



## **AQUIFER PROTECTION PLAN**

**3450 Trans-Canada Highway, Cobble Hill, BC  
[PID 000-033-057]**

### **PREPARED FOR:**

**Craig Little  
Little Island Holdings Ltd  
995 Chapman Road, Cobble Hill, BC  
V0R 1L7**

### **PREPARED BY:**

**MADRONE ENVIRONMENTAL SERVICES LTD.**

**May 23, 2023**

MADRONE ENVIRONMENTAL SERVICES LTD.

#201 - 470 TRANS-CANADA HWY. • DUNCAN • BC • V9L 3R6

TEL 250.746.5545 • WWW.MADRONE.CA

DOSSIER: 23.0037-001

## TABLE OF CONTENTS

<b>1</b>	<b>INTRODUCTION.....</b>	<b>1</b>
1.1	PROJECT OVERVIEW .....	1
1.2	PROPOSED DEVELOPMENT .....	1
<b>2</b>	<b>PHYSICAL AND HYDROLOGICAL SETTING .....</b>	<b>2</b>
2.1	GENERAL DESCRIPTION.....	2
2.2	CLIMATE .....	2
2.3	TOPOGRAPHY AND DRAINAGE.....	3
2.3.1	PHYSIOGRAPHY .....	3
2.3.2	WATERCOURSES AND SIGNIFICANT AQUATIC VALUES .....	3
2.4	SOILS, GEOLOGY AND HYDROGEOLOGIC SETTING .....	3
2.4.1	LOCAL SOILS.....	3
2.4.2	LOCAL SURFICIAL GEOLOGY AND BEDROCK.....	4
2.4.3	AQUIFER DESCRIPTION AND LOCAL GROUNDWATER.....	4
2.4.4	SUMMARY OF NEIGHBORING WELLS .....	4
2.4.5	HYDRAULIC CONNECTION OF SOURCE AQUIFER AND INFORMATION ON HYDRAULICALLY CONNECTED FEATURES.....	5
2.4.6	RELEVANT GROUNDWATER DISCHARGE .....	5
2.4.7	HYDRAULIC PROPERTIES OF SOURCE AQUIFER.....	5
<b>3</b>	<b>SITE ASSESSMENT .....</b>	<b>6</b>
3.1	TEST PITS .....	6

3.2	GROUNDWATER WELL INFORMATION .....	7
3.3	INTRINSIC VULNERABILITY .....	7
<b>4</b>	<b>DISCUSSION .....</b>	<b>10</b>
4.1	CONCEPTUAL FLOW MODEL AND LIKELIHOOD OF HYDRAULIC CONNECTION .....	10
4.2	ASSESSMENT OF POTENTIAL IMPACTS TO WATER RESOURCES .....	10
4.3	ISSUES RELATED TO PROPOSED DEVELOPMENT, LAND AND PUBLIC SAFETY .....	11
<b>5</b>	<b>SUMMARY .....</b>	<b>12</b>
5.1	AQUIFER VULNERABILITY ASSESSMENT .....	12
5.2	RISK MITIGATION AND FURTHER RECOMMENDATIONS .....	12
<b>APPENDIX A - MAPS AND FIGURES .....</b>		<b>A1</b>
<b>APPENDIX B - GROUNDWATER WELLS INFORMATION .....</b>		<b>B1</b>
<b>APPENDIX C - SITE PHOTOS .....</b>		<b>C1</b>
<b>APPENDIX D - LIMITATIONS AND CONDITIONS OF USE .....</b>		<b>D1</b>

## LIST OF TABLES

TABLE 1. CLIMATE DATA (1981 TO 2010 CLIMATE NORMALS) .....	2
TABLE 2. TEST PIT LITHOLOGY DESCRIPTIONS .....	6
TABLE 3. GROUNDWATER WELL CHARACTERISTICS .....	7
TABLE 4. LAND USE AND HAZARD IDENTIFICATION MATRIX AS FOUND IN THE GUIDE TO THE USE OF INTRINSIC AQUIFER VULNERABILITY MAPPING (2011) .....	9

## LIST OF FIGURES

FIGURE 1. AERIAL VIEW OF 3450 TRANS CANADA HIGHWAY (OUTLINED IN YELLOW). THE LOCATIONS OF THE TEST PITS EXCAVATED FOR MADRONE ENVIRONMENTAL SERVICES' ASSESSMENT TO INFORM AN AQUIFER PROTECTION PLAN AS RED PLACEMARKS. THE LOCATION OF GROUNDWATER UPWELLING INTO A SMALL POOND OBSERVED BY MADRONE IS MARKED. IMAGERY PROVIDED BY THE COWICHAN VALLEY REGIONAL DISTRICT (WORLD VIEW).....	A2
FIGURE 2. GROUNDWATER WELLS WITHIN A 0.5KM RADIUS OF 3450 TRANS CANADA HIGHWAY (OUTLINED IN YELLOW). MAPPING PROVIDED BY THE PROVINCE OF BRITISH COLUMBIA. ....	A3
FIGURE 3. REGIONALLY MAPPED AQUIFER INTRINSIC VULNERABILITY SHOWING THE LOCATION OF THE PROPERTY (OUTLINED IN BLACK). INTRINSIC VULNERABILITY HAS BEEN DETERMINED BASED ON THE DRASTIC MODEL. ....	A4

## LIST OF PHOTOS

PHOTO 1. PROFILE OF TEST PIT 1 EXCAVATED TO INFORM THE AQUIFER PROTECTION PLAN DEVELOPED BY MADRONE ENVIRONMENTAL SERVICES. PHOTO DATED FEBRUARY 22, 2023. ....	C2
PHOTO 2. PROFILE OF TEST PIT 2 EXCAVATED TO INFORM THE AQUIFER PROTECTION PLAN DEVELOPED BY MADRONE ENVIRONMENTAL SERVICES. PHOTO DATED FEBRUARY 22, 2023. ....	C3
PHOTO 3. PROFILE OF TEST PIT 3 EXCAVATED TO INFORM THE AQUIFER PROTECTION PLAN DEVELOPED BY MADRONE ENVIRONMENTAL SERVICES. PHOTO DATED FEBRUARY 22, 2023. ....	C4
PHOTO 4. VIEW STANDING ON THE NORTH SIDE OF THE PROPERTY LOOKING EAST. TEST PIT 1 IS SHOWN IN THE FOREGROUND. PHOTO DATED FEBRUARY 22, 2023. ....	C5
PHOTO 5. VIEW STANDING ON THE EAST SIDE OF THE PROPERTY LOOKING SOUTHEAST TOWARDS THE MAIN ENTRANCE. PHOTO DATED FEBRUARY 22, 2023. ....	C5
PHOTO 6. VIEW STANDING IN THE CENTRE OF THE PROPERTY LOOKING SOUTH. PHOTO DATED FEBRUARY 22, 2023. ....	C6
PHOTO 7. VIEW STANDING ON THE EAST SIDE OF THE PROPERTY LOOKING NORTH. TEST PIT 3 IS SHOWN IN THE FOREGROUND. THE FORMER RESIDENCE IS SHOWN IN THE BACKGROUND. PHOTO DATED FEBRUARY 22, 2023.....	C6
PHOTO 8. VIEW STANDING ON THE NORTHEAST SIDE OF THE PROPERTY LOOKING EAST. THE FORMER RESIDENCE IS SHOWN IN THE BACKGROUND. PHOTO DATED FEBRUARY 22, 2023. ....	C7

PHOTO 9. VIEW STANDING ON THE NORTH SIDE OF THE PROPERTY LOOKING NORTH. THE TRANS-CANADA HIGHWAY IS SHOWN IN THE BACKGROUND. PHOTO DATED FEBRUARY 22, 2023. ....	C7
PHOTO 10. VIEW LOOKING DOWN A GROUNDWATER WELL LOCATED PROXIMAL TO THE FORMER RESIDENCE. STATIC WATER LEVEL DURING THE TIME OF MADRONE'S ASSESSMENT WAS ESTIMATED TO BE ~1.5 M. PHOTO DATED FEBRUARY 22, 2023. ....	C8
PHOTO 11. VIEW STANDING ON THE WEST SIDE OF THE PROPERTY IN THE SPARSELY FORESTED AREA. PHOTO DATED FEBRUARY 22, 2023. ....	C9
PHOTO 12. VIEW OF A SPRING POOLING INTO A SMALL POND ON THE NORTHWESTERN SIDE OF THE PROPERTY INDICATING THE PRESENCE OF UPWELLING GROUNDWATER. PHOTO DATED FEBRUARY 22, 2023. ....	C9

## **AQUIFER PROTECT PLAN**

# **3450 Trans-Canada Highway, Cobble Hill, BC [PID 000-033-057]**

## **1 Introduction**

### **1.1 Project Overview**

Little Island Holdings Ltd ('the Clients') have retained Madrone Environmental Services Ltd. ('Madrone') to complete an Aquifer Protection Plan for 3450 Trans-Canada Highway, Cobble Hill, BC (hereafter referred to as 'the Property' Madrone understands that the Client is intending to submit a rezoning application to the Cowichan Valley Regional District (CVRD), requesting that the Property be rezoned from RR-2 (Rural Residential 2) to C-3 (Rural Service Commercial 3). Because the Property is mapped within the CVRD's Development Permit Area (DPA) 4 Aquifer Protection boundary, the submission of an Aquifer Protection Plan, developed by a Qualified Professional (QP), is required to facilitate the Client's rezoning application. The purpose of DPA 4, according to the CVRD, is to protect the natural environment, its ecosystems and biological diversity pursuant to section 488(1)(a) of the *Local Government Act*<sup>1</sup>; and to conserve water pursuant to section 488(1)(i) of the *Local Government Act*.

### **1.2 Proposed Development**

The Client has indicated to Madrone that they intend to expand their RV sales business currently located across the street at 1060 Chapman Road and 3430 Trans Canada Hwy onto the property at 3450 Trans Canada Hwy. As such, Madrone has developed this Aquifer Protection Plan and recommendation based on the proposed future land-use plans which includes the operation of a commercial RV sales business.

---

<sup>1</sup> CVRD (2020). Schedule C Development Permit Areas.

[https://cvrld.ca/DocumentCenter/View/99165/2020\\_12\\_09-Development-Permit-Areas](https://cvrld.ca/DocumentCenter/View/99165/2020_12_09-Development-Permit-Areas).

Accessed May 4, 2023.

## 2 Physical and Hydrological Setting

### 2.1 General Description

The Property is located at the intersection of Trans-Canada Highway and Chapman Road, in the Cobble Hill area, ~15 km south of Duncan (**Figure 1**). According to CVRD mapping<sup>2</sup>, the Property covers an area of 1.9 ha (4.8 acres). The Trans-Canada Highway borders the Property along the west boundary, and Chapman Road borders its southern boundary. The Property is currently zoned Rural Residential 2 (RR-2) and is in a mixed-use area with nearby parcels being zoned for agriculture (A1), commercial and mixed use (C-3) and comprehensive development (CD-3). Satellite imagery (World View) provided on the CVRD mapping tool shows that the Property has been mostly cleared, with sparse forested areas existing only on the western side of the parcel, and along the southern parcel boundary. A large unpaved parking area is visible in the southern portion of the Property with an unoccupied building north of this parking area. Main access to the Property is from Chapman Road via a gravel driveway on the southeast side of the parcel.

### 2.2 Climate

The nearest Environment Canada Climate Station to the Property with climate normal data is Shawnigan Lake (Station ID 1017230), located 5.7 km from the Property, at 159 meters above sea level (masl). Climate data (1981 to 2010 Climate Normals) is summarized in **Table 1**.

**TABLE 1. CLIMATE DATA (1981 TO 2010 CLIMATE NORMALS)**

Climate Parameter	Recording
Daily average air surface temperature	9.9 °C
Annual precipitation	1182.0 mm
Annual snowfall	67.9 cm
Extreme daily precipitation	117.2 mm; recorded October 16, 2003
Days with rainfall (≥ 10 mm)	37.5 days
Days with rainfall (≥ 5 mm)	67.1 days

<sup>2</sup> CVRD (2022). CVRD Web Map. <https://www.cvrld.ca/2025/Maps-GIS>. Accessed May 4, 2023.

## 2.3 Topography and Drainage

### 2.3.1 Physiography

The elevation of the Property, based on available contour mapping, ranges from ~85 to 91 m above sea level (masl). The surface expression over most of the Property is a plain as defined by the *Terrain Classification System for British Columbia*, with slopes ranging between 0 to 3° (0 to 5%). Towards the southern parcel boundary of the Property, there are gentle, linear slopes ranging between 6 to 26° (4 to 15%). There are no significant geomorphic features in the immediate vicinity of the Property.

### 2.3.2 Watercourses and Significant Aquatic Values

The Property is within the Shawnigan Creek watershed based on mapping from the CVRD. Mapping by the CVRD and Habitat Wizard<sup>3</sup> shows an unnamed watercourse flowing across the northeast corner of the Property. However, based on a previous assessment conducted by Madrone<sup>4</sup>, no stream was observed flowing through the Property during a site assessment. A pond was noted the northwest corner of the Property, and the outlet drainage was observed to be piped in the subsurface for the entire length of the parcel before discharging into the ditch adjacent to Chapman Road. As such, Madrone concluded that there is potential connectivity via the pond on site, with limited connectivity through watercourses, since the primary flow of water on the Property is restricted is underground piping.

## 2.4 Soils, Geology and Hydrogeologic Setting

### 2.4.1 Local Soils

Provincial mapping<sup>5</sup> indicates three mapped soil associations on the Property – Koksilah, Cowichan, and Shawnigan. Koksilah and Cowichan soils are characterized as a poorly drained silt loam, while Shawnigan soils are characterized as a moderately well drained loam.

---

<sup>3</sup> Province of British Columbia (2022). Habitat Wizard. <https://maps.gov.bc.ca/ess/hm/habwiz/>. Accessed May 4, 2023.

<sup>4</sup> RE: 3450 Trans - Canada Highway, Cobble Hill, BC – Overview Ecological Assessment. Prepared by Justin Lange, B.Sc., R.P.Bio., Madrone Environmental Services Ltd. Prepared for Craig Little, Little Island Holdings Ltd. Dated June 30, 2021. Madrone Dossier 21.0155.

<sup>5</sup> Province of British Columbia (2022). BC Soil Information Finding Tool. <https://www2.gov.bc.ca/gov/content/environment/air-land-water/land/soil/soil-information-finder>. Accessed May 4, 2023.



### 2.4.2 Local Surficial Geology and Bedrock

The surficial geology mapped<sup>6</sup> for the area consists of ground moraine deposits of till, lenses of gravel, sand, and silt with a thickness up to 23 m. The underlying bedrock mapped for the area is the Mesozoic, Upper Cretaceous aged Nanaimo group which is comprised of undivided sedimentary rocks containing boulder, cobble, and pebble conglomerate, coarse to fine sandstone, siltstone, shale, and coal.

### 2.4.3 Aquifer Description and Local Groundwater

The Property is mapped as being atop Aquifer 197<sup>7</sup> and Aquifer 203<sup>8</sup>.

- Aquifer 197 (Cherry Point) is characterized as a confined sand and gravel aquifer from the Quadra Sand and Dashwood Drift. The aquifer is 48.6 km<sup>2</sup> and has a moderate intrinsic vulnerability. There are 945 wells correlated to this aquifer and median depth to water is 27.74 m.
- Aquifer 203 (Shawnigan Lake/Cobble Hill/Mill Bay) is characterized as a fractured crystalline bedrock aquifer within the Wark and Colquitz Gneiss and Bonanza Group. The aquifer is 122.7 km<sup>2</sup> and has a moderate intrinsic vulnerability. There are 1248 wells correlated to this aquifer and the median depth to water is 7.47 m.

### 2.4.4 Summary of Neighboring Wells

The BC Groundwater Wells and Aquifers Database<sup>9</sup> was used to identify registered wells in the vicinity of the Property. A search of the database identified ninety-two (92) existing registered water wells within 0.5 km from the perimeter of the Property (**Figure 2**; Appendix A). Information related to these wells is summarized in *Appendix B*.

---

<sup>6</sup> Geological Survey of Canada (1966). Surficial geology of Duncan and Shawnigan map - areas, British Columbia, Paper 65-24. <https://doi.org/10.4095/100947>. Accessed May 4, 2023.

<sup>7</sup> Province of British Columbia (2022). Aquifer 197 Summary Report. <https://apps.nrs.gov.bc.ca/gwells/aquifers/197>. Accessed May 4, 2023.

<sup>8</sup> Province of British Columbia (2022). Aquifer 203 Summary Report. <https://apps.nrs.gov.bc.ca/gwells/aquifers/203>. Accessed May 4, 2023.

<sup>9</sup> Province of British Columbia (2023). Groundwater Wells and Aquifers. Well Search. <https://apps.nrs.gov.bc.ca/gwells/>. Accessed May 4, 2023.

#### **2.4.5 Hydraulic Connection of Source Aquifer and Information on Hydraulically Connected Features**

The hydraulic conductivity of the aquifer material in Aquifer 197 is assumed to be relatively high<sup>10</sup>. Well lithology records indicate one or more confining units of low permeability material (till, clay) exists for the majority of well locations. The combined thickness of confining units ranges approximately from 1 to 85 m thick but is typically 15 m thick. The confining material is inferred to be aerially extensive but may be thin or absent in some areas (e.g., closer to major drainage features such as Koksilah River). The depth to bottom of the deepest confining unit is typically moderately shallow (15 to 30 m).

The hydraulic conductivity of the aquifer material in Aquifer 203 is assumed to be relatively low<sup>11</sup>. Well lithological records indicate a confining layer of low permeability material (till, clay) exists, ranging from approximately 1 to 60 m thick but typically 5 m thick. However, the confining layer may be thin or absent in some areas. Water-bearing fracture zones are typically 80 m deep based on the median depth of existing wells. Additional studies are required for interactions with Shawnigan Lake and drainage features in the area. The extent of hydraulic connections with seawater along the coastline, mapped faults, and the overlying unconsolidated aquifers are unknown.

#### **2.4.6 Relevant Groundwater Discharge**

No groundwater discharge information for the Property is available from the CVRD or the Province of British Columbia. During our field assessment (*3 Site Assessment*), Madrone observed a spring pooling into a small pond on the northwestern side of the Property which indicates the presence of upwelling groundwater (**Figure 1**; *Appendix A*).

#### **2.4.7 Hydraulic Properties of Source Aquifer**

The median well yield from Aquifer 197 is reported as 0.63 L/s. There is a 'Moderate' Vulnerability to Contamination and an 'Unknown' Productivity. The median well yield from Aquifer 203 is reported as 0.25L/s. There is a 'Moderate' Vulnerability to Contamination and an 'Unknown' Productivity.

---

<sup>10</sup> Province of British Columbia (2019). Aquifer 197 Mapping Report. [https://s3.ca-central-1.amazonaws.com/aquifer-docs/00100/AQ\\_00197\\_197\\_Aquifer\\_Mapping\\_Report\\_2019.pdf](https://s3.ca-central-1.amazonaws.com/aquifer-docs/00100/AQ_00197_197_Aquifer_Mapping_Report_2019.pdf). Accessed May 7, 2023.

<sup>11</sup> Province of British Columbia (2019). Aquifer 203 Mapping Report. [https://s3.ca-central-1.amazonaws.com/aquifer-docs/00200/AQ\\_00203\\_203\\_Aquifer\\_Mapping\\_Report\\_2019.pdf](https://s3.ca-central-1.amazonaws.com/aquifer-docs/00200/AQ_00203_203_Aquifer_Mapping_Report_2019.pdf). Accessed May 7, 2023.

### 3 Site Assessment

#### 3.1 Test Pits

To characterize the drainage subsurface conditions of the Property to inform the Aquifer Protection Plan, on February 22, 2022, Daniel Lamhonwah, P.Ag., and Julie-Ann Ishikawa, P.Geo., under supervision of Roberta Adams, P.Geo., of Madrone assessed three test pits (TEST PIT 1, TEST PIT 2, and TEST PIT 3) that were mechanically dug to a depth of 155 to 170 cm below ground. All test pits were within the parcel boundaries of the Property (**Figure 1**; *Appendix A*) and located in areas determined by Madrone to draw conclusions about subsurface drainage characteristics inferred by the physical characteristics of the on-site lithologies. A summary of the test pit findings is provided in **Table 2**. Photos taken of the Property during Madrone's assessment, including photos of the test pits, are presented in *Appendix C*.

**TABLE 2. TEST PIT LITHOLOGY DESCRIPTIONS**

Test Pit	Depth (cm)	Description
1	0 to 15	Dark brown organics
	15 to 100	Firm, compact, silty sand matrix (S 80%; Z 15%; Z 5%); 10% coarse fragment content (gravel to cobble range; subrounded to rounded); moist
	100 to 150	Firm, compact, sand with some silt (S 90%; Z 10%; Z 0%); 10% coarse fragment content (pebbles; gravel to pebble range; subrounded); moist; mottles; seepage observed at 110 cm depth
	150 to 170	Firm, compact, silty sand matrix (S 85%; Z 15%; Z 0%); 40% coarse fragment content (gravel to cobble range; subangular to subrounded); wet
2	0 to 20	Dark brown organics
	20 to 70	Firm, compact, sandy silt matrix (S 20%; Z 75%; Z 5%); 15% coarse fragment content (gravel to cobble range; subrounded); moist
	70 to 140	Firm, compact, sand with some silt (S 90%; Z 10%; Z 0%); 10% coarse fragment content (pebble to cobble range; subrounded); moist
	140 to 170	Very firm, compact, silty sand matrix (S 70%; Z 30%; Z 0%); 5% coarse fragment content (gravel; subrounded); moist; some mottles
	170 +	Firm to very firm, compact, sand with trace silt (S 95%; Z 5%; Z 0%); occasional silt lenses; 0% coarse fragment content; moist
3	0 to 5	Dark brown organics
	5 to 155	Firm to very firm, compact, silt and sand matrix (S 50%; Z 50%; Z 0%); 10 to 15% coarse fragment content (pebble to cobble range; subangular to subrounded); moist; mottles between 30 and 110 cm

TEST PIT 1 (Photo 1; *Appendix C*) and TEST PIT 2 (Photo 2; *Appendix C*) were observed by Madrone to contain alternating layers of firm to very firm and compact sandy silt to sand, with variable coarse fragment contents between 5 to 40% (gravel to cobble range and generally subrounded to rounded. In TEST PIT 1, mottles and seepage were observed at a depth of ~100 cm. Observations of TEST PIT 3 (Photo 3; *Appendix C*) indicate that the lithology here is homogenous from a depth of 5 to 155 cm below ground, characterized by a firm to very firm and compact silt and sand matrix, and 10 to 15% coarse fragment content (pebble to cobble range; subangular to subrounded). Mottles were observed between 30 to 110 cm.

The characteristics of surficial materials observed on the Property by Madrone are variable, however still conform to the general description of the surficial geology mapped for the area (deposits of glacial till, lensed gravel, sand, and silt) suggesting that materials here are glacial till with occasional silt and sand lenses (*2.4.2 Local Surficial Geology and Bedrock*).

### 3.2 Groundwater Well Information

There are two groundwater wells registered and mapped on the Property. Madrone understands that there are three wells on the Property, however only two contain provincial records as presented below in **Table 3**.

**TABLE 3. GROUNDWATER WELL CHARACTERISTICS.**

Well ID	Latitude (°N)	Longitude (°W)	Finished well depth (ft bgl)	Depth to bedrock (ft bgl)	Reported characteristics
Well Tag Number: 8968 Well ID Plate Number: Not specified	48.68406	-123.57617	20	Not specified	<ul style="list-style-type: none"> <li>• Hardpan with sandy layers</li> </ul>
Well Tag Number: 42662 Well ID Plate Number: Not specified	48.683752	-123.57604	71	Not specified	<ul style="list-style-type: none"> <li>• 0 to 1 ft bgl: topsoil</li> <li>• 1 to 3 ft bgl; hardpan</li> <li>• 3 to 17 ft bgl: sand with layers of hardpan</li> <li>• 17 to 29 ft bgl: sand (? blue colour)</li> <li>• 58 to 71 ft bgl: sand, water bearing</li> </ul>

### 3.3 Intrinsic Vulnerability

The entirety of the Property is within the regionally mapped<sup>12</sup> intrinsic aquifer vulnerability DRASTIC assessment and is characterized as being within a MODERATE and HIGH aquifer vulnerability zone (**Figure 2; Appendix A**). The DRASTIC method's main assumptions are that:

- Contaminant are introduced at ground surface and move at the same rate as water (e.g., dissolved in the water), vertically through the unsaturated zone driven by precipitation (i.e., not taking into account specifics of a particular contaminant's transport);
- More rapid pathways such as an open well or fracture are not considered; and

<sup>12</sup> iMapBC (2022). Aquifer Intrinsic Vulnerability – DRASTIC layer, <https://maps.gov.bc.ca/ess/hm/imap4m/>. Accessed May 7, 2023.

- The size of the mapped area is 100 acres (40.4 ha) or larger<sup>13</sup>.

As the Property is smaller than intended for the use of this method, the delineation of the boundary of intrinsic vulnerability values should be taken as approximate. To assign a hazard level and recommended mitigation plan, we have referred to **Table 4** from the *Guide to the Use of Intrinsic Aquifer Vulnerability Mapping*<sup>14</sup>.

Areas of HIGH intrinsic vulnerability offer less natural protection than areas of LOW or MODERATE vulnerability; therefore, land use activities which pose a high hazard should be discouraged from these areas or require much more stringent hydrogeological assessment and reporting requirements to ensure prevention of contamination is maximized.

Madrone understands that Property is to be developed as a commercial RV sales operation and assess the development hazard as MODERATE based on the examples provided in **Table 4**. The MODERATE hazard, combined with the MODERATE to HIGH aquifer vulnerability determines a Level 3 to Level 4 Hydrologic Assessment based on the *Guide to the Use of Intrinsic Aquifer Vulnerability Mapping*.

A Level 3 Hydrologic Assessment includes the following examples of requirements:

- Demonstrated groundwater protection plan
  - Extensive site investigation for baseline soil and water data. Definition of groundwater flow system is required. Engineering designs for any artificial barriers to be provided. An effluent/water management plan is required. Calculations or modelling results are to be provided in support of conclusions on level of impact. Demonstrated management skills have to be shown. A groundwater protection plan is required coupled with a monitoring schedule and an annual report.

A Level 4 Hydrologic Assessment includes the following examples of requirements:

- Demonstrated emergency response plan
  - For moderate vulnerability areas, or where the previous levels of investigation indicate a clear risk to groundwater, a detailed groundwater site investigation is required.

---

<sup>13</sup> Aller, L., Bennett, T., Lehr, J., Petty, R., Hackett, G., (1987). DRASTIC: A standardized system for evaluating ground water pollution potential using hydrogeologic settings. EPA-600/2-87-035, National Water Well Association, Dublin, Ohio/EPA Ada. Oklahoma.

<sup>14</sup> Ministry of Forests, Lands, Natural Resource Operations and Rural Development (MFLNRORD) and the Cowichan Valley Regional District (CVRD) (2011). A Guide to the Use of Intrinsic Aquifer Vulnerability Mapping. <https://www.cvrld.bc.ca/DocumentCenter/View/7838/Guide-to-use-of-intrinsic-aquifer-vulnerability-m?bidId>. Accessed May 7, 2023.

- The work should include an ongoing monitoring program, specifics of the potential contaminants (toxicity, quantity, transport behaviour), details on the protection design factors (natural attenuation, physical barriers, etc.), a detailed emergency response plan as well as an assessment of the financial capacity of the responsible party to enact the plan.

**TABLE 4. LAND USE AND HAZARD IDENTIFICATION MATRIX AS FOUND IN THE GUIDE TO THE USE OF INTRINSIC AQUIFER VULNERABILITY MAPPING (2011).**

Development Type - Source of contamination (Hazard)	Intrinsic Vulnerability		
	High	Moderate	Low
<b>High</b>			
<b>Industrial</b> e.g. Chemical manufacturing, electronics, petroleum, refining and storage, metal treating, food processing, wood, and pulp processing, textile manufacturing	Level 5	Level 4	Level 3
<b>Commercial</b> e.g. Gas stations, furniture strippers, drum cleaning			
<b>Other</b> e.g. road de-icing, underground pipelines, waste disposal			
<b>Moderate</b>			
<b>Industrial</b> e.g. gravel pits	Level 4	Level 3	Level 2
<b>Commercial</b> e.g. Dry cleaners, junk yards auto repair and body shops, pest control companies, photographic processing, machine shops, auto part stores, lawn and garden/farm stores, paint stores, hardware stores, medical facilities			
<b>Agricultural</b> e.g. Heavy chemical use agricultural (fruits and vegetables), manure storage (lagoons, stockpiles).			
<b>Residential</b> e.g. Urban housing, high density (>5 dwelling units per hectare) using septic systems, trailer parks, sewer mains.			
<b>Other</b> e.g. Highways, roads,			
<b>Low</b>			
<b>Commercial</b> e.g. Grocery stores, department stores, office buildings, laundromats, food service, shoe repair, barber and beauty shop	Level 3	Level 2	Level 1
<b>Agricultural</b> e.g. Low chemical use agriculture (forage crops).			
<b>Residential</b> e.g. Moderate and low density (<5 dwelling units per hectare) using septic systems			

## 4 Discussion

### 4.1 Conceptual Flow Model and Likelihood of Hydraulic Connection

In all of the assessed pits, Madrone observed firm to very firm compact till, comprising of gravel, sand, and silt. It is our opinion that infiltration to groundwater will be attenuated due to a confining layer or layers between the surface and Aquifers 197 and 203, thus retarding horizontal flow of potential contaminants originating from the proposed commercial development on the Property into groundwater. The permeability and hydraulic conductivity of this confining layer is presumed to be low based on the observed lithology in the test pits

Madrone's observations of upwelling on the western side of the Property provides further evidence of infiltration to groundwater is likely to be attenuated due to a confining layer or layers. The upwelling is likely due to artesian conditions whereby there is a pressure difference caused by a perched, intermediate aquifer between confining layers.

As such, it is Madrone's professional opinion that there is LOW likelihood of hydraulic connection for the majority of the Property, and MODERATE likelihood within 30 m of the pond to the underlying aquifer(s).

### 4.2 Assessment of Potential Impacts to Water Resources

Madrone understands that the Client is proposing a commercial RV sales operation on the Property which is anticipated to be an extension of existing operations (Mill Bay Arbutus RV) from the parcel immediately south of the Property on the opposite side of Chapman Road. Madrone also understands that proposed commercial activities on the Property will include RV sales, and the repair and maintenance of RVs. ***Madrone understands that the repair and maintenance of RVs will not include automotive repairs***, and as such will not include the use, exchange, and/or general handling of fuels, oils, and lubricants. The repair and maintenance of RVs is proposed to be conducted within a structure or structures with paved (i.e., impermeable) building aprons to mitigate any risk to the aquifer.

Madrone further understands that travel trailers, bunkhouses, fifth wheels, and truck campers will not contain any liquids or chemicals while being showcased on the Property. Class A and Class C RVs will contain basic vehicle fluids such as fuels, oils, and lubricants, which may, if spilled, be a potential source of contamination to water sources. However, as mentioned, no automotive repairs are proposed to be done on the Property, and as such the risk of fuel, oil, and/or lubricant spillage is low.

As such, based on what is known about the nature of future land use, it is the opinion of Madrone that the risk and consequence to water resources (surface or ground) from the proposed commercial development on the Property is LOW.

#### **4.3 Issues Related to Proposed Development, Land and Public Safety**

Madrone did not observe any potential issues related to the proposed development on the Property, the land, and/or public safety.



## 5 Summary

### 5.1 Aquifer Vulnerability Assessment

To determine the vulnerability of the underlying aquifers, Madrone considered the following:

- Based on the proposed commercial development, the risk associated with contaminant release to the environment is MODERATE, but the likelihood is LOW.
- The intrinsic vulnerability of the underlying aquifers is rated as MODERATE to HIGH.

From the DRASTIC methodology, there is a MODERATE hazard of contamination to groundwater resources given the land use and intrinsic vulnerability. However, we have considered the frequency and severity of a contamination event, and the consequence would be LOW given:

- The LOW likelihood of hydrological connectivity from surface water to groundwater for the majority of the property, and the absence of sensitive hydrological receptors (e.g., streams) flowing through or proximal to the Property. However, within 30 m of the pond, we estimate a MODERATE likelihood of hydrological connection.

*Therefore, Madrone has determined that there is an overall LOW risk to hydrogeologic resources associated with the proposed commercial development, if a minimum 30 m buffer is applied around the pond with appropriate protection measures.*

### 5.2 Risk Mitigation and Further Recommendations

Madrone understands that repair and maintenance of RVs is proposed to be conducted within a structure or structures with paved (i.e., impermeable) building aprons. This practice to mitigate any risk to the aquifer is supported. Following review of the proposed development, Madrone recommends the following recommendations be applied to further protect Aquifer 197 and Aquifer 203 from potential contamination. Our suggestions align with current best-management practices, and include:

- 30 m buffer around pond and upwelling on the property;
- An emergency spill response kit is maintained and available for use on site;
- Regular inspection of vehicles on impermeable and permeable areas to detect and manage incipient leakage;

- Proper storage and labelling of all chemicals used for motorized vehicle operations (e.g., oils and lubricants) and cleaning (e.g., waxes, soaps) in areas with impermeable surfaces, and sheltered from precipitation; and
- Drainage control measures are designed to prevent run off from entering the 30 m setback area around the pond. This could include ensuring that the land is grading to facilitate runoff into the adjacent stormwater ditches (to the north and east) to reduce the likelihood of pooled water on the Property.

Please contact the undersigned authors should there be any questions regarding the contents of this report.

Sincerely,

**MADRONE ENVIRONMENTAL SERVICES LTD.**

EGBC Permit # 1001749

***Prepared by:***

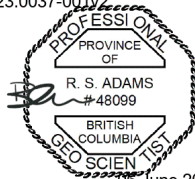
*\*This is a digitally signed duplicate of the official manually signed and sealed document*



Daniel Lamhonwah, PhD, MES, P.Ag  
Professional Agrologist, Hydrologist

***Reviewed by:***

23.0037-001v2



06 June 2023

Roberta Adams, MSc, P. Geo  
Professional Geoscientist, Hydrogeologist



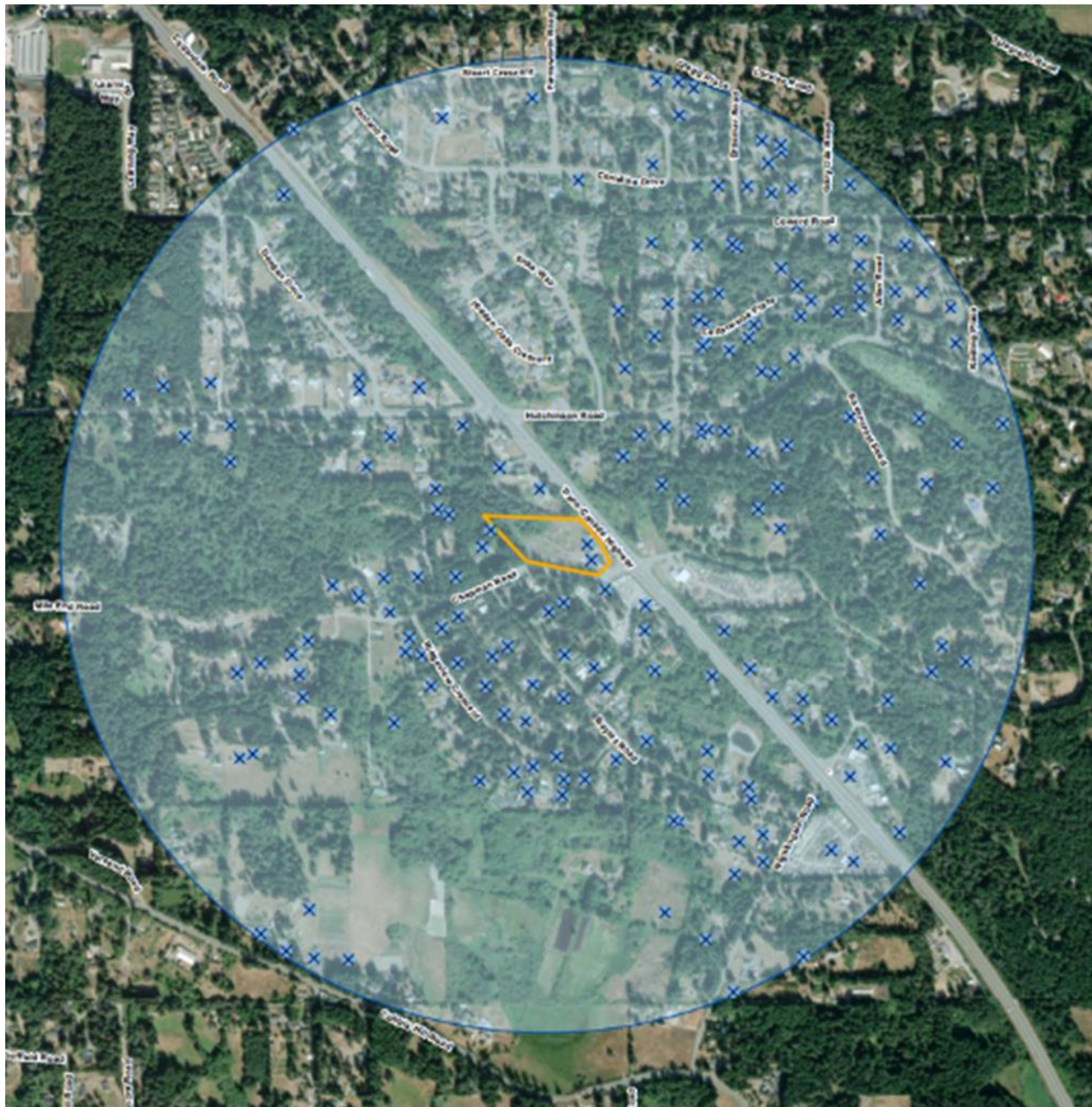
## **APPENDIX A**

# **Maps and Figures**

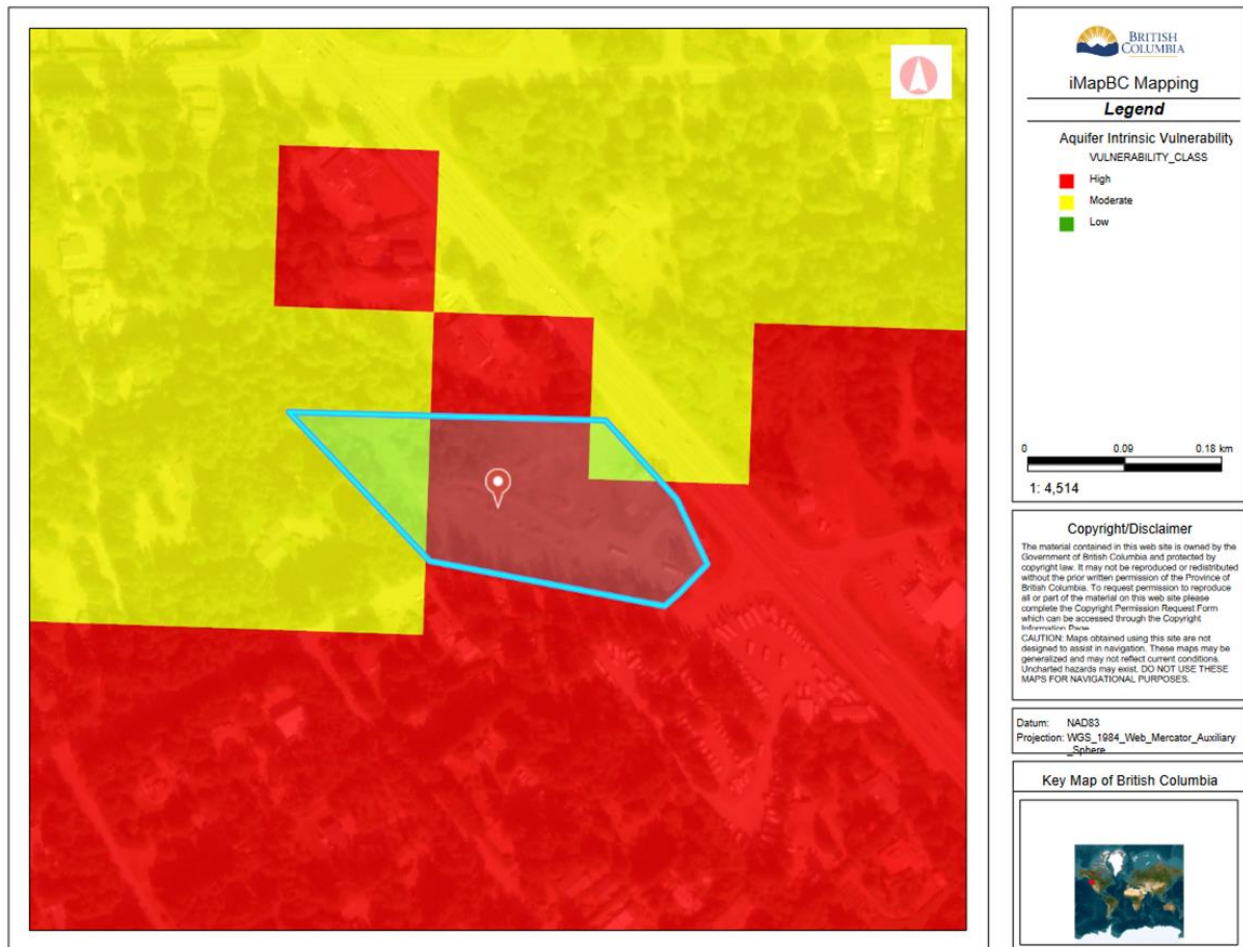


**FIGURE 1. AERIAL VIEW OF 3450 TRANS CANADA HIGHWAY (OUTLINED IN YELLOW). THE LOCATIONS OF THE TEST PITS EXCAVATED FOR MADRONE ENVIRONMENTAL SERVICES' ASSESSMENT TO INFORM AN AQUIFER PROTECTION PLAN AS RED PLACEMARKS. THE LOCATION OF GROUNDWATER UPWELLING INTO A SMALL POOND OBSERVED BY MADRONE IS MARKED. IMAGERY PROVIDED BY THE COWICHAN VALLEY REGIONAL DISTRICT (WORLD VIEW).**





**FIGURE 2. GROUNDWATER WELLS WITHIN A 0.5KM RADIUS OF 3450 TRANS CANADA HIGHWAY (OUTLINED IN YELLOW). MAPPING PROVIDED BY THE PROVINCE OF BRITISH COLUMBIA.**



**FIGURE 3. REGIONALLY MAPPED AQUIFER INTRINSIC VULNERABILITY SHOWING THE LOCATION OF THE PROPERTY (OUTLINED IN BLACK). INTRINSIC VULNERABILITY HAS BEEN DETERMINED BASED ON THE DRASTIC MODEL.**



## **APPENDIX B**

# **Groundwater Wells Information**

Well Tag Number	Street Address	Well Use	Finished well depth (ft)	Well Yield (Usgpm)	Static water level (ft)
8939		Unknown Well Use	17.5	0.0	0.0
8943		Unknown Well Use	10.0	0.0	0.0
8967		Unknown Well Use	16.0	0.0	0.0
8968		Unknown Well Use	20.0	0.0	17.0
9002		Unknown Well Use	8.0	0.0	3.0
9006		Unknown Well Use	72.0	4.0	0.0
9008		Unknown Well Use	10.0	0.0	0.0
14080		Unknown Well Use	60.0	1.0	6.0
19282		Unknown Well Use	35.0	2.5	11.0
24311		Unknown Well Use	55.0	5.0	33.0
24317		Unknown Well Use	72.0	15.0	14.0
23768		Unknown Well Use	177.0	0.0	155.0
27078	CHAPMAN RD	Unknown Well Use	40.0	30.0	0.0
24473	BOYLE RD	Unknown Well Use	55.0	20.0	0.0
24487	CHAPMAN ROAD	Private Domestic	125.0	8.0	43.0
24598		Unknown Well Use	70.0	1.0	14.0
25087		Unknown Well Use	187.0	4.5	165.0
25095	1005 CEDARWOOD PLACE	Private Domestic	230.0	8.0	185.0
29547		Unknown Well Use	148.0	10.0	124.0
29556	OFF COWARD RD	Unknown Well Use	175.0	10.0	161.0
29831	HUTCHINSON RD	Unknown Well Use	145.0	6.0	98.0
27658	HUTCHINSON RD	Unknown Well Use	360.0	15.0	100.0
28491	NIGHTINGALE & COBBLE HILL RD	Unknown Well Use	100.0	10.0	0.0
28493	CHAPMAN RD	Unknown Well Use	57.0	6.0	36.0
28249		Unknown Well Use	60.0	6.0	32.0
28638	CHAPMAN	Not Applicable	34.0	5.0	19.0
28266		Unknown Well Use	65.0	5.0	22.0
33069		Unknown Well Use	250.0	3.0	15.0
32538	TRANS CANADA HIGHWAY	Unknown Well Use	82.0	5.0	0.0
33035	COWARD RD	Unknown Well Use	219.0	15.0	160.0
33041	527 CHAPMAN RD	Unknown Well Use	530.0	2.5	200.0
30725		Not Applicable	43.0	10.0	22.0
30744	BOYLES RD	Not Applicable	44.0	7.0	20.0
30487	NIGHTINGALE RD & BOYLES	Unknown Well Use	90.0	10.0	20.0
31226	RIGDEVIEW CRESENT	Unknown Well Use	35.0	25.0	3.0
33889	RIDGE VIEW RD	Private Domestic	58.0	35.0	32.0
34279	HUTCHISON RD	Unknown Well Use	218.0	8.0	0.0
34340	3265 COBBLE HILL RD	Irrigation	370.0	47.0	5.0
33699	3369 RIDGEVIEW CRES.	Unknown Well Use	40.0	8.0	0.0



Well Tag Number	Street Address	Well Use	Finished well depth (ft)	Well Yield (Usgpm)	Static water level (ft)
33868		Unknown Well Use	58.0	10.0	3.0
34229	COWERD ROAD	Unknown Well Use	190.0	15.0	138.0
38640	HUTCHINSON RD	Not Applicable	228.0	15.0	167.0
38641	HUTCHINSON RD	Unknown Well Use	250.0	4.0	165.0
36805	RIDGEVIEW CRES	Unknown Well Use	38.0	15.0	10.0
36114	BOYLES RD	Unknown Well Use	37.0	20.0	24.0
36115		Unknown Well Use	14.0	15.0	4.0
36126	COBBLE HILL ROAD	Private Domestic	330.0	2.0	10.0
36840	HUTCHISON RD	Unknown Well Use	260.0	8.5	0.0
36182		Unknown Well Use	510.0	1.0	10.0
36961	CHAPMAN RD	Not Applicable	36.0	15.0	0.0
40793	HUTCHINSON RD	Unknown Well Use	167.0	10.0	139.0
39236	CHAPMAN RD	Unknown Well Use	38.0	10.0	18.0
39628	CHAPMAN RD	Unknown Well Use	33.0	0.0	15.0
39680	BOYLES RD	Unknown Well Use	60.0	5.0	30.0
40125	BOYLES RD	Unknown Well Use	46.0	10.0	9.0
43773	3376 BOYLES RD.	Private Domestic	66.5	6.0	25.0
43856	3385 TRANS CANADA HWY.	Private Domestic	310.0	4.0	8.0
44207	RIDGEVIEW CRES	Private Domestic	46.0	8.0	15.0
43965	RIDGEVIEW RD	Private Domestic	250.0	5.0	0.0
42023		Unknown Well Use	168.0	20.0	135.0
42024		Unknown Well Use	153.0	10.0	104.0
41707	CEDARWOOD PLACE	Unknown Well Use	184.0	10.0	130.0
42077	HUTCHINSON RD & HWY WEST SIDE	Unknown Well Use	117.0	25.0	47.0
42412	TRANS CANADA HWY	Unknown Well Use	58.0	9.0	14.0
42414	RIDGEVIEW CRES	Not Applicable	50.0	20.0	25.0
42619	NIGHTGALE RD	Unknown Well Use	510.0	1.5	53.0
42628		Unknown Well Use	56.0	12.0	8.0
42965		Unknown Well Use	168.0	8.0	118.0
42662	HWY & CHAPMAN	Unknown Well Use	71.0	14.0	32.0
41634	RIDGEVIEW CRES	Unknown Well Use	33.0	10.0	11.0
46716	BRAEMAR DR	Private Domestic	197.0	15.0	159.0
46091	COWERD RD	Unknown Well Use	200.0	10.0	167.0
45164	CEDARWOOD CRES	Private Domestic	203.0	10.0	138.0
44636	COWERD RD	Private Domestic	256.0	30.0	170.0
45032	BRAEMAR & CHRISTINA DR	Private Domestic	189.0	15.0	146.0
48636	CEDARWOOD PL	Unknown Well Use	172.0	5.0	123.0
49345	1024 HUTCHINSON ROAD	Private Domestic	143.0	8.0	110.0
48839	ALLAN RD	Unknown Well Use	218.0	10.0	150.0

Well Tag Number	Street Address	Well Use	Finished well depth (ft)	Well Yield (Usgpm)	Static water level (ft)
49572	CHAPMAN RD	Private Domestic	67.0	20.0	30.0
48942	HUTCHINSON RD	Private Domestic	236.0	5.0	0.0
47328	KEELING RD	Unknown Well Use	235.5	10.0	170.0
47792	HUTCHINSON ROAD	Private Domestic	39.0	10.0	12.0
48273	986 COWERD ROAD	Private Domestic	199.0	10.0	130.0
52784	3500 RAVENCREST	Private Domestic	222.0	5.0	173.0
52012	HUTCHINSON ROAD	Private Domestic	193.0	35.0	130.0
52640	HUTCHINSON ROAD	Private Domestic	50.0	4.0	20.0
52068	CHAPMAN RD	Private Domestic	117.0	4.0	36.0
50048	T C H	Private Domestic	158.0	10.0	0.0
50604	BOYLES ROAD	Irrigation	440.0	40.0	2.0
55526	ALLEN RD	Private Domestic	204.0	15.0	145.0
55562	BOYLES RD	Private Domestic	490.0	0.8	10.0
54642	BOYLES ROAD	Private Domestic	55.0	8.0	5.0
53969	CHRISTINA RD	Private Domestic	177.0	20.0	156.0
53051	3345 TRANS CANADA HWY	Water Supply System	600.0	15.0	100.0
53063	3367 TRANS CANADA HWY.	Private Domestic	150.0	3.0	10.0
53090	ALLEN RD	Not Applicable	244.0	10.0	149.0
52831	HUTCHINSON	Private Domestic	178.0	5.0	125.0
55800	1135 HUTCHINSON ROAD	Water Supply System	158.0	25.0	90.0
56712	HUTCHINSON ROAD	Private Domestic	39.0	7.0	16.0
63013	1171	Private Domestic	178.0	20.0	110.0
63017	3646 GREGG PL	Private Domestic	185.0	10.0	145.0
63025	1095 HUTCHINSON RD	Private Domestic	192.0	40.0	112.0
63130	3364 RIDGEVIEW	Private Domestic	52.0	15.0	12.0
63136	3336 BOYLES RD	Private Domestic	590.0	0.8	0.0
63478	3420 TRANS CANADA HWY	Private Domestic	37.0	6.0	12.0
63499	1019 KNIGHTENGAL RD	Private Domestic	160.0	5.0	25.0
64093	980 NIGHTINGALE ROAD	Private Domestic	390.0	0.0	10.0
64116	927 CHAPMAN RD	Private Domestic	530.0	2.0	200.0
64125	3640 GREGG PL	Private Domestic	177.0	8.0	151.0
64131	3356 RIDGEVIEW CRES	Private Domestic	48.0	10.0	13.0
65055	CEDARWOOD PL	Private Domestic	156.0	15.0	117.0
64711	3336 BOYLES RD	Private Domestic	400.0	4.0	10.0
63993	3390 RIDGEVIEW CRES	Private Domestic	36.0	8.0	8.0
68774	ALLAN RD	Private Domestic	237.0	15.0	167.0
68789	3638 GREGG PL	Private Domestic	190.0	10.0	153.0
68794	1240 CHAPMAN RD	Private Domestic	290.0	5.0	27.0
68528	1018 NIGHTINGALE ROAD	Private Domestic	470.0	25.0	15.0

Well Tag Number	Street Address	Well Use	Finished well depth (ft)	Well Yield (Usgpm)	Static water level (ft)
68531	MILE END RD	Private Domestic	440.0	3.0	0.0
68533	915 CHAPMAN RD	Private Domestic	430.0	1.0	0.0
68595	3371 BOYLES RD	Private Domestic	45.0	10.0	20.0
68596	CHAPMAN ROAD	Private Domestic	265.0	6.0	92.0
68597	1134 CHAPMAN ROAD	Water Supply System	57.0	20.0	34.0
68601		Private Domestic	57.0	8.0	0.0
68602	1015 CHAPMAN RD	Private Domestic	37.0	5.0	29.0
68603	RAVENCREST RD	Private Domestic	189.0	3.0	0.0
68604	1040 CHAPMAN RDUUF	Commercial and Industrial	48.0	15.0	28.0
68605	HUTCHINSON RD	Private Domestic	184.0	10.0	151.0
68606	1135 HUTCHINSON RD	Private Domestic	187.0	10.0	152.0
68608	ALLAN RD	Private Domestic	218.0	10.0	153.0
68609	3578 ALLEN RD	Private Domestic	240.0	15.0	95.0
68610	3558 KEELING PL	Private Domestic	262.0	5.0	190.0
68614	3625 BROOKSIDE	Private Domestic	185.0	10.0	149.0
68615	995 COWERD	Private Domestic	200.0	18.0	163.0
74986	RAVENCREST	Private Domestic	240.0	6.0	177.0
75029	3430 TRANS CANADA HWY	Private Domestic	75.0	5.0	20.0
75084	938 COWERD ROAD	Private Domestic	260.0	20.0	187.0
75126	COWERD ROAD	Private Domestic	162.0	7.0	132.0
75145	3615 RAEVIEW CRESCENT	Private Domestic	207.0	5.0	171.0
75152	CHAPMAN ROAD	Private Domestic	97.0	6.0	52.0
81863	3398 RIDGEVIEW CRESCENT	Private Domestic	61.0	5.0	15.0
84511	3471 TRANS. CANADA HIGHWAY	Private Domestic	111.0	7.0	90.0
84859	1240 CHAPMAN ROAD	Private Domestic	130.0	7.0	0.0
84863	1012 CEDARWOOD ROAD	Private Domestic	174.0	10.0	0.0
84864	3415 TRANS CANADA HWY	Private Domestic	26.0	5.0	0.0
84543	1137 CHAPMAN ROAD	Private Domestic	66.0	10.0	23.0
85147	1024 HUTCHINSON RD	Private Domestic	143.0	8.0	0.0
84555	1010 COWERED ROAD	Private Domestic	178.0	15.0	140.0
85230	1135 HUTCHINSON RD	Water Supply System	240.0	0.0	100.0
85048	3375 TRANS CANADA HIGHWAY	Private Domestic	240.0	20.0	0.0
84808	3440 RAVENCREST	Private Domestic	196.0	4.0	0.0
84809	3343 BOYLES ROAD	Private Domestic	530.0	1.5	0.0
84812	1137 CHAPMAN ROAD	Private Domestic	66.0	10.0	0.0
84813	1162 CHAPMAN ROAD	Private Domestic	240.0	30.0	0.0
84106	995 HUTCHINSON ROAD	Private Domestic	44.5	3.0	0.0
83537	3325 TRANS CANADA HWY	Private Domestic	187.0	12.0	0.0
86866	3344 BOYLES ROAD	Private Domestic	21.5	6.0	5.0

Well Tag Number	Street Address	Well Use	Finished well depth (ft)	Well Yield (Usgpm)	Static water level (ft)
86579	1165 CHAPMAN ROAD	Private Domestic	38.0	5.0	15.0
88947	3619 RAEVIEW CRESCENT	Private Domestic	230.0	6.0	167.0
88795		Private Domestic	190.0	12.0	151.0
88800		Private Domestic	165.0	10.0	140.0
88803	1265 HUTCHINSON	Private Domestic	150.0	5.0	118.0
91800	RAVENCREST ROAD	Private Domestic	167.0	8.0	138.0
91172	1034 COWERD ROAD	Private Domestic	174.0	12.0	134.0
91208	1017 CEDARWOOD	Private Domestic	175.0	10.0	144.0
90568	TRANS CANADA HIGHWAY	Private Domestic	540.0	2.0	110.0
92676	3356 RIDGEVIEW CRESCENT	Private Domestic	547.0	5.0	3.0
93612	3642 CHRISTINA DRIVE	Private Domestic	190.0	20.0	150.0
96539	1100 STEWART AVENUE	Private Domestic	212.0	15.0	165.0
95350	HUTCHINSON ROAD	Private Domestic	80.0	7.0	36.0
100252	1115 CHAPMAN	Private Domestic	63.0	15.0	8.0
100392	1017 CEDARWOOD PLACE	Private Domestic	148.0	4.0	142.0
100415		Private Domestic	141.5	4.0	132.0
100430	1008 CEDARWOOD	Private Domestic	171.0	6.0	131.0
103058	1023 COWERD ROAD	Unknown Well Use	164.0	5.0	151.5
105340	3261 COBBLE HILL RD	Private Domestic	427.0	5.0	9.0
105773	3265 COBBLE HILL RD	Private Domestic	605.0	15.0	11.8
110098	RAVENCREST	Private Domestic	665.0	0.5	214.0
109636	1010 HUTCHINSON ROAD	Unknown Well Use	49.0	20.0	29.0
109037	995 HUTCHINSON ROAD	Private Domestic	175.0	8.0	133.0
112841	3433 RAVENCREST	Private Domestic	206.0	10.0	155.0
111272	3623 RAEVIEW CRESCENT	Private Domestic	215.0	10.0	162.0
112161	1014 COWERD ROAD	Private Domestic	197.0	12.0	150.0
113811	3344 BOYLES ROAD	Private Domestic	241.0	3.5	11.0
113956	920 CHAPMAN ROAD	Private Domestic	460.0	12.0	130.0
120423	1080 HUTCHINSON ROAD	Private Domestic	12.0	0.0	0.0
119956	1231 HUTCHINSON ROAD	Unknown Well Use	165.0	0.0	153.0
118490	3381 TRANS CANADA HWY	Private Domestic	280.0	4.0	68.0
122448	1044 HUTCHINSON ROAD	Private Domestic	620.0	30.0	93.5
124778	1013 CEDARWOOD PLACE	Private Domestic	172.0	10.0	145.0
123524	3412 TRANS CANADA HWY	Private Domestic	365.0	3.0	35.0
125761	960 NIGHTINGALE ROAD	Private Domestic	360.0	1.3	203.0



## **APPENDIX C**

### **Site Photos**



**PHOTO 1. PROFILE OF TEST PIT 1 EXCAVATED TO INFORM THE AQUIFER PROTECTION PLAN DEVELOPED BY MADRONE ENVIRONMENTAL SERVICES. PHOTO DATED FEBRUARY 22, 2023.**





**PHOTO 2. PROFILE OF TEST PIT 2 EXCAVATED TO INFORM THE AQUIFER PROTECTION PLAN DEVELOPED BY MADRONE ENVIRONMENTAL SERVICES. PHOTO DATED FEBRUARY 22, 2023.**



**PHOTO 3. PROFILE OF TEST PIT 3 EXCAVATED TO INFORM THE AQUIFER PROTECTION PLAN DEVELOPED BY MADRONE ENVIRONMENTAL SERVICES. PHOTO DATED FEBRUARY 22, 2023.**





**PHOTO 4. VIEW STANDING ON THE NORTH SIDE OF THE PROPERTY LOOKING EAST. TEST PIT 1 IS SHOWN IN THE FOREGROUND. PHOTO DATED FEBRUARY 22, 2023.**



**PHOTO 5. VIEW STANDING ON THE EAST SIDE OF THE PROPERTY LOOKING SOUTHEAST TOWARDS THE MAIN ENTRANCE. PHOTO DATED FEBRUARY 22, 2023.**





**PHOTO 6. VIEW STANDING IN THE CENTRE OF THE PROPERTY LOOKING SOUTH. PHOTO DATED FEBRUARY 22, 2023.**



**PHOTO 7. VIEW STANDING ON THE EAST SIDE OF THE PROPERTY LOOKING NORTH. TEST PIT 3 IS SHOWN IN THE FOREGROUND. THE FORMER RESIDENCE IS SHOWN IN THE BACKGROUND. PHOTO DATED FEBRUARY 22, 2023.**





**PHOTO 8. VIEW STANDING ON THE NORTHEAST SIDE OF THE PROPERTY LOOKING EAST. THE FORMER RESIDENCE IS SHOWN IN THE BACKGROUND. PHOTO DATED FEBRUARY 22, 2023.**



**PHOTO 9. VIEW STANDING ON THE NORTH SIDE OF THE PROPERTY LOOKING NORTH. THE TRANS-CANADA HIGHWAY IS SHOWN IN THE BACKGROUND. PHOTO DATED FEBRUARY 22, 2023.**





**PHOTO 10. VIEW LOOKING DOWN A GROUNDWATER WELL LOCATED PROXIMAL TO THE FORMER RESIDENCE. STATIC WATER LEVEL DURING THE TIME OF MADRONE'S ASSESSMENT WAS ESTIMATED TO BE ~ 1.5 M. PHOTO DATED FEBRUARY 22, 2023.**





**PHOTO 11. VIEW STANDING ON THE WEST SIDE OF THE PROPERTY IN THE SPARSELY FORESTED AREA. PHOTO DATED FEBRUARY 22, 2023.**



**PHOTO 12. VIEW OF A SPRING POOLING INTO A SMALL POND ON THE NORTHWESTERN SIDE OF THE PROPERTY INDICATING THE PRESENCE OF UPWELLING GROUNDWATER. PHOTO DATED FEBRUARY 22, 2023.**

## **APPENDIX D**

# **Limitations and Conditions of Use**

The contents of this Aquifer Protection Plan (referred to hereafter as the 'Report') prepared for the Client, Little Island Holdings Ltd. for 3450 Trans-Canada Highway, Cobble Hill, BC, remain the copyright property of Madrone Environmental Services Ltd. ('Madrone').

By using the Report, including but not limited to providing the Report to other parties or relying on the information, observations, findings, suggestions, recommendations, and opinions contained in the Report, a person who uses the Report (the 'User') accepts and agrees to the limitations and conditions set out below.

To the extent that these limitations and conditions of use conflict with any previous agreements between Madrone and the Client, these limitations and conditions will prevail.

Madrone grants the Client a non-transferable license to use this Report in connection with the particular project for which it has been prepared. This license does not apply to any draft version of any document. The Client may not use the Report in connection with any other work or project without prior written approval by Madrone. If the Client is in breach of any obligation to make payment to Madrone, Madrone may revoke the license referred to above and the Client will cause to be returned to Madrone the Report and any associated documents and all copies thereof and the Client will remove from its computer systems any electronic copies of any of the documents.

Unless Madrone provides written consent, no party other than the Client may rely on the observations, data, interpretations, findings, or recommendations of this report, except that regulatory authorities may rely on it with respect to the project for which it was prepared. Madrone will consider any reasonable request by the Client to provide consent for other parties to rely on this report.

If a User, including but not limited to the Client, provides the Report to another party, the User will provide the other party with the entire Report including these limitations and conditions of use, and the User agrees to indemnify Madrone against claims by such other party arising from the failure of the other party to comply with the limitations and conditions of use.

All documents generated as part of the services for the Client with respect to the project for which the Report has been prepared, including drawings, reports, instructions, and correspondence, whether hardcopy or electronic, but excluding draft documents, are inherent components of the Report. To properly understand the information, observations, findings, suggestions, recommendations, and opinions contained in the Report, reference must be made to the whole of the Report. Madrone is not responsible for use by any party of portions of the Report without reference to the whole Report and its various components.



The User agrees that no portion of the Report, whether electronic or hard copy, no matter who owns or uses them, may be altered by any party except Madrone. If Madrone has submitted both electronic and hard copy versions of the Report, only the signed and sealed hard copy versions shall be considered final and legally binding upon Madrone.

Madrone will maintain professional liability insurance that is usual and customary for similar firms. The total amount of all claims arising from the Report, by all Users, against Madrone or any present or former partner; executive officer, director, stockholder, employee, or agent thereof, including but not limited to claims for negligence, and negligent misrepresentation, will be strictly limited to the amount of any professional liability insurance that Madrone may have available for such claims.

Madrone will not be liable for any consequential loss, injury or damages suffered by any User, including but not limited to loss of use, earnings, and business interruption.

No User may bring a claim against Madrone in contract or tort more than two (2) years after Madrone's involvement in the project.

Madrone has conducted this investigation and prepared the Report in a manner consistent with the level of care normally exercised by professionals currently practicing in the area under similar conditions and budgetary constraints. No other warranties, either expressed or implied, are made.

Madrone has assumed that information provided to Madrone by the Client or other individuals or organizations is factual, complete, and accurate. Madrone is not responsible for any inaccuracies, deficiencies, or omissions resulting from receipt of incorrect or fraudulent information.

The Report pertains only to development plans and project design disclosed to Madrone by the Client at the time the Report was prepared. The applicability and reliability of any of the information, observations, findings, suggestions, recommendations, and opinions contained in the Report are only valid to the extent that there have been no material alterations to or variations from any of the said descriptions provided by the Client to Madrone unless the Client has specifically requested Madrone to review and revise the Report in light of such alterations or variations. If the project does not commence within two (2) years of the Report date, no party may rely on the Report unless Madrone has been engaged to review it.

Madrone has made reasonable efforts to collect information and site observations that are representative of conditions in the relevant portions of the site; however, conditions may vary from place to place, and conditions may change with the passage of time. Site information contained in the report pertains specifically to the points and dates of observation.

The findings of this investigation and report are based in part on Madrone's visual observations of site conditions. Madrone's opinions do not extend to portions of the site that were unavailable for direct observations due to circumstances reasonably beyond Madrone's control. Madrone is not responsible for detecting conditions in areas beyond the site, if the conditions could not reasonably be known by Madrone given restrictions to accessing such areas and the budgetary and time constraints under which the investigation was performed.

Classification and identification of the soils, rocks, and geologic units of these materials or units involves judgment, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, Madrone does not warrant or guarantee the exactness of the descriptions.

If unexpected conditions are encountered on the site, the Client must notify Madrone in order that Madrone may determine if modifications to the findings are necessary.

The exploration and review provided in the Report are for geotechnical purposes only unless otherwise specifically stated and identified in the Report. Environmental aspects of soil and groundwater have not been included, investigated, or addressed in any other way.

Madrone makes no representations whatsoever, as to the legal significance of its findings, or as to other legal matters touched on in the Report, including, but not limited to, ownership of any property, or the application of any law to the facts set forth in the Report.