STAFF REPORT TO COMMITTEE

DATE OF REPORT	December 9, 2024
MEETING TYPE & DATE	Special Electoral Area Services Committee Meeting of January 15, 2025
FROM:	Development Services Division Land Use Services Department
SUBJECT:	Application No. RZ23I02 (8545 Hemlock Street/PIDs: 003-500-535 & 005-500-770)
FILE:	RZ23I02

PURPOSE/INTRODUCTION

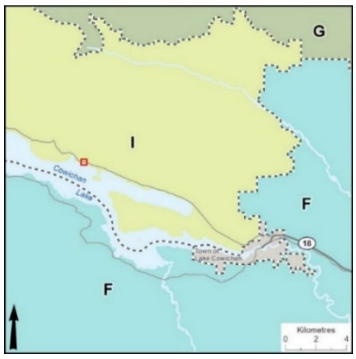
The purpose of this report is to present an application to amend Electoral Area I – Youbou/Meade Creek Zoning Bylaw No. 2465 and the Official Community Plan for the Electoral Areas Bylaw No. 4270 to permit a multi-unit residential development at 8545 Hemlock Street (PIDs: 003-500-535 & 005-500-770).

RECOMMENDED RESOLUTION

That it be recommended to the Board that Application No. RZ23I02 (8545 Hemlock Street, PIDs: 003-500-535 & 005-500-770), be referred to the following external agencies:

1. Electoral Area I – Youbou/Meade Creek Community Parks Commission;
2. BC Transit;
3. Cowichan Valley School District (SD. No. 79);
4. Youbou Fire Rescue;
5. Island Health;
6. Ministry of Municipal Affairs & Housing;
7. Ministry of Transportation & Transit;
8. Ministry of Environment and Parks
9. Royal Canadian Mounted Police (RCMP);
10. Cowichan Tribes;
11. Ditidaht First Nation; and
12. Ts'uubaa-asatx Nation.

LOCATION MAP



BACKGROUND

The subject properties are located at 8545 Hemlock Road, approximately 3.11 ha in area, and are the location of the prior Yount Elementary School. The school has been closed for many years and the property was sold by School District No. 79. The properties are located across from the Youbou Community Hall and Bowling Alley. The current land use designation is Institutional, and the zoning is P-2 – Institutional 2 Zone. The properties fall within the Youbou Water System service area, Youbou Fire Service area, and the Youbou Growth Containment Boundary; however, the properties are not within a sewer system service area. Residential parcels zoned R-3 – Urban Residential 3 Zone surround the property.

The proposal was first submitted to the CVRD in the summer of 2023, with internal referrals sent in August 2023. The applicant revised the proposal to address a number staff concerns following the internal referral process and provided updated documentation in October 2024.

Revisions of note include reducing the proposed density from a 104 multi-unit residential development and 1,400 m^2 of commercial floor space, to a 45 multi-unit residential development with no commercial component. The reduction in density and land uses was driven largely by an Onsite Sewage System Capacity Report prepared by Canadian Sewage Solutions Incorporated. This report confirmed that the development as originally proposed would exceed the maximum capacity of the site for septic servicing. With the reduced density, the applicant has proposed a path forward for septic system servicing for the development under the jurisdiction of BC Ministry of Health (i.e. Island Health).

For more information, please see:

- Attachment A – Background Table
- Attachment B – Context Maps
- Attachment C – Site Plan

OFFICIAL COMMUNITY PLAN / POLICY CONSIDERATIONS

Electoral Area I Zoning Bylaw No. 2465:
The subject property is currently zoned P-2 – Institutional 2, which permits institutional uses and accessory structures, as well as a single-detached dwelling accessory to an institutional use.

The proposed development requires rezoning to permit principal residential use.

Official Community Plan for the Electoral Areas No. 4270:

The property is regionally and locally designated Institutional; however, this application proposes to re-designate to a higher density multi-unit residential designation. The following policies may be relevant to the proposed development:

Goal 1. Manage Growth Holistically
The objective of this goal is to direct growth that will benefit/enhance the whole community to serviced areas in settlement nodes within growth containment boundaries that are not subject to hazards or environmental health risks.

3.2.1.2 Policies

3. *Supports new development in growth containment boundaries consistent with servicing capacity*
5. *Supports compact development near transit and within serviced areas that have capacity for growth*

Goal 2. Improve and Expand the Range of Housing and Type of Construction

The objective of this goal is to increase the affordability and range of housing types provided in the CVRD.

3.2.1.4 Policies

2. *Supports housing that is consistent with the surrounding context including character of existing neighborhoods and rural areas*
3. *Supports provision of housing to people with special needs and seniors, including housing that gives people the ability to age in place*

4.10 Residential Designation

The objective of this designation is to provide a wide range of housing and lifestyle options for various stages of life and different community lifestyles while ensuring residential developments are compatible with physical site conditions.

4.10.2 Policies

1. *Encourages innovative housing and subdivision designs such as clustered residential developments, particularly for sloped upland areas; the Regional District will provide flexibility in regulatory bylaws.*
2. *Encourages affordable housing in all communities.*
3. *Encourages secondary suites or second dwelling units in service areas.*
4. *Encourages development of multi-family housing in a manner that is clustered and is not disruptive to the environment and existing adjacent human-made structures.*
5. *Supports environmental design criteria for building materials, lighting, landscaping and access and egress, designed to maintain or improve safety for pedestrians, cyclists and motorists.*

Schedule B – Electoral Area I – Youbou/Meade Creek Local Area Plan:

2.1.1 Growth Containment Boundary Objectives

The objectives of the Growth Containment Boundary are intended to keep residential areas as compact as possible and to maintain the surrounding rural areas and working resource land base

2.1.2 Growth Containment Boundary Policies

The regional board:

1. *Supports the integrity of the growth containment boundary, which has the following intent:*
   a. *preserve the resource land base of the plan area and allow no net loss of these resource lands, which will maximize the efficiency of land use;*
   b. *encourage appropriate community amenities and services with commercial areas within a walking distance of most residential areas; and*
   c. *delineate areas where mixed residential, commercial and institutional land uses will be*

focused, to create complete, healthy and livable communities.
2. *Supports investment in a community sewer system to support densification in the growth containment boundary.*
3. *Supports compact development and energy efficiency design.*

2.9.1 Residential Objective
General objectives and policies are for sewage disposal and general development.

2.9.2 Residential Policies
The regional board:
1. *Supports new designation of lands for residential purposes with the following considerations:*
   a. *located within the growth containment boundary;*
   b. *buffering between the residence and the Cowichan Lake shoreline;*
   c. *location adjacent to existing residential subdivisions;*
   d. *location in close proximity to community amenities and services;*
   e. *connection to existing community water systems and community sewer systems; and*
   f. *expansion of the community sewer system in the growth containment boundary to accommodate increased density within the Urban Residential designation.*
3. *Considers new subdivision with the following characteristics:*
   a. *cluster new lots on land with the best capacity for residential development and least value for agriculture or forestry, or the least need for environmental protection; and*
   b. *provide adequate buffer strips on residential lands.*

2.9.12 Urban Residential Policies
To be considered in the modernization

2.11.2 Roads and Servicing Policies
The regional board:
1. *Considers the following hierarchy of roads:*
   a. *major network roads: North Shore Road, Meade Creek Road, Youbou Road; and*
   b. *local roads: all other roads.*
2. *Discourages creation of residential lots fronting onto a major network road.*

COMMISSION / AGENCY / DEPARTMENTAL CONSIDERATIONS

The application was referred to internal CVRD divisions. Internal referral comments are summarized as follows:

- The proposed development is generally supported by the recent Housing Needs Report (2024) and Complete Communities analysis.
- Local Area Plan engagement recommended the following community amenities be provided through rezoning processes: community arts initiatives; community collaboration; safer transit bus stops/shelters; CVRD boat launches; more public access to the Youbou lakefront; improvements to Youbou Hall.
- This parcel is in the Youbou Water system and is capable of connection, as the school was previously connected. Some upgrades may be required to the water system to accommodate the proposed development.

- The proposed development is located within 200 m of a transit bus stop, which is consistent with BC Transit standards for pedestrians to access transit service.

In accordance with the CVRD Development Application Referrals Policy, this application has not yet been referred to external agencies or First Nations.

Staff note that the Electoral Area I – Youbou/Meade Creek Advisory Planning Commission (APC) does not currently have sufficient number of members for quorum. In lieu of referral to the APC, staff are recommending referral to the Parks Commission; however, an alternative would be referral to another APC such as the Electoral Area E or F APC. Another option would be for members of the Parks Advisory Commission (or another APC) to be cross-appointed to the Area I APC.

PLANNING ANALYSIS

The following table outlines the revised proposed development on the subject properties. A total of 45 dwelling units are proposed, as follows:

	Proposed Lot A – Approx. 12, 500 m^2	Proposed Lot B – Approx. 7, 500m^2	Proposed Lot C – Approx. 1,286m^2
Proposed Density	19 three-storey townhouses with garage	1 three-storey multi-unit residential building with 26 units: • 22 2-bedroom units; and • 4 1-bedroom units	CVRD Park • Trail between Youbou Rd and Hemlock Rd • Playground
Parking	2 spaces per unit (38 spaces total)	1.5 spaces per unit (39 spaces total)	
Proposed Max. Height	10 m	12 m	
Proposed Gross Floor Area (GFA)	238.5m^2	2,550m^2	
Proposed Parcel Coverage	12.1%	14.3%	
Other	Outdoor residential amenity	Two-storey resident amenity building • Pool/lounge • Indoor gym/spa	Proposed park area is 6% of total area of subject properties (proposed lot A+B+C)

Proposed Subdivision:

The overall development would include consolidation of the two lots and then a further subdivision to create three new fee simple lots (one park lot, two subject properties for development of multi-unit residential). It is the intention of the property owner to create building strata for the apartment and townhomes.

Sewage:

The applicants propose an onsite-sewage system and have provided a professional report, which can be reviewed in Attachment D. The septic systems would not be taken over by the CVRD. Comments from Island Health may inform best practices of a septic system for a development of this size.

Community Water:

The applicant intends to connect to the Youbou Community Water System and have further stated "It is understood that cash-in-lieu in an amount determined by a Qualified Engineer will be provided for any service upgrades necessary to connect the proposed development to the existing system."

Stormwater Management:

The applicant has noted that an area in the southwest of the site, near the proposed parkland, has been reserved for a stormwater management system at the direction of Canadian Sewage Solutions engineers. It has been noted that the soils within the subject property are reasonably permeable with good drainage. The applicant proposes to design a Stormwater Management Plan (SWMP) after approval of the OCP Amendment and rezoning application. The staff recommendation is that a SWMP be designed *prior* to adoption of any amendment bylaws.

Park Dedication:

The applicant has stated that "the layout of the proposed parkland dedication has been revised so as to include access to a network of walking trails open to the public, as well as a playground to replace the well-used and highly valued amenities currently on the Subject Properties."

The CVRD Parks Division is currently reviewing the proposed park location. While formal comments have not been received, internal discussion suggests the preferred location for a park would be across from the community hall rather than in the southwestern corner of the property, as shown in Attachment C.

Steep Slopes:

The subject property itself is relatively flat consist. Based on information provided in the Canadian Sewage Solutions Incorporated report, it appears that the playing field area was leveled more than 20 years ago by importing permeable fill to build up an existing slope.

There is a steep slope to the north of the subject properties; however, the subject property is not identified in the Youbou Geohazard area. A geotechnical assessment has not been submitted at this time; however, the applicant has noted they are amenable to providing one if required. Should this application proceed, staff would recommend a site-specific geotechnical assessment be completed prior to adoption of any bylaw amendments particularly considering the proposed use is multi-unit residential.

Roads:

The applicant has stated that the proposed strata roads will be 8 m wide and are wide enough to allow for waste collection and emergency vehicles. It is unclear what the impact on local traffic would be. Should this application proceed, a Traffic Impact Assessment prepared by a Qualified Professional may be required prior to adoption of any bylaw amendments.

Housing Needs Report for Electoral Area I:

The CVRD Housing Needs Report notes that our communities require increased housing affordability, including housing options covering a wide spectrum of housing needs. Infrastructure and services were also highlighted as a future need, including better transportation, healthcare and support for seniors and unhoused residents, as well as improved active transportation networks.

Specifically, within Electoral Area I, calculations show that approximately 205 new housing units will be required over the next 20 years to support growth projections.

- See Attachment C – Proposed Site Plan
- See Attachment D – Onsite Sewage System Capacity Report

OPTIONS

Option 1: (recommended)

That it be recommended to the Board that Application No. RZ23I02 (8545 Hemlock Street/ PIDs: 003-500-535 & 005-500-770), be referred to the following external agencies:

1. Electoral Area I – Youbou/Meade Creek Community Parks Commission;
2. BC Transit;
3. Cowichan Valley School District (SD No. 79);
4. Youbou Fire Rescue;
5. Island Health;
6. Ministry of Municipal Affairs & Housing;
7. Ministry of Transportation & Infrastructure;
8. Ministry of Environment and Parks
9. Royal Canadian Mounted Police (RCMP);
10. Cowichan Tribes;
11. Ditidaht First Nation; and
12. Ts'uubaa-asatx Nation.

Option 2: (refer application back to staff for more information, prior to further consideration)

That it be recommended to the Board that Application No. RZ23I02 (8545 Hemlock Street/ PIDs: 003-500-535 & 005-500-770), be referred back to staff for further information, including: *[requested information to be identified by the Board]*, prior to further consideration.

Option 3: (advance the application without seeking comments from referral agencies)

That it be recommended to the Board:

1. That a Zoning Amendment Bylaw for Application No. RZ23I02 (8545 Hemlock Street/ PIDs: 003-500-535 & 005-500-770), be prepared and forwarded to the Board for consideration of 1st and 2nd reading.
2. That a public hearing be scheduled for Application No. RZ23I02 (8545 Hemlock Street/ PIDs: 003-500-535 & 005-500-770).

Option 4: (deny the application)

That it be recommended to the Board that Application No RZ23I02 (8545 Hemlock Street/ PIDs: 003-500-535 & 005-500-770), be denied.

GENERAL MANAGER COMMENTS

Key factors influencing housing affordability include dwelling size and location, and proximity to transit/transportation and services. Smaller multi-unit dwellings are generally more affordable than larger single detached dwellings. Through a rezoning process, the Board may request that "perpetually affordable" housing be secured through a housing agreement. However, housing agreements do require ongoing monitoring and administration, which involves cost to the agency responsible for monitoring the agreement.

The applicant has not proposed community amenities consistent with the recommendations emerging from Local Area Plan engagement. However, as this application is at a preliminary stage, there is ample time for staff to discuss potential community amenity contributions with the applicant. Further detail may also emerge through referrals to agencies and the APC.

Prepared by:

Richenda Woods
Planner II

Reviewed by:

Lauren Wright, MCIP, RPP
A/Manager, Development Services Division
Planning Coordinator, Community Planning Division

Ann Kjerulf, MCP, RPP, MCIP
General Manager, Land Use Services

Reviewed for form and content and approved for submission to the Committee:

Resolution:

☒ Corporate Officer

Financial Considerations:

☒ Chief Financial Officer

ATTACHMENTS:
Attachment A – Background Table
Attachment B – Context Maps
Attachment C – Site Plan
Attachment D – Onsite Sewage System Capacity Report

BACKGROUND TABLE

File: RZ23I02 (8545 Hemlock Street/PID:003-500-535)

Applicant:	Isaac Keast (OTG Developments Ltd.)
Registered Property Owner:	1941182 Alberta Ltd., Inc.No. A0118640
Civic Address / PID:	8545 Hemlock Street PIDs: 003-500-535 & 005-500-770
Legal Description:	LOT A, BLOCK 136, COWICHAN LAKE DISTRICT, PLAN 21269 LOT 1, BLOCK 7, COWICHAN LAKE DISTRICT, PLAN 8301
CVRD Covenants on Title:	None
Size of Existing Parcel(s):	1.15 ha (2.84 acres) 0.96 ha (2.38 acres)
Existing Use of Parcel(s):	School (Institutional)
Natural Hazards:	None identified
Archaeological Site:	None identified
Environmentally Sensitive Areas:	None identified
Species at Risk:	None identified
Agricultural Land Reserve (ALR):	Not within nor adjacent
Land Use Designation:	Institutional
Containment Boundary:	Youbou Growth Containment Boundary
Development Permit Areas (DPA's):	DPA 1- Riparian Protection DPA 4 – Aquifer Protection DPA 5 – Wildfire Hazard
Zoning:	P-2 – Institutional 2 Zone
Fire Service:	Youbou Fire Service ARea
Existing Water Service:	Youbou Water System
Existing Sewerage Service:	Private Septic System
Existing Drainage Service:	Unknown
Proposed Designation	Village Core
Proposed Zoning	CD – Comprehensive Development
Proposed Water Service	Youbou Water System
Proposed Sewer Service	CVRD-owned septic system
Proposed Drainage Service	Unknown

Attachment B

CVRD

This map is compiled from various sources for internal use and is designed for reference purposes only.

The Regional District does not warrant the accuracy.

All persons making use of this compilation are advised that amendments have been consolidated for convenience purposes only and that boundaries are representational.

The original Bylaws should be consulted for all purposes of interpretation and application of the Bylaws.

Printed: August 8, 2023

Youbou Community Lane
Hemlock St
Maple Ridge Rd
Cedar Dr
Cedar Lane
Lake Blvd
Youbou Rd
Cypress Rd
Block 136
8550
8554
8559
8555
8551
8547
8543
8535
10585
10651
10642
10638
10648
10634
10630
10616
10610
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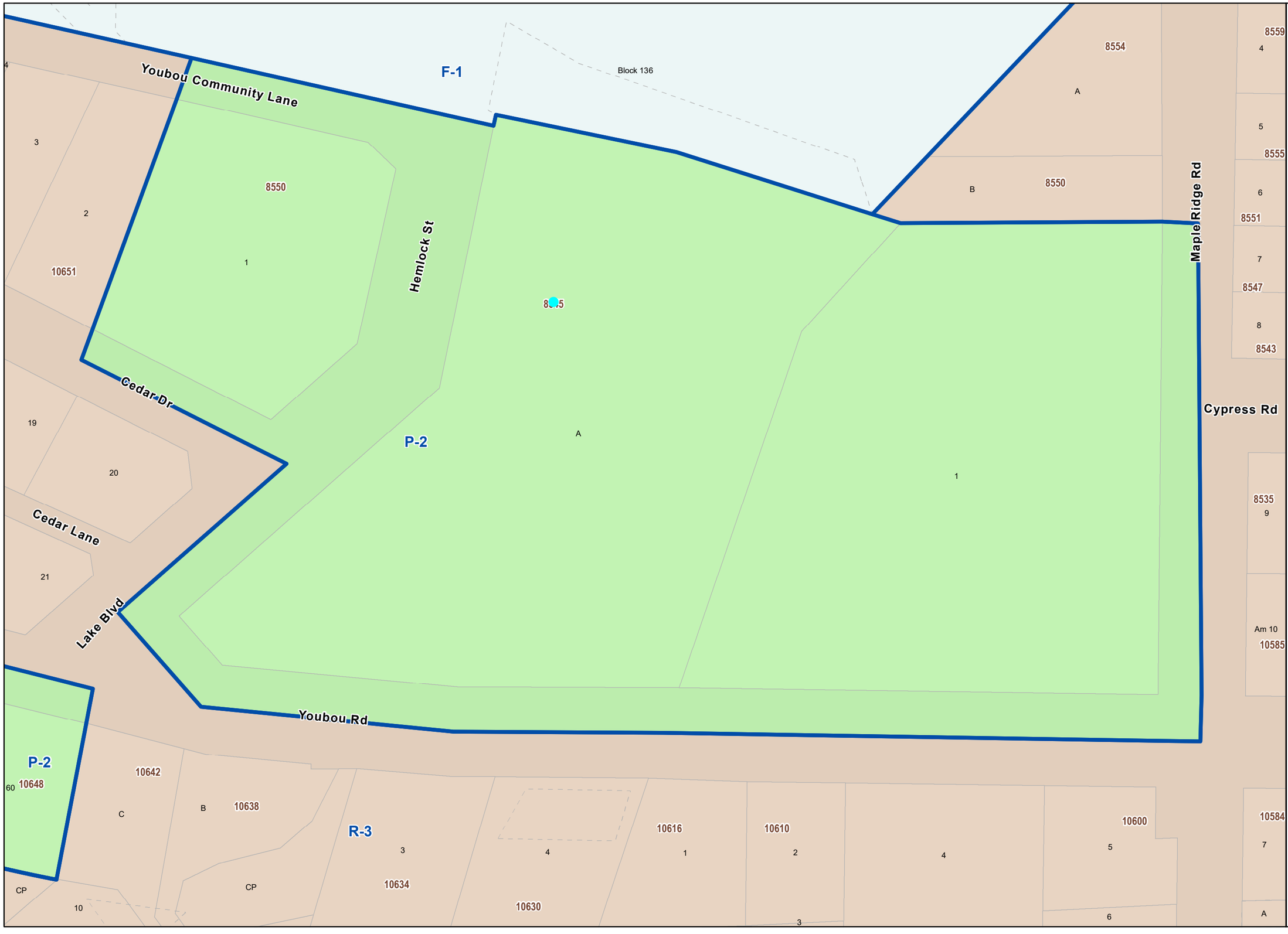
Scale: 1:804



CVRD

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N
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Scale: 1:804


Youbou Community Ln
Youbou Community Ln
Youbou Community Ln
Youbou Community Bowling Alley
Cowichan Lake Recreation
Maple Ridge St
Cedar Dr
Cedar Dr
Cedar Dr
Hemlock St
Hemlock St
School District No 79
Cypress Rd
Cedar Ln
Cedar Ln
Hemlock St
Maple Ridge St
Maple Ridge St
Hemlock St
Youbou Rd
Youbou Rd
Youbou Rd
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Youbou Rd
Google

22 - 2 bed units (approx 900ft²) = 19,800ft²
4 - 1 bed units (approx. 600ft²) = 2400ft²
Approx. total floor area needed = 22,200ft²

22,200ft²/9149ft² per floor = 3 storeys

LEGEND:

- EXISTING PROPERTY LINE
- PROPOSED PROPERTY LINE
- BUILDING ENVELOPE
- PARK LAND
- WALKING PATH
- ROAD
- LANDSCAPING

ZONING: PROPOSED CD ZONE

OTG DEVELOPMENTS LTD.
LAND USE CONSULTING & DEVELOPMENT

PROJECT LOCATION
8545 HEMLOCK ST
DRAFT SITE PLAN

PROJECT NUMBER
22-471

DRAWN BY:
BRITTANY FEAVER

DATE:
OCT 2 2024

SHEET:
1

SCALE:
1:1000

Canadian Sewage Solutions Inc.
EGBC Permit #: 1000879

Capacity of the Property at 8545 Hemlock Street, Youbou, BC for an Onsite Sewage System

Prepared by:

Kelly R. Karr, P.Eng.
Canadian Sewage Solutions Inc.
EGBC Permit to Practice #: 1000879

Stephen Coburn, P. Eng.
Canadian Sewage Solutions Inc.

Table of Contents

Table of Figures

Change/Issue Log

Version	Date	Who	Description
0.1	04 Dec 2023	SAC	Draft document
0.2	07 Feb 2024	SAC	Background info – jurisdiction, design flow
0.3	04 Apr 2024	SAC	Draft Scenarios #1 & #2
0.4	05 Apr 2024	SAC	Revise scenarios, update events, format
0.9	25 Jul 2024	SAC/KK	Revisions, formatting
1.0	26 Jul 2024	SAC/KK	Issue report

1. Background

Canadian Sewage Solutions Inc. (CSSi) was contracted by the Client to conduct a thorough site assessment at 8545 Hemlock Street in Youbou, BC. The main purpose of this study was to determine the capacity of the site to handle an onsite sewage system. CSSi analyzed test pits and conducted groundwater mounding testing to determine a maximum allowable application rate of sewage to the site. Based on this data, a maximum allowable design flow can be determined to guide development of the property.

The site consists two lots containing a decommissioned school with a level playing field. The playing field appears to have been levelled by importing fill material to build up an existing slope. There is a steep slope at the north end of the field that slopes towards the playing field to the south. South of the dispersal field is a treed area with a steep slope running towards Youbou Road. There was no observable ditch on the upslope (north) side of Youbou Road. There were healthy, mature arbutus trees located on both slopes which typically indicate that the soil has good drainage.

2. Site and Soil Analysis

2.1 Test Pits

On 30 Nov 2023, six (6) test pits were excavated in the field area north of the infiltration trench. Based on our observations of the test pits and the excavations for the piezometers, we observed the following general properties:

- In general, the soil appears to be **gravelly silt loam fill** that has been built-up in layers
- No groundwater was encountered during the site investigation – test pits were excavated to depths between 160 cm to 400 cm
- Groundwater mounding will be closer to the surface near the north end of the dispersal field (90 to 140 cm) compared to middle of the field (180 to 270 cm)
- Some clay fill was encountered in excavation of Piezometer A-2 and A-3 at approx. 180 cm below surface

Figure 1 - Test Pit M-2/U-2

2.2 Groundwater Mounding Test

2.2.1 Test Set Up

The test was set up along the southern edge of the playing field. The 100-m long trench was excavated parallel the top of the bank and the fence line, set back approx. 8 m from the fence. The top of the bank was between 0.5 m and 1.5 m from the fence.

Figure 2 - Trench and Downslope Piezometers During Test Setup

The water was supplied from the existing building. Two 1.25" PVC S40 pipes were connected to external hose bibs to bring water to the infiltration trench. Each water supply line was be equipped with a metric water meter and pressure gauge. Two 16-mm pressure-compensating subsurface driplines were applied to the trench in order to apply water evenly along the trench.

Figure 3 - Typical Flow Meter and Pressure Gauge

Piezometers were installed to measure the depth of the groundwater table over the course of the test. The piezometers consist of 1.5” to 2” PVC pipe. The bottom 20 cm of the pipes were slotted to allow water to enter the pipe without plugging it with dirt. Piezometers were installed to a depth of approx. 2 to 3 m below ground surface with the exception of the two (2) that were installed to a depth of approx. 5 m.

Figure 4 - Typical Piezometer Installation

Piezometers were installed in three (3) rows downslope of the dispersal field and one (1) row upslope of the dispersal field. An additional three (3) piezometers were installed in some of the test pits north and upslope of the trench.

A summary of the piezometer locations and spacing:

Table 1 - Piezometer Installation Details

Line	Location	Spacing (m)	Number
A	3 m upgradient of trench	33	4
C	3 m downgradient of trench	20	6
D	7.5 m downgradient of trench	20	6
R	Upslope of Youbou Road in trees	33	4
U	In test pits at north & east edges of playing field	varies	3

2.2.2 Monitoring

The following were recorded/observed by the Client or Canadian Sewage Solutions employee over the course of testing:

1. Flow meter readings
2. Pressure gauge readings
3. Depth of water in each piezometer
4. Depth of water ponding in the test trench
5. Rainfall in the two rain gauges
6. Observations looking for water break out along the bank upslope of Youbou Road

In general, readings and observations were taken daily. CSSi reviewed the data and, when necessary, provided instructions to adjust flow rates. Periodically, fluorescein dye was added to the trench in order to assist in identifying if water was breaking out at the surface.

2.2.3 Event Log

Summary of notable events during the setup and analysis of the groundwater mounding test:

Table 2 - Groundwater Mounding Test Event Log

Date(s)	**Description**
29 Nov 2023 – 02 Dec 2023	Test set up, trench, install piezometers + start application of water
16 Dec 2023	Add additional drip lines to increase flow
22 Dec 2023	Shortened test trench from 100 m to 80 m
09 Jan 2024	Pause testing due to freezing risk, peak flow approx. 52 m^3/day
27 Jan 2024	Restart testing, shorten field to 50 m (eastern half)
18 Feb 2024	Switch testing to western 50 m of trench
07 Mar 2024	Reduce flow from 48.5 m^3/day to 31.4 m^3/day
27 Mar 2024	Shut off flow
03 Apr 2024	Restart flow to west half of trench – 48 m^3/day
10 Apr 2024	Reduce flow to west half of trench – 16 m^3/day
16 Apr 2024	End of test

2.3 Results

2.3.1 Groundwater Mounding Test Results

Over the course of testing, only four of the piezometers showed changes in groundwater readings in response to test flows and rainfall. The results of the monitoring can be seen in the following graph(s):

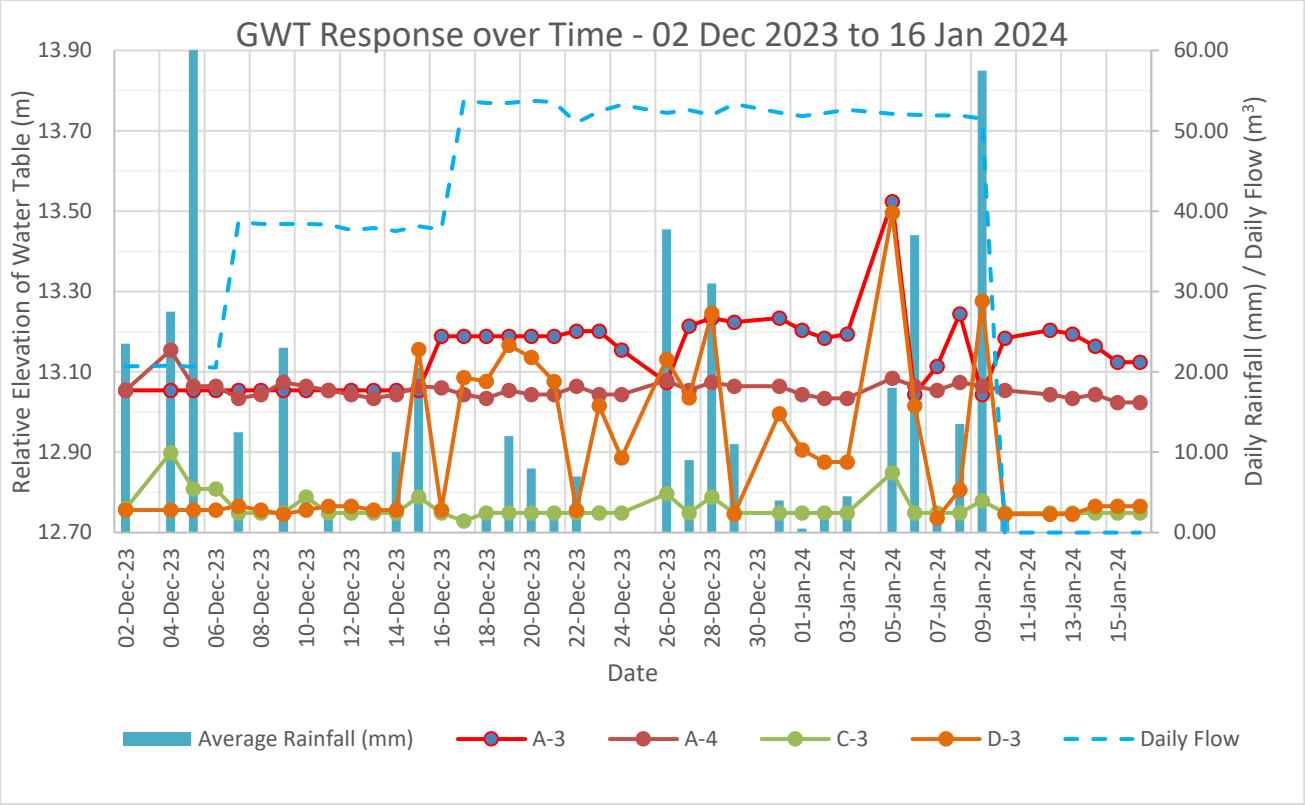


Figure 5 - Groundwater Response over Time – 02 Dec 2023 to 15 Jan 2024.

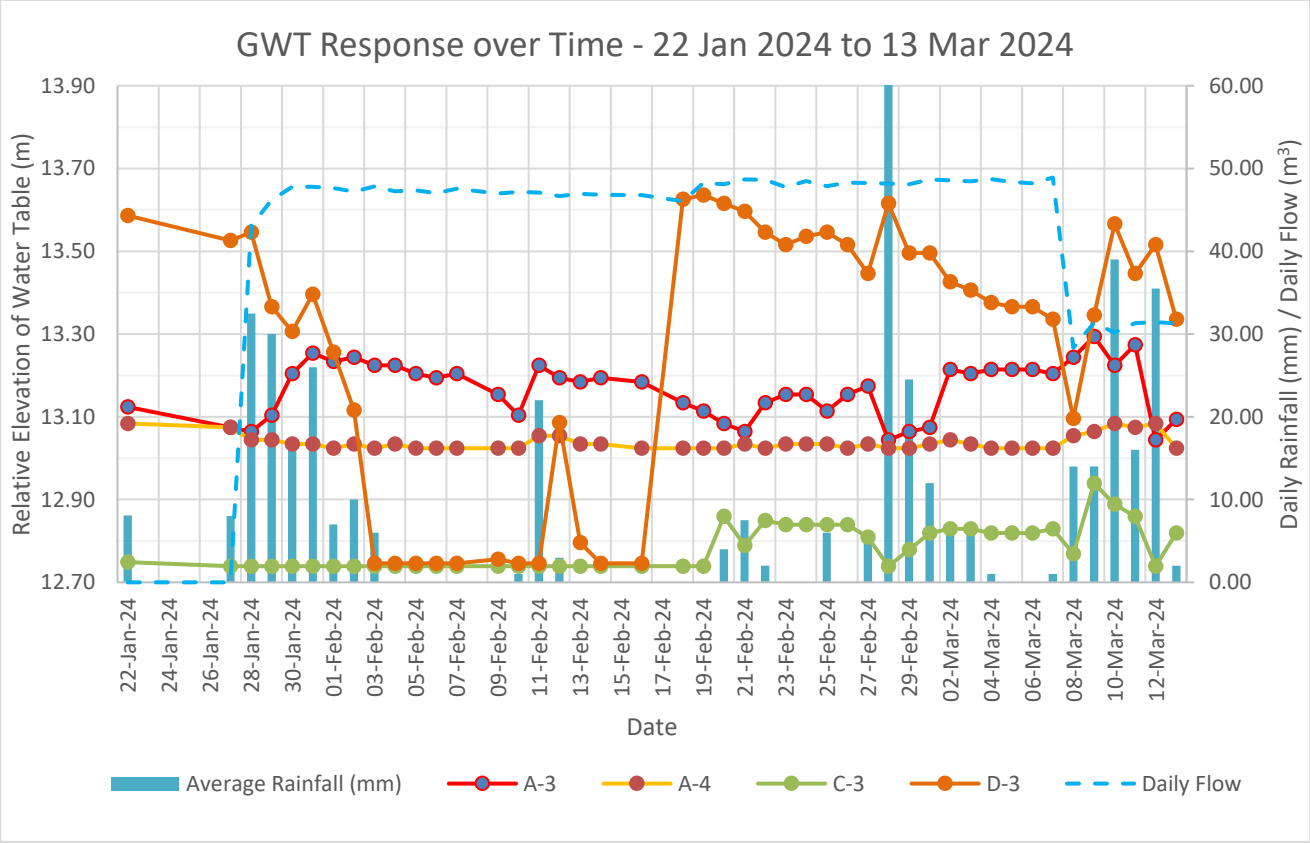


Figure 6 - Groundwater Response over Time – 22 Jan 2024 to 13 Mar 2024

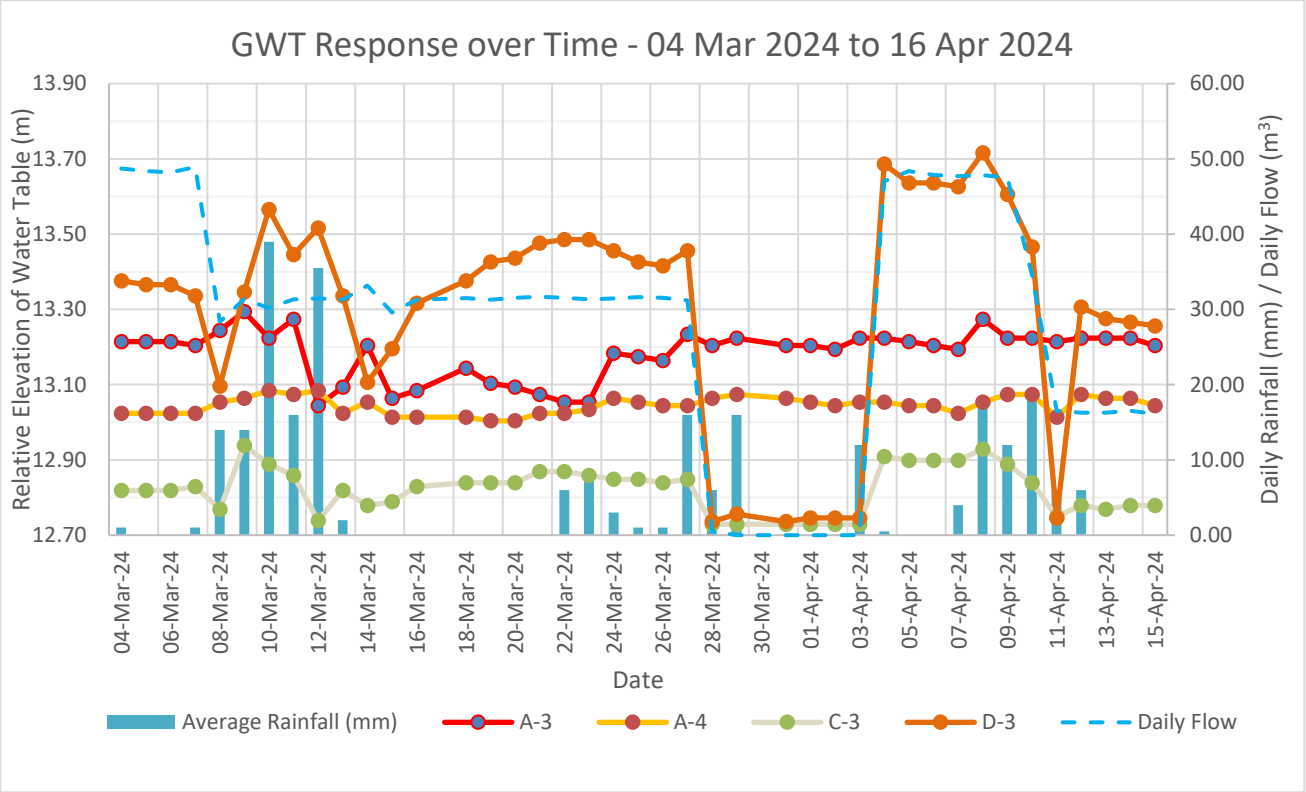


Figure 7 - Groundwater Response over Time – 04 Mar 2024 to 16 Apr 2024

Piezometers A-3, C-3, and D-3 showed the largest changes in response to test flows and rainfall. These piezometers were installed near the midpoint of the test trench indicating that there may be an underground channel or seam of higher permeability soil which may be concentrating the groundwater in the test area.

No change in the groundwater table was detected in the piezometers upslope from Youbou Road, and no observable surface breakout of the test water was detected over the course of testing.

Table 3 - Peak Groundwater Table Elevation

Piezo	Elevation (m)		Minimum Vertical Separation (m)
	Ground Surface	Peak Groundwater Table	
A-3	15.42	13.52	1.90
A-4	15.67	13.15	2.52
C-3	15.44	12.94	2.50
D-3	15.31	13.72	1.59

The maximum flow rate over the course of testing was 53.74 m^3/day; the maximum linear loading rate and hydraulic loading rate over the course of testing was 978 L/m/day and 1087 L/m^2/day, respectively. Over the course of testing, the highest the water table reached was a relative elevation of 13.72 m in D-3. Based on ground surface elevation at D-3 of 15.31 m, we would estimate a reasonable native soil vertical separation of 1.59 m for this test site. Given that effluent would be applied over a larger area for a sewage system dispersal

field, we would expect that the groundwater table would be deeper in the ground during if wastewater was discharged at a similar rate to the test flow rates

.

The soil onsite appears to be imported fill which is a not allowed soil type under the BC Sewerage System Standard Practice Manual. However, the fill has been in place for more than 20 years, and it is reasonably permeable. Therefore, after extensive testing, we have determined that the soil can be used for onsite sewage disposal. In addition, replacing some of the soil with engineered sand, the hydraulic loading rate could be increased further to maximize the allowable hydraulic loading rate which subsequently minimizes the area that needs to be reserved for the onsite sewage system

2.3.2 Rainfall Data

24-hour rainfall was measured and recorded over the duration of testing to assess the effect of precipitation on the depth of the groundwater table.

Rainfall data was compared to historical weather station data from weather stations closest to the site (located in Lake Cowichan).

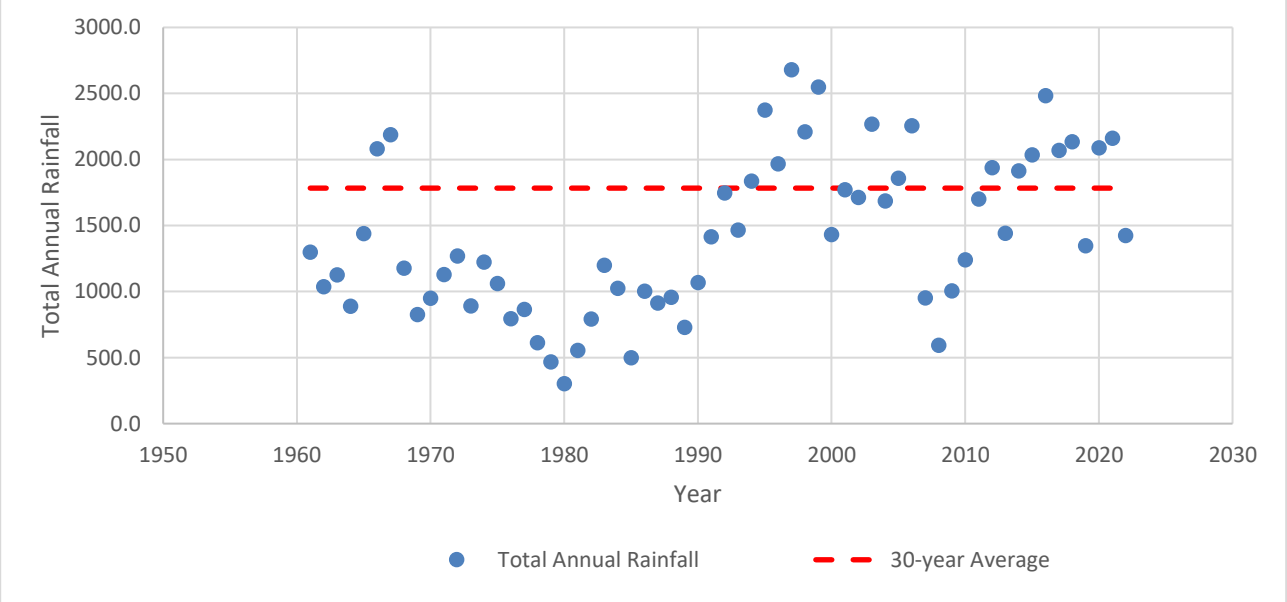


Figure 8 - Total Annual Rainfall - Lake Cowichan

In general, there was a notable effect on the groundwater table during and following rainfall events. Significant rainfall events caused the water table to rise in the piezometers within 24 hours. After a rainfall event, the groundwater levels also subsided quickly indicating a high hydraulic conductivity.

Table 4 - Historical Rainfall Data (1967 - 2023)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Max	668	558	488	272	160	116	75	219	242	514	621	581	**2680**
Average	231	141	153	96	51	36	23	29	56	158	233	207	**1412**

BC SPM III-4.1.4 recommends that loading rates be reduced by 15% if the average annual rainfall exceeds 1800 mm/year. Given that the average annual rainfall is 1412 mm/day as shown in Table 4, the loading rate does not need to be reduced.

2.4 Design Values

Based on the testing, the following values would be used for consideration in the design of a dispersal field:

1. Type 1 hydraulic loading rate: 56 L/m^2/day
2. Type 2 hydraulic loading rate: 81 L/m^2/day
3. Type 3 hydraulic loading rate: 134 L/m^2/day
4. Max linear loading rate: 960 L/m/day
5. Native soil vertical separation: 160 cm

The maximum hydraulic loading rates were derived from the overall K(fs) using methods outlined in the *BC Sewerage System Standard Practice Manual Version 2 Appendix G Design HLR*.

3. Design Considerations

3.1 Jurisdiction over Onsite Sewage Systems

Depending on the sewage system design flow, the sewage system design may fall under one of two regulations:

Table 5 - Wastewater Discharge Regulations

Ministry	Regulation	Design Flow Limit (L/day)
BC Ministry of Health	Sewerage System Regulation	< 22,700
BC Ministry of Environment	Municipal Wastewater Regulation	> 22,700

In general, it would be preferable to have the sewage system(s) under the Sewerage System Regulation rather than the Municipal Wastewater Regulation:

Advantages

- Typically a much quicker approval process (days versus years)
- Smaller footprint – less reserve area, no backup field requirement, reduced setback requirements

Disadvantages

- Less efficiencies – potentially higher cost for two separate systems vs. one combined system
- Smaller design flow potential

In our discussions with a Land Use/Drinking Water Consultant at Island Health in February 2024, since the lots are adjacent, it is possible but unlikely that the Ministry of Environment would consider both the lots to be under their jurisdiction if the property was kept as two separate lots each with a sewage system handling less than 22,700 L/day of wastewater.

Since the property is already divided into two lots, this is potentially a benefit. If it was one lot, the entire development would be limited to a design flow of 22,700 L/day. With there being two lots, each with a maximum potential of 22,700 L/day, you have the opportunity to develop up to 45,400 L/day without being subject to the BC Ministry of Environment approval process.

In our opinion, the best strategy for the sewage system design would be to have each lot have its own sewage system with a maximum daily discharge of less than 22,700 L/day in order to avoid being under the jurisdiction of the BC Ministry of Environment.

3.2 Lot Line Adjustment/Subdivision

For one of the scenarios, a lot line adjustment is proposed. This is because the current property line between the two lots splits the test trench in such a way that 20 m of the test trench is on Lot 1 while 80 m of the test trench is on Lot 2. The property line could be adjusted in such a way such that the test trench is split equally and both lots can dispose up to 22,700 L/day under the Sewerage System Regulation.

In general, a lot line adjustment would follow a subdivision process. The process would be initiated by the Authority Having Jurisdiction (AHJ) which in this case may be the Cowichan Valley Regional District or the BC Ministry of Transportation and Infrastructure. Once the application is received, the AHJ will request comment from various ministries.

In addition, Island Health also has a subdivision process for determining suitable primary and reserve dispersal field areas. This information has been captured in our analysis, so the Island Health Subdivision application could be submitted quickly. We would expect the lot line adjustment to be resolved within 2 to 3 months.

A survey would be required to layout out the new lot line.

3.3 Bylaws

The development of the property may be affected by the following Cowichan Valley Regional District Bylaws:

- CVRD Electoral Area I – Youbou/Mease Creek Zoning Bylaw No. 2464

3.4 Design Flows

3.4.1 Residential Sewage System Flows

Residential sewage system flows are based on the methods prescribed in the BC Ministry of Health Sewerage System Version 3. This method is based on number of bedrooms in a given living unit. Suites are considered separate living units – for example, a 2-bedroom house w/ 2-bedroom suite would be considered two 2-bedroom units, not one 4-bedroom unit.

For typical residential units, the following will apply:

Table 6 - Residential Design Flows

Number of Bedrooms per Living Unit	Average Flow per Living Unit (L/day)	Daily Design Flow (L/day)
1	350	700
2	500	1000
3	650	1300
4	800	1600

The average daily flows are based on the values found in BC SPM Table II-8. The values were reduced to their average values by removing the peaking factor of 2. A safety factor was applied to the average daily flows in the analysis.

3.4.2 Commercial Sewage System Design Flows

Any sewage/liquid waste other than from residential source would have to be evaluated on a case-by-case basis. In addition to the amount of wastewater discharge to the ground, additional treatment may be required to breakdown higher-strength waste and to treat higher contaminant loads.

For example, a full-service restaurant with 50 seats might have a design flow of approximately 5000 L/day to 6000 L/day but would need to consider source controls and additional treatment to properly handle the high loading of cleaning chemicals and oils and greases. Brewery or distillery wastewater could be up to 30 times stronger than residential sewage.

Non-residential wastewater may need additional treatment facilities compared to residential wastewater in order to be safely discharged to the ground.

3.5 Treatment Facilities

Several tanks will likely be required to treat the sewage prior to being discharged to the dispersal field. It may possible to locate these tanks under roadways/pathways to save space. A utility building may also be required to house other components of the sewage system including flow meters, linear air pumps, and control panels.

Table 7 - Potential Treatment Technologies

Manufacturer	Technology	Effluent Output	Dispersal Field Type
Orenco	Packed bed filter	Type 2	Standard
Canadian Wastewater Systems	Moving bed bioreactor	Type 2	Standard
Glendon Biofilter	Upflow sand filter	Type 2/3	Combined
BioNest	Aerated treatment w/ attached growth	Type 2	Standard

3.6 Stormwater Management System

This analysis does not take into account the design and size of a stormwater management system. In general, stormwater management systems require onsite infiltration facilities, such as rock pits, to return runoff from roofs and hard surfaces to the groundwater table. These facilities would need to be setback from the sewage system to avoid cross-contamination. Any upslope stormwater infiltration facilities could also affect the sewage system by raising the water table.

To avoid conflicts between the stormwater management system and the onsite sewage systems, Canadian Sewage Solutions Inc. should either prepare the stormwater management plan or work collaboratively with the consultant that is designing the stormwater management system.

3.7 South Slope Along Youbou Road

There is a large slope between the test area and Youbou Road to the south. Given that this slope is considered a breakout point, the test was setback 7.5 m from the top of the bank. The test trench would represent the closest that the sewage system could reasonably be installed to reduce the risk of effluent breaking out of the bank. As a result of this, the area between Youbou Road and the test trench would need to preserved as is to avoid causing a health hazard.

It might make sense to designate the area for small, low impact walking trails.

4. Development Scenarios

4.1 Scenario #1: No Lot Line Adjustment, 2 Separate Sewage Systems

This scenario considers developing the two existing lots as they are each with separate sewage systems to the maximum daily design flow that is suitable for each lot. Both lots would be under the Ministry of Health maximum discharge of 22,700 L/day.

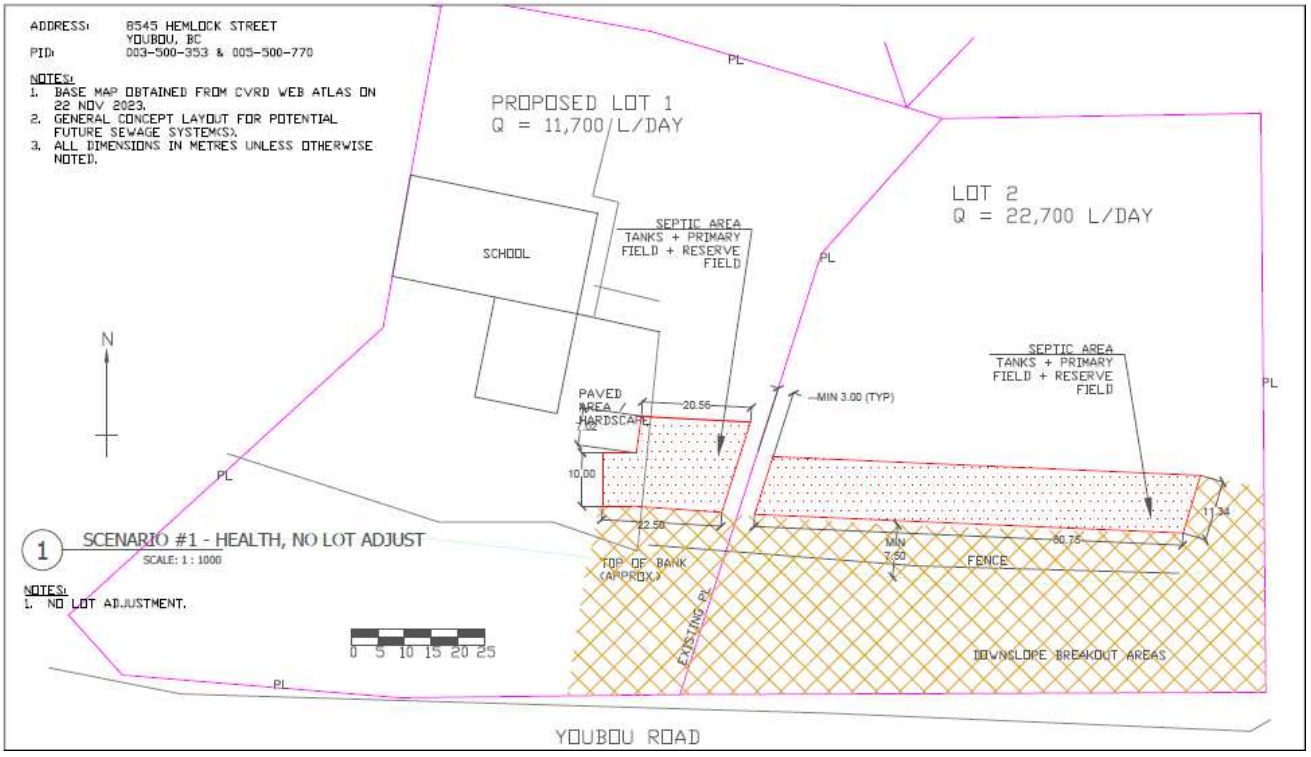


Figure 9 - Proposed Sewage Areas - Health, No Adjustments – 33,400 L/day

- Lot 1 can be developed to a maximum design flow of 11,700 L/day.
- Lot 2 can be developed to a maximum design flow of 22,700 L/day.

One potential layout might be as follows:

Lot 1 – 11,700 L/day

- 8 – 2 bedroom units
- Commercial floor space usage to be taken as basic retail – no food, salons, medical buildings

Lot 2 – 22,700 L/day

- 23 – 2-bedroom apartments

Based on the BC Sewerage System Regulation, the following areas will be required by the sewage system or will be unavailable for development:

Table 8 - Scenario #1 - Reserved Areas

Purpose	Description	Area (m^2)
Total Septic Area – Lot 1	Lot 1 – Field 17 m x 17 m, Tanks 10 m x 5 m	339
Total Septic Area – Lot 2	Lot 2 – Field 70 m x 11 m, Tanks 10 m x 10 m	870
Downslope Areas	Setback 7.5 m from top of south and east banks, slopes unusable	4071
Total Reserved Area		**5280**

The hope is with the above configuration, development of the lots could be separated and the development would have less hurdles when compared to a comparable design flow under the Municipal Wastewater Regulation.

4.2 Scenario #2: Adjust Lot Line between Properties, 2 Separate Sewage Systems

This scenario considers reductions in the original proposal and an adjustment of the lot lines to have two separate sewage systems each operating under 22,700 L/day in order to be under Ministry of Health guidelines. This would result in a total design flow for the area to be less than 45,400 L/day. Beyond the areas we have identified to be reserved for the sewage system, the new lot line can run however you would like.

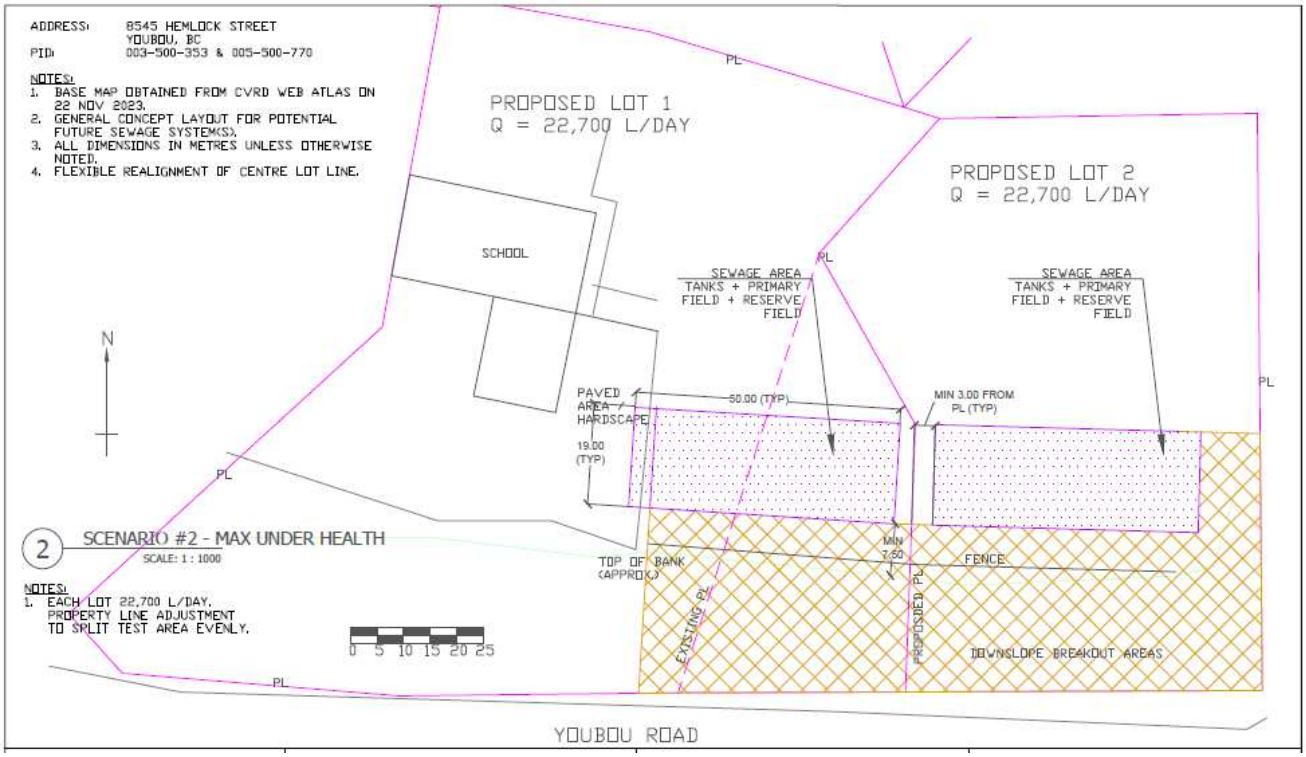


Figure 10 - Proposed Sewage Layout – Health, Adjust Lot Line - 45,400 L/day

One potential layout over the two lots might be as follows:

- 4 – 1-bedroom apartments
- 22 – 2-bedroom apartments
- 19 – 3-bedroom townhomes

- Commercial floor space usage to be taken as basic retail – no food, salons, medical buildings

Considering a factor of safety of 1.75, the design flow is approx. 22,700 L/day per lot – townhomes on one system, mixed use building on the other.

Based on the BC Sewerage System Regulation, the following areas will be required by the sewage system or will be unavailable for development:

Table 9 - Scenario #2 - Reserved Areas

Purpose	Description	Area (m^2)
Total Septic Area – Lot 1	Lot 1 – Field 50 m x 11 m, Tanks 50 m x 5 m	800
Total Septic Area – Lot 2	Lot 2 – Field 50 m x 11 m, Tanks 50 x 5 m	800
Downslope Areas	Setback 7.5 m from top of south and east banks, slopes unusable	4071
Total Reserved Area		**5671**

The hope is with the above configuration, development of the lots could be separated and the development would have less hurdles when compared to a comparable design flow under the Municipal Wastewater Regulation. The above scenario would also save on the amount of area required for a comparable combined sewage system designed under the Municipal Wastewater Regulation, but this would be the maximum design flow where the BC Sewerage System Regulation could possibly apply for this property.

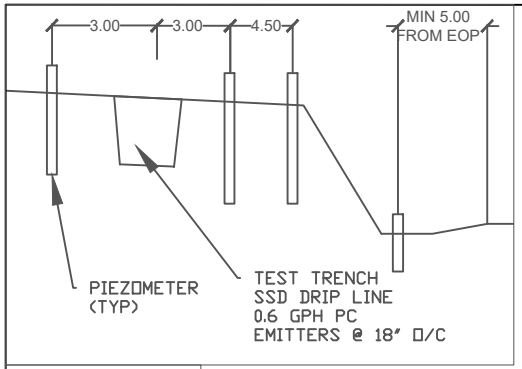
4.3 Limitations on Analysis

This analysis represents a high-level examination of potential requirements for a sewage system based on general occupancy inputs and information gathered during the site analysis. A detailed design of the sewage system(s) may require more or less area than outlined in the outlined scenarios.

5. Recommendations/Conclusions

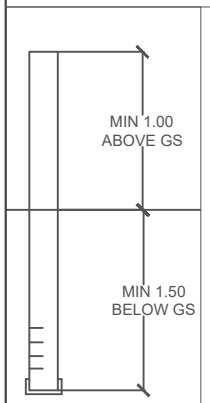
1. For design purposes, we would recommend the following hydraulic loading rates be used:
    a. Type 1 hydraulic loading rate: 56 L/m^2/day
    b. Type 2 hydraulic loading rate: 81 L/m^2/day
    c. Type 3 hydraulic loading rate: 134 L/m^2/day
    d. Max linear loading rate: 960 L/m/day (limited to 688 L/m/day for Scenario 1, Lot 1)
    e. Native soil vertical separation: 160 cm
2. Potential treatment plants – see Section 3.5.
3. Sewage system areas required – see Section 4.
4. For development, we would recommend Scenario #2 (45,400 L/day combined) with lot line adjustment to maximize design flow without the need to go through the Ministry of Environment process.
5. The sewage system designer should either work with the designer of the stormwater management system or should also design the stormwater management system to avoid conflicts.

APPENDIX A – SITE ASSESSMENT DATA



2 TEST TYPICAL SECTION

SCALE: NTS



PIEZOMETER LAYOUT		
LINE	DESCRIPTION	PIEZOMETER SPACING ALONG LINE (M)
A	10.5 M FROM D	20
B	7.5 M FROM D	20
C	4.5 M FROM D	20
D	TOP OF BANK	20
R	MIN 3 M U/S OF SOUTH PL	20

ADDRESS: 8545 HEMLOCK STREET
YOUBOU, BC
PID: 003-500-353 & 005-500-770

NOTES:
1. BASE MAP OBTAINED FROM CVRD WEB ATLAS ON 22 NOV 2023.
2. THIS DESIGN AND DRAWING IS THE PROPERTY OF CANADIAN SEWAGE SOLUTIONS INC. CANADIAN SEWAGE SOLUTIONS INC. WILL NOT BE HELD RESPONSIBLE FOR THE IMPROPER OR UNAUTHORIZED USE OF THIS DESIGN OR DRAWING.
3. IMPLEMENTATION OF THIS DESIGN IS SUBJECT TO REVIEW BY CANADIAN SEWAGE SOLUTIONS INC.
4. DESIGN AS PER BC SEWERAGE SYSTEM STANDARD PRACTICE MANUAL V3 (SEPT 2014) UNLESS OTHERWISE NOTED.
5. ALL DIMENSIONS IN METRES UNLESS OTHERWISE NOTED.

1 PIEZOMETER DETAIL

SCALE: NTS

NOTES:
1. ALL DIMENSIONS IN METRES UNLESS OTHERWISE NOTED.
2. INSTALL SLIP CAP TO BASE OF PIEZOMETER.
3. CUT SLITS UP TO MIN 0.20 M FROM BASE OF PIEZOMETER.

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
K. R. KARR
13207
2024-07-26
SEAL

Canadian Sewage Solutions Inc.

EGBC PERMIT TO PRACTICE
NO. 1000879

809 INDUSTRIAL WAY
VICTORIA, BC V9B 6E2
250-478-1158
WWW.SEWAGESOLUTIONS.COM

ISSUE LOG				REVISION/CHECK LOG			
NO	DATE	BY	REMARKS	NO	DATE	BY	REMARKS
				2	01 DEC 2023	SAC	AS-CONSTRUCTED
1	24 NOV 2023	KK	DRAFT TO MP	1	22 NOV 2023	SAC	PROPOSED TEST LAYOUT

PROJECT: OTG LTAR TESTING

DRAING TITLE: LTAR TESTING LAYOUT - PLAN

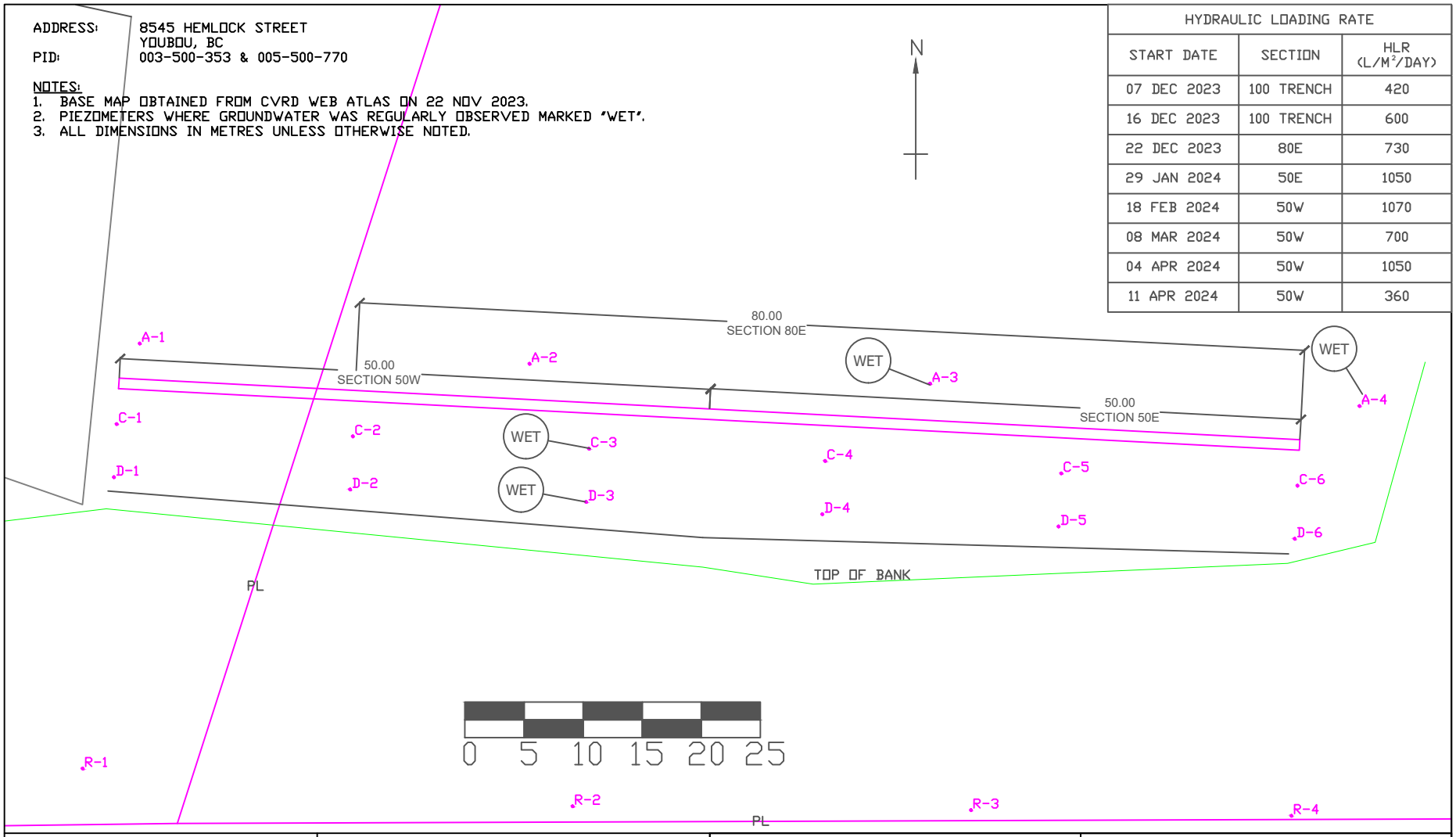
CLIENT: OTG DEVELOPMENTS

SCALE:	SHEET SIZE:	SHEET:	DRAWING NO:
1 : 1000	A	1 OF 2	23049-01

ADDRESS: 8545 HEMLOCK STREET
YOUBOU, BC
PID: 003-500-353 & 005-500-770

NOTES:
1. BASE MAP OBTAINED FROM CVRD WEB ATLAS ON 22 NOV 2023.
2. PIEZOMETERS WHERE GROUNDWATER WAS REGULARLY OBSERVED MARKED "WET".
3. ALL DIMENSIONS IN METRES UNLESS OTHERWISE NOTED.

HYDRAULIC LOADING RATE		
START DATE	SECTION	HLR (L/M²/DAY)
07 DEC 2023	100 TRENCH	420
16 DEC 2023	100 TRENCH	600
22 DEC 2023	80E	730
29 JAN 2024	50E	1050
18 FEB 2024	50W	1070
08 MAR 2024	50W	700
04 APR 2024	50W	1050
11 APR 2024	50W	360



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NO. 1000879

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250-478-1158
WWW.SEWAGESOLUTIONS.COM

ISSUE LOG				REVISION/CHECK LOG			
NO	DATE	BY	REMARKS	NO	DATE	BY	REMARKS
				3	25 JUN 2024	SAC	ADD PHASING, HLR TABLE
				2	01 DEC 2023	SAC	AS-CONSTRUCTED
1	24 NOV 2023	KK	DRAFT TO MP	1	22 NOV 2023	SAC	PROPOSED TEST LAYOUT

PROJECT: OTG LTAR TESTING

DRAING TITLE: LTAR TESTING TEST TRENCH

CLIENT: OTG DEVELOPMENTS

SCALE:	SHEET SIZE:	SHEET:	DRAWING NO:
1 : 500	A	2 OF 2	23049-01

Test Pit Log Sheet

Project:		23049	Client:	OTG Developments		Tech/Eng:	SAC		Date:		30-Nov-23
Pit Location:		Middle of field near north slope/tree line							Slope of land:		2%
Pit :	**M1**				Structure			Roots		Mottles		
Horizon	Depth (cm)		Texture	Colour	CF (%)	Type	Grade (F-P-VP-NA)	Consistence	Max depth (cm)	Qty (f,c,m) Size (f, m, c)	Depth Range (cm)	Qty (f,c,m) Constrast (F, D, P)	Moisture (S, W, M, D)
	0	20	topsoil	black		fr/bl	F						
	20	90	si gr compact fill	orange brown		massive	VP/NA						
	90	260	si gr compact fill	grey/blue grey			VP/NA						

Project:		23049	Client:	OTG Developments		Tech/Eng:	SAC		Date:		30-Nov-23
Pit Location:		Middle of field							Slope of land:		2%
Pit :	**M2**				Structure			Roots		Mottles		
Horizon	Depth (cm)		Texture	Colour	CF (%)	Type	Grade (F-P-VP-NA)	Consistence	Max depth (cm)	Qty (f,c,m) Size (f, m, c)	Depth Range (cm)	Qty (f,c,m) Constrast (F, D, P)	Moisture (S, W, M, D)
	0	20	topsoil	black		fr/bl	F						
	20	180	si gr compact fill	orange brown		massive	VP/NA						
	180	310	si gr compact fill	grey/blue grey			VP/NA						

Project:		23049	Client:	OTG Developments		Tech/Eng:	SAC		Date:		30-Nov-23
Pit Location:		Field near NE corner + base of slope/treed area							Slope of land:		2%
Pit :	**E1**				Structure			Roots		Mottles		
Horizon	Depth (cm)		Texture	Colour	CF (%)	Type	Grade (F-P-VP-NA)	Consistence	Max depth (cm)	Qty (f,c,m) Size (f, m, c)	Depth Range (cm)	Qty (f,c,m) Constrast (F, D, P)	Moisture (S, W, M, D)
	0	20	topsoil	black		fr/bl	F						
	20	160	si gr compact fill	orange brown		massive	VP/NA		140	ff - fm			

Project:		23049	Client:	OTG Developments		Tech/Eng:	SAC		Date:		30-Nov-23
Pit Location:		Field near NE corner							Slope of land:		2%
Pit :	**E2**				Structure			Roots	Mottles		
Horizon	Depth (cm)	Texture	Colour	CF (%)	Type	Grade (F-P-VP-NA)	Consistence	Max depth (cm)	Qty (f,c,m) Size (f, m, c)	Depth Range (cm)	Qty (f,c,m) Constrast (F, D, P)	Moisture (S, W, M, D)
	0 20	topsoil	black		fr/bl	F						
	20 260	si gr compact fill	orange brown		massive	VP/NA		190	ff - fm			

Project:		23049	Client:	OTG Developments		Tech/Eng:	SAC		Date:		30-Nov-23
Pit Location:		Field middle of E edge; piezometer installed							Slope of land:		2%
Pit :	**E3**				Structure			Roots	Mottles		
Horizon	Depth (cm)	Texture	Colour	CF (%)	Type	Grade (F-P-VP-NA)	Consistence	Max depth (cm)	Qty (f,c,m) Size (f, m, c)	Depth Range (cm)	Qty (f,c,m) Constrast (F, D, P)	Moisture (S, W, M, D)
	0 20	topsoil	black		fr/bl	F						
	20 350	si gr compact fill	orange brown		massive	VP/NA		270	fm			

Project:		23049	Client:	OTG Developments		Tech/Eng:	SAC		Date:		30-Nov-23
Pit Location:		Field middle of E edge; piezometer installed							Slope of land:		2%
Pit :	**E4**				Structure			Roots	Mottles		
Horizon	Depth (cm)	Texture	Colour	CF (%)	Type	Grade (F-P-VP-NA)	Consistence	Max depth (cm)	Qty (f,c,m) Size (f, m, c)	Depth Range (cm)	Qty (f,c,m) Constrast (F, D, P)	Moisture (S, W, M, D)
	0 20	topsoil	black		fr/bl	F						
	20 400	si gr compact fill	orange brown		massive	VP/NA		270	fc			

Groundwater Mounding Test -
Daily Input

Date:			30-Nov-23	02-Dec-23	04-Dec-23	05-Dec-23	06-Dec-23	07-Dec-23	08-Dec-23	09-Dec-23	10-Dec-23
Readings by:			SAC	KK	RN	RN	SF / DF	RN	RN	RN	RN
Flow Meter 1 Reading (m^3)				203.0612		237.50735	237.50735	259.32175	277.61425	295.94365	311.8678
Time				2:04 PM		4:04 PM	9:51 AM	2:35 PM	2:59 PM	3:43 PM	1:18 PM
Pressure (psi)				35		0				55	55
Flow Meter 2 Reading (m^3)			1018.8685	1060.594	1102.778	1124.308	1139.435	1163.9	1184.712	1206.016	1224.453
Time			1:57 PM	2:21 PM	3:07 PM	4:08 PM	9:49 AM	2:35 PM	3:03 PM	3:50 PM	1:12 PM
Pressure (psi)			26	30				56.5			30
Flow rate (m^3/day)				**20.690**	**20.760**	**20.655**	**20.531**	**38.632**	**38.408**	**38.417**	**38.416**
Rain Gauge 1 (mm)				42	55	60		12	0	22	0
Rain Gauge 2 (mm)				52	55	63		13	0	24	0
Average 24-h Rainfall				**23.5**	**27.5**	**61.5**		**12.5**	**0**	**23**	**0**
Weather			drizzle	sunny							cloudy
Trench W - water level (cm)								79.4	80.6	76.8	80.01
Trench E - water level (cm)								88.9	87.0	87.0	87.63
Comments			#1 not online	#1 online, all piezos dry, dye added			R-line added, piezos adjusted, all piezos dry				
Line	#	Piezometer	Depth of water table (cm)								
A	1	A-1		269	270	270	d	270	270	271	270
A	2	A-2		293	293	294	d	293	294	294	294
A	3	A-3		247			d				
A	4	A-4		282	272	281	d	284	283	280	281
C	1	C-1		261	263	263	d	261	261	263	261
C	2	C-2		273	275	274	d	274	275	275	274
C	3	C-3		299	285	294	d	300	300	300	296
C	4	C-4		298	299	300	d	300	300	300	300
C	5	C-5		264	265	264	d	262	263	264	263
C	6	C-6		284	286	285	d	286	286	287	286
D	1	D-1		283	284	285	d	285	284	284	284
D	2	D-2		255	256	257	d	257	257	257	258
D	3	D-3		286	286	286	d	285	286	287	286
D	4	D-4		328	327	329	d	328	329	329	328
D	5	D-5		284	286	287	d	286	286	286	286
D	6	D-6		309	307	308	d	309	308	309	308
U	1	U-1		239	240	240	d	240	239	240	241
U	4	U-4		503	506	505	d	505	505	508	508
U	5	U-5		587	488	488	d	489	489	487	489
R	1	R-1					d	180	181	181	181
R	2	R-2					d	177	177	177	177
R	3	R-3					d	203	203	203	203
R	4	R-4					d	192	192	193	192

Groundwater Mounding Test -
Daily Input

Date:			11-Dec-23	12-Dec-23	13-Dec-23	14-Dec-23	15-Dec-23	16-Dec-23	17-Dec-23	18-Dec-23	19-Dec-23	20-Dec-23	21-Dec-23
Readings by:			RN	RN	RN	RN	RN	KK	RN	RN	RN	RN	RN
Flow Meter 1 Reading (m^3)			330.4782	347.92555	365.08575	383.5353	401.4707	416.36355	453.7192	487.48005	520.6968	553.6326	585.44673
Time			2:39 PM	2:31 PM	2:06 PM	3:30 PM	4:15 PM	11:59 AM	3:09 PM	3:26 PM	3:21 PM	3:03 PM	2:02 PM
Pressure (psi)			56	54	57	56	58		28	28	28	28	28
Flow Meter 2 Reading (m^3)			1246.49	1266.505	1286.607	1307.88	1329.26	1345.8	1368.81	1389.127	1409.18	1429.295	1448.8
Time			2:43 PM	2:35 PM	2:11 PM	3:34 PM	4:19 PM	12:36 PM	3:14 PM	3:30 PM	3:25 PM	3:06 PM	2:06 PM
Pressure (psi)													
Flow rate (m^3/day)			**38.346**	**37.672**	**37.906**	**37.546**	**38.124**	**37.684**	**53.736**	**53.461**	**53.455**	**53.737**	**53.574**
Rain Gauge 1 (mm)			3	0	0	10	20	0	0	2	12	8	2
Rain Gauge 2 (mm)			2	0	0	10	21	0	0	2	12	8	2
Average 24-h Rainfall			**2.5**	**0**	**0**	**10**	**20.5**	**0**	**0**	**2**	**12**	**8**	**2**
Weather			cloudy	cloudy	overcast	cloudy	cloudy	cloudy	cloudy	cloudy	rain	cloudy	cloudy
Trench W - water level (cm)			80.0	80.0	80.0	80.0	72.4		70.5	69.9	69.9	69.9	69.9
Trench E - water level (cm)			87.6	87.6	87.6	87.6	87.6		85.1	82.6	78.7	78.1	78.7
Comments								Added additional 100 m drip line to Flow Meter #1					
Line	#	Piezometer											
A	1	A-1	270	270	270	270	270	269	270	270	270	270	271
A	2	A-2	294	293	295	294	294	294	294	293	294	293	294
A	3	A-3						233.5					
A	4	A-4	282	283	284	283	281	281.4	283	284	282	283	283
C	1	C-1	262	262	261	262	263	261.5	263	281	261	263	261
C	2	C-2	275	274	275	275	275	274	276	274	275	275	275
C	3	C-3	300	300	300	300	296	300	302	300	300	300	300
C	4	C-4	300	300	300	300	300	299	300	300	300	300	299
C	5	C-5	263	263	263	262	264	263	263	263	264	262	262
C	6	C-6	287	287	286	286	287	286	287	286	287	286	286
D	1	D-1	285	285	283	285	287	284	286	285	284	286	285
D	2	D-2	256	257	257	257	258	257	257	257	257	257	257
D	3	D-3	285	285	286	286	246	286	253	254	245	248	254
D	4	D-4	329	329	329	329	330	329	328	330	329	329	329
D	5	D-5	287	287	286	286	285	286	287	286	286	286	286
D	6	D-6	308	308	309	308	308	307	310	309	310	309	309
U	1	U-1	239	239	240	240	239	239	241	240	240	240	240
U	4	U-4	507	508	508	508	506	506	508	506	506	506	506
U	5	U-5	489	487	489	489	487	486	488	490	488	488	490
R	1	R-1	181	180	181	181	181	181	182	181	181	182	182
R	2	R-2	177	178	177	177	178	177	176	176	178	177	177
R	3	R-3	203	203	203	203	203	203	204	203	203	203	203
R	4	R-4	193	192	192	193	193	192	193	193	193	193	193

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Daily Input

Date:			22-Dec-23	23-Dec-23	24-Dec-23	26-Dec-23	27-Dec-23	28-Dec-23	29-Dec-23	31-Dec-23	01-Jan-24	02-Jan-24	03-Jan-24
Readings by:			KK	RN	RN	KK	RN	RN	RN	RN	RN	RN	RN
Flow Meter 1 Reading (m^3)			617.53065	649.94985	681.6587	747.37655	781.16555	814.54695	847.72205	910.4733	944.594	977.21095	1010.3959
Time			2:40 PM	2:35 PM	1:50 PM	2:12 PM	3:03 PM	3:41 PM	3:54 PM	2:17 PM	3:22 PM	3:27 PM	3:51 PM
Pressure (psi)				28	28	28	28	28	28	28	28		
Flow Meter 2 Reading (m^3)			1469.435	1488.841	1508.69	1548.174	1568.9	1588.82	1609.46	1647.725	1667.7645	1687.505	1707.835
Time			3:13 PM	2:37 PM	1:53 PM	2:10 PM	3:05 PM	3:43 PM	3:56 PM	2:19 PM	3:24 PM	3:29 PM	3:53 PM
Pressure (psi)													
Flow rate (m^3/day)			**50.977**	**52.436**	**53.206**	**52.236**	**52.597**	**51.931**	**53.334**	**52.269**	**51.821**	**52.176**	**52.638**
Rain Gauge 1 (mm)			7	0	0	77	9	30	12	8	1	2	5
Rain Gauge 2 (mm)			7	0	0	74	9	32	10	8	0	4	4
Average 24-h Rainfall			**7**	**0**	**0**	**37.75**	**9**	**31**	**11**	**4**	**0.5**	**3**	**4.5**
Weather			cloudy				rainy						
Trench W - water level (cm)				69.9			63.5	64.1	64.1	63.5	64.1	63.1	64.1
Trench E - water level (cm)				78.1	85.7		85.1	78.7	83.2	83.8	85.1	85.1	85.7
Comments			Shortened field length to 80 m										
Line	#	Piezometer											
A	1	A-1	269	272	270	269	269	269	270	269	270	270	270
A	2	A-2	293	295	294	293	293	294	294	294	294	294	294
A	3	A-3	232.3		237	245	231	229	230	229	232	234	233
A	4	A-4	281	283	283	279.5	282	280	281	281	283	284	284
C	1	C-1	261	259	262	262	262	263	261	262	263	262	262
C	2	C-2	274	275	275	275	275	274	275	275	278	275	275
C	3	C-3	300	300	300	295.2	300	296	300	300	300	300	300
C	4	C-4	299	298	300	300	300	300	300	300	300	300	300
C	5	C-5	262	262	263	262	262	263	263	262	264	263	263
C	6	C-6	286	286	287	286	286	286	286	285	288	287	286
D	1	D-1	284	284	285	285	284	284	285	285	285	284	285
D	2	D-2	256	257	257	257	257	257	257	257	258	257	257
D	3	D-3	286	260	273	248.5	258	237	287	262	271	274	274
D	4	D-4	329	329	330	330	330	330	330	329	330	330	330
D	5	D-5	286	286	286	286	288	286	286	286	287	287	286
D	6	D-6	307	309	308	308	309	209	310	308	309	309	309
U	1	U-1	239	240	239	239	240	240	240	240	240	240	240
U	4	U-4	505.5	506	506	505	506	507	506	506	509	506	506
U	5	U-5	488	492	488	488	489	489	488	488	489	488	488
R	1	R-1	181	181	181	181	182	182	182	182	182	181	182
R	2	R-2	177	177	177	177	177	178	178	178	178	178	178
R	3	R-3	203	203	203	203	204	203	203	203	203	202	205
R	4	R-4	192	193	193	192	192	193	192	192	192	192	193

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Date:			05-Jan-24	06-Jan-24	07-Jan-24	08-Jan-24	09-Jan-24	10-Jan-24	12-Jan-24	13-Jan-24	14-Jan-24
Readings by:			RN	RN	RN	RN	SAC	RN	CK	CK	CK
Flow Meter 1 Reading (m^3)			1076.0152	1107.3973	1140.1045	1172.1632	1199.970625	1199.97063	1199.97063	1199.97063	1199.97063
Time			4:16 PM	3:22 PM	3:32 PM	3:13 PM	11:56 AM	12:40 PM	3:00 PM	4:00 PM	5:00 PM
Pressure (psi)											
Flow Meter 2 Reading (m^3)			**1747.35**	1765.975	1785.564	1804.7033	1821.395	1821.395	1821.395	1821.395	1821.395
Time			4:18 PM	3:23 PM	3:35 PM	3:14 PM	11:59 AM	12:40 PM	3:00 PM	4:00 PM	5:00 PM
Pressure (psi)											
Flow rate (m^3/day)			**52.115**	**51.969**	**51.909**	**51.910**	**51.521**	**0.000**	**0.000**	**0.000**	**0.000**
Rain Gauge 1 (mm)			36	38	2	13	58	2	0	0	0
Rain Gauge 2 (mm)			36	36	2	14	57	2	0	0	0
Average 24-h Rainfall			**18**	**37**	**2**	**13.5**	**57.5**	**2**	**0**	**0**	**0**
Weather			rain						-10 s	-5 pc	-3 pc
Trench W - water level (cm)			61.0	61.6		67.0	70.0	69.2	72.4	72.4	72.4
Trench E - water level (cm)			76.2	85.1		87.6	87.0				
Comments			Q #2 unreadable (estimate flow), heavy surface flow from asphalt to trench				Turn off water, adjust field length to 50 m				
Line	#	Piezometer									
A	1	A-1	270	270	270	270	269	270	270	270	270
A	2	A-2	294	294	294	294	296	294	294	294	294
A	3	A-3	200	248	241	228	248	234	232	233	236
A	4	A-4	279	281	282	280	281	282	283	284	283
C	1	C-1	262	261	263	262	261	262	262	262	262
C	2	C-2	275	275	275	275	274.5	275	275	275	275
C	3	C-3	290	300	300	300	297	300	300	300	300
C	4	C-4	300	300	300	300	299	300	300	300	300
C	5	C-5	264	264	263	263	262	264	263	263	263
C	6	C-6	287	286	286	287	287	287	287	287	287
D	1	D-1	285	284	285	285	264	285	285	285	285
D	2	D-2	257	257	257	257	258	257	257	257	257
D	3	D-3	212	260	288	281	234	287	287	287	285
D	4	D-4	330	330	330	330	330	330	330	330	331
D	5	D-5	287	286	286	286	286	287	237	287	287
D	6	D-6	309	310	309	309	286	310	309	309	307
U	1	U-1	240	241	240	240	240	240	240	240	240
U	4	U-4	508	510	507	510	506	508	509	509	509
U	5	U-5	489	490	587	491	488	489	492	492	492
R	1	R-1		182		182	180	182	182	182	182
R	2	R-2		178		177	177	178	178	178	178
R	3	R-3		204		204	203	204	204	204	204
R	4	R-4		193		193	190	193	193	193	193

Groundwater Mounding Test - Daily Input										
Date:			15-Jan-24	16-Jan-24	22-Jan-24	27-Jan-24	28-Jan-24	29-Jan-24	30-Jan-24	31-Jan-24	01-Feb-24
Readings by:			CK	CK	CK	JR/KK	RN	RN	RN	RN	RN
Flow Meter 1 Reading (m^3)			1199.97063	1199.970625	1199.970625	1199.970625	1227.1251	1260.95275	1292.2187	1322.5544	1354.61095
Time			6:00 PM	7:00 PM	4:00 PM	12:00 PM	12:49 PM	3:07 PM	3:33 PM	3:10 PM	4:12 PM
Pressure (psi)											
Flow Meter 2 Reading (m^3)			1821.395	1821.395	1821.395	1821.395	1838.7705	1855.5875	1872.963	1889.673	1907.3
Time			6:00 PM	7:00 PM	4:00 PM	12:00 PM	12:49 PM	3:07 PM	3:33 PM	3:10 PM	4:12 PM
Pressure (psi)											
Flow rate (m^3/day)			**0.000**	**0.000**	**0.000**	**0.000**	**43.065**	**46.216**	**47.779**	**47.809**	**47.633**
Rain Gauge 1 (mm)			0	0	50	38	30	30	16	26	6
Rain Gauge 2 (mm)			0	0	47	42	35	30	16	26	8
Average 24-h Rainfall			**0**	**0**	**8.083333333**	**8**	**32.5**	**30**	**16**	**26**	**7**
Weather			1 cloudy	-1 cloudy	2 rain		10 cloudy	12 rain	11 cloudy	11 rain	9 cloudy
Trench W - water level (cm)			72.4	72.4	full of snow		51.4	60.3	62.9	60.3	62.2
Trench E - water level (cm)							75.565	76.835	76.2	75.565	76.2
Comments						Start 50 m trench - E	Times approx				
Line	#	Piezometer									
A	1	A-1	270	270	267	268	269	270	271	270	270
A	2	A-2	294	294	294	287	293	283	291	294	294
A	3	A-3	240	240		245	246	242	232	227	229
A	4	A-4	285	285	279	280	283	283	284	284	285
C	1	C-1	262	252	261	262	262	263	262	262	263
C	2	C-2	275	275	275	275	276	276	276	276	276
C	3	C-3	300	300	300	301	301	301	301	301	301
C	4	C-4	300	300	298	298	300	300	300	300	300
C	5	C-5	263	263	263	262	263	263	263	263	263
C	6	C-6	287	287	287	286	287	287	287	287	287
D	1	D-1	285	285	283	284	285	286	285	285	285
D	2	D-2	257	257	257	257	257	257	257	258	256
D	3	D-3	285	285	203	209	207	225	231	222	236
D	4	D-4	331	331	330	329	330	330	230	330	330
D	5	D-5	287	287	286	285	286	286	287	287	287
D	6	D-6	307	307	308	307	309	309	308	308	309
U	1	U-1	240	240	240	241	241	241	241	241	241
U	4	U-4	509	509	506	505	506	507	506	507	507
U	5	U-5	492	492	488	486	488	492	489	489	490
R	1	R-1	182	182	181	181	182	182	182	182	182
R	2	R-2	178	178	177	177	177	177	177	177	178
R	3	R-3	204	204	203	203	203	203	203	203	204
R	4	R-4	193	193	193	192	193	193	193	193	193

Groundwater Mounding Test -
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Date:			02-Feb-24	03-Feb-24	04-Feb-24	05-Feb-24	06-Feb-24	07-Feb-24	09-Feb-24	10-Feb-24	11-Feb-24
Readings by:			RN	RN	RN	RN	RN	RN	RN	RN	RN
Flow Meter 1 Reading (m^3)			1385.5031	1414.37205	1445.66	1476.24355	1505.957925	1535.888567	1595.74985	1627.823	1658.28865
Time			4:28 PM	3:08 PM	3:51 PM	3:54 PM	3:27 PM	2:50 PM	2:14 PM	3:35 PM	3:45 PM
Pressure (psi)											
Flow Meter 2 Reading (m^3)			1924.142	1940.4315	1957.8	1974.668	1991.09	2007.531667	2040.415	2058.168	2075.011
Time			4:28 PM	3:08 PM	3:51 PM	3:54 PM	3:27 PM	2:50 PM	2:14 PM	3:35 PM	3:35 PM
Pressure (psi)											
Flow rate (m^3/day)			**47.210**	**47.815**	**47.246**	**47.353**	**47.018**	**47.578**	**46.968**	**47.173**	**47.099**
Rain Gauge 1 (mm)			10	12	0	0	0	0	0	1	22
Rain Gauge 2 (mm)			10	0	0	0	0	0	0	1	22
Average 24-h Rainfall			**10**	**6**	**0**	**0**	**0**	**0**	**0**	**1**	**22**
Weather			8 cloudy	8 cloudy	8 p cloudy	7 cloudy	7 p cloudy	7 cloudy	6 cloudy	5 rain	6 cloudy
Trench W - water level (cm)			65.4	62.9	62.9	62.9	62.9	62.9	62.9	62.9	63.5
Trench E - water level (cm)			76.2	76.2	76.2	76.835	76.2	76.2	76.2	80.01	77.47
Comments								No flow data - interpolated between Feb 6 and Feb 9			
Line	#	Piezometer									
A	1	A-1	270	270	270	270	270	270	270	270	270
A	2	A-2	294	294	295	293	294	294	294	294	294
A	3	A-3	228	230	230	232	233	232	237	242	230
A	4	A-4	284	285	284	285	285	285	285	285	282
C	1	C-1	261	262	262	263	263	263	263	262	262
C	2	C-2	275	276	276	275	276	276	276	276	276
C	3	C-3	301	301	301	301	301	301	301	301	301
C	4	C-4	300	300	300	300	300	300	300	300	300
C	5	C-5	263	264	264	262	263	263	263	263	263
C	6	C-6	287	287	287	287	287	287	287	287	287
D	1	D-1	285	285	285	285	285	285	285	285	285
D	2	D-2	257	257	257	257	257	257	258	257	257
D	3	D-3	250	287	287	287	287	287	286	287	287
D	4	D-4	330	330	330	330	330	330	330	330	330
D	5	D-5	287	287	287	287	287	287	287	287	287
D	6	D-6	309	309	309	309	309	309	310	310	309
U	1	U-1	241	241	241	240	241	241	241	241	241
U	4	U-4	506	508	506	507	507	507	507	506	507
U	5	U-5	489	488	489	489	488	488	489	489	488
R	1	R-1	182	182	182	182	182	182	182	182	182
R	2	R-2	177	177	177	177	177	177	177	177	178
R	3	R-3	203	203	203	204	204	204	204	204	204
R	4	R-4	193	193	193	194	194	194	194	194	193

Groundwater Mounding Test -
Daily Input

Date:			12-Feb-24	13-Feb-24	14-Feb-24	16-Feb-24	18-Feb-24	19-Feb-24	20-Feb-24	21-Feb-24	22-Feb-24
Readings by:			RN	RN	RN	RN	RN	RN	RN	RN	RN
Flow Meter 1 Reading (m^3)			1687.6396	1718.83205	1747.93195	1811.06475	1869.38305	1895.8653	1931.65235	1962.62695	1988.34655
Time			3:09 PM	3:53 PM	3:00 PM	5:03 PM	3:49 PM	12:03 PM	3:35 PM	3:05 PM	10:49 AM
Pressure (psi)											
Flow Meter 2 Reading (m^3)			2091.284	2108.463	2124.47	2158.869	2190.295	2204.484	2223.87	2240.565	2254.829
Time			3:09 PM	3:53 PM	3:00 PM	5:03 PM	3:49 PM	12:03 PM	3:35 PM	3:05 PM	10:49 AM
Pressure (psi)											
Flow rate (m^3/day)			**46.676**	**46.937**	**46.831**	**46.768**	**46.056**	**48.243**	**48.093**	**48.684**	**48.629**
Rain Gauge 1 (mm)			2	0	0	0	0	0	4	7	2
Rain Gauge 2 (mm)			4	0	0	0	0	0	4	8	2
Average 24-h Rainfall			**3**	**0**	**0**	**0**	**0**	**0**	**4**	**7.5**	**2**
Weather			9 p cloudy	7 sunny	5 p cloudy	6 cloudy	7 cloudy	8 cloudy	7 showers	8 cloudy	7 cloudy
Trench W - water level (cm)			63.5	62.9	62.9	63.5	31.8	29.2	31.8	32.4	34.9
Trench E - water level (cm)			79.4	81.28	83.2	83.185	31.1	29.21	31.8	32.4	34.9
Comments							W Trench - 50 m				
Line	#	Piezometer									
A	1	A-1	271	270	271	271	271	270	270	270	270
A	2	A-2	294	294	294	294	294	294	294	294	294
A	3	A-3	233	234	233	234	239	241	244	246	239
A	4	A-4	282	284	284	285		285	285	284	285
C	1	C-1	262	263	262	262	262	262	262	262	263
C	2	C-2	276	276	276	276	276	276	276	276	276
C	3	C-3	301	301	301	301	301	301	289	296	290
C	4	C-4	300	300	300	300	300	300	300	300	300
C	5	C-5	263	263	263	263	263	263	262	262	261
C	6	C-6	287	287	287	287	287	285	285	285	285
D	1	D-1	285	284	285	285	285	285	285	285	285
D	2	D-2	258	257	258	257	258	258	257	256	256
D	3	D-3	253	282	287	287	199	198	200	202	207
D	4	D-4	330	330	331	330	330	330	330	330	330
D	5	D-5	287	287	287	286	286	287	287	287	287
D	6	D-6	309	310	310	310	310	308	308	308	309
U	1	U-1	241	241	241	241	241	241	241	241	241
U	4	U-4	507	507	507	507	507	506	506	506	506
U	5	U-5	489	489	488	488	487	488	488	488	488
R	1	R-1	182	182	182	181	181	182	181	182	181
R	2	R-2	178	178	178	178	178	178	178	178	178
R	3	R-3	204	204	204	204	203	203	203	204	204
R	4	R-4	193	193	193	193	193	192	192	192	192

Groundwater Mounding Test -
Daily Input

Date:			23-Feb-24	24-Feb-24	25-Feb-24	26-Feb-24	27-Feb-24	28-Feb-24	29-Feb-24	01-Mar-24	02-Mar-24
Readings by:			RN	RN	RN	RN	RN	RN	RN	CB	CB
Flow Meter 1 Reading (m^3)			2028.45955	2057.458	2088.7338	2116.3955	2148.2503	2183.3963	2216.70545	2250	2281.5
Time			5:34 PM	3:34 PM	3:37 PM	12:44 PM	1:08 PM	4:00 PM	5:29 PM	4:30 PM	4:30 PM
Pressure (psi)											
Flow Meter 2 Reading (m^3)			2275.878	2291.342	2308.016	2322.837	2340.06	2358.826	2376.6	2390	2407.07
Time			5:34 PM	3:34 PM	3:37 PM	12:44 PM	1:08 PM	4:00 PM	5:29 PM	4:30 PM	4:30 PM
Pressure (psi)											
Flow rate (m^3/day)			**47.736**	**48.504**	**47.850**	**48.283**	**48.273**	**48.160**	**48.110**	**48.689**	**48.570**
Rain Gauge 1 (mm)			0	0	6	0	4	86	24	12	6
Rain Gauge 2 (mm)			0	0	6	0	6	88	25	12	6
Average 24-h Rainfall			**0**	**0**	**6**	**0**	**5**	**87**	**24.5**	**12**	**6**
Weather			7 cloudy	7 cloudy	4 cloudy	5 p cloudy	1 snow	6 rain	2 cloudy	3 rain + snow	2 cloudy
Trench W - water level (cm)			38.1	36.8	34.3	35.6	45.1	35.6	39.4	42.5	45.1
Trench E - water level (cm)			38.1	36.8	34.3	35.6	45.1	35.6	39.4	42.5	45.1
Comments											
Line	#	Piezometer									
A	1	A-1	270	270	270	270	270	270	270	270	270
A	2	A-2	294	294	294	295	295	294	295	294	294
A	3	A-3	237	237	241	237	235	248	246	245	231
A	4	A-4	284	284	284	285	284	285	285	284	283
C	1	C-1	263	263	262	262	262	262	262	262	262
C	2	C-2	276	276	276	276	276	276	276	276	276
C	3	C-3	291	291	291	291	294	301	297	293	292
C	4	C-4	300	300	300	300	300	300	300	300	300
C	5	C-5	261	261	261	263	263	263	263	263	263
C	6	C-6	285	285	286	287	287	287	287	287	287
D	1	D-1	285	285	285	285	285	285	285	285	285
D	2	D-2	256	256	256	257	257	257	257	257	257
D	3	D-3	210	208	207	210	217	200	212	212	219
D	4	D-4	330	330	330	331	331	331	331	331	330
D	5	D-5	287	287	286	287	287	287	287	287	287
D	6	D-6	309	309	309	309	309	309	309	309	309
U	1	U-1	241	241	241	241	241	241	241	241	241
U	4	U-4	506	506	506	507	507	507	507	507	507
U	5	U-5	488	488	488	489	489	489	489	489	489
R	1	R-1	181	181	181	182	182	182	182	182	182
R	2	R-2	178	178	178	178	178	178	178	178	178
R	3	R-3	204	204	204	204	204	204	204	204	203
R	4	R-4	192	192	192	194	194	194	194	194	194

Groundwater Mounding Test -
Daily Input

Date:			03-Mar-24	04-Mar-24	05-Mar-24	06-Mar-24	07-Mar-24	08-Mar-24	09-Mar-24	10-Mar-24	11-Mar-24
Readings by:			CB	CB	CB	CB	CB	CB	CB	CB	CB
Flow Meter 1 Reading (m^3)			2308.34405	2340.8117	2371.762	2401.89485	2432.4477	2464.3286	2493.0195	2524.508	2558.1188
Time			3:15 PM	3:15 PM	2:45 PM	1:30 PM	12:15 PM	3:20 PM	1:17 PM	2:20 PM	4:05 PM
Pressure (psi)											
Flow Meter 2 Reading (m^3)			2426.152	2442.389	2458.82	2474.4045	2490.215	2490.32	2490.32	2490.32	2490.32
Time			3:15 PM	3:15 PM	2:45 PM	1:30 PM	12:15 PM	3:20 PM	1:17 PM	2:20 PM	4:05 PM
Pressure (psi)											
Flow rate (m^3/day)			**48.449**	**48.705**	**48.389**	**48.229**	**48.911**	**28.344**	**31.370**	**30.169**	**31.327**
Rain Gauge 1 (mm)			6	2	0	0	2	14	14	39	16
Rain Gauge 2 (mm)			6	0	0	0	0	14	14	39	16
Average 24-h Rainfall			**6**	**1**	**0**	**0**	**1**	**14**	**14**	**39**	**16**
Weather			1 snow	2 cloudy		3 cloudy	5 cloudy	4 rain	1 rain	5 rain	4 rain
Trench W - water level (cm)			46.4	49.5	50.8	50.8	49.5	34.3	53.3	40.6	47.0
Trench E - water level (cm)			46.4	49.5	50.8	50.8	49.5	34.3	53.3	40.6	47.0
Comments							reduce flow				
Line	#	Piezometer									
A	1	A-1	270	270	270	270	270	270	270	270	269
A	2	A-2	294	294	294	294	294	294	294	293	294
A	3	A-3	232	231	231	231	232	228	223	230	225
A	4	A-4	284	285	285	285	285	282	281	279	280
C	1	C-1	262	262	262	262	262	262	262	262	261
C	2	C-2	275	275	275	275	275	275	275	275	276
C	3	C-3	292	293	293	293	292	298	281	286	289
C	4	C-4	300	300	300	300	300	300	300	300	300
C	5	C-5	262	262	262	262	262	262	262	262	263
C	6	C-6	287	287	287	287	287	287	287	287	287
D	1	D-1	285	285	285	285	285	285	285	285	285
D	2	D-2	257	257	257	257	257	257	257	257	257
D	3	D-3	221	224	225	225	228	252	227	205	217
D	4	D-4	330	330	330	330	330	330	330	330	331
D	5	D-5	287	287	287	287	287	287	287	287	287
D	6	D-6	309	309	309	309	309	309	309	309	310
U	1	U-1	241	241	241	241	241	241	241	241	240
U	4	U-4	506	506	506	506	506	506	506	506	506
U	5	U-5	489	489	489	489	489	489	489	489	488
R	1	R-1	181	182	182	182	182	182	182	182	182
R	2	R-2	177	177	177	177	177	177	177	177	177
R	3	R-3	203	203	203	203	203	203	203	203	203
R	4	R-4	194	194	194	194	194	194	194	194	194

Groundwater Mounding Test -
Daily Input

Date:			12-Mar-24	13-Mar-24	14-Mar-24	15-Mar-24	16-Mar-24	18-Mar-24	19-Mar-24	20-Mar-24	21-Mar-24
Readings by:			CB	CB	CB	CB	CB	CB	CB	RN	RN
Flow Meter 1 Reading (m^3)			2589.5603	2619.2693	2654.3288	2683.2881	2714.78	2776.8378	2812.03455	2839.21975	2872.7216
Time			4:05 PM	2:52 PM	4:15 PM	3:45 PM	3:55 PM	3:10 PM	6:10 PM	2:51 PM	4:15 PM
Pressure (psi)											
Flow Meter 2 Reading (m^3)			2490.32	2490.32	2490.32	2490.32	2490.32	2490.32	2490.32	2490.32	2490.32
Time			4:05 PM	2:52 PM	4:15 PM	3:45 PM	3:55 PM	3:10 PM	6:10 PM	2:51 PM	4:15 PM
Pressure (psi)											
Flow rate (m^3/day)			**31.441**	**31.296**	**33.149**	**29.575**	**31.275**	**31.521**	**31.286**	**31.544**	**31.655**
Rain Gauge 1 (mm)			35	2	0	0	0	0	0	0	0
Rain Gauge 2 (mm)			36	2	0	0	0	0	0	0	0
Average 24-h Rainfall			**35.5**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Weather			6 rain	7 p cloudy	11 cloudy	16 sunny	19 sunny	18 sunny	15	8 cloudy	11 cloudy
Trench W - water level (cm)			41.9	53.3	58.4	54.6	49.5	45.7	44.5	41.9	39.4
Trench E - water level (cm)			44.5	53.3	58.4	54.6	49.5	45.7	44.5	41.9	39.4
Comments											
Line	#	Piezometer									
A	1	A-1	270	270	270	270	270	270	270	270	270
A	2	A-2	294	294	294	294	294	294	294	294	294
A	3	A-3	248	243	232	246	244	238	242	243	245
A	4	A-4	279	285	282	286	286	286	287	287	285
C	1	C-1	262	262	262	262	262	262	262	262	262
C	2	C-2	275	275	275	275	275	275	275	275	275
C	3	C-3	301	293	297	296	292	291	291	291	288
C	4	C-4	300	300	300	300	300	300	300	300	300
C	5	C-5	262	262	262	262	262	262	263	263	263
C	6	C-6	287	287	287	287	287	287	287	287	287
D	1	D-1	285	285	285	285	285	285	285	285	285
D	2	D-2	257	257	257	257	257	257	257	257	257
D	3	D-3	210	228	251	242	230	224	219	218	214
D	4	D-4	330	330	330	330	330	330	330	330	330
D	5	D-5	287	287	287	287	287	287	288	288	288
D	6	D-6	309	309	309	309	309	309	309	309	309
U	1	U-1	241	241	241	241	241	241	241	241	241
U	4	U-4	506	506	506	506	506	506	506	506	506
U	5	U-5	489	489	489	489	489	489	488	488	488
R	1	R-1	182	182	182	182	182	182	182	182	182
R	2	R-2	177	177	177	177	177	177	177	177	177
R	3	R-3	203	203	203	203	203	203	202	202	202
R	4	R-4	194	194	194	194	194	194	194	194	194

Groundwater Mounding Test -
Daily Input

Date:			22-Mar-24	23-Mar-24	24-Mar-24	25-Mar-24	26-Mar-24	27-Mar-24	28-Mar-24	29-Mar-24	31-Mar-24
Readings by:			RN	RN	RN	RN	RN	RN	RN	RN	RN
Flow Meter 1 Reading (m^3)			2903.59775	2933.49895	2965.1973	2998.1301	3027.58595	3061.2426	3061.8093	3061.8093	3061.8093
Time			3:45 PM	2:40 PM	2:50 PM	3:50 PM	2:15 PM	4:09 PM	4:32 PM	3:54 PM	1:00 PM
Pressure (psi)											
Flow Meter 2 Reading (m^3)			2490.32	2490.32	2490.32	2490.32	2490.32	2490.32	2490.32	2490.32	2490.32
Time			3:45 PM	2:40 PM	2:50 PM	3:50 PM	2:15 PM	4:09 PM	4:32 PM	3:54 PM	1:00 PM
Pressure (psi)											
Flow rate (m^3/day)			**31.533**	**31.315**	**31.480**	**31.615**	**31.536**	**31.188**	**0.558**	**0.000**	**0.000**
Rain Gauge 1 (mm)			6	8	3	1	1	16	6	16	0
Rain Gauge 2 (mm)			6	8	3	1	1	16	6	16	0
Average 24-h Rainfall			**6**	**8**	**3**	**1**	**1**	**16**	**6**	**16**	**0**
Weather			6 rain	6 rain	9 sun	4 rain	6 rain	7 cloudy	8 rain	11 rain	14 pc
Trench W - water level (cm)			39.4	38.1	38.1	38.1	38.1	36.8	64.1	64.1	64.1
Trench E - water level (cm)			39.4	38.1	38.1	38.1	38.1	36.8	64.1	64.8	64.1
Comments								Shut off flow			
Line	#	Piezometer									
A	1	A-1	270	270	270	270	270	270	270	270	270
A	2	A-2	294	294	294	294	294	295	295	293	294
A	3	A-3	247	247	234	235	236	229	232	230	232
A	4	A-4	285	284	281	282	283	283	281	280	281
C	1	C-1	262	262	262	262	262	262	262	262	262
C	2	C-2	275	275	275	275	275	275	275	275	275
C	3	C-3	288	289	290	290	291	290	302	302	302
C	4	C-4	300	300	300	300	300	300	300	300	300
C	5	C-5	263	263	263	263	263	263	263		263
C	6	C-6	287	287	287	287	287	287	287		287
D	1	D-1	285	285	285	285	285	285	285	285	285
D	2	D-2	257	257	257	257	257	257	257	257	257
D	3	D-3	213	213	216	219	220	216	288	286	288
D	4	D-4	330	330	330	330	330	330	330	330	330
D	5	D-5	288	288	288	288	288	288	288	288	288
D	6	D-6	309	309	309	309	309	309	309	309	309
U	1	U-1	241	241	241	241	241	241	241	241	241
U	4	U-4	506	506	506	506	506	506	506	506	506
U	5	U-5	488	488	488	488	488	488	488	488	488
R	1	R-1	182	182	182	182	182	182	182	182	182
R	2	R-2	177	177	177	177	177	177	177	177	177
R	3	R-3	202	202	202	202	202	202	202	202	202
R	4	R-4	194	194	194	194	194	194	194	194	194

Groundwater Mounding Test -
Daily Input

Date:			01-Apr-24	02-Apr-24	03-Apr-24	04-Apr-24	05-Apr-24	06-Apr-24	07-Apr-24	08-Apr-24	09-Apr-24
Readings by:			RN	RN	RN	RN	RN	RN	RN	RN	RN
Flow Meter 1 Reading (m^3)			3061.8093	3061.8093	3061.8093	3096.22175	3128.66935	3159.961	3191.09175	3223.4816	3254.29755
Time			4:02 PM	3:33 PM	12:40 PM	3:00 PM	3:40 PM	3:41 PM	3:36 PM	4:25 PM	4:10 PM
Pressure (psi)											
Flow Meter 2 Reading (m^3)			2490.32	2490.32	2490.32	2507.504	2524.791	2541.3955	2557.795	2574.847	2591.051
Time			4:02 PM	3:33 PM	12:40 PM	3:00 PM	3:40 PM	3:41 PM	3:36 PM	4:25 PM	4:10 PM
Pressure (psi)											
Flow rate (m^3/day)			**0.000**	**0.000**	**0.000**	**47.025**	**48.390**	**47.863**	**47.696**	**47.815**	**47.515**
Rain Gauge 1 (mm)			0	0	12	1	0	0	4	18	12
Rain Gauge 2 (mm)			0	0	12	0	0	0	4	18	12
Average 24-h Rainfall			**0**	**0**	**12**	**0.5**	**0**	**0**	**4**	**18**	**12**
Weather			15 cloudy	9 cloudy	7 cloudy	9 p cloudy	13 sunny	7 cloudy	8 cloudy	8 rain	11 p cloudy
Trench W - water level (cm)			64.1	64.1	53.3	27.3	25.4	26.7	27.9	25.4	29.2
Trench E - water level (cm)			64.1	64.1	53.3	27.3	25.4	26.7	27.9	25.4	29.2
Comments					Water restarted @ 12:40 PM						
Line	#	Piezometer									
A	1	A-1	270	270	270	270	270	270	270	269	269
A	2	A-2	294	294	294	294	294	294	294	294	294
A	3	A-3	232	233	230	230	231	232	233	225	230
A	4	A-4	282	283	282	282	283	283	285	282	280
C	1	C-1	262	262	262	262	262	262	262	262	262
C	2	C-2	275	275	276	276	276	276	276	274	274
C	3	C-3	302	302	302	284	285	285	285	282	286
C	4	C-4	300	300	300	300	300	300	300	300	300
C	5	C-5	263	263	263	263	263	263	263	262	262
C	6	C-6	287	287	287	287	287	287	287	287	287
D	1	D-1	285	285	285	285	285	285	285	285	285
D	2	D-2	257	257	257	258	258	258	258	256	256
D	3	D-3	287	287	287	193	198	198	199	190	201
D	4	D-4	330	330	330	330	330	330	330	330	330
D	5	D-5	288	288	288	288	288	288	288	286	286
D	6	D-6	309	309	309	309	309	309	309	309	309
U	1	U-1	241	241	241	241	241	241	241	240	240
U	4	U-4	506	506	506	506	506	506	506	506	506
U	5	U-5	488	488	488	488	488	488	487	489	489
R	1	R-1	182	182	182	182	182	182	182	182	182
R	2	R-2	177	177	177	177	177	177	177	177	177
R	3	R-3	202	202	202	202	202	202	202	203	203
R	4	R-4	194	194	194	194	194	194	194	194	194

Groundwater Mounding Test -
Daily Input

Date:			10-Apr-24	11-Apr-24	12-Apr-24	13-Apr-24	14-Apr-24	15-Apr-24	16-Apr-24
Readings by:			RN	RN	RN	RN	RN	RN	RN
Flow Meter 1 Reading (m^3)			3271.9943	3271.9943	3271.9943	3271.9943	3271.9943	3271.9943	3271.9943
Time			3:40 PM	4:10 PM	3:53 PM	7:33 PM	4:45 PM	2:30 PM	3:46 PM
Pressure (psi)									
Flow Meter 2 Reading (m^3)			2607.187	2624.08	2640.186	2658.971	2673.56	2688.161	2705.658
Time			3:40 PM	4:10 PM	3:53 PM	7:33 PM	4:45 PM	2:30 PM	3:46 PM
Pressure (psi)									
Flow rate (m^3/day)			**34.553**	**16.548**	**16.298**	**16.295**	**16.516**	**16.111**	**16.620**
Rain Gauge 1 (mm)			19	6	6	0	0	0	0
Rain Gauge 2 (mm)			19	6	6	0	0	0	0
Average 24-h Rainfall			**19**	**6**	**6**	**0**	**0**	**0**	**0**
Weather			12 cloudy	7 rain	12 sunny	17 sunny	15 cloudy	10 cloudy	12 cloudy
Trench W - water level (cm)			48.3	57.2	57.2	56.5	54.6	54.6	57.2
Trench E - water level (cm)			48.3	57.3	57.2	56.5	54.6	54.6	57.2
Comments			Water shut pff at 5:45 AM						End of test
Line	#	Piezometer							
A	1	A-1	269	269	269	269	269	269	269
A	2	A-2	294	294	294	294	294	294	294
A	3	A-3	230	231	230	230	230	232	232
A	4	A-4	280	286	280	281	281	283	283
C	1	C-1	262	262	262	262	262	262	262
C	2	C-2	274	274	274	274	274	274	274
C	3	C-3	291	300	297	298	297	297	298
C	4	C-4	300	300	300	300	300	300	300
C	5	C-5	262	262	262	262	262	262	262
C	6	C-6	287	287	287	287	287	287	287
D	1	D-1	285	285	285	285	285	285	285
D	2	D-2	256	256	256	256	256	256	256
D	3	D-3	215	287	231	234	235	236	243
D	4	D-4	330	330	330	330	330	330	330
D	5	D-5	286	286	286	286	286	286	286
D	6	D-6	309	309	309	309	309	309	309
U	1	U-1	240	240	240	240	240	240	240
U	4	U-4	506	506	506	506	506	506	586
U	5	U-5	489	489	489	489	489	489	489
R	1	R-1	182	182	182	182	182	182	182
R	2	R-2	177	177	177	177	177	177	177
R	3	R-3	203	203	203	203	203	203	203
R	4	R-4	194	194	194	194	194	194	194

APPENDIX B – HYDRAULIC LOADING RATE CALCULATIONS

Determining HLR - #23049 OTG

Calcs by: SAC

Date: 26-Jul-24

Trench Length (m)	50	m	
Trench width (m)	0.9	m	
A = Trench AIS (m2)	45	m2	
Q (m3/day)	48.0	m3/day	
Q/A	1066.7	m/day	
dh	1.05	m	difference from trench elev @ MP and elev of water level in D3
L	7.5	m	distance between trench and D3
i	0.14		hydraulic gradient, I = dh/L
Kfs	7.62	m/day	Q=kiA
Min Kfs	761.9	cm/day	
Ksat	1523.8	cm/day	Ksat = 2 x Kfs
Max LLR	960	L/m/day	LLR = Q/trench length

Method 1

LTAR per effluent type	% flow rate	LTAR (L/m2/day)	From discussion w/ M. Payne
Type 2	4%	42.7	
Type 3	8%	85.3	

Method 2

BC SPM V2 Appendix G

Formula	HLR = F x Ksat ^0.25, Ksat = cm/day			HLR (L/m2/day)	
Effluent Type	F	P	Max limit P x Ksat (mm/day)	Calc	Limit
1	9	0.1		56.23	152.38
2	18	0.2		112.46	304.76
3	36	0.3		224.92	457.14

BOD (mg/L)	TSS (mg/L)	BOD + TSS (mg/L)	AISt/AISs	HLR (L/m2/day)
210	60	270	1.0	**56.2**
45	45	90	0.7	**81.1**
10	10	20	0.4	**133.9**
5	5	10	0.3	**168.7**

AISt = AISs x ((BODt + TSSt)/(BODs + TSSs))^1/3

where s = for Type 1 effluent

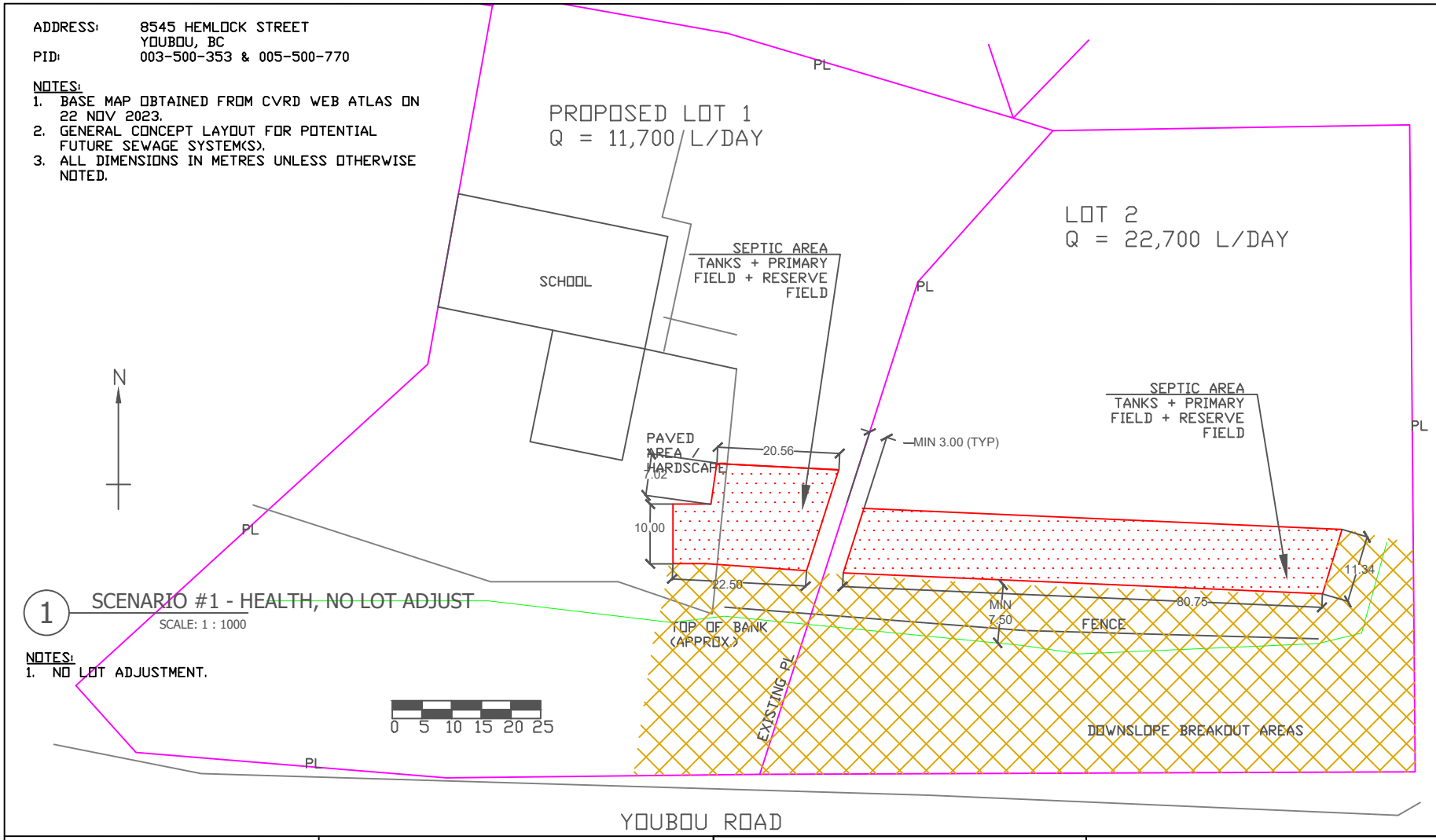
t = treated effluent

AIS = area of infiltrative surface

APPENDIX C – SCENARIO DRAWINGS

ADDRESS: 8545 HEMLOCK STREET
YOUBOU, BC
PID: 003-500-353 & 005-500-770

NOTES:
1. BASE MAP OBTAINED FROM CVRD WEB ATLAS ON 22 NOV 2023.
2. GENERAL CONCEPT LAYOUT FOR POTENTIAL FUTURE SEWAGE SYSTEM(S).
3. ALL DIMENSIONS IN METRES UNLESS OTHERWISE NOTED.



1 SCENARIO #1 - HEALTH, NO LOT ADJUST
SCALE: 1 : 1000

NOTES:
1. NO LOT ADJUSTMENT.

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
K. R. KARR
13207
2024-07-26
SEAL

Canadian Sewage Solutions Inc.

EGBC PERMIT TO PRACTICE
NO. 1000879

809 INDUSTRIAL WAY
VICTORIA, BC V9B 6E2
250-478-1158
WWW.SEWAGESOLUTIONS.COM

ISSUE LOG				REVISION/CHECK LOG			
NO	DATE	BY	REMARKS	NO	DATE	BY	REMARKS
				2	26 JUL 2024	SAC	REVISED LAYOUT
1				1	10 MAY 2024	SAC	PROPOSED LAYOUT

PROJECT: OTG LTAR TESTING

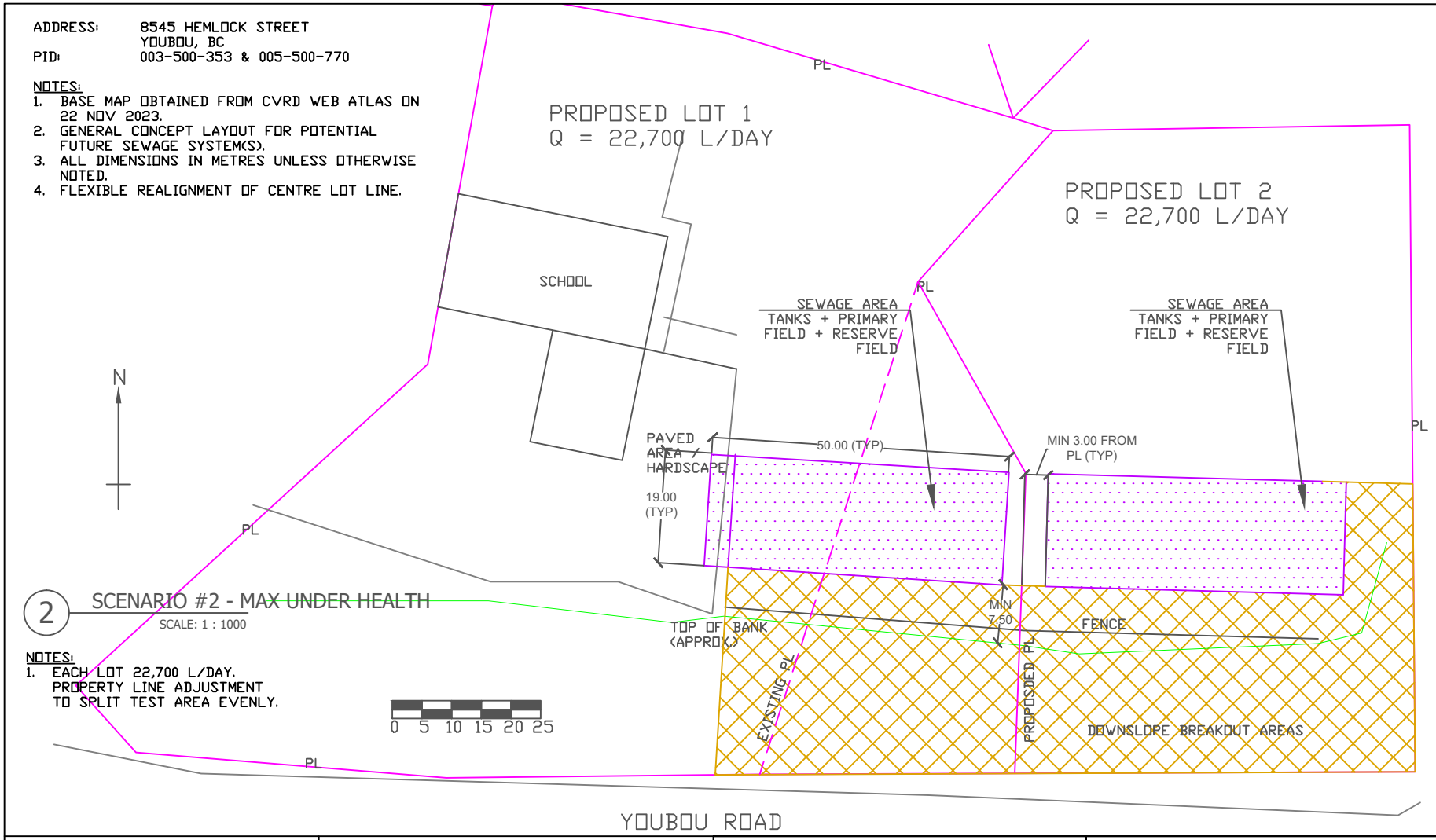
DRAING TITLE: SCENARIO #1 - NO LOT ADJUSTMENT - 34,400 L/DAY

CLIENT: OTG DEVELOPMENTS

SCALE:	SHEET SIZE:	SHEET:	DRAWING NO:
1 : 1000	A	1 OF 2	23049-02

ADDRESS: 8545 HEMLOCK STREET
YOUBOU, BC
PID: 003-500-353 & 005-500-770

NOTES:
1. BASE MAP OBTAINED FROM CVRD WEB ATLAS ON 22 NOV 2023.
2. GENERAL CONCEPT LAYOUT FOR POTENTIAL FUTURE SEWAGE SYSTEM(S).
3. ALL DIMENSIONS IN METRES UNLESS OTHERWISE NOTED.
4. FLEXIBLE REALIGNMENT OF CENTRE LOT LINE.



2 SCENARIO #2 - MAX UNDER HEALTH
SCALE: 1 : 1000

NOTES:
1. EACH LOT 22,700 L/DAY. PROPERTY LINE ADJUSTMENT TO SPLIT TEST AREA EVENLY.

0 5 10 15 20 25

PROFESSIONAL ENGINEER
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2024-07-26
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NO. 1000879

809 INDUSTRIAL WAY
VICTORIA, BC V9B 6E2
250-478-1158
WWW.SEWAGESOLUTIONS.COM

ISSUE LOG				REVISION/CHECK LOG			
NO	DATE	BY	REMARKS	NO	DATE	BY	REMARKS
				2	26 JUL 2024	SAC	REV LAYOUT
1				1	10 MAY 2024	SAC	PROPOSED LAYOUT

PROJECT: OTG LTAR TESTING

DRAING TITLE: SCENARIO #2 - 2 LOTS, 22,700 L/DAY EACH

CLIENT: OTG DEVELOPMENTS

SCALE:	SHEET SIZE:	SHEET:	DRAWING NO:
1 : 1000	A	2 OF 2	23049-02

APPENDIX D - REFERENCES

BC Ministry of Health - Health Protection Branch. (2014). *Sewerage System Standard Practice Manual Version 3*.

British Columbia Onsite Sewage Association. (2007). Appendix G: Design HLR. In *Sewerage System Standard Practice Manual Version 2.* BC Ministry of Health.

Download: Station Data. (2024, 01 17). Retrieved from ClimateData.ca: https://climatedata.ca/download/#station-download