cm}$ both increasing by 11 to 15%, respectively.
- However, EC remained below the threshold limit of 1000 $\mu\text{S}/\text{cm}$ listed in the Best Practices for Prevention of Saltwater Intrusion FLNRORD (2016).
- The calculated TDS concentrations from the measured EC values, had a maximum concentration of 261 mg/L, only slightly higher than the average value from laboratory analysis (244 mg/L) but below threshold limit of 700 mg/L (FLNRORD, 2016).

5.0 DISCUSSION AND CONCLUSIONS

WIN 25324 is located 170 m from the shoreline on the east side of Gabriola Island. One active surface water license and one non-domestic groundwater user were identified from the 148 registered locations within a 1-km radius of the Site. During the field-verification survey, 23 residential locations were visited and the status of 17 groundwater wells were documented. Some well yields have remained unchanged (WIN 13370) since the 1970s, with year-round use, while other wells (WTN 45043) have issues maintaining flow during the low recharge months. Well completion depths near the Site are variable and target various water-bearing fracture zones within the Gabriola Formation. Surface water is expected to drain from the center of Gabriola Island to the shorelines. Dick Brook is the closest freshwater body, which flows northward, located 900 m northwest of the Site. Surface water on the Site flows east, following topography and draining into the ocean.

WIN 25324 (pumping well) is an open borehole completion within the fractured bedrock aquifer (Aquifer #709). The aquifer is considered unconfined at the Site. A decreasing water level trend was observed from June to September (seasonal trend), which is consistent with water level data recorded at OW 197 and OW 316, the closest provincial observation wells.

Based on results from the pump testing, groundwater originates from several fractures, with the main water bearing fracture at a depth of 41.9 mbgl or -10.9 masl. The extent and interconnectivity of the fracture system is unknown. As such, the bedrock aquifer was considered as an equivalent porous media for the purpose of analyzing the well response, which suggests that a long-term sustainable yield (Q_{20}) for WIN 25324 is 9 m³/d. This assumes continuous pumping 24 hours per

day, 365 days per year. The well could also be used intermittently (i.e., discontinuous use) at a higher pumping rate for shorter periods of time (days) followed by longer periods of recovery.

Distance drawdown calculations based on 20-years of continuous pumping at 9 m³/d suggest that drawdown could be 0.3 m at 75 m from the pumping well, which is roughly the distance of the closest verified user (WTN 123444). However, the response to pumping from WIN 25324 as observed at WTN 22523 was muted, indicative of the limited directional permeability between fractures in the vicinity of the pumping center.

Groundwater samples collected before and after the constant rate test plot as a sodium-bicarbonate type on the Piper plot. There was a slight increasing shift in the percentage of the chloride ion in the water sample collected at the end of the pump test compared to at the start of the test. Continuous monitoring of EC also showed an increasing trend throughout the test, suggesting some evidence of potential salinization. However, groundwater chemistry at WIN 25324 remained consistent with freshwater conditions throughout the pumping period as the EC and calculated TDS concentrations were lower than the threshold limits indicative of saltwater intrusion.

In conclusion, the results of this assessment suggest that WIN 25324 can support a long-term sustainable yield of 9 m³/d. Groundwater diversion should not negatively impact adjacent users or the environmental flow needs of Dick Brook. There are some slight changes in groundwater chemistry which could indicate some salinization, however, ongoing monitoring is required to confirm this trend.

6.0 RECOMMENDATIONS

As part of the conditional use license approval and commissioning of the water supply well (WIN 25324), the Client should:

- Monitor groundwater use and groundwater levels by installing a flow meter with long-term data logging capabilities and a dedicated pressure transducer;
- Monitor groundwater chemistry by installing an EC probe to confirm changes in groundwater salinity;
- Review the monitoring data on an annual basis to assess aquifer and well performance over time; and
- Develop an adaptive management plan for the operation of WIN 25324 based on the principles for preparing an adaptive management plan listed in provincial guidance document (ENV, 2022). Threshold limits for certain groundwater chemical parameters (EC, TDS) and groundwater levels (70% of the available head; near sea level) should be enforced in the conditional use license and adjusted in the future following the review of monitoring data.

7.0 CERTIFICATION

This document was prepared under the direction of a professional geoscientist registered in the Province of British Columbia.

Waterline Resources Inc. trusts that the information provided in this document is sufficient for your requirements. Should you have any questions or concerns, please do not hesitate to contact the undersigned.

Respectfully submitted,

Waterline Resources Inc.
EGBC Permit No. 1000669

Reviewed By:

Original signed and stamped

Original signed

Simon Wing, P. Geo. (BC)
Hydrogeologist

Shermin Negari, M.Eng. P.Eng. (BC)
Hydrogeological Engineer

Original signed

Jan Michaelian, B.Sc., P.Geo.(BC)
Principal Hydrogeologist



8.0 REFERENCES

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Waterline Resources Inc. (Waterline). 2019. Silva Bay Resort – Phase 1 Hydrogeological and Water Supply Assessment. Submitted to Silva Bay Resort & Marina (1167433 BC Ltd.). July 19, 2019.

9.0 LIMITATIONS AND USE

The information presented in this document was compiled exclusively for 1167433 BC Ltd (the Client) by Waterline Resources Inc. (Waterline). This work was completed in accordance with the scope of work for this project that was agreed between Waterline and the Client. Waterline exercised reasonable skill, care, and diligence to assess the information acquired during the preparation of this document but makes no guarantees or warranties as to the accuracy or completeness of this information. The information contained in this document is based upon, and limited by, the circumstances and conditions acknowledged herein, and upon information available at the time of the preparation of this document. Any information provided by others is believed to be accurate but cannot be guaranteed. No other warranty, expressed or implied, is made as to the professional services provided to the Client.

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FIGURES

Figure 1: Location Map

Figure 2: Site Map

Figure 3: Bedrock Geology and Aquifer Map

Figure 4: Registered Surface Water and Groundwater Users Within 1-Km of WIN 25324

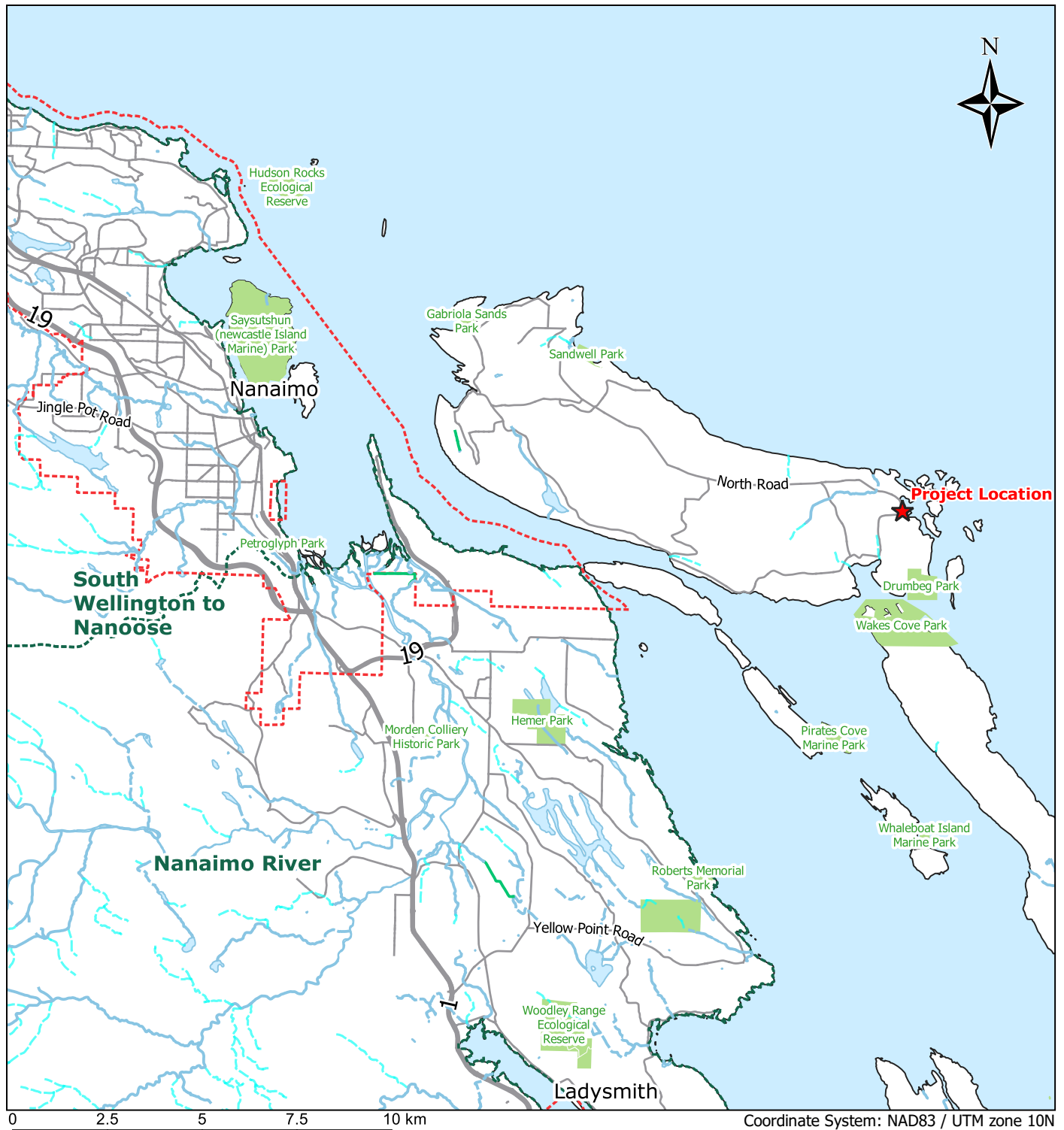
Figure 5: Pre-Pumping Test – Overview Chart

Figure 6: Constant Rate Pump Test - Overview Chart

Figure 7: Piper Plot

Figure 8: Trend Chart for Electrical Conductivity Measured during the Constant Rate Pump Test at WIN 25324

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- ★ Project Location
- Canal/Ditch
- River/Stream - Definite
- - - River/Stream - Indefinite
- · - · - River/Stream - Intermittent
- Road - Expressway / Highway
- Road - Arterial / Collector
- - - Municipality
- Protected Park
- Waterbody
- · - · - Water Region Boundaries

References:

Government of BC Ministry of Environment - Parks Planning and Management, 2015.
Contains information licensed under the Open Government Licence – British Columbia and the Open Government Licence – Canada

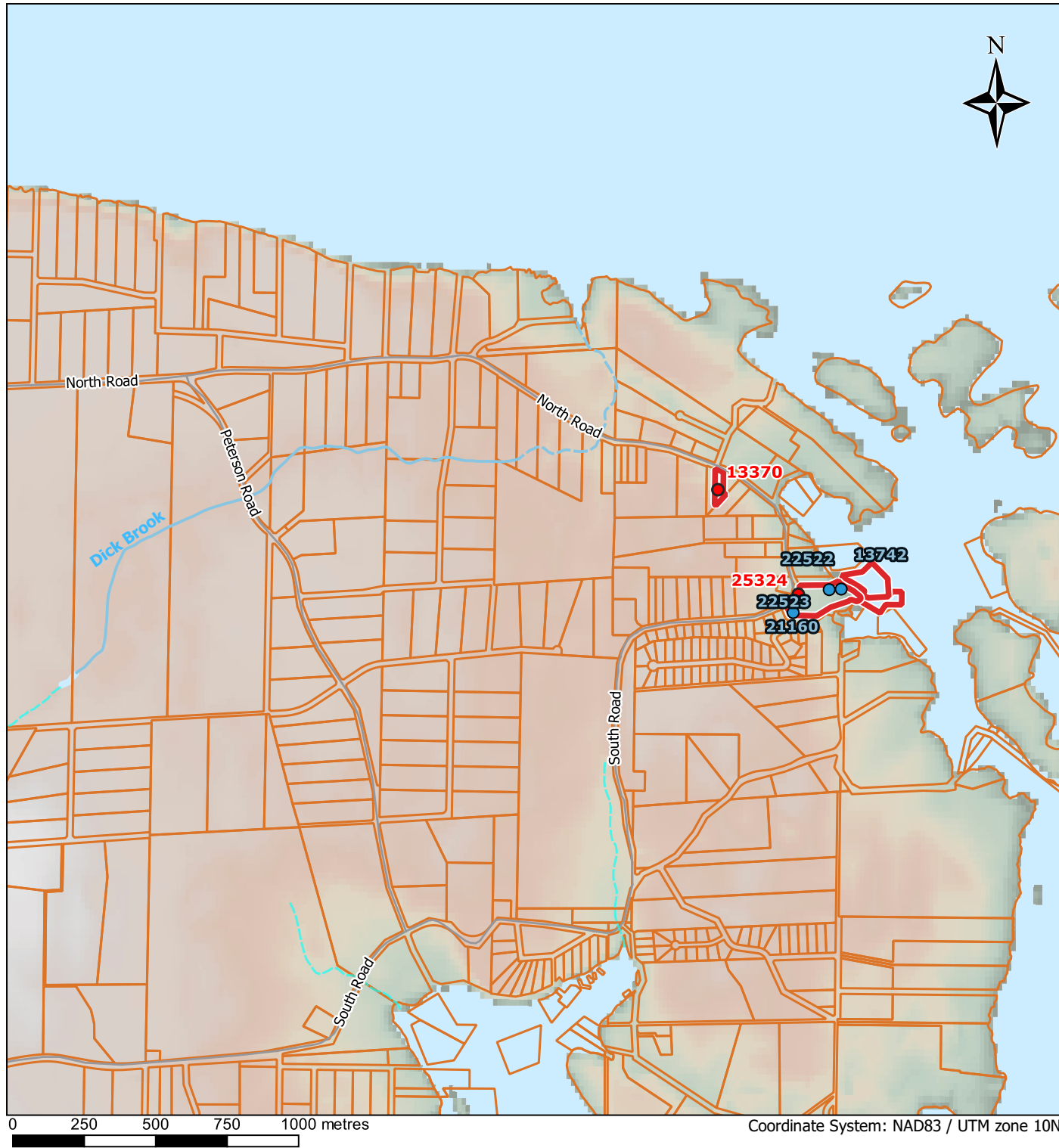
**Technical Assessment for a New Use Groundwater Licence Application
Lot A, Section 5, Gabriola Island Nanaimo District, Plan 21876, British
Columbia
Submitted to Silva Bay Resort and Marina**

LOCATION PLAN



Prepared By: Waterline Resources Inc.
Project Number: 3190-19-001
Compiled By: mscott
Date Issued: February 2023
Date Revised: --

FIGURE 1



References:

Canada digital elevation data. [computer file]. Ottawa, ON: Natural Resources Canada, 1997-1999.

Contains information licensed under the Open Government Licence – British Columbia and the Open Government Licence – Canada.

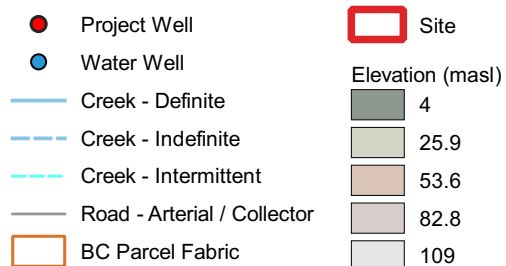
Technical Assessment for a New Use Groundwater Licence Application
Lot A, Section 5, Gabriola Island Nanaimo District, Plan 21876, British Columbia
Submitted to Silva Bay Resort and Marina

SITE PLAN

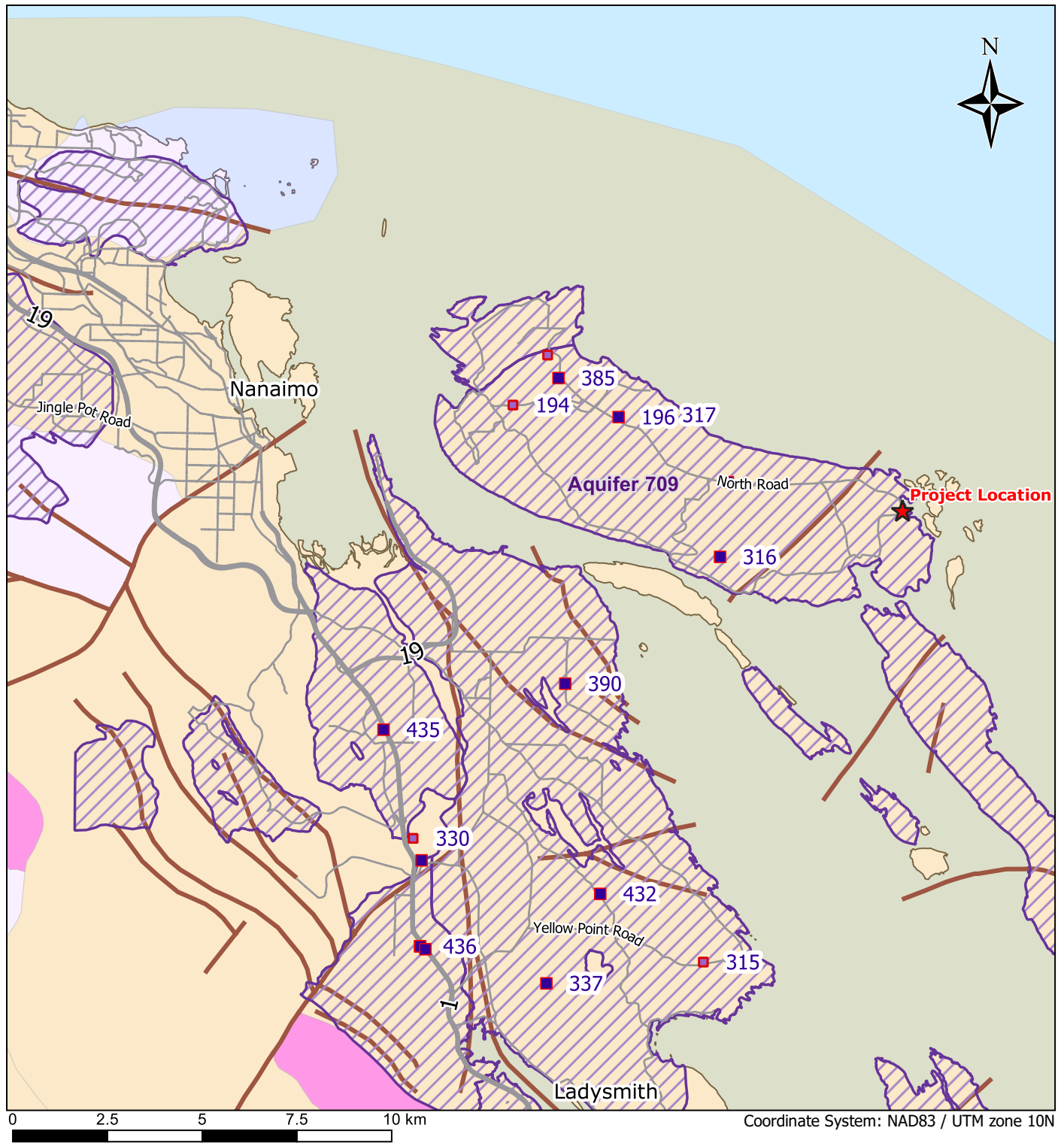


Prepared By: Waterline Resources Inc.
 Project Number: 3170-19-001
 Compiled By: Ian
 Date Issued: February 2023
 Date Revised: February 2023 [MS]

FIGURE 2



\\waterline\B\Projects\2019 PROJECTS\19-BC 1167433 BC Ltd. Silva Bay Hydrogeological Assessment\001 WIN 25324_Groundwater Supply & Testing\Data\Drafting\support\3190_figs_rev1.qgz



References:

Government of BC Ministry of Environment - Parks Planning and Management, 2015.
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Technical Assessment for a New Use Groundwater Licence Application
Lot A, Section 5, Gabriola Island Nanaimo District, Plan 21876, British Columbia
Submitted to Silva Bay Resort and Marina

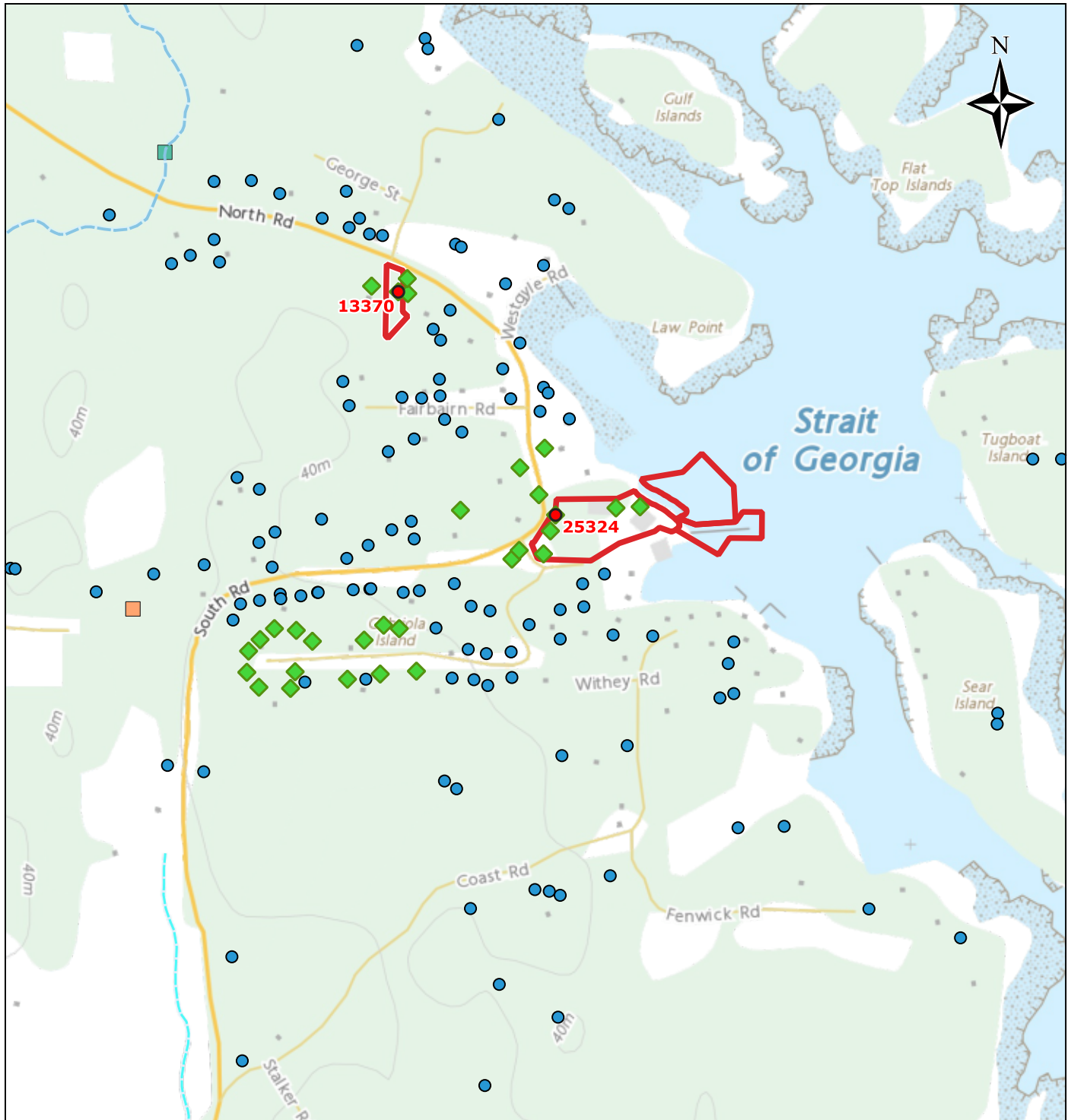
BEDROCK GEOLOGY and AQUIFER MAP



Prepared By: Waterline Resources Inc.
Project Number: 3190-19-001
Compiled By: mscott
Date Issued: February 2023
Date Revised: --

FIGURE 3

\\waterline\Projects\2019 PROJECTS\190-19-BC 1167483 BC Ltd. Silva Bay Hydrogeological Assessment\001 WIN 25324_Groundwater Supply & Testing\Data\Drafting\support\3190_fig_rev1.qgz



0 100 200 300 400 metres

Coordinate System: NAD83 / UTM zone 10N

- Project Well
- Water Well
- Active Surface Water Diversion
- Inactive Surface Water Diversion
- ◆ Field Verified Well
- River/Stream - Indefinite
- River/Stream - Intermittent
- Site
- Canada Base Map – Transportation

References:

Canada digital elevation data. [computer file]. Ottawa, ON: Natural Resources Canada, 1997-1999.

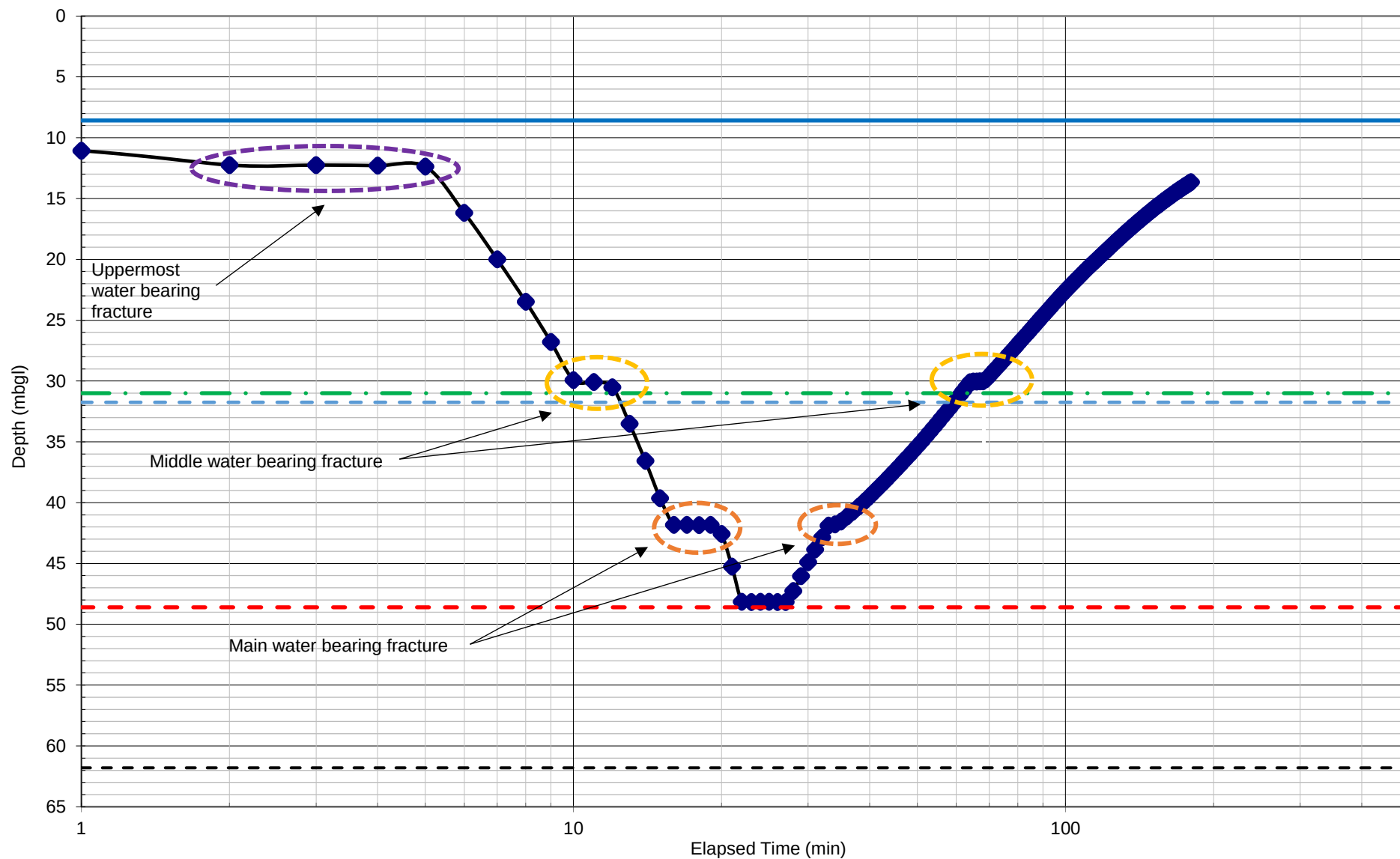
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**Technical Assessment for a New Use Groundwater Licence Application
Lot A, Section 5, Gabriola Island Nanaimo District, Plan 21876, British
Columbia
Submitted to Silva Bay Resort and Marina**

**REGISTERED SURFACE WATER and
GROUNDWATER USERS WITHIN 1-KM of WIN 25324**

	Prepared By: Waterline Resources Inc.
	Project Number: 3170-19-001
	Compiled By: mscott
	Date Issued: February 2023
	Date Revised: --

FIGURE 4



LEGEND:

◆ WIN 25324 Groundwater Level Data

— Sea Level

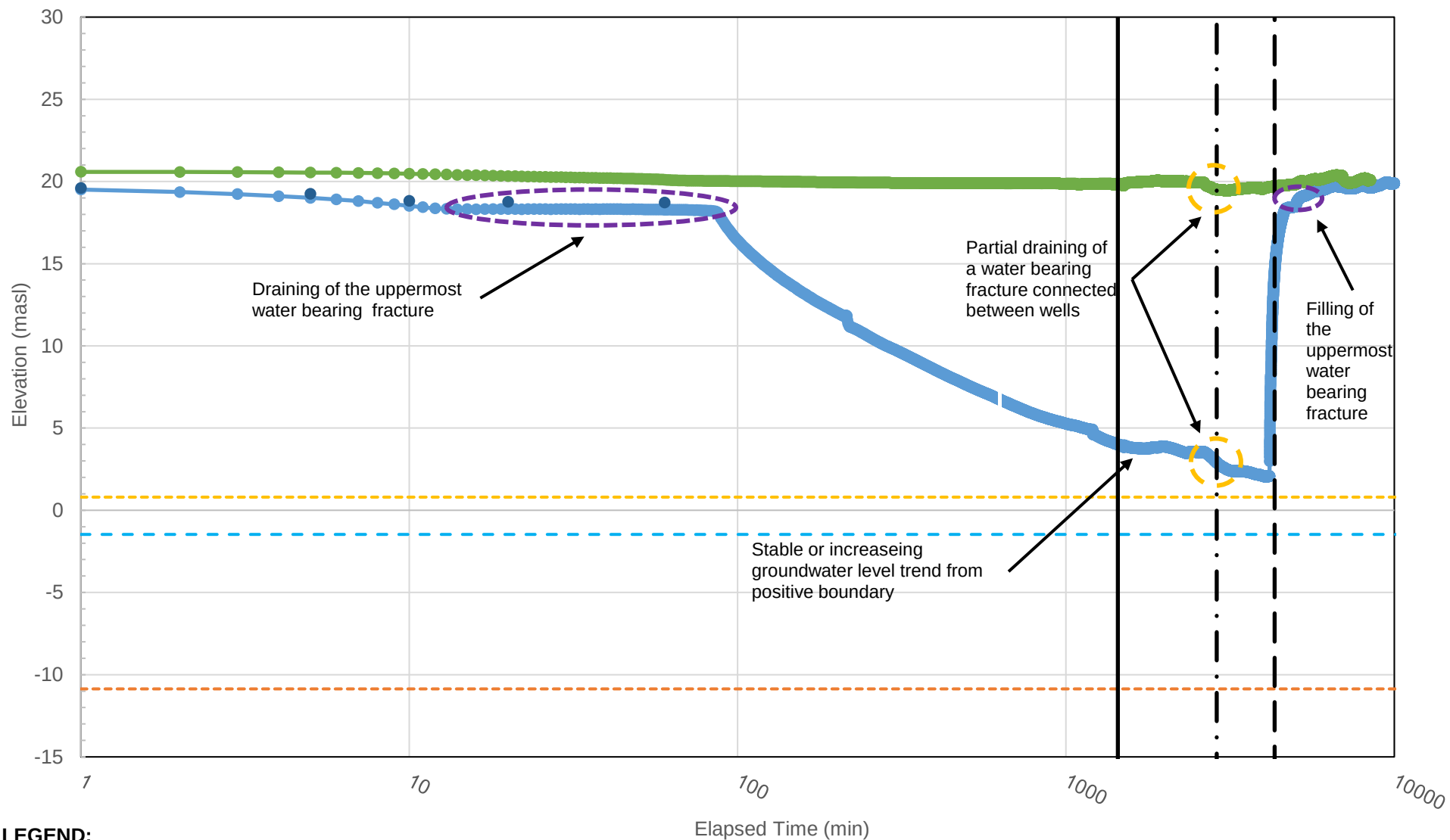
--- Pump Intake Depth

— Static WL - August 20, 2019

--- 70% Available Head Depth - August 20, 2019

--- Well Total Depth

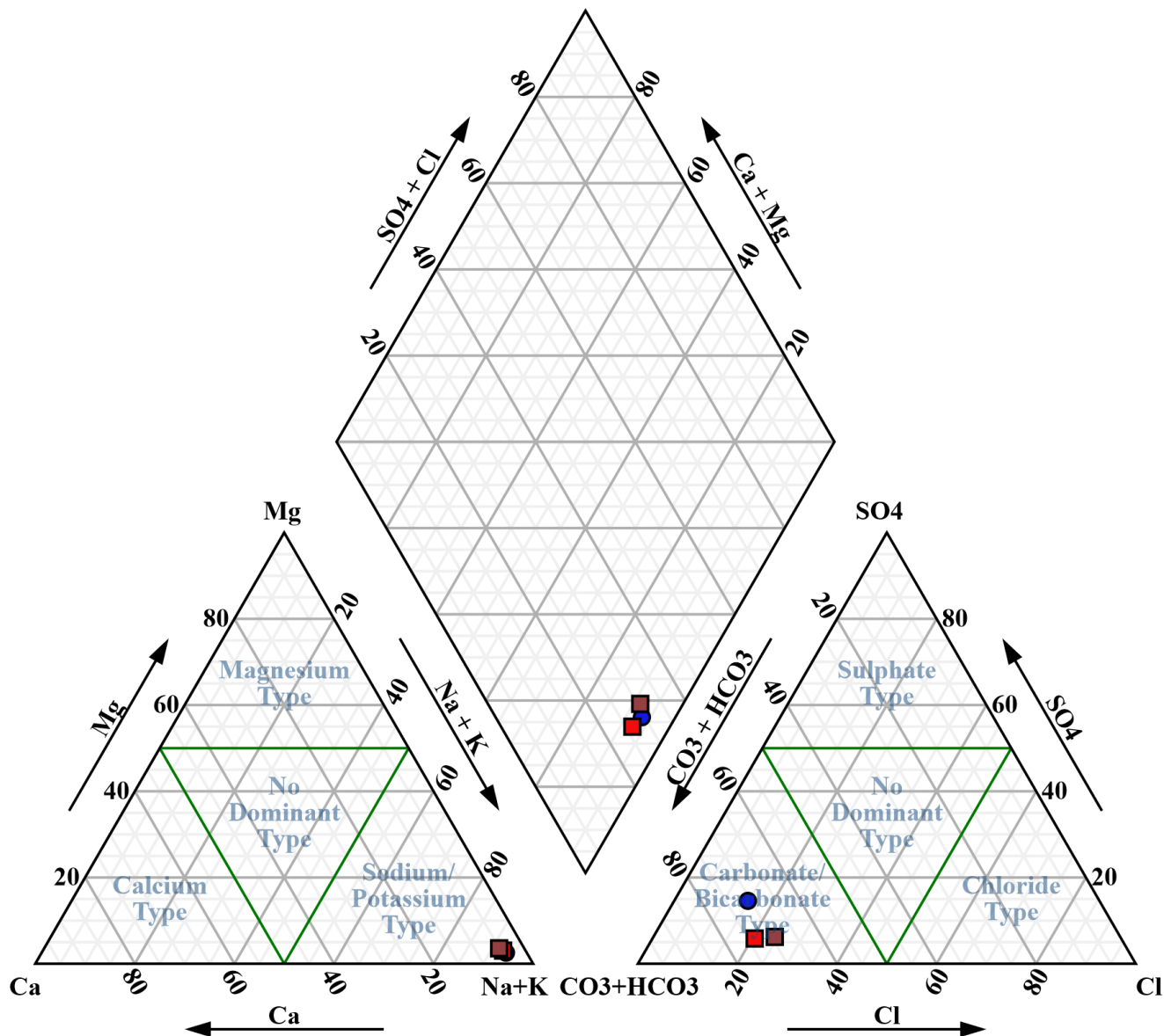
PROJECT		Technical Assessment for a New Use Groundwater Licence Application - Lot A, Section 5, Gabriola Island Nanaimo District, Plan 21876, British Columbia	
TITLE		PRE-PUMPING TEST - OVERVIEW CHART	
		PREPARED BY: Waterline Resources Inc.	FIGURE 5
		PROJECT: 3190-19-001	
		COMPILED BY: SW	
		DATE ISSUED: February 2023	
		REVISED: -	



LEGEND:

- WIN 25324 Groundwater Data
- WTN 22523 Groundwater Data
- Manual Groundwater Elevation @ WIN 25324
- - - 70% Available of Head Elevation @ WIN 25324
- - - Main Water Bearing Fracture Elevation @ WIN 25324
- - - Middle Water Bearing Fracture Elevation @ WIN 25324
- 24-hours
- 48-hours
- - - 72-hours

PROJECT Technical Assessment for a New Use Groundwater Licence Application - Lot A, Section 5, Gabriola Island Nanaimo District, Plan 21876, British Columbia		
TITLE CONSTANT RATE PUMP TEST - OVERVIEW CHART		
	PREPARED BY: Waterline Resources Inc.	FIGURE 6
	PROJECT: 3190-19-001	
	COMPILED BY: SW	
	DATE ISSUED: February 2023	
REVISED: -		



● WIN 13370
 WIN 25324
 ■ 2019-Aug-21 25234 - 9082105-01
 ■ 2019-Sep-06 03190190906001 - 9090600-01

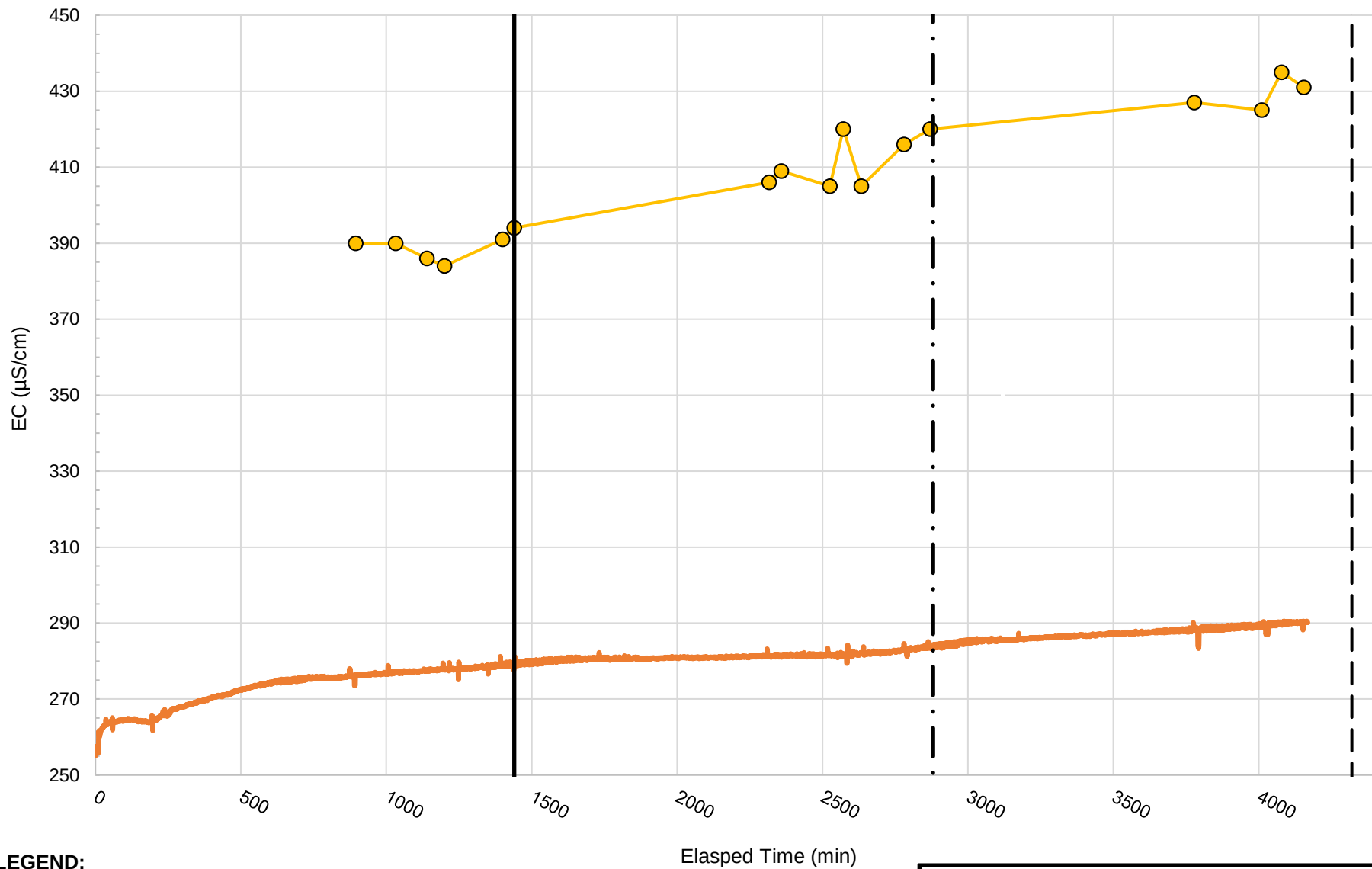
Technical Assessment for a New Use Groundwater Licence
 Application - Lot A, Section 5, Gabriola Island Nanaimo District,
 Plan 21876, British Columbia

PIPER PLOT



PREPARED BY: Waterline Resources Inc.
 PROJECT: 3157-19-001
 COMPILED BY: Hydrachem
 DATE ISSUED: 2023-Feb-10
 REVISED: -

FIGURE 7



LEGEND:

- Electrical Conductivity Values from WIN 25324 - Continuous Measurements
- Field Conductivity (EC) - Manual Measurements
- 24-hours
- • — 48-hours
- - - - 72-hours

PROJECT			Technical Assessment for a New Use Groundwater Licence Application - Lot A, Section 5, Gabriola Island Nanaimo District, Plan 21876, British Columbia		
TITLE			TREND CHART FOR ELECTRICAL CONDUCTIVITY MEASURED DURING THE CONSTANT RATE PUMP TEST AT WIN 25324		
			PREPARED BY: Waterline Resources Inc.		
			PROJECT: 3190-19-001		
			COMPILED BY: SW		
			DATE ISSUED: February 2023		
			REVISED: -		
			FIGURE 8		

Appendix A
Photograph Log



Photographs A1 (LEFT): Looking west, upslope towards South Road detailing topography and tree cover and some bedrock exposure near ground level. **Photograph A2 (RIGHT):** Looking east towards the shoreline and the site of the old restaurant building, just above from the marina.



Photograph A3 (LEFT): Looking down at WIN 25234 (pumping well) with the Well Identification Number affixed to the casing. The well is properly capped. **Photograph A4 (RIGHT):** Looking down at the electrical submersible pump assembly with the 3” Grundfos pump and flexible hose (drop pipe)



Photograph A5 (LEFT): Looking down at the 20 L pail for measuring flow rates. **Photograph A6 (RIGHT):** Looking down and south at the groundwater being discharging in a wooded area downslope of the well casing.

Appendix B

Driller's Logs



☒ Well Construction Report

☐ Well Closure Report

☐ Well Alteration Report

Stamp company name/address/
phone/fax/email here, if desired.

Ministry Well ID Plate Number: _____
Ministry Well Tag Number: 13742
Existing Well Tag Number: _____
☐ Confirmation/alternative specs. attached
☐ Original well construction report attached

Red lettering indicates minimum mandatory information

See reverse for notes & definitions of abbreviations

Owner Name: SILVA BAY RESORT

Mailing address: _____ Town _____ Prov _____ Postal Code _____

Well location: Street _____ Town _____

or

Legal description: Lot A Plan 21876 D.L. _____ Block _____ Sec. 5 Twp. _____ Rg. _____ Land District NANAIMO

or

PID: _____ and Description of well location (attach sketch, if nec.): _____

NAD 83:Zone: 10 UTM Northing: 5444361 m Latitude (see note 3): 49° 08' 59.82"

(see note 2) and UTM Easting: 448967 m or Longitude: 123° 41' 59.37"

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

Orientation of well: ☐ vertical ☐ horizontal Ground elevation: 0 ft (asl) Method (see note 4): _____

Class of well (see note 5): _____ Sub-class of well: _____

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

Lithologic description (see notes 7-14) or closure description (see notes 15 and 16)

From ft (bgl)	To ft (bgl)	Relative Hardness	Colour	Description	Material Description (use recommended terms on reverse. List in order of decreasing amount, if applicable)	Water-bearing Estimated Flow (USgpm)	Observations (e.g. fractured, weathered, well sorted, silty wash), closure details
0	2				LOAM		
2	12				BROWN CLAY		
12	20				BLUE CLAY		
20	21				ROTTEN SANDSTONE & GRAVEL		
21	53				BLUE SANDSTONE		
53	55				SHALE		
55	56				CONGLOMERATE HARD		
56	60				SHALE SOFT		

Casing details

Screen details

From ft (bgl)	To ft (bgl)	Dia in	Casing Material/Open Hole	Wall Thickness in	Drive Shoe	From ft (bgl)	To ft (bgl)	Dia in	Type (see note 18)	Slot Size
------------------	----------------	-----------	---------------------------	-------------------------	---------------	------------------	----------------	-----------	--------------------	-----------

Production Casing Diameter: 0.0 in

Surface seal: Type: _____ Depth: _____ ft

Method of installation: ☐ Poured ☐ Pumped Thickness: _____ 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

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 ☐ Surging ☐ Jetting ☐ Pumping ☐ Bailing

☐ Other (specify): _____ Total duration: _____ hrs

Notes: _____

Well yield estimated by:

☐ Pumping ☐ Air lifting ☐ Bailing ☐ Other (specify): _____

Rate: _____ USgpm Duration: _____ hrs

SWL before test: _____ ft (btoc) Pumping water level: _____ ft (btoc)

Final well completion data:

Total depth drilled: _____ ft Finished well depth: 60 ft bgl

Final stick up: _____ in Depth to bedrock: 21 ft bgl

SWL: 24 ft (btoc) Estimated well yield: 4.00 USgpm

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

Type of well cap: _____ Well disinfected: ☐ yes ☒ no

Where well ID plate is attached: _____

Obvious water quality characteristics:

☐ Fresh ☐ Salty ☐ Clear ☐ Cloudy ☐ Sediment ☐ Gas

Colour/odour: _____ Water sample collected: ☐

Well driller (print clearly):

Name (first, last) (see note 19): _____

Registration no. (see note 20): _____

Consultant (if applicable name and company): _____

Well closure information:

Reason for closure: _____

Method of closure: _____

Sealant material: _____ Backfill material: _____

Details of closure: _____

Date of work (YYYY/MM/DD):

Started: 1952/01/01 Completed: 1952/01/01

Comment: METHOD OF DRILLING = DRILLED

Signature of Driller Responsible

General

- 1. Requirements for well construction and well closure reports are found in Part 5 of the Water Act and the Ground Water Protection Regulation. Part 5 of the act and regulation are available at: http://www.env.gov.bc.ca/wsd/plan_protect_sustain/groundwater/index.html.
- 2. The current Ministry standard datum for mapping and geodetic use is the North American Datum of 1983 (NAD 83). To determine GPS coordinates using a Global Positioning System (GPS), set the datum to NAD 83.
- 3. For latitude and longitude coordinates, provide coordinates either in degree, minutes and seconds (e.g., 50° 2¿ 21.037¿) or decimal degrees (e.g., 50.039175°).
- 4. For the method of determining ground elevation, enter: GPS, differential GPS, level, altimeter, 1:50,000 map, 1:20,000 map, 1:10,000 map or 1:5,000 map.
- 5. The classes and sub-classes of wells are shown below:

Class	Sub-class (if applicable)
Water supply	Domestic; Non-domestic
Monitoring	Temporary; Permanent
Recharge or injection	
Dewatering or drainage	Temporary; Permanent
Remediation	Temporary; Permanent
Geotechnical	Borehole; Test pit; Special type of hole; Closed loop geothermal
- 6. Well reports submitted to the Deputy Comptroller, or retained by the person responsible, as required under the Water Act and the Ground Water Protection Regulation, shall be considered part of the Provincial Government records and is subject to the Freedom of Information and Protection of Privacy Act.

How to Fill Out the Lithologic Description Table

- 7. Each row in the lithologic description table represents either a depth interval or depth in the well.
- 8. A row could represent a depth interval (e.g., from 0 feet to 12 feet), such as for a geologic stratum or a specific depth (e.g., 120 feet), such as for a depth location of a water-bearing fracture.
- 9. For a depth interval, enter the relative hardness of the material in the column ¿Relative Hardness," if applicable: Very Hard (VH), Hard (H), Dense (D), Stiff (ST), Medium (M), Loose (L), Soft (S), Very Soft (VS).
- 10. For a depth interval, enter the letter for the overall colour of the geologic material in the column "Colour," if applicable: White (W), Grey (Gy), Blue (Bl), Green (G), Yellow (Y), Brown (Br), Red (R), Tan (T), Black (Bk).
- 11. For each depth interval, enter the description of the geologic materials encountered during drilling in the column "Material Description.¿ Material descriptions should be chosen from the following recommended list of materials:

Surficial materials (approximate range of particle size)	Bedrock materials
boulders (greater than 10 inches)	conglomerate
cobbles (21/2 inches to 10 inches)	sandstone
gravel (80 slot to 21/2 inches)	shale
coarse sand (25 slot to 80 slot)	siltstone
medium sand (10 slot to 25 slot)	limestone
fine sand (2 slot to 10 slot)	crystalline
silt (less than 2 slot)	granite
clay (much less than 2 slot)	basalt
till (variable particle size)	volcanic
organics (e.g., top soil, wood, peat)	bedrock

- 12. In describing the material, list the material in order from greatest to least and indicate what materials occur in trace (less than 5%) amounts. The word "and" means both materials occur in approximately equal amounts (e.g., "gravel and coarse sand, trace silt").
- 13. Under the column "Water-bearing Estimated Flow (USgpm)," use "D" for "dry," "W" for "wet," or enter the estimated flow in USgpm.
- 14. If a water-bearing fracture is encountered, the depth of the fracture should be recorded in a row and the estimated flow of water in the fracture can be entered in the column "Water-bearing Estimated Flow (USgpm)."

How to Fill Out the Closure Description Table and the Well Closure Information Section

- 15. Each row in the closure description table represents either a depth interval (e.g., from 0 feet to 12 feet) or depth (e.g., 120 feet) in the well.
- 16. For a depth interval, enter the type of backfill or sealant material(s) in the column "Material Description."
- 17. Indicate in "Details of closure" whether casing(s) or screen(s) were pulled or left in place. If casing(s) were left in place, indicate whether it was perforated or ripped.

Screen Details

- 18. "Type" includes riser pipe, K-packer, screen, screen blank, or tail pipe.

Well Driller

- 19. Fill in the name of the driller who constructed the well.

Registration Number of Driller Responsible

- 20. Fill in the registration number on the Qualified Well Driller identification card. If the work was completed by a driller who is not registered as a Qualified Well Driller, the Qualified Well Driller who is directly supervising the work should fill in their registration number on their Qualified Well Driller identification card. The Qualified Well Driller signs the form.

Definitions of Abbreviations

asl	ft	PID	USgpm ...
bgl	hrs	Rg.	UTM
btoc	in	Sec.	Mercator Grid
Dia	NAD 83 ...	SWL	
D.L.	Datum (1983)	Twp.	



☒ Well Construction Report

☐ Well Closure Report

☐ Well Alteration Report

Stamp company name/address/
phone/fax/email here, if desired.

Ministry Well ID Plate Number:

Ministry Well Tag Number: 21160

Existing Well Tag Number:

☐ Confirmation/alternative specs. attached

☐ Original well construction report attached

Red lettering indicates minimum mandatory information

See reverse for notes & definitions of abbreviations

Owner Name: SILVA BAY RESORT

Mailing address: "" Town Prov Postal Code

Well location: Street Town

Legal description: Lot A Plan 21876 D.L. Block Sec. 5 Twp. Rg. Land District NANAIMO

PID: and Description of well location (attach sketch, if nec.):

NAD 83:Zone: 10 UTM Northing: 5444279 m Latitude (see note 3): 49° 08' 57.11"

(see note 2) UTM Easting: 448799 m Longitude: 123° 42' 07.62"

Method of drilling: air rotary cable tool mud rotary auger driving jetting excavating other (specify):

Orientation of well: vertical horizontal Ground elevation: 0 ft (asl) Method (see note 4):

Class of well (see note 5): Sub-class of well:

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

Lithologic description (see notes 7-14) or closure description (see notes 15 and 16)

From ft (bgl)	To ft (bgl)	Relative Hardness	Colour	Description	Material Description (use recommended terms on reverse. List in order of decreasing amount, if applicable)	Water-bearing Estimated Flow (USgpm)	Observations (e.g. fractured, weathered, well sorted, silty wash), closure details
0	11				SANDSTONE		
11	19				CLAY		
19	30				SANDSTONE		
30	35				SHALE		
35	40				CLAY		
40	50				SHALE		
50	60				SANDSTONE & ROCK		
60	65				SANDSTONE		
65	74				SANDSTONE		

Casing details

Screen details

From ft (bgl)	To ft (bgl)	Dia in	Casing Material/Open Hole	Wall Thickness in	Drive Shoe	From ft (bgl)	To ft (bgl)	Dia in	Type (see note 18)	Slot Size
------------------	----------------	-----------	---------------------------	-------------------------	---------------	------------------	----------------	-----------	--------------------	-----------

Production Casing Diameter: 6.0 in

Surface seal: Type: Depth: ft

Method of installation: Poured Pumped Thickness: 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

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 Surging Jetting Pumping Bailing

Other (specify): Total duration: hrs

Notes:

Well yield estimated by:

Pumping Air lifting Bailing Other (specify):

Rate: USgpm Duration: hrs

SWL before test: ft (btoc) Pumping water level: ft (btoc)

Obvious water quality characteristics:

Fresh Salty Clear Cloudy Sediment Gas

Colour/odour: Water sample collected:

Well driller (print clearly):

Name (first, last) (see note 19):

Registration no. (see note 20):

Consultant (if applicable name and company):

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

Signature of Driller Responsible

Final well completion data:

Total depth drilled: ft Finished well depth: 74 ft bgl

Final stick up: in Depth to bedrock: 0 ft bgl

SWL: 35 ft (btoc) Estimated well yield: 5.00 USgpm

Artesian flow: USgpm, or artesian pressure: ft

Type of well cap: Well disinfected: yes no

Where well ID plate is attached:

Well closure information:

Reason for closure:

Method of closure:

Sealant material: Backfill material:

Details of closure:

Date of work (YYYY/MM/DD):

Started: 1968/01/01 Completed: 1968/01/01

Comment: METHOD OF DRILLING = DRILLED

Please Note: The information recorded in this well report describes the works and hydrogeologic conditions at the time of construction, alteration or closure, 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 work, which may change over time.

Well Owner Copy

Sheet 1 of 2

General

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- 3. For latitude and longitude coordinates, provide coordinates either in degree, minutes and seconds (e.g., 50° 2¿ 21.037¿) or decimal degrees (e.g., 50.039175°).
- 4. For the method of determining ground elevation, enter: GPS, differential GPS, level, altimeter, 1:50,000 map, 1:20,000 map, 1:10,000 map or 1:5,000 map.
- 5. The classes and sub-classes of wells are shown below:

Class	Sub-class (if applicable)
Water supply	Domestic; Non-domestic
Monitoring	Temporary; Permanent
Recharge or injection	
Dewatering or drainage	Temporary; Permanent
Remediation	Temporary; Permanent
Geotechnical	Borehole; Test pit; Special type of hole; Closed loop geothermal
- 6. Well reports submitted to the Deputy Comptroller, or retained by the person responsible, as required under the Water Act and the Ground Water Protection Regulation, shall be considered part of the Provincial Government records and is subject to the Freedom of Information and Protection of Privacy Act.

How to Fill Out the Lithologic Description Table

- 7. Each row in the lithologic description table represents either a depth interval or depth in the well.
- 8. A row could represent a depth interval (e.g., from 0 feet to 12 feet), such as for a geologic stratum or a specific depth (e.g., 120 feet), such as for a depth location of a water-bearing fracture.
- 9. For a depth interval, enter the relative hardness of the material in the column ¿Relative Hardness," if applicable: Very Hard (VH), Hard (H), Dense (D), Stiff (ST), Medium (M), Loose (L), Soft (S), Very Soft (VS).
- 10. For a depth interval, enter the letter for the overall colour of the geologic material in the column "Colour," if applicable: White (W), Grey (Gy), Blue (Bl), Green (G), Yellow (Y), Brown (Br), Red (R), Tan (T), Black (Bk).
- 11. For each depth interval, enter the description of the geologic materials encountered during drilling in the column "Material Description.¿ Material descriptions should be chosen from the following recommended list of materials:

Surficial materials (approximate range of particle size)	Bedrock materials
boulders (greater than 10 inches)	conglomerate
cobbles (21/2 inches to 10 inches)	sandstone
gravel (80 slot to 21/2 inches)	shale
coarse sand (25 slot to 80 slot)	siltstone
medium sand (10 slot to 25 slot)	limestone
fine sand (2 slot to 10 slot)	crystalline
silt (less than 2 slot)	granite
clay (much less than 2 slot)	basalt
till (variable particle size)	volcanic
organics (e.g., top soil, wood, peat)	bedrock

- 12. In describing the material, list the material in order from greatest to least and indicate what materials occur in trace (less than 5%) amounts. The word "and" means both materials occur in approximately equal amounts (e.g., "gravel and coarse sand, trace silt").
- 13. Under the column "Water-bearing Estimated Flow (USgpm)," use "D" for "dry," "W" for "wet," or enter the estimated flow in USgpm.
- 14. If a water-bearing fracture is encountered, the depth of the fracture should be recorded in a row and the estimated flow of water in the fracture can be entered in the column "Water-bearing Estimated Flow (USgpm)."

How to Fill Out the Closure Description Table and the Well Closure Information Section

- 15. Each row in the closure description table represents either a depth interval (e.g., from 0 feet to 12 feet) or depth (e.g., 120 feet) in the well.
- 16. For a depth interval, enter the type of backfill or sealant material(s) in the column "Material Description."
- 17. Indicate in "Details of closure" whether casing(s) or screen(s) were pulled or left in place. If casing(s) were left in place, indicate whether it was perforated or ripped.

Screen Details

- 18. "Type" includes riser pipe, K-packer, screen, screen blank, or tail pipe.

Well Driller

- 19. Fill in the name of the driller who constructed the well.

Registration Number of Driller Responsible

- 20. Fill in the registration number on the Qualified Well Driller identification card. If the work was completed by a driller who is not registered as a Qualified Well Driller, the Qualified Well Driller who is directly supervising the work should fill in their registration number on their Qualified Well Driller identification card. The Qualified Well Driller signs the form.

Definitions of Abbreviations

asl	ft	PID	USgpm ...
bgl	hrs	Rg.	UTM
btoc	in	Sec.	Mercator Grid
Dia	NAD 83 ...	SWL	
D.L.	Datum (1983)	Twp.	



☒ Well Construction Report

☐ Well Closure Report

☐ Well Alteration Report

Stamp company name/address/
phone/fax/email here, if desired.

Ministry Well ID Plate Number:

Ministry Well Tag Number: 22522

Existing Well Tag Number:

☐ Confirmation/alternative specs. attached

☐ Original well construction report attached

Red lettering indicates minimum mandatory informationSee reverse for notes & definitions of abbreviations

Owner Name: SILVA BAY RESORT

Mailing address:

Town Prov Postal Code

Well location: Street

Town

or

Legal description: Lot A Plan 21876 D.L. Block Sec. 5 Twp. Rg. Land District NANAIMO

or

PID: and Description of well location (attach sketch, if nec.):

NAD 83:Zone: 10

UTM Northing: 5444359 m

Latitude (see note 3): 49° 08' 59.74"

(see note 2)

UTM Easting: 448925 m

Longitude: 123° 42' 01.44"

Method of drilling:

☐ air rotary☐ cable tool☐ mud rotary☐ auger☐ driving☐ jetting☐ excavating☒ other (specify):

Orientation of well:

☐ vertical☐ horizontal

Ground elevation: 0 ft (asl) Method (see note 4):

Class of well (see note 5): Sub-class of well:

Water supply wells, indicate intended water use:

☐ private domestic☐ water supply system☐ irrigation☐ commercial or industrial☐ other (specify):

Lithologic description (see notes 7-14) or closure description (see notes 15 and 16)

From ft (bgl)	To ft (bgl)	Relative Hardness	Colour	Description	Material Description (use recommended terms on reverse. List in order of decreasing amount, if applicable)	Water-bearing Estimated Flow (USgpm)	Observations (e.g. fractured, weathered, well sorted, silty wash), closure details
0	9.5				OVERBURDEN		
9.5	15				SANDSTONE		
15	45				ROCK & CLAY		
45	65				SANDSTONE		

Casing details

From ft (bgl)	To ft (bgl)	Dia in	Casing Material/Open Hole	Wall Thickness in	Drive Shoe	From ft (bgl)	To ft (bgl)	Dia in	Type (see note 18)	Slot Size
------------------	----------------	-----------	---------------------------	-------------------------	---------------	------------------	----------------	-----------	--------------------	-----------

Screen details

From ft (bgl)	To ft (bgl)	Dia in	Type (see note 18)	Slot Size
------------------	----------------	-----------	--------------------	-----------

Production Casing Diameter: 6.0 in

Surface seal: Type: Depth: ft

Method of installation:

☐ Poured☐ Pumped

Thickness: in

Backfill: Type: Depth: ft

Liner:

☐ PVC☐ Other (specify):

Diameter: inThickness: in

From: ft bglTo: ft bglPerforated: From: ft bglTo: ft bgl

Developed by:

☐ Air lifting☐ Surging☐ Jetting☐ Pumping☐ Bailing

☐ Other (specify): Total duration: hrs

Notes:

Well yield estimated by:

☐ Pumping☐ Air lifting☐ Bailing☐ Other (specify):

Rate: USgpmDuration: hrs

SWL before test: ft (btoc)Pumping water level: ft (btoc)

Obvious water quality characteristics:

☐ Fresh☐ Salty☐ Clear☐ Cloudy☐ Sediment☐ Gas

Colour/odour: Water sample collected:

Well driller (print clearly):

Name (first, last) (see note 19):

Registration no. (see note 20):

Consultant (if applicable name and company):

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

Signature of Driller Responsible

Final well completion data:

Total depth drilled: ftFinished well depth: 65 ft bgl

Final stick up: inDepth to bedrock: 10 ft bgl

SWL: 6 ft (btoc)Estimated well yield: 4.00 USgpm

Artesian flow: USgpm, or artesian pressure: ft

Type of well cap: Well disinfected:

☐ yes☒ no

Where well ID plate is attached:

Well closure information:

Reason for closure:

Method of closure:

Sealant material: Backfill material:

Details of closure:

Date of work (YYYY/MM/DD):

Started: 1969/07/01Completed: 1969/07/01

Comment: METHOD OF DRILLING = DRILLED

Please Note: The information recorded in this well report describes the works and hydrogeologic conditions at the time of construction, alteration or closure, 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 work, which may change over time.

Well Owner Copy

Sheet 1 of 2

General

1. Requirements for well construction and well closure reports are found in Part 5 of the Water Act and the Ground Water Protection Regulation. Part 5 of the act and regulation are available at: http://www.env.gov.bc.ca/wsd/plan_protect_sustain/groundwater/index.html.
2. The current Ministry standard datum for mapping and geodetic use is the North American Datum of 1983 (NAD 83). To determine GPS coordinates using a Global Positioning System (GPS), set the datum to NAD 83.
3. For latitude and longitude coordinates, provide coordinates either in degree, minutes and seconds (e.g., 50° 2¿ 21.037¿) or decimal degrees (e.g., 50.039175°).
4. For the method of determining ground elevation, enter: GPS, differential GPS, level, altimeter, 1:50,000 map, 1:20,000 map, 1:10,000 map or 1:5,000 map.
5. The classes and sub-classes of wells are shown below:

Class	Sub-class (if applicable)
Water supply	Domestic; Non-domestic
Monitoring	Temporary; Permanent
Recharge or injection	
Dewatering or drainage	Temporary; Permanent
Remediation	Temporary; Permanent
Geotechnical	Borehole; Test pit; Special type of hole; Closed loop geothermal
6. Well reports submitted to the Deputy Comptroller, or retained by the person responsible, as required under the Water Act and the Ground Water Protection Regulation, shall be considered part of the Provincial Government records and is subject to the Freedom of Information and Protection of Privacy Act.

How to Fill Out the Lithologic Description Table

7. Each row in the lithologic description table represents either a depth interval or depth in the well.
8. A row could represent a depth interval (e.g., from 0 feet to 12 feet), such as for a geologic stratum or a specific depth (e.g., 120 feet), such as for a depth location of a water-bearing fracture.
9. For a depth interval, enter the relative hardness of the material in the column ¿Relative Hardness," if applicable: Very Hard (VH), Hard (H), Dense (D), Stiff (ST), Medium (M), Loose (L), Soft (S), Very Soft (VS).
10. For a depth interval, enter the letter for the overall colour of the geologic material in the column "Colour," if applicable: White (W), Grey (Gy), Blue (Bl), Green (G), Yellow (Y), Brown (Br), Red (R), Tan (T), Black (Bk).
11. For each depth interval, enter the description of the geologic materials encountered during drilling in the column "Material Description.¿ Material descriptions should be chosen from the following recommended list of materials:

Surficial materials (approximate range of particle size)	Bedrock materials
boulders (greater than 10 inches)	conglomerate
cobbles (21/2 inches to 10 inches)	sandstone
gravel (80 slot to 21/2 inches)	shale
coarse sand (25 slot to 80 slot)	siltstone
medium sand (10 slot to 25 slot)	limestone
fine sand (2 slot to 10 slot)	crystalline
silt (less than 2 slot)	granite
clay (much less than 2 slot)	basalt
till (variable particle size)	volcanic
organics (e.g., top soil, wood, peat)	bedrock

12. In describing the material, list the material in order from greatest to least and indicate what materials occur in trace (less than 5%) amounts. The word "and" means both materials occur in approximately equal amounts (e.g., "gravel and coarse sand, trace silt").
13. Under the column "Water-bearing Estimated Flow (USgpm)," use "D" for "dry," "W" for "wet," or enter the estimated flow in USgpm.
14. If a water-bearing fracture is encountered, the depth of the fracture should be recorded in a row and the estimated flow of water in the fracture can be entered in the column "Water-bearing Estimated Flow (USgpm)."

How to Fill Out the Closure Description Table and the Well Closure Information Section

15. Each row in the closure description table represents either a depth interval (e.g., from 0 feet to 12 feet) or depth (e.g., 120 feet) in the well.
16. For a depth interval, enter the type of backfill or sealant material(s) in the column "Material Description."
17. Indicate in "Details of closure" whether casing(s) or screen(s) were pulled or left in place. If casing(s) were left in place, indicate whether it was perforated or ripped.

Screen Details

18. "Type" includes riser pipe, K-packer, screen, screen blank, or tail pipe.

Well Driller

19. Fill in the name of the driller who constructed the well.

Registration Number of Driller Responsible

20. Fill in the registration number on the Qualified Well Driller identification card. If the work was completed by a driller who is not registered as a Qualified Well Driller, the Qualified Well Driller who is directly supervising the work should fill in their registration number on their Qualified Well Driller identification card. The Qualified Well Driller signs the form.

Definitions of Abbreviations

asl	ft	PID	USgpm ...
bgl	hrs	Rg.	UTM
btoc	in	Sec.	Mercator Grid
Dia	NAD 83 ...	SWL	
D.L.	Datum (1983)	Twp.	



☒ Well Construction Report

☐ Well Closure Report

☐ Well Alteration Report

Stamp company name/address/
phone/fax/email here, if desired.

Ministry Well ID Plate Number:

Ministry Well Tag Number: 22523

Existing Well Tag Number:

☐ Confirmation/alternative specs. attached

☐ Original well construction report attached

Red lettering indicates minimum mandatory information

See reverse for notes & definitions of abbreviations

Owner Name: SILVA BAY RESORT

Mailing address: "" Town Prov Postal Code

Well location: Street Town

or

Legal description: Lot A Plan 21876 D.L. Block Sec. 5 Twp. Rg. Land District NANAIMO

or

PID: and Description of well location (attach sketch, if nec.):

NAD 83:Zone: 10 UTM Northing: 5444319 m Latitude (see note 3): 49° 08' 58.41"

(see note 2) and UTM Easting: 448811 m or Longitude: 123° 42' 07.05"

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

Orientation of well: ☐ vertical ☐ horizontal Ground elevation: 0 ft (asl) Method (see note 4):

Class of well (see note 5): Sub-class of well:

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

Lithologic description (see notes 7-14) or closure description (see notes 15 and 16)

From ft (bgl)	To ft (bgl)	Relative Hardness	Colour	Description	Material Description (use recommended terms on reverse. List in order of decreasing amount, if applicable)	Water-bearing Estimated Flow (USgpm)	Observations (e.g. fractured, weathered, well sorted, silty wash), closure details
0	9.5				OVERBURDEN		
9.5	11				CLAY		
11	20				SANDSTONE		
20	40				SANDSTONE		
40	45				SHALE		
45	50				SANDSTONE		
50	60				SHALE & SANDSTONE		
60	110				SANDSTONE		

Casing details

From ft (bgl)	To ft (bgl)	Dia in	Casing Material/Open Hole	Wall Thickness in	Drive Shoe
------------------	----------------	-----------	---------------------------	-------------------------	---------------

Screen details

From ft (bgl)	To ft (bgl)	Dia in	Type (see note 18)	Slot Size
------------------	----------------	-----------	--------------------	-----------

Production Casing Diameter: 6.0 in

Surface seal: Type: Depth: ft

Method of installation: ☐ Poured ☐ Pumped Thickness: 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

Developed by:

☐ Air lifting ☐ Surging ☐ Jetting ☐ Pumping ☐ Bailing

☐ Other (specify): Total duration: hrs

Notes:

Well yield estimated by:

☐ Pumping ☐ Air lifting ☐ Bailing ☐ Other (specify):

Rate: USgpm Duration: hrs

SWL before test: ft (btoc) Pumping water level: ft (btoc)

Obvious water quality characteristics:

☐ Fresh ☐ Salty ☐ Clear ☐ Cloudy ☐ Sediment ☐ Gas

Colour/odour: Water sample collected:

Well driller (print clearly):

Name (first, last) (see note 19):

Registration no. (see note 20):

Consultant (if applicable name and company):

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

Signature of Driller Responsible

Final well completion data:

Total depth drilled: ft Finished well depth: 110 ft bgl

Final stick up: in Depth to bedrock: 11 ft bgl

SWL: 40 ft (btoc) Estimated well yield: 5.00 USgpm

Artesian flow: USgpm, or artesian pressure: ft

Type of well cap: Well disinfected: ☐ yes ☒ no

Where well ID plate is attached:

Well closure information:

Reason for closure:

Method of closure:

Sealant material: Backfill material:

Details of closure:

Date of work (YYYY/MM/DD):

Started: 1969/07/01 Completed: 1969/07/01

Comment: METHOD OF DRILLING = DRILLED

Please Note: The information recorded in this well report describes the works and hydrogeologic conditions at the time of construction, alteration or closure, 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 work, which may change over time.

Well Owner Copy

Sheet 1 of 2

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4. For the method of determining ground elevation, enter: GPS, differential GPS, level, altimeter, 1:50,000 map, 1:20,000 map, 1:10,000 map or 1:5,000 map.
5. The classes and sub-classes of wells are shown below:

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cobbles (21/2 inches to 10 inches)	sandstone
gravel (80 slot to 21/2 inches)	shale
coarse sand (25 slot to 80 slot)	siltstone
medium sand (10 slot to 25 slot)	limestone
fine sand (2 slot to 10 slot)	crystalline
silt (less than 2 slot)	granite
clay (much less than 2 slot)	basalt
till (variable particle size)	volcanic
organics (e.g., top soil, wood, peat)	bedrock

12. In describing the material, list the material in order from greatest to least and indicate what materials occur in trace (less than 5%) amounts. The word "and" means both materials occur in approximately equal amounts (e.g., "gravel and coarse sand, trace silt").
13. Under the column "Water-bearing Estimated Flow (USgpm)," use "D" for "dry," "W" for "wet," or enter the estimated flow in USgpm.
14. If a water-bearing fracture is encountered, the depth of the fracture should be recorded in a row and the estimated flow of water in the fracture can be entered in the column "Water-bearing Estimated Flow (USgpm)."

How to Fill Out the Closure Description Table and the Well Closure Information Section

15. Each row in the closure description table represents either a depth interval (e.g., from 0 feet to 12 feet) or depth (e.g., 120 feet) in the well.
16. For a depth interval, enter the type of backfill or sealant material(s) in the column "Material Description."
17. Indicate in "Details of closure" whether casing(s) or screen(s) were pulled or left in place. If casing(s) were left in place, indicate whether it was perforated or ripped.

Screen Details

18. "Type" includes riser pipe, K-packer, screen, screen blank, or tail pipe.

Well Driller

19. Fill in the name of the driller who constructed the well.

Registration Number of Driller Responsible

20. Fill in the registration number on the Qualified Well Driller identification card. If the work was completed by a driller who is not registered as a Qualified Well Driller, the Qualified Well Driller who is directly supervising the work should fill in their registration number on their Qualified Well Driller identification card. The Qualified Well Driller signs the form.

Definitions of Abbreviations

asl	ft	PID	USgpm ...
bgl	hrs	Rg.	UTM
btoc	in	Sec.	Mercator Grid
Dia	NAD 83 ...	SWL	
D.L.	Datum (1983)	Twp.	

Appendix C

List of Surface water and Groundwater Users within 1-km of WIN 25324

Table C1: Registered Groundwater and Surface water Users Within 1-km of WIN 25324

Well Tag Number	Well Owner	Well Use Type	Yield Value (m³/d)	Depth Drilled (mbgl)	Groundwater Level Depth (mbgl)	UTM Coordinates (Zone 10)		License Status
						Northing	Easting	
13747	MYERS	Private Domestic	109	61.0	15.2	5443945	448945	UNLICENSED
13867	FRANK LE POIDEVIN	Private Domestic	38	23.8	9.8	5444187	448869	UNLICENSED
13865	PAGE	Unknown Well Use	27	23.5	7.6	5444136	448989	UNLICENSED
14286	WHITNEY SHIPYARD	Private Domestic	11	37.2	8.5	5444244	448905	UNLICENSED
36188	A BENTZEN	Private Domestic	UNKNOWN	4.7	2.7	5444138	448920	UNLICENSED
22522	SILVA BAY RESORT	Unknown Well Use	22	19.8	1.8	5444359	448925	UNLICENSED
71152	FRITZE	Private Domestic	11	12.2	0.6	5444002	449589	UNLICENSED
71153	FRITZE	Private Domestic	UNKNOWN	-	-	5443983	449588	UNLICENSED
13742	SILVA BAY RESORT	Unknown Well Use	22	18.3	7.3	5444361	448967	UNLICENSED
13866	PAGE	Private Domestic	5	20.4	4.9	5444126	449130	UNLICENSED
68815	MITCHELL JAMES	Unknown Well Use	16	41.2	13.7	5443719	448915	UNLICENSED
13746	DR J S THYHURST	Private Domestic	14	30.5	2.4	5443611	449524	UNLICENSED
5449	PAGES STORE	Business or Other Organization	82	27.4	3.7	5444088	449120	UNLICENSED
96337	TYHURST	Private Domestic	3	109.8	103.7	5443661	449365	UNLICENSED
98443	PAGE	Unknown Well Use	22	-	-	5444028	449106	UNLICENSED
101873	ROYAL VANCOUVER YACHT CLUB	Private Domestic	16	15.2	5.5	5444444	449700	UNLICENSED
101874	ROYAL VANCOUVER YACHT CLUB	Private Domestic	14	16.2	9.1	5444444	449650	UNLICENSED
106498	HARDMAN	Private Domestic	65	-	6.1	5444036	449130	UNLICENSED
106426	SHROEDER	Private Domestic	55	45.7	12.2	5443802	449137	UNLICENSED
65135	EMBERSON & CSAPO	Unknown Well Use	UNKNOWN	30.5	13.7	5444317	448332	UNLICENSED
64306	SYNENKO	Unknown Well Use	38	33.5	4.6	5443662	448672	UNLICENSED
64263	WALL J B	Private Domestic	11	61.0	25.9	5444513	448627	UNLICENSED
64268	LEAF GEORGE	Private Domestic	109	24.4	10.7	5444227	448867	UNLICENSED
64282	REID HENRY	Private Domestic	5	65.5	13.7	5445035	448721	UNLICENSED
64224	ATCHISON	Unknown Well Use	UNKNOWN	83.8	-	5444339	448679	UNLICENSED
64231	MAURO RAY	Unknown Well Use	UNKNOWN	76.2	-	5444131	448828	UNLICENSED
64369	DENBOER PETER	Unknown Well Use	65	25.9	1.2	5444244	448121	UNLICENSED
51285	JOHN HIGGINS	Private Domestic	109	45.7	-	5444213	448021	UNLICENSED
14628	A WATSON	Private Domestic	27	12.2	4.9	5444646	448758	UNLICENSED
14287	JOE DAVIS	Unknown Well Use	109	18.3	2.4	5444781	448799	UNLICENSED
14866	Teichroeb	Private Domestic	14	21.3	9.8	5444703	448637	UNLICENSED
13912	G BROWN	Private Domestic	7	19.2	9.5	5444554	448619	UNLICENSED
15618	A FERRERO	Unknown Well Use	44	23.5	13.4	5444549	448742	UNLICENSED
5450	W KRULL	Private Domestic	UNKNOWN	4.9	-	5444826	448226	UNLICENSED
13868	R B LORO	Unknown Well Use	11	45.1	6.1	5444880	448843	UNLICENSED
18854	R W KIRKLAND	Unknown Well Use	14	18.3	9.1	5444457	448529	UNLICENSED
19278	WAYMAN	Unknown Well Use	5	18.3	2.7	5444579	448450	UNLICENSED
19279	WALLS	Unknown Well Use	8	30.5	4.6	5444491	448657	UNLICENSED
5482	GEORGE DETTWEILER	Unknown Well Use	33	38.1	9.1	5444906	448340	UNLICENSED
5331	JOHN OLSON	Unknown Well Use	5	25.9	9.1	5444601	448728	UNLICENSED
5372	T MACDONALD	Private Domestic	UNKNOWN	2.4	0.6	5443911	448145	UNLICENSED
14288	F P GIBSON	Private Domestic	19	32.9	7.3	5444412	448266	UNLICENSED
14865	O NUKKA	Private Domestic	13	36.6	12.8	5444463	448801	UNLICENSED
46723	TOM BANNISTER	Unknown Well Use	33	45.7	22.9	5444070	448515	UNLICENSED
49732	RON SMITH	Unknown Well Use	22	45.7	3.0	5444074	448367	UNLICENSED
45680	JOHN CIRCOLO	Private Domestic	16	25.0	14.6	5444215	448583	UNLICENSED
24138	J E DOYLE	Private Domestic	8	24.4	9.1	5444156	448774	UNLICENSED
24755	T L MALLINSON	Unknown Well Use	11	15.9	4.9	5444192	448272	UNLICENSED
20849	A R MUSCLOW	Unknown Well Use	98	36.6	-	5444271	448457	UNLICENSED
5435	GABRIOLA WILDWOOD ES	Unknown Well Use	136	21.3	0.6	5444270	448744	UNLICENSED
28148	DAVE MCKENZIE	Unknown Well Use	19	54.9	36.6	5444073	448283	UNLICENSED
32426	JAN ANDREASSEN	Unknown Well Use	98	33.5	7.6	5444180	448706	UNLICENSED
36189	MYERS	Unknown Well Use	UNKNOWN	3.7	0.9	5443928	448831	UNLICENSED
51204	EGON & ANN HOLZWORTH	Unknown Well Use	33	30.5	12.2	5444113	448668	UNLICENSED
51828	RUSS BUTTERFIELD	Unknown Well Use	27	44.2	25.9	5444129	448487	UNLICENSED
45133	DAN BROWN	Unknown Well Use	5	30.5	12.2	5443695	448784	UNLICENSED
45383	TOM GALOZO	Unknown Well Use	3	35.1	12.2	5444209	448341	UNLICENSED
14289	D P HOGAN	Private Domestic	22	30.5	16.8	5443578	448257	UNLICENSED
5451	C L MUSCLOW	Private Domestic	UNKNOWN	2.7	-	5444305	448574	UNLICENSED
31607	PAUL GOETZE	Unknown Well Use	19	33.5	3.7	5444254	447872	UNLICENSED
24040	FIDDLER	Private Domestic	33	22.9	7.6	5444212	448555	UNLICENSED
22876	CALVIN MCKINNON	Unknown Well Use	16	20.1	7.6	5444321	448535	UNLICENSED
22834	J L HALVERSON	Unknown Well Use	30	18.6	5.5	5444227	448644	UNLICENSED
29486	FAIBAIRN	Unknown Well Use	UNKNOWN	5.5	-	5444551	448553	UNLICENSED
23122	SILVA BAY MARINA RES	Unknown Well Use	55	61.0	9.1	5444684	448420	UNLICENSED
30861	R KIRKLAND	Unknown Well Use	142	35.1	-	5444479	448574	UNLICENSED
36300	GEORGE DETTWEILER	Unknown Well Use	27	39.6	9.1	5444910	448456	UNLICENSED
31803	JOHN CARSON	Unknown Well Use	27	33.2	12.2	5444732	448563	UNLICENSED
21159	E A SILVA	Private Domestic	22	21.3	-	5444569	448799	UNLICENSED
39667	DR JOHN GARSON	Private Domestic	55	53.4	17.1	5444758	448562	UNLICENSED
38530	G DETTWEILER	Unknown Well Use	55	29.0	12.2	5444929	448291	UNLICENSED
49979	N WAYMAN	Unknown Well Use	44	29.0	-	5444537	448461	UNLICENSED
49750	JAMES DAVIS	Unknown Well Use	22	30.5	3.0	5444559	448807	UNLICENSED
48715	WILLIAM A TITLEY	Unknown Well Use	33	45.7	-	5444847	448461	UNLICENSED
73021	SHIPLEY	Unknown Well Use	44	42.7	18.3	5444336	448569	UNLICENSED
68810	WEEKS BRIAN	Unknown Well Use	33	45.7	21.3	5443354	448697	UNLICENSED
69466	SALE FRED	Unknown Well Use	44	61.0	30.5	5444155	448521	UNLICENSED
73240	SWAGLEY	Unknown Well Use	33	45.7	18.3	5444212	448406	UNLICENSED
73164	MARANATHA FISHING &	Unknown Well Use	87	47.3	12.2	5443692	448809	UNLICENSED
73064	PARDEE	Unknown Well Use	55	33.5	16.2	5444339	448413	UNLICENSED
64284	WHITE KATHY	Private Domestic	22	67.1	19.8	5444745	448500	UNLICENSED
14867	HENRY SILVA	Unknown Well Use	16	20.7	4.3	5444749	448733	UNLICENSED
83408	MORIN	Private Domestic	14	54.9	-	5444217	448468	UNLICENSED
83384	VELSEN	Private Domestic	44	48.8	-	5444218	448499	UNLICENSED
64232	SMITH RON	Unknown Well Use	22	45.7	-	5444056	448384	UNLICENSED
45043	S.WARK	Private Domestic	16	41.2	29.0	5444130	448306	UNLICENSED
32266	H L WALKER	Unknown Well Use	22	37.8	18.3	5444382	448791	UNLICENSED



Well Tag Number	Well Owner	Well Use Type	Yield Value (m³/d)	Depth Drilled (mbgl)	Groundwater Level Depth (mbgl)	UTM Coordinates (Zone 10)		License Status
						Northing	Easting	
36296	R FRAYNE	Unknown Well Use	UNKNOWN	4.3	0.6	5444391	448305	UNLICENSED
30200	JOE MARSALE	Unknown Well Use	82	44.2	1.2	5444863	448414	UNLICENSED
14855	H HALVERSON	Unknown Well Use	27	21.3	9.8	5444514	448844	UNLICENSED
18829	A REID	Private Domestic	22	55.5	19.8	5445176	448593	UNLICENSED
18855	J DAVIS	Unknown Well Use	22	21.3	10.1	5444527	448793	UNLICENSED
55705	KJELL OHLSSON	Unknown Well Use	5	25.9	6.1	5444075	448578	UNLICENSED
21160	SILVA BAY RESORT	Unknown Well Use	27	22.6	10.7	5444279	448799	UNLICENSED
24752	A CLEMENTS	Unknown Well Use	14	18.3	2.4	5444182	448828	UNLICENSED
38657	W BATUTE	Unknown Well Use	33	45.7	-	5444127	448397	UNLICENSED
51381	CARL BARSTEAD	Unknown Well Use	55	39.6	12.2	5444294	448494	UNLICENSED
20820	A R MUSCLOW	Private Domestic	98	36.6	-	5444256	448327	UNLICENSED
73206	MARTIN	Unknown Well Use	44	30.5	6.4	5444206	448377	UNLICENSED
13864	DR GREEN	Unknown Well Use	27	31.7	23.8	5444429	448758	UNLICENSED
85022	FARLEY	Private Domestic	8	99.1	-	5444260	448209	UNLICENSED
64223	SMITH RON	Unknown Well Use	16	68.6	-	5444045	448359	UNLICENSED
68886	PERSIN TONY	Unknown Well Use	16	33.5	19.8	5444198	448305	UNLICENSED
56122	JAN ANDREASSEN	Private Domestic	5	45.7	7.6	5444188	448673	UNLICENSED
64407	LAUDER	Unknown Well Use	49	44.2	19.8	5444061	448458	UNLICENSED
54253	JOHN PRICE	Unknown Well Use	16	38.1	22.9	5444550	448587	UNLICENSED
55837	R A MAURO	Private Domestic	5	48.8	-	5444164	448259	UNLICENSED
48475	R K PETERSON	Private Domestic	2	61.6	33.5	5444110	448286	UNLICENSED
64379	NELSON	Unknown Well Use	109	27.4	7.6	5444818	448646	UNLICENSED
24041	R HOBBS	Private Domestic	19	25.9	9.1	5444108	448743	UNLICENSED
69298	REINER	Unknown Well Use	33	30.5	2.4	5444218	448497	UNLICENSED
39560	E B COCKRILL	Unknown Well Use	65	33.5	12.2	5444670	448607	UNLICENSED
64261	CHAPMAN ROSS	Private Domestic	UNKNOWN	122.0	3.0	5445158	448598	UNLICENSED
43597	E B COCKRILL	Unknown Well Use	44	29.0	18.3	5444651	448620	UNLICENSED
26105	RUTH WAGENBLAST	Unknown Well Use	11	15.2	0.9	5444863	448479	UNLICENSED
22523	SILVA BAY RESORT	Unknown Well Use	27	33.5	12.2	5444319	448811	UNLICENSED
23403	D G WRIGHT	Unknown Well Use	3	33.5	6.1	5444833	448519	UNLICENSED
44669	A M LAW	Unknown Well Use	8	38.1	7.6	5444895	448818	UNLICENSED
91659	DUFFIN & FRAYNE	Private Domestic	3	61.0	-	5444299	448304	UNLICENSED
91663	HARRISON	Private Domestic	164	79.3	-	5444063	448640	UNLICENSED
91669	HOLLER	Private Domestic	55	62.2	24.4	5444146	448369	UNLICENSED
88958	DALEN	Private Domestic	16	106.7	-	5444212	448407	UNLICENSED
91506	POIRLER	Private Domestic	8	76.2	-	5444047	448304	UNLICENSED
89843	LAUDER	Private Domestic	14	45.7	-	5444061	448490	UNLICENSED
89857	DESCHAMBAULT	Private Domestic	27	31.4	12.2	5444050	448702	UNLICENSED
92052	KLARDIE	Private Domestic	218	80.8	25.0	5444150	448612	UNLICENSED
101436	GARDNER	Private Domestic	14	85.4	25.9	5444583	448618	UNLICENSED
101368	WEDLAKE	Private Domestic	33	44.2	-	5443900	448208	UNLICENSED
105796	WEEKS	Private Domestic	8	61.0	7.6	5444869	448044	UNLICENSED
106487	MEYER	Private Domestic	33	-	15.2	5443870	448648	UNLICENSED
106421	WANNER	Private Domestic	55	-	5.5	5444064	448744	UNLICENSED
106458	ABRAMS	Private Domestic	27	-	12.2	5444813	448656	UNLICENSED
106548	CHAPMAN	Private Domestic	55	-	27.4	5445164	448475	UNLICENSED
106558	GILL	Private Domestic	65	45.7	9.1	5443530	448722	UNLICENSED
106566	ZOENIG	Private Domestic	11	-	25.9	5444149	448548	UNLICENSED
106568	KRULL	Private Domestic	65	-	-	5444799	448185	UNLICENSED
106577	STIENE	Private Domestic	14	-	18.3	5444060	448678	UNLICENSED
106580	WHITE	Private Domestic	27	33.5	7.6	5444784	448152	UNLICENSED
106619	GIBSON	Private Domestic	27	-	15.2	5444927	448226	UNLICENSED
106427	LABELL	Private Domestic	65	-	30.5	5443685	448828	UNLICENSED
106512	SIMROSE	Private Domestic	44	-	6.1	5443473	448824	UNLICENSED
106520	FIDDLER	Private Domestic	33	22.9	7.6	5444201	448342	UNLICENSED
106526	BAKER	Private Domestic	22	-	33.5	5444149	448331	UNLICENSED
107295	DEKKER	Private Domestic	273	83.8	5.2	5444253	447880	UNLICENSED
106483	MEYER	Private Domestic	27	-	21.3	5443884	448627	UNLICENSED
Surface Water License Number	Water Purpose	Licensing District	Quantity (m³/year)	Water Source	UTM Coordinates (Zone 10)		License Status	
					Northing	Easting		
	C061944	08A - Stream Storage: Non-Power	Nanaimo / Nanaimo	1233.5	Toadeye Swamp	5444184	448084	Abandoned
	C061943	03B - Irrigation: Private	Nanaimo / Nanaimo	1233.5	Toadeye Swamp			Abandoned
C065734	01A - Domestic	Nanaimo / Nanaimo	2.3	Dick Brook	5444977	448142	Current	

Notes: m³/d means cubic metres per day; m³/year means cubic metres per year; mbgl means metres below ground level



Appendix D

Pumping Test Analysis Methodology



1.0 APPENDIX D: METHODOLOGY FOR ESTIMATING WELL YIELD

1.1 Estimating Aquifer Parameters

AQTESOLV provides analytical solutions for evaluating hydraulic parameters in the unconfined, aquifer system. In this analysis, aquifer test data is analyzed by visual curve matching to determine the “best fit,” and in turn, select the most representative interpretation of aquifer conditions for long-term sustainable use.

The Cooper-Jacob (1946), Agarwal (1980), and Moench (1984) solutions for an unconfined aquifer were used for analysis of the groundwater level data collected at water supply well (WIN 25324) during the aquifer pumping and recovery test phases. Specific assumptions were made with respect to aquifer characteristics using the data evaluation methods. The following assumptions are implicit with the uses of all analytical solutions:

- Aquifer is homogeneous, isotropic, of uniform thickness and of unlimited lateral extent;
- Aquifer potentiometric surface is initially horizontal;
- Flow to pumping well is horizontal;
- Water is released instantaneously from storage with decline of hydraulic head; and
- Diameter of pumping well is very small so that storage in the well can be neglected.

As the above-noted assumptions are typically not realized in nature, there will invariably be some discrepancy between predicted (i.e., theoretical) and measured drawdown. Solutions that ignore all, or a component of recharge, often over-predict drawdown, and are therefore inherently conservative.

1.2 Calculation for Long-term Sustainable Yield (Q_{20})

For the purposes of this evaluation, the Moell (1975) method, as modified by van der Kamp and Maathuis (2005), was used to determine the theoretical 20-year safe yield (Q_{20}).

$$Q_{20} = \frac{0.7 \times Q \times H_a}{S_{100 \text{ mins}} + (S_{20 \text{ yrs}} - S_{100 \text{ mins}})_{\text{Theor}}}$$

Where:

- H_a = Available head (m), calculated as distance from the non-pumping water level (NPWL) to the main water bearing fracture;
- Q = Well pumping rate during the aquifer test (m^3/d);
- $S_{100 \text{ mins}}$ = Measured drawdown at 100 minutes (m);
- $(S_{100 \text{ mins}})_{\text{Theor}}$ = Calculated theoretical drawdown after 100 minutes of pumping at Q (m);
- $(S_{20 \text{ yrs}})_{\text{Theor}}$ = Calculated theoretical drawdown after 20 years of pumping at Q (m); and
- 0.7 = Arbitrary safety factor to allow for aquifer heterogeneity, boundaries, etc.

The theoretical drawdown after 100 minutes of pumping ($(S_{100mins})_{Theor}$) and after 20 years of pumping ($(S_{20yrs})_{Theor}$) was calculated based on the following relation (Theis, 1935):

$$\Delta s = \frac{Q}{4\pi T} W(u) \quad (1)$$

$$u = \frac{r^2 S}{4Tt} \quad (2)$$

Where:

- r = radial distance from the pumping well (m);
- S = aquifer storativity (unitless);
- T = estimated transmissivity (mid-time value applied to $(S_{100mins})_{Theor}$ calculation (m²/day);
- t = elapsed time since pumping began (min);
- s = drawdown (m) at a distance r;
- Q = constant pumping rate (m³/d); and

$$W(u) = -0.5772 - \ln(u) + u - \frac{u^2}{2 \times 2!} + \frac{u^3}{3 \times 3!} - \dots$$

It should be noted that the Moell (1975) Q_{20} calculation has added safety factors that account for well inefficiencies.

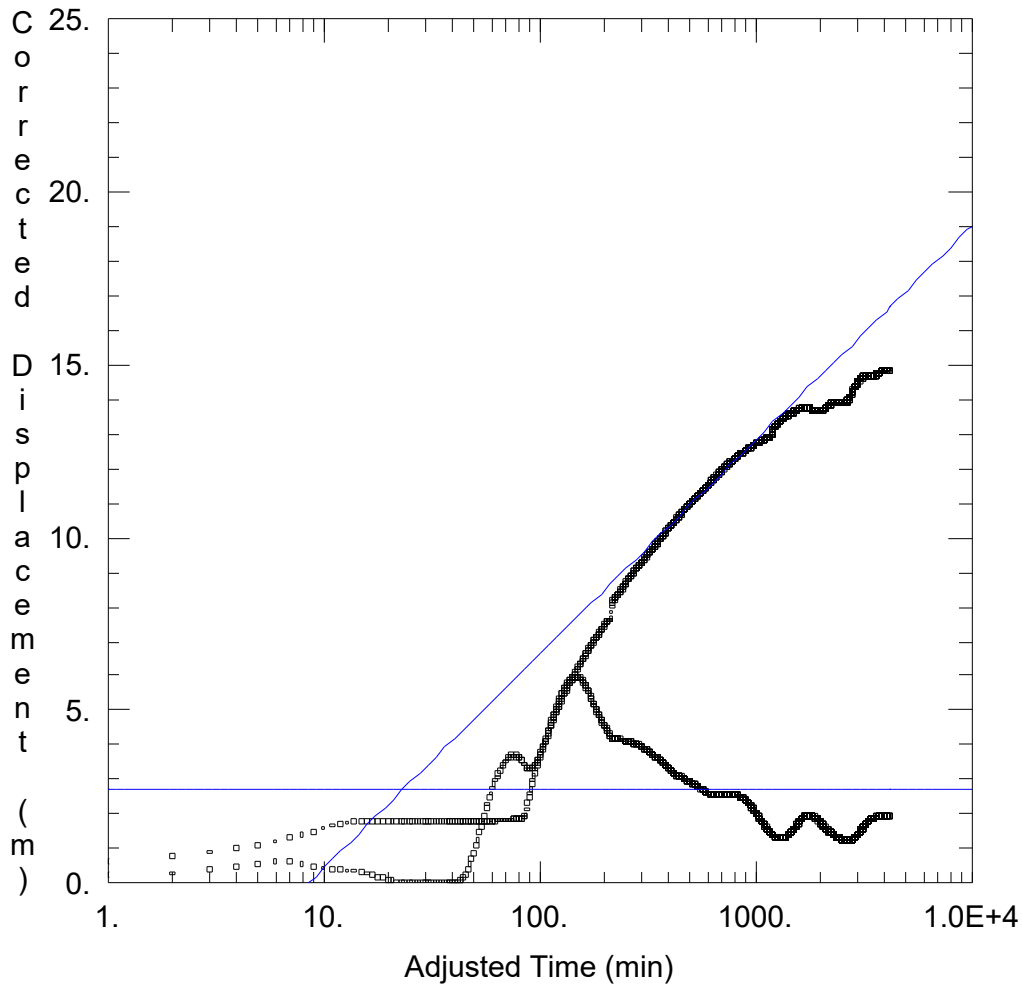
Appendix E
AQTESOLV Analysis



Figure E1: Mid-Time Pumping Response (Cooper- Jacob Solution)

Prepared By:
Waterline Resources
Project:
3190-19-001

Prepared For:
1167433 BC Ltd
Location:
Silva Bay Resort and Marina



Data Set: P:\...\Figure E1_Mid Tim CJ.aqt
Date: 02/22/23 Time: 17:02:30

SOLUTION

Aquifer Model: Unconfined
Solution Method: Cooper-Jacob
T = 0.42 m²/day S = 1.

AQUIFER DATA

Saturated Thickness: 50.9 Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
WIN 25324 (PW)	448819	5444347

Observation Wells

Well Name	X (m)	Y (m)
WIN 25324 (PW)	448819	5444347

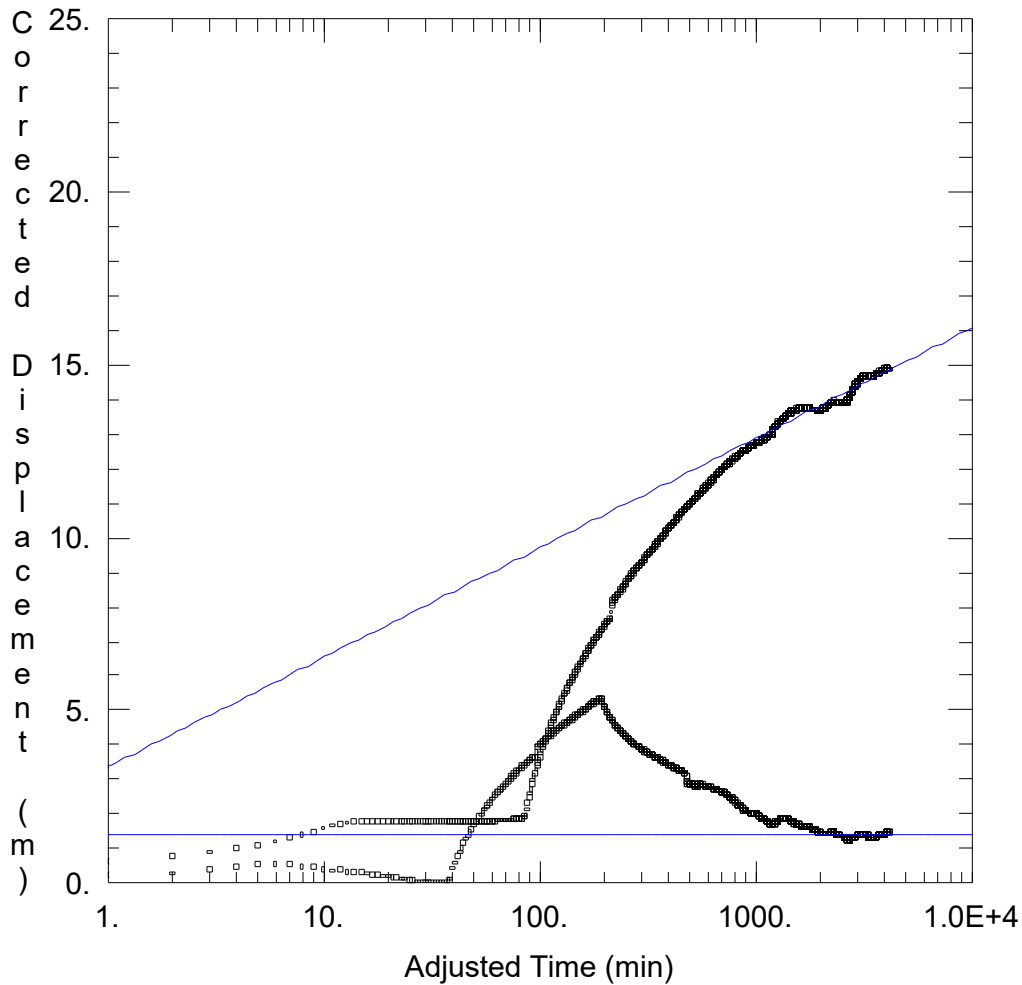
Figure E2: Late-Time Pumping Response (Cooper Jacob Solution)

Prepared By:
Waterline Resources

Prepared For:
1167433 BC Ltd

Project:
3190-19-001

Location:
Silva Bay Resort and Marina



Data Set: P:\...\Figure E2_Late Time CJ.aqt
Date: 02/22/23 Time: 17:04:05

SOLUTION

Aquifer Model: Unconfined
Solution Method: Cooper-Jacob
T = 0.82 m²/day S = 0.02

AQUIFER DATA

Saturated Thickness: 51.2 Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
WIN 25324 (PW)	448819	5444347

Observation Wells

Well Name	X (m)	Y (m)
WIN 25324 (PW)	448819	5444347

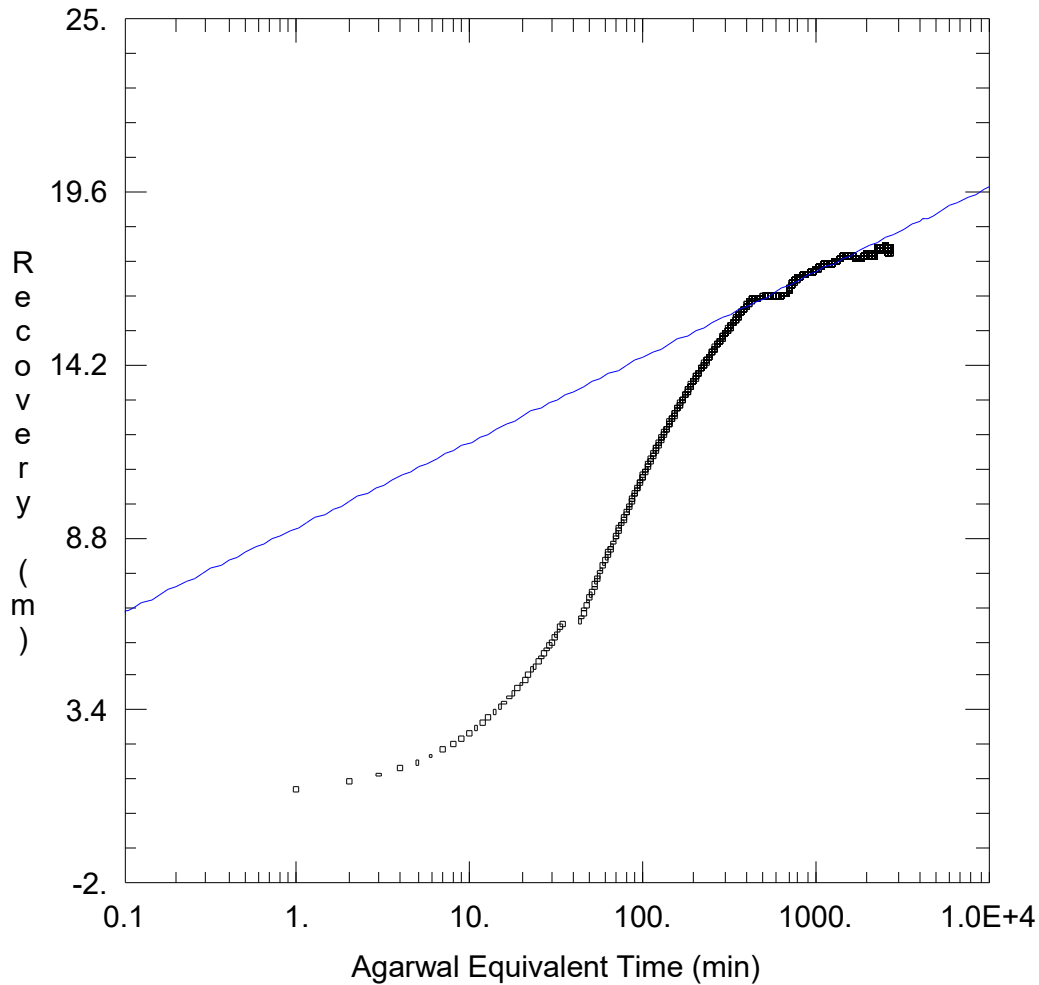
Figure E3: Recovery Response (Agarwal Solution)

Prepared By:
Waterline Resources

Prepared For:
1167433 BC Ltd

Project:
3190-19-001

Location:
Silva Bay Resort and Marina



Data Set: P:\...\Figure E3 Recovery Agarwal.aqt
Date: 02/22/23 Time: 17:05:36

SOLUTION

Aquifer Model: Unconfined
Solution Method: Cooper-Jacob
T = 0.98 m²/day S = 0.0001

AQUIFER DATA

Saturated Thickness: 51.2 Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
WIN 25324 (PW)	448819	5444347

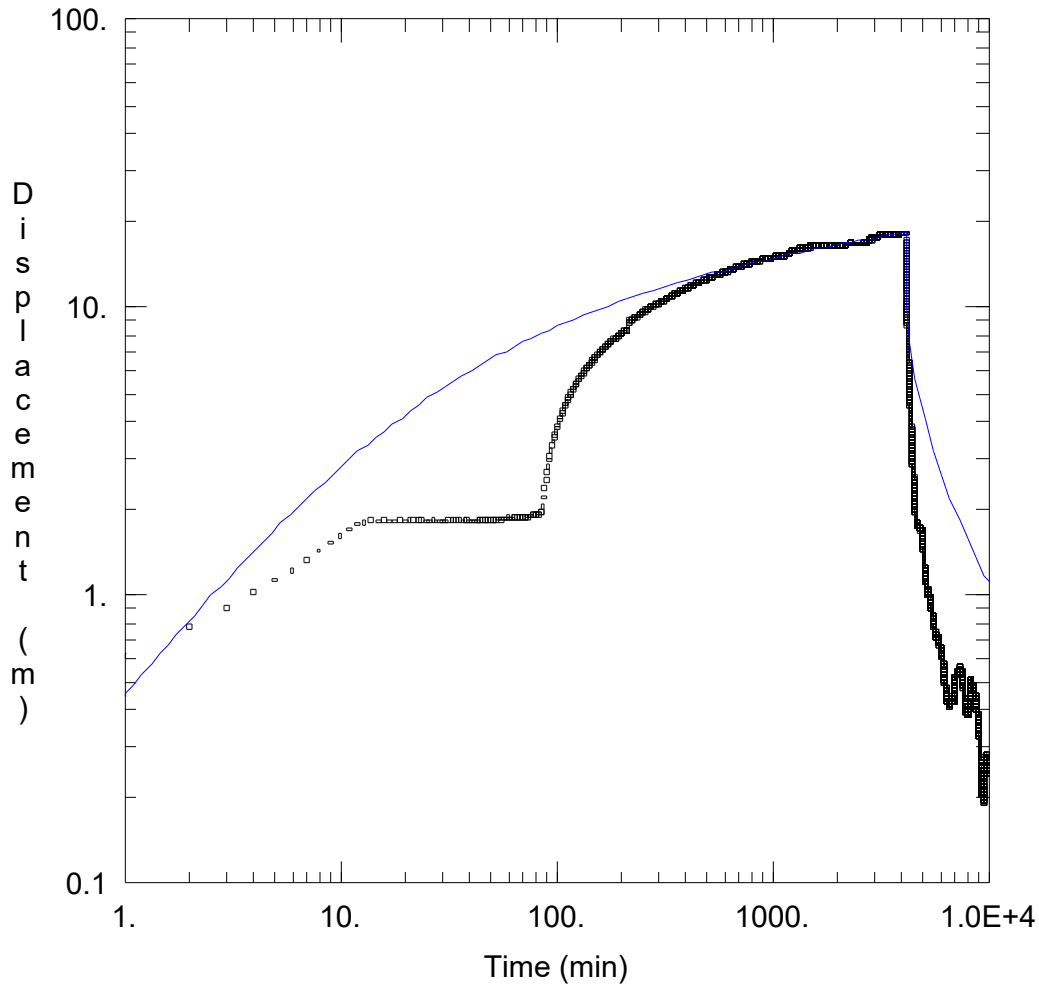
Observation Wells

Well Name	X (m)	Y (m)
◻ WIN 25324 (PW)	448819	5444347

Figure E4: Mid-Time Pumping Response (Moench Solution)

Prepared By:
Waterline Resources
Project:
3190-19-001

Prepared For:
1167433 BC Ltd
Location:
Silva Bay Resort and Marina



Data Set: P:\...\Figure E4_Mid Time Moench.aqt
Date: 02/22/23 Time: 17:06:33

SOLUTION

Aquifer Model: Unconfined
Solution Method: Moench

T = 0.42 m²/day S = 0.005
Sy = 0.3 Kz/Kr = 0.1
Sw = -2.2 r(w) = 0.075 m
r(c) = 0.075 m alpha = 1.0E+30 min⁻¹

AQUIFER DATA

Saturated Thickness: 31.3 Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
WIN 25324 (PW)	448819	5444347

Observation Wells

Well Name	X (m)	Y (m)
WIN 25324 (PW)	448819	5444347

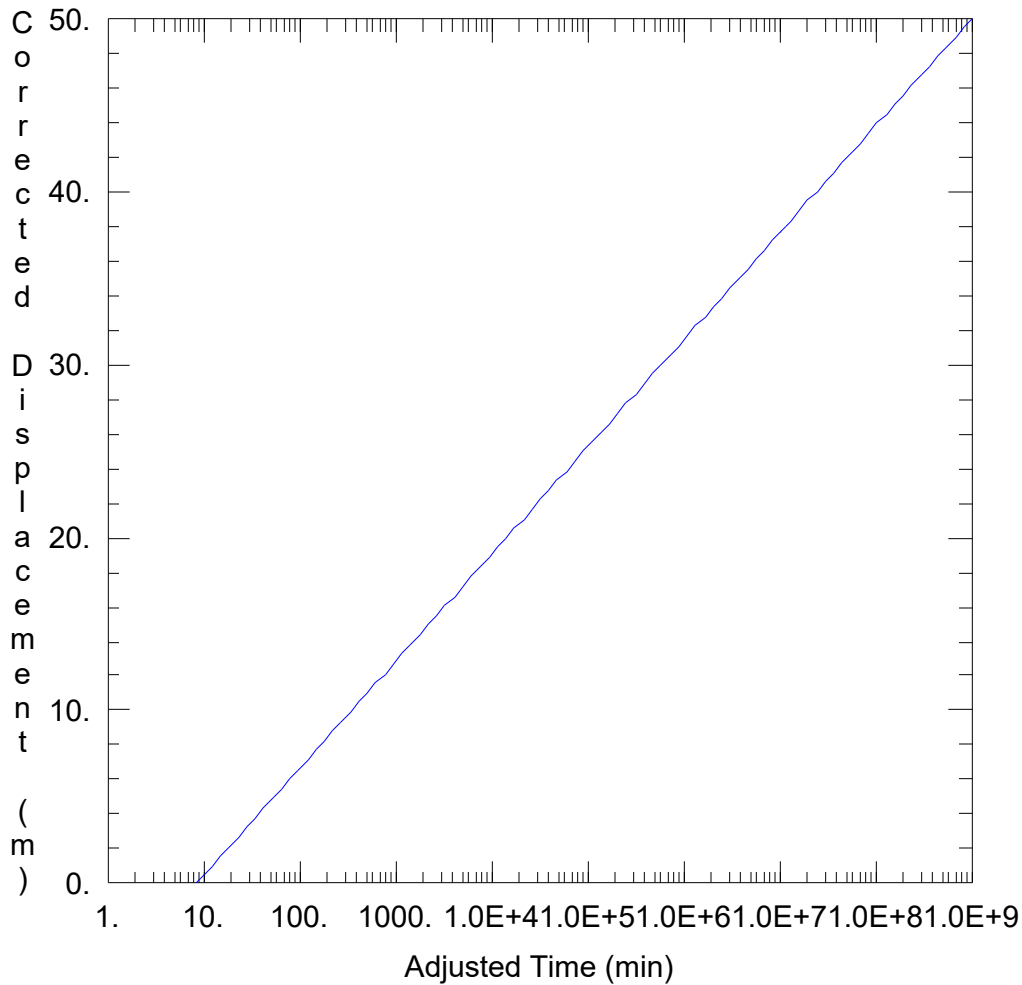
Figure E5: Q20 Prediction (Cooper Jacob Solution)

Prepared By:
Waterline Resources

Prepared For:
1167433 BC Ltd

Project:
3190-19-001

Location:
Silva Bay Resort and Marina



Data Set: P:\...\Figure E5_Q20 with CJ.aqt
Date: 02/22/23 Time: 17:07:14

SOLUTION

Aquifer Model: Unconfined
Solution Method: Cooper-Jacob
T = 0.42 m²/day S = 1.

AQUIFER DATA

Saturated Thickness: 51.2 Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
WIN 25234 (PW)	448819	5444347

Observation Wells

Well Name	X (m)	Y (m)
▫ WIN 25234 (PW)	448819	5444347

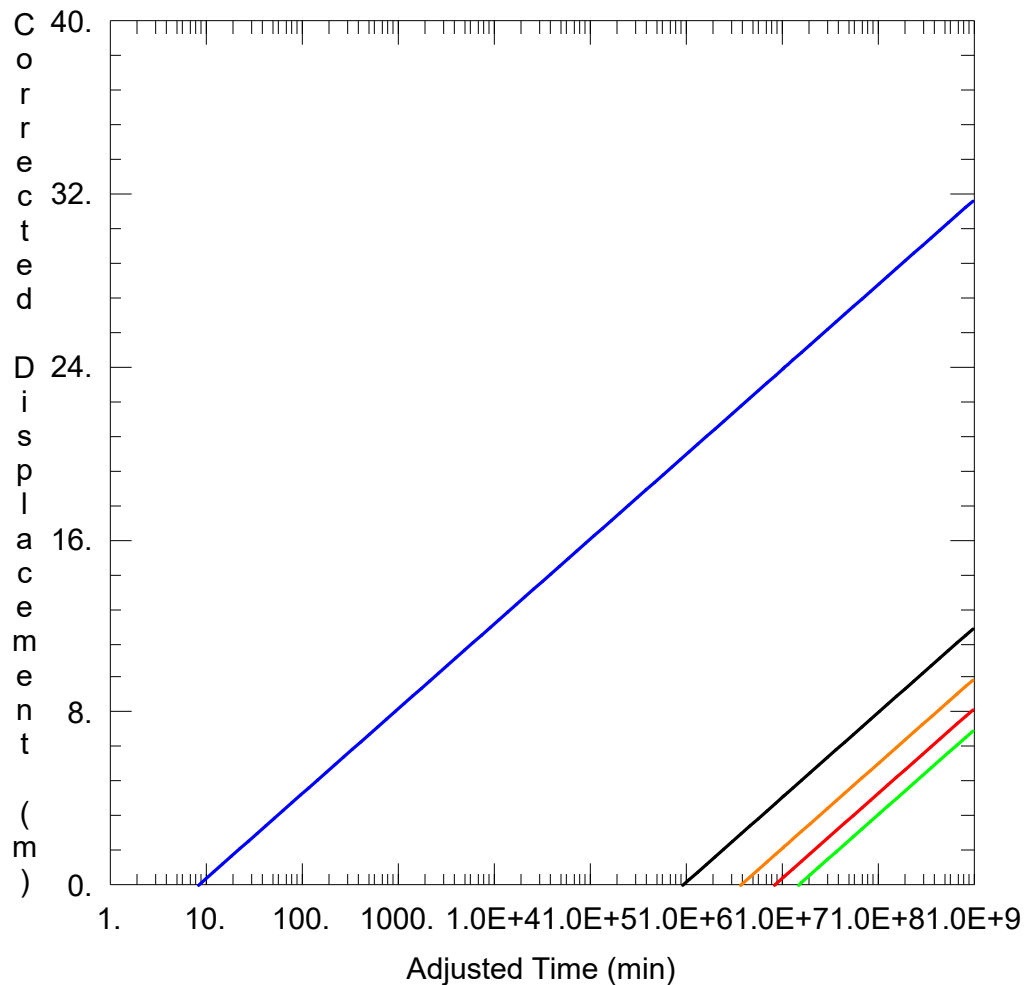
Figure E6: Pumping Response - Distance Drawdown 20-years (Cooper Jacob Solution)

Prepared By:
Waterline Resources

Prepared For:
1167433 BC Ltd

Project:
3190-19-001

Location:
Silva Bay Resort and Marina



Data Set: P:\...\Figure E6_Distance Drawdown.aqt
Date: 02/22/23 Time: 17:14:51

SOLUTION

Aquifer Model: Unconfined
Solution Method: Cooper-Jacob
T = 0.42 m²/day S = 1.

AQUIFER DATA

Saturated Thickness: 51.2 Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
WIN 25234 (PW)	0	0

Observation Wells

Well Name	X (m)	Y (m)
WIN 25234 (PW)	0	0
25m Radius	0	25
50m Radius	0	50
75m Radius	0	75
100m Radius	0	100

Appendix F

Groundwater Chemistry Results



Table F1: Groundwater Chemistry Results - General and Nutrient Parameters

				General										Nutrients					
Sample Location	Sample Date	Field Sample ID	Lab ID	Colour	Alkalinity, Total (as CaCO ₃)	Conductivity (EC)	Langelier Index	Temperature	Total Dissolved Solids-Calculated	Total Hardness (CaCO ₃)	Total Organic Carbon (TOC)	Turbidity	pH	Ammonia-Total (as N)	Nitrate+Nitrite-N	Nitrate-N	Nitrite-N	Organic Nitrogen-Total (as N)	Total Kjeldahl Nitrogen
			Units	TCU	mg/L	µS/cm	-	°C	mg/L	mg/L	mg/L	NTU	-	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Guidelines		GCDWQ AO		15	-	-	-	15	500	-	-	0.1	7-10.5	-	-	-	-	-	-
		GCDWQ MAC		-	-	-	-	-	-	-	-	-	-	-	-	10	1	-	-
WIN 25324	2019-08-21	Before CRPT	9082105-01	51	160	415	-1	23.6	240	16.5	2.75	115	7.57	0.146	<0.0100	<0.010	<0.010	0.243	0.389
WIN 25324	2019-09-06	After CRPT	9090600-01	10	159	450	-0.7	23.8	248	18.7	2.64	4.38	8.04	0.045	<0.0100	<0.010	<0.010	0.091	0.136

Notes:

Guidelines - Health Canada, June 2019, Guidelines for Canadian Drinking Water Quality (GCDWQ), Summary Table.

Violet highlight - Value exceeds the Aesthetic Objectives (AO).

Yellow highlight - Value exceeds the Maximum Acceptable Concentration (MAC).

mg/L means milligrams per litre; µS/cm means micro Siemens per centimeter; °C means degrees Celsius; TCU means True Color Unit; NTU means Nephelometric Turbidity Unit

Table F2: Groundwater Chemistry Results - Major Ions

Sample Location	Sample Date	Field Sample ID	Lab ID	Bicarbonate (HCO ₃)	Calcium (Ca)-Dissolved	Carbonate (CO ₃)	Chloride (Cl)	Fluoride (F)	Hydroxide (OH)	Ion Balance	Iron (Fe)-Dissolved	Magnesium (Mg)-Dissolved	Manganese (Mn)-Dissolved	Phenolphthalein	Potassium (K)-Dissolved	Sodium (Na)-Dissolved	Sulphate (SO ₄)
			Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Guidelines		GCDWQ AO		-	-	-	250	-	-	-	0.3	-	0.02	-	-	200	500
		GCDWQ MAC		-	-	-	-	1.5	-	-	-	-	0.12	-	-	-	-
WIN 25324	2019-08-21	Before CRPT	9082105-01	195	3.95	<0.600	31.6	0.21	<0.340	101	0.018	1.62	0.0293	<1.0	0.18	92.9	12.2
WIN 25324	2019-09-06	After CRPT	9090600-01	194	4.37	<0.600	39.6	0.28	<0.340	94.3	0.015	1.88	0.0179	<1.0	0.24	90.8	13.7

Notes:

Guidelines - Health Canada, June 2019, Guidelines for Canadian Drinking Water Quality (GCDWQ), Summary Table.

Violet highlight - Value exceeds the Aesthetic Objectives (AO).

Yellow highlight - Value exceeds the Maximum Acceptable Concentration (MAC).

mg/L means milligrams per litre

Table F3: Groundwater Chemistry Results - Microbiological Parameters

Sample Location	Sample Date	Field Sample ID	Lab ID	E. Coli	E. Coli	Fecal Coliform	Heterotrophic Plate Count	Total Coliforms	Total Coliforms
			Units	CFU/100 mL	MPN/100mL	CFU/100 mL	cfu/mL	CFU/100 mL	MPN/100mL
Guidelines		GCDWQ AO		-	-	-	-	-	-
		GCDWQ MAC		0	0	0	-	0	0
WIN 25324	2019-08-21	Before CRPT	9082105-01	<10	-	<10	8000	<10	-
WIN 25324	2019-09-06	After CRPT	9090600-01	-	<1.1	-	-	-	<1.1

Notes:

Guidelines - Health Canada, June 2019, Guidelines for Canadian Drinking Water Quality (GCDWQ), Summary Table.

Laboratory results that were less than detection limits and greater than the applied guidelines are not shown as exceedances.

Violet highlight - Value exceeds the Aesthetic Objectives (AO).

Yellow highlight - Value exceeds the Maximum Acceptable Concentration (MAC).

CFU means Colony Forming Unit; MPN means Most Probable Number

Table F4: Groundwater Chemistry Results - Dissolved Metals

Sample Location	Sample Date	Field Sample ID	Lab ID	Aluminum (Al)-Dissolved	Antimony (Sb)-Dissolved	Arsenic (As)-Dissolved	Barium (Ba)-Dissolved	Boron (B)-Dissolved	Cadmium (Cd)-Dissolved	Chromium (Cr)-Dissolved	Cobalt (Co)-Dissolved	Copper (Cu)-Dissolved	Lead (Pb)-Dissolved	Lithium (Li)-Dissolved	Mercury (Hg)-Dissolved	Nickel (Ni)-Dissolved	Phosphorus (P)-Dissolved	Selenium (Se)-Dissolved	Strontium (Sr)-Dissolved	Sulphur (S)-Dissolved	Uranium (U)-Dissolved	Zinc (Zn)-Dissolved
			Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Guidelines		GCDWQ AO		-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	5
		GCDWQ MAC		-	0.006	0.01	1	5	0.005	0.05	-	2	0.005	-	0.001	-	-	0.05	7	-	0.02	-
WIN 25324	2019-08-21	Before CRPT	9082105-01	0.0375	0.00022	0.00077	0.015	0.447	<0.000010	<0.00050	<0.00010	0.0014	<0.00020	0.00851	<0.000010	0.00054	0.0524	<0.00050	0.0674	<3.0	0.00007	0.0232
WIN 25324	2019-09-06	After CRPT	9090600-01	0.0165	<0.00020	0.00092	0.0126	0.383	<0.000010	<0.00050	<0.00010	0.00075	<0.00020	0.00732	<0.000010	0.00047	<0.050	<0.00050	0.0774	4.2	0.000089	0.0267

Notes:

Guidelines - Health Canada, June 2019, Guidelines for Canadian Drinking Water Quality (GCDWQ), Summary Table.

Violet highlight - Value exceeds the Aesthetic Objectives (AO).

Yellow highlight - Value exceeds the Maximum Acceptable Concentration (MAC).

mg/L means milligrams per litre

Table F5: Groundwater Chemistry Results - Total Metals

Sample Location	Sample Date	Field Sample ID	Lab ID	Aluminum (Al)-Total	Antimony (Sb)-Total	Arsenic (As)-Total	Barium (Ba)-Total	Boron (B)-Total	Cadmium (Cd)-Total	Calcium (Ca)-Total	Chromium (Cr)-Total	Cobalt (Co)-Total	Copper (Cu)-Total	Iron (Fe)-Total	Lead (Pb)-Total	Magnesium (Mg)-Total	Manganese (Mn)-Total	Mercury (Hg)-Total	Nickel (Ni)-Total	Potassium (K)-Total	Selenium (Se)-Total	Sodium (Na)-Total	Strontium (Sr)-Total	Uranium (U)-Total	Zinc (Zn)-Total
			Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Guidelines		GCDWQ AO		-	-	-	-	-	-	-	-	-	1	0.3	-	-	0.02	-	-	-	-	200	-	-	5
		GCDWQ MAC		-	0.006	0.01	1	5	0.005	-	0.05	-	2	-	0.005	-	0.12	0.001	-	-	0.05	-	7	0.02	-
WIN 25324	2019-08-21	Before CRPT	9082105-01	4.13	0.00039	0.00135	0.0687	0.377	<0.000010	4.61	0.00569	0.00183	0.0066	4.31	0.00118	3.36	0.117	<0.000040	0.00484	0.69	<0.00050	88.7	0.0802	0.000209	0.0463
WIN 25324	2019-09-06	After CRPT	9090600-01	0.212	<0.00020	0.00097	0.0147	0.35	<0.000010	4.35	0.00055	0.00013	0.00126	0.213	<0.00020	2.01	0.0217	<0.000010	0.0007	0.28	<0.00050	94.1	0.0754	0.000097	0.0278

Notes:

Guidelines - Health Canada, June 2019, Guidelines for Canadian Drinking Water Quality (GCDWQ), Summary Table.

Violet highlight - Value exceeds the Aesthetic Objectives (AO).

Yellow highlight - Value exceeds the Maximum Acceptable Concentration (MAC).

mg/L means milligrams per litre

Table F6: Groundwater Chemistry Results - Field Chemistry Parameters

Sample Location	Sample Date	Field pH	Field Conductivity (EC)	Total Dissolved Solids	Field Temperature
Units		-	µS/cm	mg/L	°C
WIN 25324	2019-09-04 06:55	5.86	390	236	13.7
WIN 25324	2019-09-04 09:12	6.68	390	236	14.4
WIN 25324	2019-09-04 11:00	6.71	386	234	14.2
WIN 25324	2019-09-04 12:00	6.93	384	233	14.7
WIN 25324	2019-09-04 15:20	6.97	391	237	14.6
WIN 25324	2019-09-04 16:00	6.99	394	239	14.4
WIN 25324	2019-09-05 06:36	7.15	406	246	14.4
WIN 25324	2019-09-05 07:18	7.09	409	248	14.3
WIN 25324	2019-09-05 10:05	7.15	405	245	14.4
WIN 25324	2019-09-05 10:51	7.06	420	255	14.5
WIN 25324	2019-09-05 11:53	7.11	405	245	14.5
WIN 25324	2019-09-05 14:20	6.83	416	252	14.7
WIN 25324	2019-09-05 15:50	6.93	420	255	14.9
WIN 25324	2019-09-06 06:58	6.75	427	259	14.3
WIN 25324	2019-09-06 10:50	6.7	425	258	14.8
WIN 25324	2019-09-06 11:58	6.67	435	264	14.7
WIN 25324	2019-09-06 13:15	6.7	431	261	15.5

Notes: TDS is calculated from EC based on a conversion of 0.65; µS/cm means micro Siemens per centimeter, °C means degrees Celsius; mg/L means milligram per litre

CERTIFICATE OF ANALYSIS

REPORTED TO Waterline Resources Inc. - Nanaimo
2430 Jingle Pot Road
Nanaimo, BC V9R 6W2

ATTENTION Gage Nordstrom

PO NUMBER

PROJECT 3190-19-001

PROJECT INFO Silva Bay

WORK ORDER 9082105

RECEIVED / TEMP 2019-08-22 09:00 / 9°C

REPORTED 2019-08-29 16:51

COC NUMBER No #

Introduction:

CARO Analytical Services is a testing laboratory full of smart, engaged scientists driven to make the world a safer and healthier place. Through our clients' projects we become an essential element for a better world. We employ methods conducted in accordance with recognized professional standards using accepted testing methodologies and quality control efforts. CARO is accredited by the Canadian Association for Laboratories Accreditation (CALA) to ISO 17025:2005 for specific tests listed in the scope of accreditation approved by CALA.

Big Picture Sidekicks



You know that the sample you collected after snowshoeing to site, digging 5 meters, and racing to get it on a plane so you can submit it to the lab for time sensitive results needed to make important and expensive decisions (whew) is VERY important. We know that too.

We've Got Chemistry



It's simple. We figure the more you enjoy working with our fun and engaged team members; the more likely you are to give us continued opportunities to support you.

Ahead of the Curve



Through research, regulation knowledge, and instrumentation, we are your analytical centre for the technical knowledge you need, BEFORE you need it, so you can stay up to date and in the know.

If you have any questions or concerns, please contact me at bshaw@caro.ca

Authorized By:

Bryan Shaw, Ph.D., P.Chem.
Client Service Coordinator

1-888-311-8846 | www.caro.ca

#110 4011 Viking Way Richmond, BC V6V 2K9 | #102 3677 Highway 97N Kelowna, BC V1X 5C3 | 17225 109 Avenue Edmonton, AB T5S 1H7

TEST RESULTS

REPORTED TO PROJECT Waterline Resources Inc. - Nanaimo
3190-19-001

WORK ORDER REPORTED 9082105
2019-08-29 16:51

Analyte	Result	RL	Units	Analyzed	Qualifier
25234 (9082105-01) Matrix: Water Sampled: 2019-08-21 12:00					F2
Anions					
Chloride	31.6	0.10	mg/L	2019-08-23	
Fluoride	0.21	0.10	mg/L	2019-08-23	
Nitrate (as N)	< 0.010	0.010	mg/L	2019-08-23	
Nitrite (as N)	< 0.010	0.010	mg/L	2019-08-23	
Sulfate	12.2	1.0	mg/L	2019-08-23	
Calculated Parameters					
Hardness, Total (as CaCO ₃)	16.5	0.500	mg/L	N/A	
Ion Balance	101		mg/L	N/A	
Langelier Index	-1.0	-5.0		2019-08-29	
Nitrate+Nitrite (as N)	< 0.0100	0.0100	mg/L	N/A	
Nitrogen, Organic	0.243	0.0500	mg/L	N/A	
Solids, Total Dissolved	239	1.00	mg/L	N/A	
Dissolved Metals					
Aluminum, dissolved	0.0375	0.0050	mg/L	2019-08-27	
Antimony, dissolved	0.00022	0.00020	mg/L	2019-08-27	
Arsenic, dissolved	0.00077	0.00050	mg/L	2019-08-27	
Barium, dissolved	0.0150	0.0050	mg/L	2019-08-27	
Beryllium, dissolved	< 0.00010	0.00010	mg/L	2019-08-27	
Bismuth, dissolved	< 0.00010	0.00010	mg/L	2019-08-27	
Boron, dissolved	0.447	0.0050	mg/L	2019-08-27	
Cadmium, dissolved	< 0.000010	0.000010	mg/L	2019-08-27	
Calcium, dissolved	3.95	0.20	mg/L	2019-08-27	
Chromium, dissolved	< 0.00050	0.00050	mg/L	2019-08-27	
Cobalt, dissolved	< 0.00010	0.00010	mg/L	2019-08-27	
Copper, dissolved	0.00140	0.00040	mg/L	2019-08-27	
Iron, dissolved	0.018	0.010	mg/L	2019-08-27	
Lead, dissolved	< 0.00020	0.00020	mg/L	2019-08-27	
Lithium, dissolved	0.00851	0.00010	mg/L	2019-08-27	
Magnesium, dissolved	1.62	0.010	mg/L	2019-08-27	
Manganese, dissolved	0.0293	0.00020	mg/L	2019-08-27	
Mercury, dissolved	< 0.000010	0.000010	mg/L	2019-08-27	
Molybdenum, dissolved	0.00286	0.00010	mg/L	2019-08-27	
Nickel, dissolved	0.00054	0.00040	mg/L	2019-08-27	
Phosphorus, dissolved	< 0.050	0.050	mg/L	2019-08-27	
Potassium, dissolved	0.18	0.10	mg/L	2019-08-27	
Selenium, dissolved	< 0.00050	0.00050	mg/L	2019-08-27	
Silicon, dissolved	8.6	1.0	mg/L	2019-08-27	
Silver, dissolved	< 0.000050	0.000050	mg/L	2019-08-27	
Sodium, dissolved	92.9	0.10	mg/L	2019-08-27	
Strontium, dissolved	0.0674	0.0010	mg/L	2019-08-27	
Sulfur, dissolved	< 3.0	3.0	mg/L	2019-08-27	

TEST RESULTS

REPORTED TO PROJECT Waterline Resources Inc. - Nanaimo
3190-19-001

WORK ORDER REPORTED 9082105
2019-08-29 16:51

Analyte	Result	RL	Units	Analyzed	Qualifier
25234 (9082105-01) Matrix: Water Sampled: 2019-08-21 12:00, Continued					F2
Dissolved Metals, Continued					
Tellurium, dissolved	< 0.00050	0.00050	mg/L	2019-08-27	
Thallium, dissolved	< 0.000020	0.000020	mg/L	2019-08-27	
Thorium, dissolved	< 0.00010	0.00010	mg/L	2019-08-27	
Tin, dissolved	< 0.00020	0.00020	mg/L	2019-08-27	
Titanium, dissolved	< 0.0050	0.0050	mg/L	2019-08-27	
Tungsten, dissolved	< 0.0010	0.0010	mg/L	2019-08-27	
Uranium, dissolved	0.000070	0.000020	mg/L	2019-08-27	
Vanadium, dissolved	0.0014	0.0010	mg/L	2019-08-27	
Zinc, dissolved	0.0232	0.0040	mg/L	2019-08-27	
Zirconium, dissolved	< 0.00010	0.00010	mg/L	2019-08-27	
General Parameters					
Alkalinity, Total (as CaCO ₃)	160	1.0	mg/L	2019-08-23	
Alkalinity, Phenolphthalein (as CaCO ₃)	< 1.0	1.0	mg/L	2019-08-23	
Alkalinity, Bicarbonate (as CaCO ₃)	160	1.0	mg/L	2019-08-23	
Alkalinity, Carbonate (as CaCO ₃)	< 1.0	1.0	mg/L	2019-08-23	
Alkalinity, Hydroxide (as CaCO ₃)	< 1.0	1.0	mg/L	2019-08-23	
Bicarbonate (HCO ₃)	195	1.22	mg/L	N/A	
Carbonate (CO ₃)	< 0.600	0.600	mg/L	N/A	
Hydroxide (OH)	< 0.340	0.340	mg/L	N/A	
Ammonia, Total (as N)	0.146	0.020	mg/L	2019-08-23	
Carbon, Total Organic	2.75	0.50	mg/L	2019-08-26	
Colour, True	51	5.0	CU	2019-08-24	
Conductivity (EC)	415	2.0	µS/cm	2019-08-23	
Cyanide, Total	< 0.0020	0.0020	mg/L	2019-08-23	
Nitrogen, Total Kjeldahl	0.389	0.050	mg/L	2019-08-24	
pH	7.57	0.10	pH units	2019-08-23	HT2
Phosphorus, Total Dissolved	0.0524	0.0020	mg/L	2019-08-25	
Temperature, at pH	23.6		°C	2019-08-23	HT2
Turbidity	115	0.10	NTU	2019-08-23	
Total Metals					
Aluminum, total	4.13	0.0050	mg/L	2019-08-28	
Antimony, total	0.00039	0.00020	mg/L	2019-08-28	
Arsenic, total	0.00135	0.00050	mg/L	2019-08-28	
Barium, total	0.0687	0.0050	mg/L	2019-08-28	
Boron, total	0.377	0.0050	mg/L	2019-08-28	
Cadmium, total	< 0.000010	0.000010	mg/L	2019-08-28	
Calcium, total	4.61	0.20	mg/L	2019-08-28	
Chromium, total	0.00569	0.00050	mg/L	2019-08-28	
Cobalt, total	0.00183	0.00010	mg/L	2019-08-28	
Copper, total	0.00660	0.00040	mg/L	2019-08-28	
Iron, total	4.31	0.010	mg/L	2019-08-28	

TEST RESULTS

REPORTED TO PROJECT Waterline Resources Inc. - Nanaimo
3190-19-001

WORK ORDER REPORTED 9082105
2019-08-29 16:51

Analyte	Result	RL	Units	Analyzed	Qualifier
25234 (9082105-01) Matrix: Water Sampled: 2019-08-21 12:00, Continued					F2

Total Metals, Continued

Lead, total	0.00118	0.00020	mg/L	2019-08-28	
Magnesium, total	3.36	0.010	mg/L	2019-08-28	
Manganese, total	0.117	0.00020	mg/L	2019-08-28	
Mercury, total	< 0.000040	0.000040	mg/L	2019-08-28	CT5
Molybdenum, total	0.00280	0.00010	mg/L	2019-08-28	
Nickel, total	0.00484	0.00040	mg/L	2019-08-28	
Potassium, total	0.69	0.10	mg/L	2019-08-28	
Selenium, total	< 0.00050	0.00050	mg/L	2019-08-28	
Sodium, total	88.7	0.10	mg/L	2019-08-28	
Strontium, total	0.0802	0.0010	mg/L	2019-08-28	
Uranium, total	0.000209	0.000020	mg/L	2019-08-28	
Zinc, total	0.0463	0.0040	mg/L	2019-08-28	

Microbiological Parameters

Coliforms, Total	<10	1	CFU/100 mL	2019-08-22	
Background Colonies	12,000	1	CFU/100 mL	2019-08-22	
Coliforms, Fecal	<10	1	CFU/100 mL	2019-08-22	
E. coli	<10	1	CFU/100 mL	2019-08-22	
Heterotrophic Plate Count	8,000	1	CFU/mL	2019-08-22	

Sample Qualifiers:

CT5 This sample has been incorrectly preserved for Mercury analysis

F2 The sample was not field-preserved with HNO3 and was therefore preserved in the laboratory and held for at least 16 hours prior to analysis for total metals.

HT2 The 15 minute recommended holding time (from sampling to analysis) has been exceeded - field analysis is recommended.

APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO PROJECT Waterline Resources Inc. - Nanaimo
3190-19-001

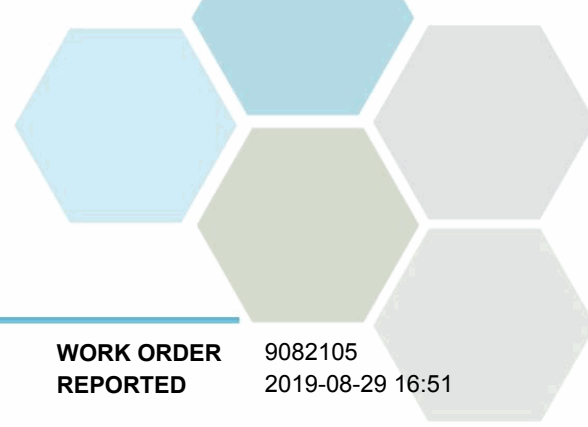
WORK ORDER REPORTED 9082105
2019-08-29 16:51

Analysis Description	Method Ref.	Technique	Location
Alkalinity in Water	SM 2320 B* (2017)	Titration with H ₂ SO ₄	Kelowna
Ammonia, Total in Water	SM 4500-NH ₃ G* (2017)	Automated Colorimetry (Phenate)	Kelowna
Anions in Water	SM 4110 B (2017)	Ion Chromatography	Kelowna
Background Colonies in Water	SM 9222 (2017)	Membrane Filtration	Sublet
Carbon, Total Organic in Water	SM 5310 B (2017)	Combustion, Infrared CO ₂ Detection	Kelowna
Coliforms, Fecal in Water	SM 9222 (2017)	Membrane Filtration	Sublet
Coliforms, Total in Water	SM 9222 (2017)	Membrane Filtration	Sublet
Colour, True in Water	SM 2120 C (2017)	Spectrophotometry (456 nm)	Kelowna
Conductivity in Water	SM 2510 B (2017)	Conductivity Meter	Kelowna
Cyanide, SAD in Water	ASTM D7511-12	Flow Injection with In-Line UV Digestion and Amperometry	Kelowna
Dissolved Metals in Water	EPA 200.8 / EPA 6020B	0.45 µm Filtration / Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS)	Richmond
E. coli in Water	SM 9223 B (2017)	Enzyme Substrate Endo Agar	Sublet
Hardness in Water	SM 2340 B (2017)	Calculation: 2.497 [diss Ca] + 4.118 [diss Mg]	N/A
Heterotrophic Plate Count in Water	SM 9215 B (2017)	Pour Plate	Sublet
Ion Balance in Water	SM 1030 E (2017)	SM 1030 E (2011)	N/A
Langelier Index in Water	SM 2330 B (2017)	Calculation	N/A
Mercury, dissolved in Water	EPA 245.7*	BrCl ₂ Oxidation / Cold Vapor Atomic Fluorescence Spectrometry (CVAFS)	Richmond
Nitrogen, Total Kjeldahl in Water	SM 4500-Norg D* (2017)	Block Digestion and Flow Injection Analysis	Kelowna
pH in Water	SM 4500-H+ B (2017)	Electrometry	Kelowna
Phosphorus, Total Dissolved in Water	SM 4500-P B.5* (2011) / SM 4500-P F (2017)	Persulfate Digestion / Automated Colorimetry (Ascorbic Acid)	Kelowna
Solids, Total Dissolved in Water	SM 1030 E (2017)	SM 1030 E (2011)	N/A
Total Metals in Water	EPA 200.2* / EPA 6020B	HNO ₃ +HCl Hot Block Digestion / Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS)	Richmond
Turbidity in Water	SM 2130 B (2017)	Nephelometry	Kelowna

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

Glossary of Terms:

RL	Reporting Limit (default)
<	Less than the specified Reporting Limit (RL) - the actual RL may be higher than the default RL due to various factors
<1	Less than the specified Reporting Limit (RL) - the actual RL may be higher than the default RL due to various factors
°C	Degrees Celcius
AO	Aesthetic Objective
CFU/100 mL	Colony Forming Units per 100 millilitres
CFU/mL	Colony Forming Units per millilitre
CU	Colour Units (referenced against a platinum cobalt standard)
MAC	Maximum Acceptable Concentration (health based)
mg/L	Milligrams per litre
NTU	Nephelometric Turbidity Units
OG	Operational Guideline (treated water)
pH units	pH < 7 = acidic, pH > 7 = basic
µS/cm	Microsiemens per centimetre



APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO PROJECT	Waterline Resources Inc. - Nanaimo	WORK ORDER REPORTED	9082105
	3190-19-001		2019-08-29 16:51
	ASTM		
	ASTM International Test Methods		
EPA	United States Environmental Protection Agency Test Methods		
SM	Standard Methods for the Examination of Water and Wastewater, American Public Health Association		

General Comments:

The results in this report apply to the samples analyzed in accordance with the Chain of Custody document. This analytical report must be reproduced in its entirety. CARO is not responsible for any loss or damage resulting directly or indirectly from error or omission in the conduct of testing. Liability is limited to the cost of analysis. Samples will be disposed of 30 days after the test report has been issued unless otherwise agreed to in writing.

Results in **Bold** indicate values that are above CARO's method reporting limits. Any results that are above regulatory limits are highlighted **red**. Please note that results will only be highlighted red if the regulatory limits are included on the CARO report. Any Bold and/or highlighted results do not take into account method uncertainty. If you would like method uncertainty or regulatory limits to be included on your report, please contact your Account Manager: bshaw@caro.ca

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO PROJECT Waterline Resources Inc. - Nanaimo
3190-19-001

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The following section displays the quality control (QC) data that is associated with your sample data. Groups of samples are prepared in "batches" and analyzed in conjunction with QC samples that ensure your data is of the highest quality. Common QC types include:

- **Method Blank (BLK):** A blank sample that undergoes sample processing identical to that carried out for the test samples. Method blank results are used to assess contamination from the laboratory environment and reagents.
- **Duplicate (Dup):** An additional or second portion of a randomly selected sample in the analytical run carried through the entire analytical process. Duplicates provide a measure of the analytical method's precision (reproducibility).
- **Blank Spike (BS):** A sample of known concentration which undergoes processing identical to that carried out for test samples, also referred to as a laboratory control sample (LCS). Blank spikes provide a measure of the analytical method's accuracy.
- **Matrix Spike (MS):** A second aliquot of sample is fortified with with a known concentration of target analytes and carried through the entire analytical process. Matrix spikes evaluate potential matrix effects that may affect the analyte recovery.
- **Reference Material (SRM):** A homogenous material of similar matrix to the samples, certified for the parameter(s) listed. Reference Materials ensure that the analytical process is adequate to achieve acceptable recoveries of the parameter(s) tested.

Each QC type is analyzed at a 5-10% frequency, i.e. one blank/duplicate/spike for every 10-20 samples. For all types of QC, the specified recovery (% Rec) and relative percent difference (RPD) limits are derived from long-term method performance averages and/or prescribed by the reference method.

Analyte	Result	RL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
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Anions, Batch B9H2036

Blank (B9H2036-BLK1)			Prepared: 2019-08-23, Analyzed: 2019-08-23						
Chloride	< 0.10	0.10 mg/L							
Fluoride	< 0.10	0.10 mg/L							
Nitrate (as N)	< 0.010	0.010 mg/L							
Nitrite (as N)	< 0.010	0.010 mg/L							
Sulfate	< 1.0	1.0 mg/L							
LCS (B9H2036-BS1)			Prepared: 2019-08-23, Analyzed: 2019-08-23						
Chloride	16.1	0.10 mg/L	16.0		100	90-110			
Fluoride	3.99	0.10 mg/L	4.00		100	88-108			
Nitrate (as N)	4.00	0.010 mg/L	4.00		100	90-110			
Nitrite (as N)	2.10	0.010 mg/L	2.00		105	85-115			
Sulfate	16.1	1.0 mg/L	16.0		101	90-110			

Dissolved Metals, Batch B9H2313

Blank (B9H2313-BLK1)			Prepared: 2019-08-27, Analyzed: 2019-08-27						
Aluminum, dissolved	< 0.0050	0.0050 mg/L							
Antimony, dissolved	< 0.00020	0.00020 mg/L							
Arsenic, dissolved	< 0.00050	0.00050 mg/L							
Barium, dissolved	< 0.0050	0.0050 mg/L							
Beryllium, dissolved	< 0.00010	0.00010 mg/L							
Bismuth, dissolved	< 0.00010	0.00010 mg/L							
Boron, dissolved	< 0.0050	0.0050 mg/L							
Cadmium, dissolved	< 0.000010	0.000010 mg/L							
Calcium, dissolved	< 0.20	0.20 mg/L							
Chromium, dissolved	< 0.00050	0.00050 mg/L							
Cobalt, dissolved	< 0.00010	0.00010 mg/L							
Copper, dissolved	< 0.00040	0.00040 mg/L							
Iron, dissolved	< 0.010	0.010 mg/L							
Lead, dissolved	< 0.00020	0.00020 mg/L							
Lithium, dissolved	< 0.00010	0.00010 mg/L							
Magnesium, dissolved	< 0.010	0.010 mg/L							
Manganese, dissolved	< 0.00020	0.00020 mg/L							
Molybdenum, dissolved	< 0.00010	0.00010 mg/L							
Nickel, dissolved	< 0.00040	0.00040 mg/L							

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Analyte	Result	RL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Dissolved Metals, Batch B9H2313, Continued									
Blank (B9H2313-BLK1), Continued					Prepared: 2019-08-27, Analyzed: 2019-08-27				
Phosphorus, dissolved	< 0.050	0.050 mg/L							
Potassium, dissolved	< 0.10	0.10 mg/L							
Selenium, dissolved	< 0.00050	0.00050 mg/L							
Silicon, dissolved	< 1.0	1.0 mg/L							
Silver, dissolved	< 0.000050	0.000050 mg/L							
Sodium, dissolved	< 0.10	0.10 mg/L							
Strontium, dissolved	< 0.0010	0.0010 mg/L							
Sulfur, dissolved	< 3.0	3.0 mg/L							
Tellurium, dissolved	< 0.00050	0.00050 mg/L							
Thallium, dissolved	< 0.000020	0.000020 mg/L							
Thorium, dissolved	< 0.00010	0.00010 mg/L							
Tin, dissolved	< 0.00020	0.00020 mg/L							
Titanium, dissolved	< 0.0050	0.0050 mg/L							
Tungsten, dissolved	< 0.0010	0.0010 mg/L							
Uranium, dissolved	< 0.000020	0.000020 mg/L							
Vanadium, dissolved	< 0.0010	0.0010 mg/L							
Zinc, dissolved	< 0.0040	0.0040 mg/L							
Zirconium, dissolved	< 0.00010	0.00010 mg/L							
Blank (B9H2313-BLK2)					Prepared: 2019-08-27, Analyzed: 2019-08-27				
Aluminum, dissolved	< 0.0050	0.0050 mg/L							
Antimony, dissolved	< 0.00020	0.00020 mg/L							
Arsenic, dissolved	< 0.00050	0.00050 mg/L							
Barium, dissolved	< 0.0050	0.0050 mg/L							
Beryllium, dissolved	< 0.00010	0.00010 mg/L							
Bismuth, dissolved	< 0.00010	0.00010 mg/L							
Boron, dissolved	< 0.0050	0.0050 mg/L							
Cadmium, dissolved	< 0.000010	0.000010 mg/L							
Calcium, dissolved	< 0.20	0.20 mg/L							
Chromium, dissolved	< 0.00050	0.00050 mg/L							
Cobalt, dissolved	< 0.00010	0.00010 mg/L							
Copper, dissolved	< 0.00040	0.00040 mg/L							
Iron, dissolved	< 0.010	0.010 mg/L							
Lead, dissolved	< 0.00020	0.00020 mg/L							
Lithium, dissolved	< 0.00010	0.00010 mg/L							
Magnesium, dissolved	< 0.010	0.010 mg/L							
Manganese, dissolved	< 0.00020	0.00020 mg/L							
Molybdenum, dissolved	< 0.00010	0.00010 mg/L							
Nickel, dissolved	< 0.00040	0.00040 mg/L							
Phosphorus, dissolved	< 0.050	0.050 mg/L							
Potassium, dissolved	< 0.10	0.10 mg/L							
Selenium, dissolved	< 0.00050	0.00050 mg/L							
Silicon, dissolved	< 1.0	1.0 mg/L							
Silver, dissolved	< 0.000050	0.000050 mg/L							
Sodium, dissolved	< 0.10	0.10 mg/L							
Strontium, dissolved	< 0.0010	0.0010 mg/L							
Sulfur, dissolved	< 3.0	3.0 mg/L							
Tellurium, dissolved	< 0.00050	0.00050 mg/L							
Thallium, dissolved	< 0.000020	0.000020 mg/L							
Thorium, dissolved	< 0.00010	0.00010 mg/L							
Tin, dissolved	< 0.00020	0.00020 mg/L							
Titanium, dissolved	< 0.0050	0.0050 mg/L							
Tungsten, dissolved	< 0.0010	0.0010 mg/L							
Uranium, dissolved	< 0.000020	0.000020 mg/L							
Vanadium, dissolved	< 0.0010	0.0010 mg/L							
Zinc, dissolved	< 0.0040	0.0040 mg/L							

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Analyte	Result	RL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Dissolved Metals, Batch B9H2313, Continued									
Blank (B9H2313-BLK2), Continued					Prepared: 2019-08-27, Analyzed: 2019-08-27				
Zirconium, dissolved	< 0.00010	0.00010 mg/L							
LCS (B9H2313-BS1)					Prepared: 2019-08-27, Analyzed: 2019-08-27				
Aluminum, dissolved	0.0213	0.0050 mg/L	0.0200		107	80-120			
Antimony, dissolved	0.0200	0.00020 mg/L	0.0200		100	80-120			
Arsenic, dissolved	0.0187	0.00050 mg/L	0.0200		93	80-120			
Barium, dissolved	0.0184	0.0050 mg/L	0.0200		92	80-120			
Beryllium, dissolved	0.0195	0.00010 mg/L	0.0200		97	80-120			
Bismuth, dissolved	0.0196	0.00010 mg/L	0.0200		98	80-120			
Boron, dissolved	0.0176	0.0050 mg/L	0.0200		88	80-120			
Cadmium, dissolved	0.0192	0.000010 mg/L	0.0200		96	80-120			
Calcium, dissolved	2.08	0.20 mg/L	2.02		103	80-120			
Chromium, dissolved	0.0187	0.00050 mg/L	0.0200		93	80-120			
Cobalt, dissolved	0.0192	0.00010 mg/L	0.0200		96	80-120			
Copper, dissolved	0.0200	0.00040 mg/L	0.0200		100	80-120			
Iron, dissolved	1.90	0.010 mg/L	2.02		94	80-120			
Lead, dissolved	0.0191	0.00020 mg/L	0.0200		95	80-120			
Lithium, dissolved	0.0202	0.00010 mg/L	0.0199		102	80-120			
Magnesium, dissolved	1.98	0.010 mg/L	2.02		98	80-120			
Manganese, dissolved	0.0192	0.00020 mg/L	0.0200		96	80-120			
Molybdenum, dissolved	0.0190	0.00010 mg/L	0.0200		95	80-120			
Nickel, dissolved	0.0191	0.00040 mg/L	0.0200		96	80-120			
Phosphorus, dissolved	2.03	0.050 mg/L	2.00		102	80-120			
Potassium, dissolved	1.84	0.10 mg/L	2.02		91	80-120			
Selenium, dissolved	0.0192	0.00050 mg/L	0.0200		96	80-120			
Silicon, dissolved	2.1	1.0 mg/L	2.00		104	80-120			
Silver, dissolved	0.0191	0.000050 mg/L	0.0200		96	80-120			
Sodium, dissolved	2.14	0.10 mg/L	2.02		106	80-120			
Strontium, dissolved	0.0193	0.0010 mg/L	0.0200		97	80-120			
Sulfur, dissolved	4.4	3.0 mg/L	5.00		88	80-120			
Tellurium, dissolved	0.0207	0.00050 mg/L	0.0200		104	80-120			
Thallium, dissolved	0.0188	0.000020 mg/L	0.0200		94	80-120			
Thorium, dissolved	0.0200	0.00010 mg/L	0.0200		100	80-120			
Tin, dissolved	0.0198	0.00020 mg/L	0.0200		99	80-120			
Titanium, dissolved	0.0195	0.0050 mg/L	0.0200		97	80-120			
Tungsten, dissolved	0.0202	0.0010 mg/L	0.0200		101	80-120			
Uranium, dissolved	0.0230	0.000020 mg/L	0.0200		115	80-120			
Vanadium, dissolved	0.0184	0.0010 mg/L	0.0200		92	80-120			
Zinc, dissolved	0.0209	0.0040 mg/L	0.0200		105	80-120			
Zirconium, dissolved	0.0218	0.00010 mg/L	0.0200		109	80-120			
Reference (B9H2313-SRM1)					Prepared: 2019-08-27, Analyzed: 2019-08-27				
Aluminum, dissolved	0.235	0.0050 mg/L	0.235		100	79-114			
Antimony, dissolved	0.0407	0.00020 mg/L	0.0431		94	89-123			
Arsenic, dissolved	0.416	0.00050 mg/L	0.423		98	87-113			
Barium, dissolved	2.85	0.0050 mg/L	3.30		86	85-114			
Beryllium, dissolved	0.216	0.00010 mg/L	0.209		103	79-122			
Boron, dissolved	1.76	0.0050 mg/L	1.65		106	79-117			
Cadmium, dissolved	0.225	0.000010 mg/L	0.221		102	89-112			
Calcium, dissolved	7.11	0.20 mg/L	7.72		92	85-120			
Chromium, dissolved	0.414	0.00050 mg/L	0.434		95	87-113			
Cobalt, dissolved	0.125	0.00010 mg/L	0.124		101	90-117			
Copper, dissolved	0.825	0.00040 mg/L	0.815		101	90-115			
Iron, dissolved	1.21	0.010 mg/L	1.27		96	86-112			
Lead, dissolved	0.111	0.00020 mg/L	0.110		101	90-113			
Lithium, dissolved	0.106	0.00010 mg/L	0.100		106	77-127			

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Analyte	Result	RL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Dissolved Metals, Batch B9H2313, Continued									
Reference (B9H2313-SRM1), Continued				Prepared: 2019-08-27, Analyzed: 2019-08-27					
Magnesium, dissolved	6.91	0.010 mg/L	6.59		105	84-116			
Manganese, dissolved	0.344	0.00020 mg/L	0.342		101	85-113			
Molybdenum, dissolved	0.382	0.00010 mg/L	0.404		95	87-112			
Nickel, dissolved	0.837	0.00040 mg/L	0.835		100	90-114			
Phosphorus, dissolved	0.539	0.050 mg/L	0.499		108	74-119			
Potassium, dissolved	2.70	0.10 mg/L	2.88		94	78-119			
Selenium, dissolved	0.0380	0.00050 mg/L	0.0324		117	89-123			
Sodium, dissolved	18.7	0.10 mg/L	18.0		104	81-117			
Strontium, dissolved	0.854	0.0010 mg/L	0.935		91	82-111			
Thallium, dissolved	0.0386	0.000020 mg/L	0.0385		100	90-113			
Uranium, dissolved	0.245	0.000020 mg/L	0.258		95	87-113			
Vanadium, dissolved	0.788	0.0010 mg/L	0.873		90	85-110			
Zinc, dissolved	0.902	0.0040 mg/L	0.848		106	88-114			

Dissolved Metals, Batch B9H2357

Blank (B9H2357-BLK1)				Prepared: 2019-08-27, Analyzed: 2019-08-27					
Mercury, dissolved	< 0.000010	0.000010 mg/L							
Reference (B9H2357-SRM1)				Prepared: 2019-08-27, Analyzed: 2019-08-27					
Mercury, dissolved	0.00538	0.000010 mg/L	0.00489		110	80-120			

General Parameters, Batch B9H2038

Blank (B9H2038-BLK1)				Prepared: 2019-08-23, Analyzed: 2019-08-23					
Ammonia, Total (as N)	< 0.020	0.020 mg/L							
Blank (B9H2038-BLK2)				Prepared: 2019-08-23, Analyzed: 2019-08-23					
Ammonia, Total (as N)	< 0.020	0.020 mg/L							
Blank (B9H2038-BLK3)				Prepared: 2019-08-23, Analyzed: 2019-08-23					
Ammonia, Total (as N)	< 0.020	0.020 mg/L							
Blank (B9H2038-BLK4)				Prepared: 2019-08-23, Analyzed: 2019-08-23					
Ammonia, Total (as N)	< 0.020	0.020 mg/L							
LCS (B9H2038-BS1)				Prepared: 2019-08-23, Analyzed: 2019-08-23					
Ammonia, Total (as N)	1.07	0.020 mg/L	1.00		107	90-115			
LCS (B9H2038-BS2)				Prepared: 2019-08-23, Analyzed: 2019-08-23					
Ammonia, Total (as N)	1.02	0.020 mg/L	1.00		102	90-115			
LCS (B9H2038-BS3)				Prepared: 2019-08-23, Analyzed: 2019-08-23					
Ammonia, Total (as N)	1.04	0.020 mg/L	1.00		104	90-115			
LCS (B9H2038-BS4)				Prepared: 2019-08-23, Analyzed: 2019-08-23					
Ammonia, Total (as N)	1.05	0.020 mg/L	1.00		105	90-115			

General Parameters, Batch B9H2048

Blank (B9H2048-BLK1)				Prepared: 2019-08-23, Analyzed: 2019-08-23					
Turbidity	< 0.10	0.10 NTU							
LCS (B9H2048-BS1)				Prepared: 2019-08-23, Analyzed: 2019-08-23					
Turbidity	37.1	0.10 NTU	40.0		93	90-110			

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Analyte	Result	RL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
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General Parameters, Batch B9H2048, Continued

Duplicate (B9H2048-DUP1)	Source: 9082105-01		Prepared: 2019-08-23, Analyzed: 2019-08-23						
Turbidity	119	0.10 NTU		115			3	15	

General Parameters, Batch B9H2049

Blank (B9H2049-BLK1)	Prepared: 2019-08-26, Analyzed: 2019-08-26								
Carbon, Total Organic	< 0.50	0.50 mg/L							
Blank (B9H2049-BLK2)	Prepared: 2019-08-26, Analyzed: 2019-08-26								
Carbon, Total Organic	< 0.50	0.50 mg/L							
Blank (B9H2049-BLK3)	Prepared: 2019-08-26, Analyzed: 2019-08-26								
Carbon, Total Organic	< 0.50	0.50 mg/L							
Blank (B9H2049-BLK4)	Prepared: 2019-08-26, Analyzed: 2019-08-26								
Carbon, Total Organic	< 0.50	0.50 mg/L							
LCS (B9H2049-BS1)	Prepared: 2019-08-26, Analyzed: 2019-08-26								
Carbon, Total Organic	9.96	0.50 mg/L	10.0		100	78-116			
LCS (B9H2049-BS2)	Prepared: 2019-08-26, Analyzed: 2019-08-26								
Carbon, Total Organic	9.83	0.50 mg/L	10.0		98	78-116			
LCS (B9H2049-BS3)	Prepared: 2019-08-26, Analyzed: 2019-08-26								
Carbon, Total Organic	9.78	0.50 mg/L	10.0		98	78-116			
LCS (B9H2049-BS4)	Prepared: 2019-08-26, Analyzed: 2019-08-26								
Carbon, Total Organic	9.71	0.50 mg/L	10.0		97	78-116			

General Parameters, Batch B9H2055

Blank (B9H2055-BLK1)	Prepared: 2019-08-23, Analyzed: 2019-08-23								
Cyanide, Total	< 0.0020	0.0020 mg/L							
Blank (B9H2055-BLK2)	Prepared: 2019-08-23, Analyzed: 2019-08-23								
Cyanide, Total	< 0.0020	0.0020 mg/L							
LCS (B9H2055-BS1)	Prepared: 2019-08-23, Analyzed: 2019-08-23								
Cyanide, Total	0.0202	0.0020 mg/L	0.0200		101	82-120			
LCS (B9H2055-BS2)	Prepared: 2019-08-23, Analyzed: 2019-08-23								
Cyanide, Total	0.0197	0.0020 mg/L	0.0200		98	82-120			
LCS Dup (B9H2055-BSD1)	Prepared: 2019-08-23, Analyzed: 2019-08-23								
Cyanide, Total	0.0201	0.0020 mg/L	0.0200		101	82-120	< 1	10	
LCS Dup (B9H2055-BSD2)	Prepared: 2019-08-23, Analyzed: 2019-08-23								
Cyanide, Total	0.0192	0.0020 mg/L	0.0200		96	82-120	3	10	

General Parameters, Batch B9H2119

Blank (B9H2119-BLK1)	Prepared: 2019-08-23, Analyzed: 2019-08-23								
Alkalinity, Total (as CaCO ₃)	< 1.0	1.0 mg/L							
Alkalinity, Phenolphthalein (as CaCO ₃)	< 1.0	1.0 mg/L							
Alkalinity, Bicarbonate (as CaCO ₃)	< 1.0	1.0 mg/L							
Alkalinity, Carbonate (as CaCO ₃)	< 1.0	1.0 mg/L							
Alkalinity, Hydroxide (as CaCO ₃)	< 1.0	1.0 mg/L							

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Analyte	Result	RL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
General Parameters, Batch B9H2119, Continued									
Blank (B9H2119-BLK1), Continued				Prepared: 2019-08-23, Analyzed: 2019-08-23					
Conductivity (EC)	< 2.0	2.0 µS/cm							
Blank (B9H2119-BLK2)				Prepared: 2019-08-23, Analyzed: 2019-08-23					
Alkalinity, Total (as CaCO ₃)	< 1.0	1.0 mg/L							
Alkalinity, Phenolphthalein (as CaCO ₃)	< 1.0	1.0 mg/L							
Alkalinity, Bicarbonate (as CaCO ₃)	< 1.0	1.0 mg/L							
Alkalinity, Carbonate (as CaCO ₃)	< 1.0	1.0 mg/L							
Alkalinity, Hydroxide (as CaCO ₃)	< 1.0	1.0 mg/L							
Conductivity (EC)	< 2.0	2.0 µS/cm							
Blank (B9H2119-BLK3)				Prepared: 2019-08-23, Analyzed: 2019-08-23					
Alkalinity, Total (as CaCO ₃)	< 1.0	1.0 mg/L							
Alkalinity, Phenolphthalein (as CaCO ₃)	< 1.0	1.0 mg/L							
Alkalinity, Bicarbonate (as CaCO ₃)	< 1.0	1.0 mg/L							
Alkalinity, Carbonate (as CaCO ₃)	< 1.0	1.0 mg/L							
Alkalinity, Hydroxide (as CaCO ₃)	< 1.0	1.0 mg/L							
Conductivity (EC)	< 2.0	2.0 µS/cm							
LCS (B9H2119-BS1)				Prepared: 2019-08-23, Analyzed: 2019-08-23					
Alkalinity, Total (as CaCO ₃)	99.9	1.0 mg/L	100		100	80-120			
LCS (B9H2119-BS2)				Prepared: 2019-08-23, Analyzed: 2019-08-23					
Alkalinity, Total (as CaCO ₃)	98.9	1.0 mg/L	100		99	80-120			
LCS (B9H2119-BS3)				Prepared: 2019-08-23, Analyzed: 2019-08-23					
Alkalinity, Total (as CaCO ₃)	101	1.0 mg/L	100		101	80-120			
LCS (B9H2119-BS4)				Prepared: 2019-08-23, Analyzed: 2019-08-23					
Conductivity (EC)	1360	2.0 µS/cm	1410		97	95-104			
LCS (B9H2119-BS5)				Prepared: 2019-08-23, Analyzed: 2019-08-23					
Conductivity (EC)	1370	2.0 µS/cm	1410		97	95-104			
LCS (B9H2119-BS6)				Prepared: 2019-08-23, Analyzed: 2019-08-23					
Conductivity (EC)	1360	2.0 µS/cm	1410		97	95-104			
Reference (B9H2119-SRM1)				Prepared: 2019-08-23, Analyzed: 2019-08-23					
pH	7.01	0.10 pH units	7.01		100	98-102			
Reference (B9H2119-SRM2)				Prepared: 2019-08-23, Analyzed: 2019-08-23					
pH	7.01	0.10 pH units	7.01		100	98-102			
Reference (B9H2119-SRM3)				Prepared: 2019-08-23, Analyzed: 2019-08-23					
pH	6.99	0.10 pH units	7.01		100	98-102			

General Parameters, Batch B9H2120

Blank (B9H2120-BLK1)				Prepared: 2019-08-23, Analyzed: 2019-08-24					
Nitrogen, Total Kjeldahl	< 0.050	0.050 mg/L							
Blank (B9H2120-BLK2)				Prepared: 2019-08-23, Analyzed: 2019-08-24					
Nitrogen, Total Kjeldahl	< 0.050	0.050 mg/L							
LCS (B9H2120-BS1)				Prepared: 2019-08-23, Analyzed: 2019-08-24					
Nitrogen, Total Kjeldahl	1.01	0.050 mg/L	1.00		101	85-115			

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO PROJECT Waterline Resources Inc. - Nanaimo
3190-19-001

WORK ORDER REPORTED 9082105
2019-08-29 16:51

Analyte	Result	RL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
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General Parameters, Batch B9H2120, Continued

LCS (B9H2120-BS2)				Prepared: 2019-08-23, Analyzed: 2019-08-24					
Nitrogen, Total Kjeldahl	1.01	0.050 mg/L	1.00		101	85-115			

General Parameters, Batch B9H2149

Blank (B9H2149-BLK1)				Prepared: 2019-08-24, Analyzed: 2019-08-24					
Colour, True	< 5.0	5.0 CU							
LCS (B9H2149-BS1)				Prepared: 2019-08-24, Analyzed: 2019-08-24					
Colour, True	21	5.0 CU	20.0		103	85-115			
Duplicate (B9H2149-DUP1)				Source: 9082105-01		Prepared: 2019-08-24, Analyzed: 2019-08-24			
Colour, True	50	5.0 CU		51			< 1	15	

Total Metals, Batch B9H2306

Blank (B9H2306-BLK1)				Prepared: 2019-08-27, Analyzed: 2019-08-28					
Aluminum, total	< 0.0050	0.0050 mg/L							
Antimony, total	< 0.00020	0.00020 mg/L							
Arsenic, total	< 0.00050	0.00050 mg/L							
Barium, total	< 0.0050	0.0050 mg/L							
Boron, total	< 0.0050	0.0050 mg/L							
Cadmium, total	< 0.000010	0.000010 mg/L							
Calcium, total	< 0.20	0.20 mg/L							
Chromium, total	< 0.00050	0.00050 mg/L							
Cobalt, total	< 0.00010	0.00010 mg/L							
Copper, total	< 0.00040	0.00040 mg/L							
Iron, total	< 0.010	0.010 mg/L							
Lead, total	< 0.00020	0.00020 mg/L							
Magnesium, total	< 0.010	0.010 mg/L							
Manganese, total	< 0.00020	0.00020 mg/L							
Mercury, total	< 0.000040	0.000040 mg/L							
Molybdenum, total	< 0.00010	0.00010 mg/L							
Nickel, total	< 0.00040	0.00040 mg/L							
Potassium, total	< 0.10	0.10 mg/L							
Selenium, total	< 0.00050	0.00050 mg/L							
Sodium, total	< 0.10	0.10 mg/L							
Strontium, total	< 0.0010	0.0010 mg/L							
Uranium, total	< 0.000020	0.000020 mg/L							
Zinc, total	< 0.0040	0.0040 mg/L							
Blank (B9H2306-BLK2)				Prepared: 2019-08-27, Analyzed: 2019-08-28					
Aluminum, total	< 0.0050	0.0050 mg/L							
Antimony, total	< 0.00020	0.00020 mg/L							
Arsenic, total	< 0.00050	0.00050 mg/L							
Barium, total	< 0.0050	0.0050 mg/L							
Boron, total	< 0.0050	0.0050 mg/L							
Cadmium, total	< 0.000010	0.000010 mg/L							
Calcium, total	< 0.20	0.20 mg/L							
Chromium, total	< 0.00050	0.00050 mg/L							
Cobalt, total	< 0.00010	0.00010 mg/L							
Copper, total	< 0.00040	0.00040 mg/L							
Iron, total	< 0.010	0.010 mg/L							
Lead, total	< 0.00020	0.00020 mg/L							
Magnesium, total	< 0.010	0.010 mg/L							
Manganese, total	< 0.00020	0.00020 mg/L							

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO PROJECT Waterline Resources Inc. - Nanaimo
3190-19-001

WORK ORDER REPORTED 9082105
2019-08-29 16:51

Analyte	Result	RL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Total Metals, Batch B9H2306, Continued									
Blank (B9H2306-BLK2), Continued				Prepared: 2019-08-27, Analyzed: 2019-08-28					
Mercury, total	< 0.000040	0.000040 mg/L							
Molybdenum, total	< 0.00010	0.00010 mg/L							
Nickel, total	< 0.00040	0.00040 mg/L							
Potassium, total	< 0.10	0.10 mg/L							
Selenium, total	< 0.00050	0.00050 mg/L							
Sodium, total	< 0.10	0.10 mg/L							
Strontium, total	< 0.0010	0.0010 mg/L							
Uranium, total	< 0.000020	0.000020 mg/L							
Zinc, total	< 0.0040	0.0040 mg/L							
Blank (B9H2306-BLK3)				Prepared: 2019-08-27, Analyzed: 2019-08-28					
Aluminum, total	< 0.0050	0.0050 mg/L							
Antimony, total	< 0.00020	0.00020 mg/L							
Arsenic, total	< 0.00050	0.00050 mg/L							
Barium, total	< 0.0050	0.0050 mg/L							
Boron, total	< 0.0050	0.0050 mg/L							
Cadmium, total	< 0.000010	0.000010 mg/L							
Calcium, total	< 0.20	0.20 mg/L							
Chromium, total	< 0.00050	0.00050 mg/L							
Cobalt, total	< 0.00010	0.00010 mg/L							
Copper, total	< 0.00040	0.00040 mg/L							
Iron, total	< 0.010	0.010 mg/L							
Lead, total	< 0.00020	0.00020 mg/L							
Magnesium, total	< 0.010	0.010 mg/L							
Manganese, total	< 0.00020	0.00020 mg/L							
Mercury, total	< 0.000040	0.000040 mg/L							
Molybdenum, total	< 0.00010	0.00010 mg/L							
Nickel, total	< 0.00040	0.00040 mg/L							
Potassium, total	< 0.10	0.10 mg/L							
Selenium, total	< 0.00050	0.00050 mg/L							
Sodium, total	< 0.10	0.10 mg/L							
Strontium, total	< 0.0010	0.0010 mg/L							
Uranium, total	< 0.000020	0.000020 mg/L							
Zinc, total	< 0.0040	0.0040 mg/L							
LCS (B9H2306-BS1)				Prepared: 2019-08-27, Analyzed: 2019-08-28					
Aluminum, total	0.0218	0.0050 mg/L	0.0200		109	80-120			
Antimony, total	0.0205	0.00020 mg/L	0.0200		102	80-120			
Arsenic, total	0.0188	0.00050 mg/L	0.0200		94	80-120			
Barium, total	0.0187	0.0050 mg/L	0.0200		93	80-120			
Boron, total	0.0206	0.0050 mg/L	0.0200		103	80-120			
Cadmium, total	0.0200	0.000010 mg/L	0.0200		100	80-120			
Calcium, total	2.18	0.20 mg/L	2.02		108	80-120			
Chromium, total	0.0190	0.00050 mg/L	0.0200		95	80-120			
Cobalt, total	0.0198	0.00010 mg/L	0.0200		99	80-120			
Copper, total	0.0209	0.00040 mg/L	0.0200		104	80-120			
Iron, total	1.93	0.010 mg/L	2.02		96	80-120			
Lead, total	0.0202	0.00020 mg/L	0.0200		101	80-120			
Magnesium, total	2.17	0.010 mg/L	2.02		107	80-120			
Manganese, total	0.0217	0.00020 mg/L	0.0200		108	80-120			
Mercury, total	0.00112	0.000040 mg/L	0.00100		112	80-120			
Molybdenum, total	0.0197	0.00010 mg/L	0.0200		98	80-120			
Nickel, total	0.0202	0.00040 mg/L	0.0200		101	80-120			
Potassium, total	1.92	0.10 mg/L	2.02		95	80-120			
Selenium, total	0.0228	0.00050 mg/L	0.0200		114	80-120			
Sodium, total	2.29	0.10 mg/L	2.02		114	80-120			

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO PROJECT Waterline Resources Inc. - Nanaimo
3190-19-001

WORK ORDER REPORTED 9082105
2019-08-29 16:51

Analyte	Result	RL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Total Metals, Batch B9H2306, Continued									
LCS (B9H2306-BS1), Continued				Prepared: 2019-08-27, Analyzed: 2019-08-28					
Strontium, total	0.0196	0.0010 mg/L	0.0200		98	80-120			
Uranium, total	0.0241	0.000020 mg/L	0.0200		120	80-120			
Zinc, total	0.0228	0.0040 mg/L	0.0200		114	80-120			
Reference (B9H2306-SRM1)				Prepared: 2019-08-27, Analyzed: 2019-08-28					
Aluminum, total	0.327	0.0050 mg/L	0.303		108	82-114			
Antimony, total	0.0483	0.00020 mg/L	0.0511		95	88-115			
Arsenic, total	0.119	0.00050 mg/L	0.118		101	88-111			
Barium, total	0.773	0.0050 mg/L	0.823		94	83-110			
Boron, total	3.85	0.0050 mg/L	3.45		112	80-118			
Cadmium, total	0.0522	0.000010 mg/L	0.0495		106	90-110			
Calcium, total	10.7	0.20 mg/L	11.6		92	85-113			
Chromium, total	0.252	0.00050 mg/L	0.250		101	88-111			
Cobalt, total	0.0408	0.00010 mg/L	0.0377		108	90-114			
Copper, total	0.527	0.00040 mg/L	0.486		108	90-117			
Iron, total	0.497	0.010 mg/L	0.488		102	90-116			
Lead, total	0.211	0.00020 mg/L	0.204		103	90-110			
Magnesium, total	4.22	0.010 mg/L	3.79		111	88-116			
Manganese, total	0.117	0.00020 mg/L	0.109		107	88-108			
Mercury, total	0.00505	0.000040 mg/L	0.00489		103	80-120			
Molybdenum, total	0.192	0.00010 mg/L	0.198		97	88-110			
Nickel, total	0.261	0.00040 mg/L	0.249		105	90-112			
Potassium, total	7.37	0.10 mg/L	7.21		102	87-116			
Selenium, total	0.148	0.00050 mg/L	0.121		122	90-122			
Sodium, total	8.19	0.10 mg/L	7.54		109	86-118			
Strontium, total	0.380	0.0010 mg/L	0.375		101	86-110			
Uranium, total	0.0329	0.000020 mg/L	0.0306		107	88-112			
Zinc, total	2.62	0.0040 mg/L	2.49		105	90-113			

CERTIFICATE OF ANALYSIS

REPORTED TO Waterline Resources Inc. - Nanaimo
2430 Jingle Pot Road
Nanaimo, BC V9R 6W2

ATTENTION Gage Nordstrom

PO NUMBER

PROJECT 3190-19-001

PROJECT INFO Silvia Bay Resort+Marina

WORK ORDER 9090600

RECEIVED / TEMP 2019-09-07 09:00 / 8°C

REPORTED 2019-09-19 12:22

COC NUMBER B68209

Introduction:

CARO Analytical Services is a testing laboratory full of smart, engaged scientists driven to make the world a safer and healthier place. Through our clients' projects we become an essential element for a better world. We employ methods conducted in accordance with recognized professional standards using accepted testing methodologies and quality control efforts. CARO is accredited by the Canadian Association for Laboratories Accreditation (CALA) to ISO 17025:2005 for specific tests listed in the scope of accreditation approved by CALA.

Big Picture Sidekicks



You know that the sample you collected after snowshoeing to site, digging 5 meters, and racing to get it on a plane so you can submit it to the lab for time sensitive results needed to make important and expensive decisions (whew) is VERY important. We know that too.

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If you have any questions or concerns, please contact me at bshaw@caro.ca

Authorized By:

Bryan Shaw, Ph.D., P.Chem.
Client Service Coordinator



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#110 4011 Viking Way Richmond, BC V6V 2K9 | #102 3677 Highway 97N Kelowna, BC V1X 5C3 | 17225 109 Avenue Edmonton, AB T5S 1H7

TEST RESULTS

REPORTED TO PROJECT Waterline Resources Inc. - Nanaimo
3190-19-001

WORK ORDER REPORTED 9090600
2019-09-19 12:22

Analyte	Result	RL	Units	Analyzed	Qualifier
03190190906001 (9090600-01) Matrix: Water Sampled: 2019-09-06 13:30					
Anions					
Chloride	39.6	0.10	mg/L	2019-09-10	
Fluoride	0.28	0.10	mg/L	2019-09-10	
Nitrate (as N)	< 0.010	0.010	mg/L	2019-09-10	HT1
Nitrite (as N)	< 0.010	0.010	mg/L	2019-09-10	HT1
Sulfate	13.7	1.0	mg/L	2019-09-10	
Calculated Parameters					
Hardness, Total (as CaCO ₃)	18.7	0.500	mg/L	N/A	
Ion Balance	94.3		mg/L	N/A	
Langelier Index	-0.7	-5.0		2019-09-16	
Nitrate+Nitrite (as N)	< 0.0100	0.0100	mg/L	N/A	
Nitrogen, Organic	0.0910	0.0500	mg/L	N/A	
Solids, Total Dissolved	248	1.00	mg/L	N/A	
Dissolved Metals					
Aluminum, dissolved	0.0165	0.0050	mg/L	2019-09-11	
Antimony, dissolved	< 0.00020	0.00020	mg/L	2019-09-11	
Arsenic, dissolved	0.00092	0.00050	mg/L	2019-09-11	
Barium, dissolved	0.0126	0.0050	mg/L	2019-09-11	
Beryllium, dissolved	< 0.00010	0.00010	mg/L	2019-09-11	
Bismuth, dissolved	< 0.00010	0.00010	mg/L	2019-09-11	
Boron, dissolved	0.383	0.0050	mg/L	2019-09-11	
Cadmium, dissolved	< 0.000010	0.000010	mg/L	2019-09-11	
Calcium, dissolved	4.37	0.20	mg/L	2019-09-11	
Chromium, dissolved	< 0.00050	0.00050	mg/L	2019-09-11	
Cobalt, dissolved	< 0.00010	0.00010	mg/L	2019-09-11	
Copper, dissolved	0.00075	0.00040	mg/L	2019-09-11	
Iron, dissolved	0.015	0.010	mg/L	2019-09-11	
Lead, dissolved	< 0.00020	0.00020	mg/L	2019-09-11	
Lithium, dissolved	0.00732	0.00010	mg/L	2019-09-11	
Magnesium, dissolved	1.88	0.010	mg/L	2019-09-11	
Manganese, dissolved	0.0179	0.00020	mg/L	2019-09-11	
Mercury, dissolved	< 0.000010	0.000010	mg/L	2019-09-11	
Molybdenum, dissolved	0.00397	0.00010	mg/L	2019-09-11	
Nickel, dissolved	0.00047	0.00040	mg/L	2019-09-11	
Phosphorus, dissolved	< 0.050	0.050	mg/L	2019-09-11	
Potassium, dissolved	0.24	0.10	mg/L	2019-09-11	
Selenium, dissolved	< 0.00050	0.00050	mg/L	2019-09-11	
Silicon, dissolved	7.6	1.0	mg/L	2019-09-11	
Silver, dissolved	< 0.000050	0.000050	mg/L	2019-09-11	
Sodium, dissolved	90.8	0.10	mg/L	2019-09-11	
Strontium, dissolved	0.0774	0.0010	mg/L	2019-09-11	
Sulfur, dissolved	4.2	3.0	mg/L	2019-09-11	

TEST RESULTS

REPORTED TO PROJECT Waterline Resources Inc. - Nanaimo
3190-19-001

WORK ORDER REPORTED 9090600
2019-09-19 12:22

Analyte	Result	RL	Units	Analyzed	Qualifier
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03190190906001 (9090600-01) | Matrix: Water | Sampled: 2019-09-06 13:30, Continued

Dissolved Metals, Continued

Tellurium, dissolved	< 0.00050	0.00050	mg/L	2019-09-11	
Thallium, dissolved	< 0.000020	0.000020	mg/L	2019-09-11	
Thorium, dissolved	< 0.00010	0.00010	mg/L	2019-09-11	
Tin, dissolved	< 0.00020	0.00020	mg/L	2019-09-11	
Titanium, dissolved	< 0.0050	0.0050	mg/L	2019-09-11	
Tungsten, dissolved	< 0.0010	0.0010	mg/L	2019-09-11	
Uranium, dissolved	0.000089	0.000020	mg/L	2019-09-11	
Vanadium, dissolved	0.0014	0.0010	mg/L	2019-09-11	
Zinc, dissolved	0.0267	0.0040	mg/L	2019-09-11	
Zirconium, dissolved	< 0.00010	0.00010	mg/L	2019-09-11	

General Parameters

Alkalinity, Total (as CaCO ₃)	159	1.0	mg/L	2019-09-11	
Alkalinity, Phenolphthalein (as CaCO ₃)	< 1.0	1.0	mg/L	2019-09-11	
Alkalinity, Bicarbonate (as CaCO ₃)	159	1.0	mg/L	2019-09-11	
Alkalinity, Carbonate (as CaCO ₃)	< 1.0	1.0	mg/L	2019-09-11	
Alkalinity, Hydroxide (as CaCO ₃)	< 1.0	1.0	mg/L	2019-09-11	
Bicarbonate (HCO ₃)	194	1.22	mg/L	N/A	
Carbonate (CO ₃)	< 0.600	0.600	mg/L	N/A	
Hydroxide (OH)	< 0.340	0.340	mg/L	N/A	
Ammonia, Total (as N)	0.045	0.020	mg/L	2019-09-11	
Carbon, Total Organic	2.64	0.50	mg/L	2019-09-11	
Colour, True	10	5.0	CU	2019-09-10	HT1
Conductivity (EC)	450	2.0	µS/cm	2019-09-11	
Cyanide, Total	< 0.0020	0.0020	mg/L	2019-09-16	
Nitrogen, Total Kjeldahl	0.136	0.050	mg/L	2019-09-12	
pH	8.04	0.10	pH units	2019-09-11	HT2
Solids, Total Dissolved	262	15	mg/L	2019-09-13	
Temperature, at pH	23.8	°C		2019-09-11	HT2
Turbidity	4.38	0.10	NTU	2019-09-09	

Total Metals

Aluminum, total	0.212	0.0050	mg/L	2019-09-11	
Antimony, total	< 0.00020	0.00020	mg/L	2019-09-11	
Arsenic, total	0.00097	0.00050	mg/L	2019-09-11	
Barium, total	0.0147	0.0050	mg/L	2019-09-11	
Boron, total	0.350	0.0050	mg/L	2019-09-11	
Cadmium, total	< 0.000010	0.000010	mg/L	2019-09-11	
Calcium, total	4.35	0.20	mg/L	2019-09-11	
Chromium, total	0.00055	0.00050	mg/L	2019-09-11	
Cobalt, total	0.00013	0.00010	mg/L	2019-09-11	
Copper, total	0.00126	0.00040	mg/L	2019-09-11	
Iron, total	0.213	0.010	mg/L	2019-09-11	

TEST RESULTS

REPORTED TO PROJECT Waterline Resources Inc. - Nanaimo
3190-19-001

WORK ORDER REPORTED 9090600
2019-09-19 12:22

Analyte	Result	RL	Units	Analyzed	Qualifier
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03190190906001 (9090600-01) | Matrix: Water | Sampled: 2019-09-06 13:30, Continued

Total Metals, Continued

Lead, total	< 0.00020	0.00020	mg/L	2019-09-11	
Magnesium, total	2.01	0.010	mg/L	2019-09-11	
Manganese, total	0.0217	0.00020	mg/L	2019-09-11	
Mercury, total	< 0.000010	0.000010	mg/L	2019-09-12	
Molybdenum, total	0.00393	0.00010	mg/L	2019-09-11	
Nickel, total	0.00070	0.00040	mg/L	2019-09-11	
Potassium, total	0.28	0.10	mg/L	2019-09-11	
Selenium, total	< 0.00050	0.00050	mg/L	2019-09-11	
Sodium, total	94.1	0.10	mg/L	2019-09-11	
Strontium, total	0.0754	0.0010	mg/L	2019-09-11	
Uranium, total	0.000097	0.000020	mg/L	2019-09-11	
Zinc, total	0.0278	0.0040	mg/L	2019-09-11	

Microbiological Parameters

Coliforms, Total	<1.1	2	MPN/100 mL	2019-09-07	
E. coli (MPN)	<1.1	2	MPN/100 mL	2019-09-07	

Sample Qualifiers:

- HT1 The sample was prepared and/or analyzed past the recommended holding time.
- HT2 The 15 minute recommended holding time (from sampling to analysis) has been exceeded - field analysis is recommended.

APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO PROJECT Waterline Resources Inc. - Nanaimo
3190-19-001

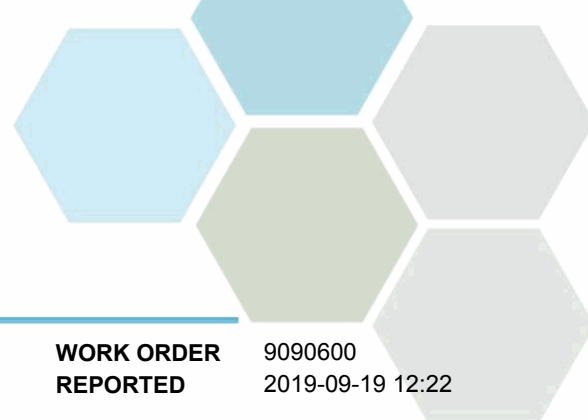
WORK ORDER REPORTED 9090600
2019-09-19 12:22

Analysis Description	Method Ref.	Technique	Location
Alkalinity in Water	SM 2320 B* (2017)	Titration with H2SO4	Kelowna
Ammonia, Total in Water	SM 4500-NH3 G* (2017)	Automated Colorimetry (Phenate)	Kelowna
Anions in Water	SM 4110 B (2017)	Ion Chromatography	Kelowna
Carbon, Total Organic in Water	SM 5310 B (2017)	Combustion, Infrared CO2 Detection	Kelowna
Coliforms, Total in Water	SM 9221 (2017)	Multiple-Tube Fermentation	Sublet
Colour, True in Water	SM 2120 C (2017)	Spectrophotometry (456 nm)	Kelowna
Conductivity in Water	SM 2510 B (2017)	Conductivity Meter	Kelowna
Cyanide, SAD in Water	ASTM D7511-12	Flow Injection with In-Line UV Digestion and Amperometry	Kelowna
Dissolved Metals in Water	EPA 200.8 / EPA 6020B	0.45 µm Filtration / Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS)	Richmond
E. coli in Water	SM 9221 (2017)	Multiple-Tube Fermentation	Sublet
Hardness in Water	SM 2340 B (2017)	Calculation: 2.497 [diss Ca] + 4.118 [diss Mg]	N/A
Ion Balance in Water	SM 1030 E (2017)	SM 1030 E (2011)	N/A
Langelier Index in Water	SM 2330 B (2017)	Calculation	N/A
Mercury, dissolved in Water	EPA 245.7*	BrCl2 Oxidation / Cold Vapor Atomic Fluorescence Spectrometry (CVAFS)	Richmond
Mercury, total in Water	EPA 245.7*	BrCl2 Oxidation / Cold Vapor Atomic Fluorescence Spectrometry (CVAFS)	Richmond
Nitrogen, Total Kjeldahl in Water	SM 4500-Norg D* (2017)	Block Digestion and Flow Injection Analysis	Kelowna
pH in Water	SM 4500-H+ B (2017)	Electrometry	Kelowna
Solids, Total Dissolved in Water	SM 2540 C* (2017)	Gravimetry (Dried at 103-105C)	Kelowna
Total Metals in Water	EPA 200.2* / EPA 6020B	HNO3+HCl Hot Block Digestion / Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS)	Richmond
Turbidity in Water	SM 2130 B (2017)	Nephelometry	Kelowna

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

Glossary of Terms:

RL	Reporting Limit (default)
<	Less than the specified Reporting Limit (RL) - the actual RL may be higher than the default RL due to various factors
<1	Less than the specified Reporting Limit (RL) - the actual RL may be higher than the default RL due to various factors
°C	Degrees Celcius
AO	Aesthetic Objective
CU	Colour Units (referenced against a platinum cobalt standard)
MAC	Maximum Acceptable Concentration (health based)
mg/L	Milligrams per litre
MPN/100 mL	Most Probable Number per 100 millilitres
NTU	Nephelometric Turbidity Units
OG	Operational Guideline (treated water)
pH units	pH < 7 = acidic, pH > 7 = basic
µS/cm	Microsiemens per centimetre
ASTM	ASTM International Test Methods
EPA	United States Environmental Protection Agency Test Methods
SM	Standard Methods for the Examination of Water and Wastewater, American Public Health Association



APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO Waterline Resources Inc. - Nanaimo
PROJECT 3190-19-001

WORK ORDER 9090600
REPORTED 2019-09-19 12:22

General Comments:

The results in this report apply to the samples analyzed in accordance with the Chain of Custody document. This analytical report must be reproduced in its entirety. CARO is not responsible for any loss or damage resulting directly or indirectly from error or omission in the conduct of testing. Liability is limited to the cost of analysis. Samples will be disposed of 30 days after the test report has been issued unless otherwise agreed to in writing.

Results in **Bold** indicate values that are above CARO's method reporting limits. Any results that are above regulatory limits are highlighted **red**. Please note that results will only be highlighted red if the regulatory limits are included on the CARO report. Any Bold and/or highlighted results do not take into account method uncertainty. If you would like method uncertainty or regulatory limits to be included on your report, please contact your Account Manager: bshaw@caro.ca

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO PROJECT Waterline Resources Inc. - Nanaimo
3190-19-001

WORK ORDER REPORTED 9090600
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The following section displays the quality control (QC) data that is associated with your sample data. Groups of samples are prepared in "batches" and analyzed in conjunction with QC samples that ensure your data is of the highest quality. Common QC types include:

- **Method Blank (Blk):** A blank sample that undergoes sample processing identical to that carried out for the test samples. Method blank results are used to assess contamination from the laboratory environment and reagents.
- **Duplicate (Dup):** An additional or second portion of a randomly selected sample in the analytical run carried through the entire analytical process. Duplicates provide a measure of the analytical method's precision (reproducibility).
- **Blank Spike (BS):** A sample of known concentration which undergoes processing identical to that carried out for test samples, also referred to as a laboratory control sample (LCS). Blank spikes provide a measure of the analytical method's accuracy.
- **Matrix Spike (MS):** A second aliquot of sample is fortified with with a known concentration of target analytes and carried through the entire analytical process. Matrix spikes evaluate potential matrix effects that may affect the analyte recovery.
- **Reference Material (SRM):** A homogenous material of similar matrix to the samples, certified for the parameter(s) listed. Reference Materials ensure that the analytical process is adequate to achieve acceptable recoveries of the parameter(s) tested.

Each QC type is analyzed at a 5-10% frequency, i.e. one blank/duplicate/spike for every 10-20 samples. For all types of QC, the specified recovery (% Rec) and relative percent difference (RPD) limits are derived from long-term method performance averages and/or prescribed by the reference method.

Analyte	Result	RL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
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Anions, Batch B9I0632

Blank (B9I0632-BLK1)			Prepared: 2019-09-10, Analyzed: 2019-09-10						
Chloride	< 0.10	0.10 mg/L							
Fluoride	< 0.10	0.10 mg/L							
Nitrate (as N)	< 0.010	0.010 mg/L							
Nitrite (as N)	< 0.010	0.010 mg/L							
Sulfate	< 1.0	1.0 mg/L							
LCS (B9I0632-BS1)			Prepared: 2019-09-10, Analyzed: 2019-09-10						
Chloride	16.1	0.10 mg/L	16.0		100	90-110			
Fluoride	4.03	0.10 mg/L	4.00		101	88-108			
Nitrate (as N)	4.01	0.010 mg/L	4.00		100	90-110			
Nitrite (as N)	2.06	0.010 mg/L	2.00		103	85-115			
Sulfate	16.0	1.0 mg/L	16.0		100	90-110			

Dissolved Metals, Batch B9I0725

Blank (B9I0725-BLK1)			Prepared: 2019-09-11, Analyzed: 2019-09-11						
Aluminum, dissolved	< 0.0050	0.0050 mg/L							
Antimony, dissolved	< 0.00020	0.00020 mg/L							
Arsenic, dissolved	< 0.00050	0.00050 mg/L							
Barium, dissolved	< 0.0050	0.0050 mg/L							
Beryllium, dissolved	< 0.00010	0.00010 mg/L							
Bismuth, dissolved	< 0.00010	0.00010 mg/L							
Boron, dissolved	< 0.0050	0.0050 mg/L							
Cadmium, dissolved	< 0.000010	0.000010 mg/L							
Calcium, dissolved	< 0.20	0.20 mg/L							
Chromium, dissolved	< 0.00050	0.00050 mg/L							
Cobalt, dissolved	< 0.00010	0.00010 mg/L							
Copper, dissolved	< 0.00040	0.00040 mg/L							
Iron, dissolved	< 0.010	0.010 mg/L							
Lead, dissolved	< 0.00020	0.00020 mg/L							
Lithium, dissolved	< 0.00010	0.00010 mg/L							
Magnesium, dissolved	< 0.010	0.010 mg/L							
Manganese, dissolved	< 0.00020	0.00020 mg/L							
Molybdenum, dissolved	< 0.00010	0.00010 mg/L							
Nickel, dissolved	< 0.00040	0.00040 mg/L							

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Analyte	Result	RL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Dissolved Metals, Batch B9I0725, Continued									
Blank (B9I0725-BLK1), Continued				Prepared: 2019-09-11, Analyzed: 2019-09-11					
Phosphorus, dissolved	< 0.050	0.050 mg/L							
Potassium, dissolved	< 0.10	0.10 mg/L							
Selenium, dissolved	< 0.00050	0.00050 mg/L							
Silicon, dissolved	< 1.0	1.0 mg/L							
Silver, dissolved	< 0.000050	0.000050 mg/L							
Sodium, dissolved	< 0.10	0.10 mg/L							
Strontium, dissolved	< 0.0010	0.0010 mg/L							
Sulfur, dissolved	< 3.0	3.0 mg/L							
Tellurium, dissolved	< 0.00050	0.00050 mg/L							
Thallium, dissolved	< 0.000020	0.000020 mg/L							
Thorium, dissolved	< 0.00010	0.00010 mg/L							
Tin, dissolved	< 0.00020	0.00020 mg/L							
Titanium, dissolved	< 0.0050	0.0050 mg/L							
Tungsten, dissolved	< 0.0010	0.0010 mg/L							
Uranium, dissolved	< 0.000020	0.000020 mg/L							
Vanadium, dissolved	< 0.0010	0.0010 mg/L							
Zinc, dissolved	< 0.0040	0.0040 mg/L							
Zirconium, dissolved	< 0.00010	0.00010 mg/L							
Blank (B9I0725-BLK2)				Prepared: 2019-09-11, Analyzed: 2019-09-11					
Aluminum, dissolved	< 0.0050	0.0050 mg/L							
Antimony, dissolved	< 0.00020	0.00020 mg/L							
Arsenic, dissolved	< 0.00050	0.00050 mg/L							
Barium, dissolved	< 0.0050	0.0050 mg/L							
Beryllium, dissolved	< 0.00010	0.00010 mg/L							
Bismuth, dissolved	< 0.00010	0.00010 mg/L							
Boron, dissolved	< 0.0050	0.0050 mg/L							
Cadmium, dissolved	< 0.000010	0.000010 mg/L							
Calcium, dissolved	< 0.20	0.20 mg/L							
Chromium, dissolved	< 0.00050	0.00050 mg/L							
Cobalt, dissolved	< 0.00010	0.00010 mg/L							
Copper, dissolved	< 0.00040	0.00040 mg/L							
Iron, dissolved	< 0.010	0.010 mg/L							
Lead, dissolved	< 0.00020	0.00020 mg/L							
Lithium, dissolved	< 0.00010	0.00010 mg/L							
Magnesium, dissolved	< 0.010	0.010 mg/L							
Manganese, dissolved	< 0.00020	0.00020 mg/L							
Molybdenum, dissolved	< 0.00010	0.00010 mg/L							
Nickel, dissolved	< 0.00040	0.00040 mg/L							
Phosphorus, dissolved	< 0.050	0.050 mg/L							
Potassium, dissolved	< 0.10	0.10 mg/L							
Selenium, dissolved	< 0.00050	0.00050 mg/L							
Silicon, dissolved	< 1.0	1.0 mg/L							
Silver, dissolved	< 0.000050	0.000050 mg/L							
Sodium, dissolved	< 0.10	0.10 mg/L							
Strontium, dissolved	< 0.0010	0.0010 mg/L							
Sulfur, dissolved	< 3.0	3.0 mg/L							
Tellurium, dissolved	< 0.00050	0.00050 mg/L							
Thallium, dissolved	< 0.000020	0.000020 mg/L							
Thorium, dissolved	< 0.00010	0.00010 mg/L							
Tin, dissolved	< 0.00020	0.00020 mg/L							
Titanium, dissolved	< 0.0050	0.0050 mg/L							
Tungsten, dissolved	< 0.0010	0.0010 mg/L							
Uranium, dissolved	< 0.000020	0.000020 mg/L							
Vanadium, dissolved	< 0.0010	0.0010 mg/L							
Zinc, dissolved	< 0.0040	0.0040 mg/L							

APPENDIX 2: QUALITY CONTROL RESULTS

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WORK ORDER REPORTED 9090600
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Analyte	Result	RL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Dissolved Metals, Batch B9I0725, Continued									
Blank (B9I0725-BLK2), Continued					Prepared: 2019-09-11, Analyzed: 2019-09-11				
Zirconium, dissolved	< 0.00010	0.00010 mg/L							
LCS (B9I0725-BS1)					Prepared: 2019-09-11, Analyzed: 2019-09-11				
Aluminum, dissolved	0.0227	0.0050 mg/L	0.0200		113	80-120			
Antimony, dissolved	0.0225	0.00020 mg/L	0.0200		112	80-120			
Arsenic, dissolved	0.0194	0.00050 mg/L	0.0200		97	80-120			
Barium, dissolved	0.0195	0.0050 mg/L	0.0200		97	80-120			
Beryllium, dissolved	0.0197	0.00010 mg/L	0.0200		98	80-120			
Bismuth, dissolved	0.0202	0.00010 mg/L	0.0200		101	80-120			
Boron, dissolved	0.0164	0.0050 mg/L	0.0200		82	80-120			
Cadmium, dissolved	0.0198	0.000010 mg/L	0.0200		99	80-120			
Calcium, dissolved	1.93	0.20 mg/L	2.02		96	80-120			
Chromium, dissolved	0.0190	0.00050 mg/L	0.0200		95	80-120			
Cobalt, dissolved	0.0191	0.00010 mg/L	0.0200		95	80-120			
Copper, dissolved	0.0194	0.00040 mg/L	0.0200		97	80-120			
Iron, dissolved	2.03	0.010 mg/L	2.02		101	80-120			
Lead, dissolved	0.0201	0.00020 mg/L	0.0200		100	80-120			
Lithium, dissolved	0.0177	0.00010 mg/L	0.0199		89	80-120			
Magnesium, dissolved	2.03	0.010 mg/L	2.02		100	80-120			
Manganese, dissolved	0.0194	0.00020 mg/L	0.0200		97	80-120			
Molybdenum, dissolved	0.0199	0.00010 mg/L	0.0200		99	80-120			
Nickel, dissolved	0.0197	0.00040 mg/L	0.0200		98	80-120			
Phosphorus, dissolved	1.91	0.050 mg/L	2.00		96	80-120			
Potassium, dissolved	1.98	0.10 mg/L	2.02		98	80-120			
Selenium, dissolved	0.0183	0.00050 mg/L	0.0200		92	80-120			
Silicon, dissolved	1.9	1.0 mg/L	2.00		97	80-120			
Silver, dissolved	0.0190	0.000050 mg/L	0.0200		95	80-120			
Sodium, dissolved	1.96	0.10 mg/L	2.02		97	80-120			
Strontium, dissolved	0.0193	0.0010 mg/L	0.0200		96	80-120			
Sulfur, dissolved	4.6	3.0 mg/L	5.00		92	80-120			
Tellurium, dissolved	0.0212	0.00050 mg/L	0.0200		106	80-120			
Thallium, dissolved	0.0199	0.000020 mg/L	0.0200		99	80-120			
Thorium, dissolved	0.0207	0.00010 mg/L	0.0200		104	80-120			
Tin, dissolved	0.0211	0.00020 mg/L	0.0200		106	80-120			
Titanium, dissolved	0.0199	0.0050 mg/L	0.0200		100	80-120			
Tungsten, dissolved	0.0209	0.0010 mg/L	0.0200		105	80-120			
Uranium, dissolved	0.0208	0.000020 mg/L	0.0200		104	80-120			
Vanadium, dissolved	0.0190	0.0010 mg/L	0.0200		95	80-120			
Zinc, dissolved	0.0212	0.0040 mg/L	0.0200		106	80-120			
Zirconium, dissolved	0.0203	0.00010 mg/L	0.0200		101	80-120			
Reference (B9I0725-SRM1)					Prepared: 2019-09-11, Analyzed: 2019-09-11				
Aluminum, dissolved	0.226	0.0050 mg/L	0.235		96	79-114			
Antimony, dissolved	0.0454	0.00020 mg/L	0.0431		105	89-123			
Arsenic, dissolved	0.431	0.00050 mg/L	0.423		102	87-113			
Barium, dissolved	3.22	0.0050 mg/L	3.30		98	85-114			
Beryllium, dissolved	0.212	0.00010 mg/L	0.209		102	79-122			
Boron, dissolved	1.57	0.0050 mg/L	1.65		95	79-117			
Cadmium, dissolved	0.220	0.000010 mg/L	0.221		99	89-112			
Calcium, dissolved	7.19	0.20 mg/L	7.72		93	85-120			
Chromium, dissolved	0.433	0.00050 mg/L	0.434		100	87-113			
Cobalt, dissolved	0.128	0.00010 mg/L	0.124		104	90-117			
Copper, dissolved	0.821	0.00040 mg/L	0.815		101	90-115			
Iron, dissolved	1.25	0.010 mg/L	1.27		98	86-112			
Lead, dissolved	0.116	0.00020 mg/L	0.110		105	90-113			
Lithium, dissolved	0.0959	0.00010 mg/L	0.100		96	77-127			

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO PROJECT Waterline Resources Inc. - Nanaimo
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WORK ORDER REPORTED 9090600
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Analyte	Result	RL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Dissolved Metals, Batch B9I0725, Continued									
Reference (B9I0725-SRM1), Continued				Prepared: 2019-09-11, Analyzed: 2019-09-11					
Magnesium, dissolved	6.39	0.010 mg/L	6.59		97	84-116			
Manganese, dissolved	0.349	0.00020 mg/L	0.342		102	85-113			
Molybdenum, dissolved	0.409	0.00010 mg/L	0.404		101	87-112			
Nickel, dissolved	0.852	0.00040 mg/L	0.835		102	90-114			
Phosphorus, dissolved	0.480	0.050 mg/L	0.499		96	74-119			
Potassium, dissolved	2.85	0.10 mg/L	2.88		99	78-119			
Selenium, dissolved	0.0323	0.00050 mg/L	0.0324		100	89-123			
Sodium, dissolved	17.2	0.10 mg/L	18.0		96	81-117			
Strontium, dissolved	0.923	0.0010 mg/L	0.935		99	82-111			
Thallium, dissolved	0.0418	0.000020 mg/L	0.0385		109	90-113			
Uranium, dissolved	0.264	0.000020 mg/L	0.258		102	87-113			
Vanadium, dissolved	0.857	0.0010 mg/L	0.873		98	85-110			
Zinc, dissolved	0.910	0.0040 mg/L	0.848		107	88-114			

Dissolved Metals, Batch B9I0881

Blank (B9I0881-BLK1)				Prepared: 2019-09-11, Analyzed: 2019-09-11					
Mercury, dissolved	< 0.000010	0.000010 mg/L							
Reference (B9I0881-SRM1)				Prepared: 2019-09-11, Analyzed: 2019-09-11					
Mercury, dissolved	0.00479	0.000010 mg/L	0.00489		98	80-120			

General Parameters, Batch B9I0562

Blank (B9I0562-BLK1)				Prepared: 2019-09-11, Analyzed: 2019-09-11					
Carbon, Total Organic	< 0.50	0.50 mg/L							
Blank (B9I0562-BLK2)				Prepared: 2019-09-11, Analyzed: 2019-09-11					
Carbon, Total Organic	< 0.50	0.50 mg/L							
LCS (B9I0562-BS1)				Prepared: 2019-09-11, Analyzed: 2019-09-11					
Carbon, Total Organic	10.2	0.50 mg/L	10.0		102	78-116			
LCS (B9I0562-BS2)				Prepared: 2019-09-11, Analyzed: 2019-09-11					
Carbon, Total Organic	10.5	0.50 mg/L	10.0		105	78-116			

General Parameters, Batch B9I0646

Blank (B9I0646-BLK1)				Prepared: 2019-09-09, Analyzed: 2019-09-09					
Turbidity	< 0.10	0.10 NTU							
LCS (B9I0646-BS1)				Prepared: 2019-09-09, Analyzed: 2019-09-09					
Turbidity	38.7	0.10 NTU	40.0		97	90-110			
Duplicate (B9I0646-DUP1)				Source: 9090600-01		Prepared: 2019-09-09, Analyzed: 2019-09-09			
Turbidity	4.35	0.10 NTU	4.38				< 1	15	

General Parameters, Batch B9I0749

Blank (B9I0749-BLK1)				Prepared: 2019-09-10, Analyzed: 2019-09-10					
Colour, True	< 5.0	5.0 CU							
Blank (B9I0749-BLK2)				Prepared: 2019-09-10, Analyzed: 2019-09-10					
Colour, True	< 5.0	5.0 CU							

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Analyte	Result	RL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
General Parameters, Batch B9I0749, Continued									
LCS (B9I0749-BS1)				Prepared: 2019-09-10, Analyzed: 2019-09-10					
Colour, True	19	5.0 CU	20.0		96	85-115			
LCS (B9I0749-BS2)				Prepared: 2019-09-10, Analyzed: 2019-09-10					
Colour, True	19	5.0 CU	20.0		96	85-115			
General Parameters, Batch B9I0763									
Blank (B9I0763-BLK1)				Prepared: 2019-09-11, Analyzed: 2019-09-11					
Alkalinity, Total (as CaCO ₃)	< 1.0	1.0 mg/L							
Alkalinity, Phenolphthalein (as CaCO ₃)	< 1.0	1.0 mg/L							
Alkalinity, Bicarbonate (as CaCO ₃)	< 1.0	1.0 mg/L							
Alkalinity, Carbonate (as CaCO ₃)	< 1.0	1.0 mg/L							
Alkalinity, Hydroxide (as CaCO ₃)	< 1.0	1.0 mg/L							
Conductivity (EC)	< 2.0	2.0 µS/cm							
Blank (B9I0763-BLK2)				Prepared: 2019-09-11, Analyzed: 2019-09-11					
Alkalinity, Total (as CaCO ₃)	< 1.0	1.0 mg/L							
Alkalinity, Phenolphthalein (as CaCO ₃)	< 1.0	1.0 mg/L							
Alkalinity, Bicarbonate (as CaCO ₃)	< 1.0	1.0 mg/L							
Alkalinity, Carbonate (as CaCO ₃)	< 1.0	1.0 mg/L							
Alkalinity, Hydroxide (as CaCO ₃)	< 1.0	1.0 mg/L							
Conductivity (EC)	< 2.0	2.0 µS/cm							
Blank (B9I0763-BLK3)				Prepared: 2019-09-11, Analyzed: 2019-09-11					
Alkalinity, Total (as CaCO ₃)	< 1.0	1.0 mg/L							
Alkalinity, Phenolphthalein (as CaCO ₃)	< 1.0	1.0 mg/L							
Alkalinity, Bicarbonate (as CaCO ₃)	< 1.0	1.0 mg/L							
Alkalinity, Carbonate (as CaCO ₃)	< 1.0	1.0 mg/L							
Alkalinity, Hydroxide (as CaCO ₃)	< 1.0	1.0 mg/L							
Conductivity (EC)	< 2.0	2.0 µS/cm							
LCS (B9I0763-BS1)				Prepared: 2019-09-11, Analyzed: 2019-09-11					
Alkalinity, Total (as CaCO ₃)	99.0	1.0 mg/L	100		99	80-120			
LCS (B9I0763-BS2)				Prepared: 2019-09-11, Analyzed: 2019-09-11					
Alkalinity, Total (as CaCO ₃)	98.7	1.0 mg/L	100		99	80-120			
LCS (B9I0763-BS3)				Prepared: 2019-09-11, Analyzed: 2019-09-11					
Alkalinity, Total (as CaCO ₃)	101	1.0 mg/L	100		101	80-120			
LCS (B9I0763-BS4)				Prepared: 2019-09-11, Analyzed: 2019-09-11					
Conductivity (EC)	1410	2.0 µS/cm	1410		100	95-104			
LCS (B9I0763-BS5)				Prepared: 2019-09-11, Analyzed: 2019-09-11					
Conductivity (EC)	1410	2.0 µS/cm	1410		100	95-104			
LCS (B9I0763-BS6)				Prepared: 2019-09-11, Analyzed: 2019-09-11					
Conductivity (EC)	1420	2.0 µS/cm	1410		100	95-104			
Reference (B9I0763-SRM1)				Prepared: 2019-09-11, Analyzed: 2019-09-11					
pH	7.00	0.10 pH units	7.01		100	98-102			
Reference (B9I0763-SRM2)				Prepared: 2019-09-11, Analyzed: 2019-09-11					
pH	6.99	0.10 pH units	7.01		100	98-102			
Reference (B9I0763-SRM3)				Prepared: 2019-09-11, Analyzed: 2019-09-11					
pH	6.97	0.10 pH units	7.01		99	98-102			

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WORK ORDER REPORTED 9090600
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Analyte	Result	RL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
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General Parameters, Batch B9I0763, Continued

General Parameters, Batch B9I0793

Blank (B9I0793-BLK1)				Prepared: 2019-09-11, Analyzed: 2019-09-12					
Nitrogen, Total Kjeldahl	< 0.050	0.050 mg/L							
LCS (B9I0793-BS1)				Prepared: 2019-09-11, Analyzed: 2019-09-12					
Nitrogen, Total Kjeldahl	1.02	0.050 mg/L	1.00		102	85-115			

General Parameters, Batch B9I0796

Blank (B9I0796-BLK1)				Prepared: 2019-09-11, Analyzed: 2019-09-11					
Ammonia, Total (as N)	< 0.020	0.020 mg/L							
Blank (B9I0796-BLK2)				Prepared: 2019-09-11, Analyzed: 2019-09-11					
Ammonia, Total (as N)	< 0.020	0.020 mg/L							
LCS (B9I0796-BS1)				Prepared: 2019-09-11, Analyzed: 2019-09-11					
Ammonia, Total (as N)	0.979	0.020 mg/L	1.00		98	90-115			
LCS (B9I0796-BS2)				Prepared: 2019-09-11, Analyzed: 2019-09-11					
Ammonia, Total (as N)	0.982	0.020 mg/L	1.00		98	90-115			

General Parameters, Batch B9I0976

Blank (B9I0976-BLK1)				Prepared: 2019-09-13, Analyzed: 2019-09-13					
Solids, Total Dissolved	< 15	15 mg/L							
LCS (B9I0976-BS1)				Prepared: 2019-09-13, Analyzed: 2019-09-13					
Solids, Total Dissolved	233	15 mg/L	240		97	85-115			

General Parameters, Batch B9I1159

Blank (B9I1159-BLK1)				Prepared: 2019-09-16, Analyzed: 2019-09-16					
Cyanide, Total	< 0.0020	0.0020 mg/L							
LCS (B9I1159-BS1)				Prepared: 2019-09-16, Analyzed: 2019-09-16					
Cyanide, Total	0.0188	0.0020 mg/L	0.0200		94	82-120			
LCS Dup (B9I1159-BSD1)				Prepared: 2019-09-16, Analyzed: 2019-09-16					
Cyanide, Total	0.0193	0.0020 mg/L	0.0200		96	82-120	2	10	

Total Metals, Batch B9I0873

Blank (B9I0873-BLK1)				Prepared: 2019-09-11, Analyzed: 2019-09-11					
Aluminum, total	< 0.0050	0.0050 mg/L							
Antimony, total	< 0.00020	0.00020 mg/L							
Arsenic, total	< 0.00050	0.00050 mg/L							
Barium, total	< 0.0050	0.0050 mg/L							
Boron, total	< 0.0050	0.0050 mg/L							
Cadmium, total	< 0.000010	0.000010 mg/L							
Calcium, total	< 0.20	0.20 mg/L							
Chromium, total	< 0.00050	0.00050 mg/L							
Cobalt, total	< 0.00010	0.00010 mg/L							
Copper, total	< 0.00040	0.00040 mg/L							
Iron, total	< 0.010	0.010 mg/L							

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO PROJECT Waterline Resources Inc. - Nanaimo
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Analyte	Result	RL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Total Metals, Batch B9I0873, Continued									
Blank (B9I0873-BLK1), Continued					Prepared: 2019-09-11, Analyzed: 2019-09-11				
Lead, total	< 0.00020	0.00020 mg/L							
Magnesium, total	< 0.010	0.010 mg/L							
Manganese, total	< 0.00020	0.00020 mg/L							
Molybdenum, total	< 0.00010	0.00010 mg/L							
Nickel, total	< 0.00040	0.00040 mg/L							
Potassium, total	< 0.10	0.10 mg/L							
Selenium, total	< 0.00050	0.00050 mg/L							
Sodium, total	< 0.10	0.10 mg/L							
Strontium, total	< 0.0010	0.0010 mg/L							
Uranium, total	< 0.000020	0.000020 mg/L							
Zinc, total	< 0.0040	0.0040 mg/L							
LCS (B9I0873-BS1)					Prepared: 2019-09-11, Analyzed: 2019-09-11				
Aluminum, total	0.0194	0.0050 mg/L	0.0200		97	80-120			
Antimony, total	0.0199	0.00020 mg/L	0.0200		99	80-120			
Arsenic, total	0.0178	0.00050 mg/L	0.0200		89	80-120			
Barium, total	0.0179	0.0050 mg/L	0.0200		89	80-120			
Boron, total	0.0185	0.0050 mg/L	0.0200		93	80-120			
Cadmium, total	0.0185	0.000010 mg/L	0.0200		93	80-120			
Calcium, total	1.75	0.20 mg/L	2.02		87	80-120			
Chromium, total	0.0180	0.00050 mg/L	0.0200		90	80-120			
Cobalt, total	0.0183	0.00010 mg/L	0.0200		91	80-120			
Copper, total	0.0190	0.00040 mg/L	0.0200		95	80-120			
Iron, total	1.84	0.010 mg/L	2.02		91	80-120			
Lead, total	0.0193	0.00020 mg/L	0.0200		96	80-120			
Magnesium, total	1.88	0.010 mg/L	2.02		93	80-120			
Manganese, total	0.0189	0.00020 mg/L	0.0200		95	80-120			
Molybdenum, total	0.0181	0.00010 mg/L	0.0200		90	80-120			
Nickel, total	0.0186	0.00040 mg/L	0.0200		93	80-120			
Potassium, total	1.80	0.10 mg/L	2.02		89	80-120			
Selenium, total	0.0192	0.00050 mg/L	0.0200		96	80-120			
Sodium, total	1.85	0.10 mg/L	2.02		92	80-120			
Strontium, total	0.0176	0.0010 mg/L	0.0200		88	80-120			
Uranium, total	0.0187	0.000020 mg/L	0.0200		94	80-120			
Zinc, total	0.0192	0.0040 mg/L	0.0200		96	80-120			
Reference (B9I0873-SRM1)					Prepared: 2019-09-11, Analyzed: 2019-09-11				
Aluminum, total	0.118	0.0050 mg/L	0.118		100	79-114			
Antimony, total	0.0225	0.00020 mg/L	0.0216		104	89-123			
Arsenic, total	0.216	0.00050 mg/L	0.212		102	87-113			
Barium, total	1.62	0.0050 mg/L	1.65		98	85-114			
Boron, total	0.811	0.0050 mg/L	0.825		98	79-117			
Cadmium, total	0.114	0.000010 mg/L	0.110		103	89-112			
Calcium, total	3.80	0.20 mg/L	3.86		98	85-120			
Chromium, total	0.229	0.00050 mg/L	0.217		106	87-113			
Cobalt, total	0.0638	0.00010 mg/L	0.0620		103	90-117			
Copper, total	0.443	0.00040 mg/L	0.408		109	90-115			
Iron, total	0.657	0.010 mg/L	0.635		103	86-112			
Lead, total	0.0601	0.00020 mg/L	0.0550		109	90-113			
Magnesium, total	3.48	0.010 mg/L	3.30		106	84-116			
Manganese, total	0.177	0.00020 mg/L	0.171		104	85-113			
Molybdenum, total	0.208	0.00010 mg/L	0.202		103	87-112			
Nickel, total	0.447	0.00040 mg/L	0.418		107	90-114			
Potassium, total	1.41	0.10 mg/L	1.44		98	78-119			
Selenium, total	0.0179	0.00050 mg/L	0.0162		110	89-123			
Sodium, total	9.36	0.10 mg/L	9.00		104	81-117			

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Analyte	Result	RL Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Total Metals, Batch B9I0873, Continued									
Reference (B9I0873-SRM1), Continued				Prepared: 2019-09-11, Analyzed: 2019-09-11					
Strontium, total	0.473	0.0010 mg/L	0.468		101	82-111			
Uranium, total	0.138	0.000020 mg/L	0.129		107	87-113			
Zinc, total	0.445	0.0040 mg/L	0.424		105	88-114			

Total Metals, Batch B9I0909

Blank (B9I0909-BLK1)				Prepared: 2019-09-11, Analyzed: 2019-09-12					
Mercury, total	< 0.000010	0.000010 mg/L							
Reference (B9I0909-SRM1)				Prepared: 2019-09-11, Analyzed: 2019-09-12					
Mercury, total	0.00471	0.000010 mg/L	0.00489		96	80-120			