



DEVELOPMENT PERMIT APPLICATION CHECKLIST

GREEN HAVEN ESTATES - SE 27-20-29 W4

The following requirements must be included with your Development Permit Application. Submissions without all necessary requirements will be deemed incomplete and will not be processed until all items have been included.

All plans shall be submitted as one (1) legible paper copy NO larger than 11x17 and/or in digital form (pdf)

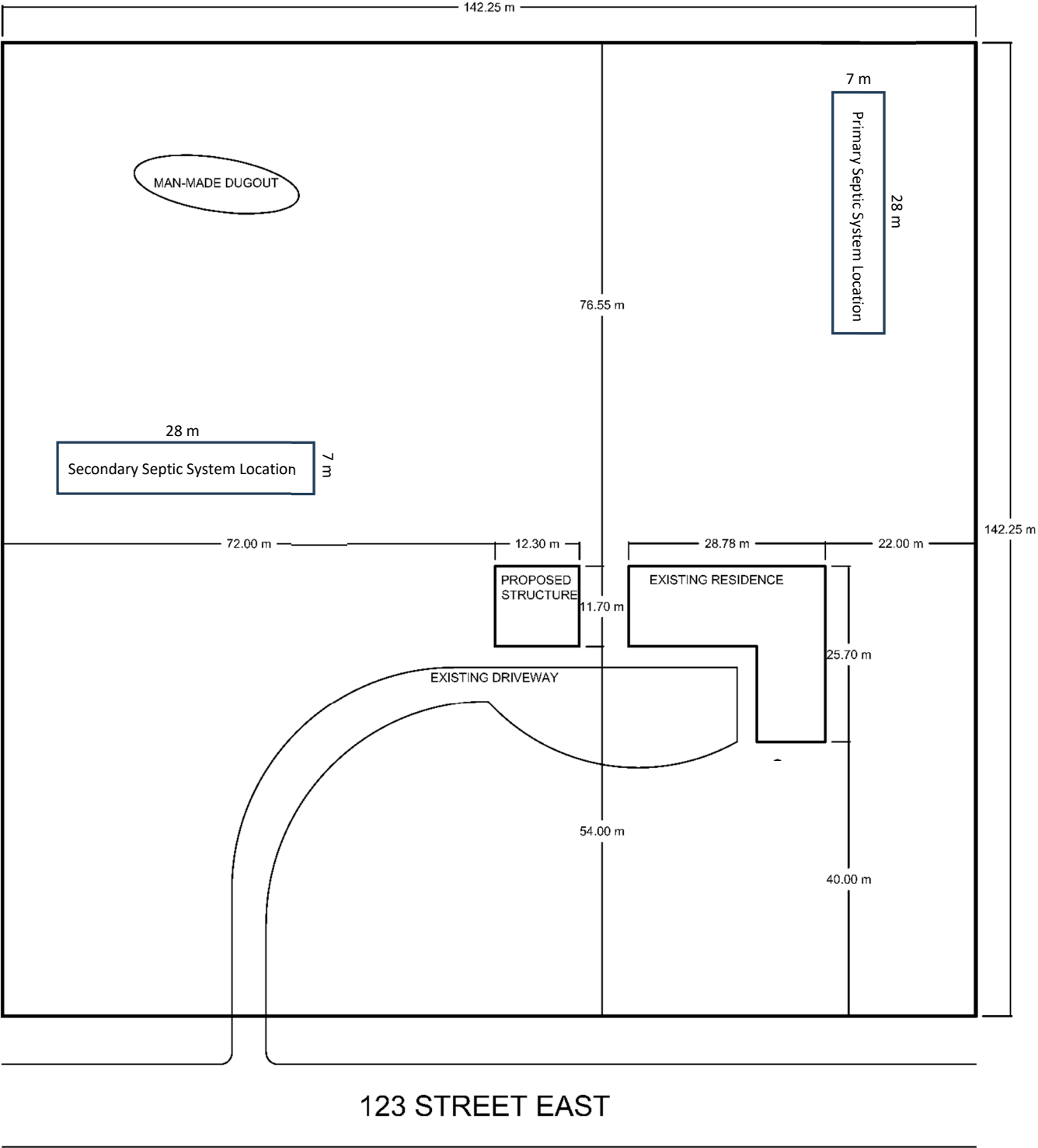
Please [v] all that are included within the submitted application package.

Complete Applications can be submitted to planning@foothillscountyab.ca

☐	Green Haven Estates Checklist Completed (attached) This checklist outlines additional information required for all Development Permit applications for parcels located within Green Haven Estates.
☐	Development Permit Application Form Completed The Development Permit Application form is to be completed in full and signed by the registered owner of the land.
☐	Development Permit Topic Sheet Requirements All information and documentation must be provided as per the Development Permit Topic Sheet specific to the use being applied for. To obtain the appropriate topic sheet please visit our website: https://www.foothillscountyab.ca/development/land-use/development-information-brochures-cheat-sheets
☐	Letter of Authorization (if required) Signed by the registered landowner(s) authorizing person(s) to act on their behalf.
☐	Affidavit or Corporate/Company Seal (if required) An affidavit or corporate seal is required when the registered owner and owner applicant identified on the certificate of title is listed as a corporation/company. If you have a seal, please affix your seal to every place where your signature is required.
☐	Application Fees Current Fees Schedule: https://www.foothillscountyab.ca/government/bylaws/fee-schedule-bylaw-672025
☐	Site Plan of the Proposed Development (example on reverse side of this page) The Site Plan must illustrate the following (if applicable): • site plan orientated so north arrow is at the top of page • the entire parcel and any other land that may be used in conjunction with the parcel for the proposed use. If additional lands are owned by others, you must include names and signed consent for proposed development; • dimensions/size of the parcel; • existing or proposed setbacks, easements, or rights of way; • the location of all existing and proposed buildings, dugouts, lagoons, culverts, approaches, and crossings that may be used in conjunction with proposed development; • dimensions and setbacks to property lines of all existing and proposed buildings and structures; • any significant natural features on or adjacent to the parcel; • identify adjacent roads and highways; and • identify proposed location of the septic system and a secondary alternative location for the septic system (both with dimensions).
☐	Abandoned Oil/Gas Well Form This form is to be completed in full and signed by the registered owner(s) of the lands or duly authorized applicant. This is a requirement of the Alberta Energy Regulator (AER).
☐	Other Requirements (attach separate page detailing additional submitted documentation) All requirements specific to the Development Permit in question must accompany the application. To determine other requirements please review Section 4.3 and Appendix A of the County's Land Use Bylaw 60/2014, which can be viewed on the County's website www.foothillscountyab.ca

NOTE: ADDITIONAL ITEMS MAY BE REQUESTED UPON RECEIPT AND REVIEW OF THE APPLICATION

EXAMPLE SITE PLAN:





Pre-Application Information: Green Haven Estates Development Permits

Foothills County – planning@foothillscountyab.ca

309 Macleod Trail, Box 5605, High River, AB T1V 1M7. Tel: 403-652-2341 Fax: 403-652-7880

Overview

To build a Single-Family Dwelling and/or Accessory Buildings in Green Haven Estates, a Development Permit is required before Building and Safety Codes Permits can be applied for, and before development can commence. This package has been created to assist you in your application process. The Development Permit application takes approximately 6-12 weeks to process, depending on several factors.

- Please contact the Architectural Review Consultant prior to making your Development Permit application
- Please contact our Planning & Development department if you have any more questions before applying
- Then, complete the application checklist and submit your application

Architectural Review Consultant – Contact Prior to Applying

Anne Ribano

anne@timbercreekhomes.ca

OR

Timber Star Inc. (c/o Blair Hann)

403-529-7817 or blairhann82@gmail.com

Application Checklist

Forms attached for completion:

1. Pre-Approval Form signed off on by the County's Public Works department for Municipal Water Servicing *(only required when additional water use/users are identified but does not include the first Dwelling Unit)*
2. Declaration of Understanding for Wastewater Servicing completed by both the landowner(s) and applicant(s)
3. Development Permit Application Form
4. Abandoned Well Sites form and map (see the link on the form to generate the map)
5. Payment of application fees (see Fee Bylaw on our website & ask our planning department if unsure of the amount)
6. \$5,000 compliance deposit (to be provided with the application OR after it is set as a pre-release condition)
7. Letter of Authorization (if applicable) and Affidavit Verifying Corporate Signing Authority (if applicable)

Obtain and include with your application:

8. A stamped plot plan (stamped by both the Architectural Review Consultant and Professional Engineer)
9. An executed County building grade slip/form (form that can be used is attached)
10. A site plan illustrating the proposed location of the septic system and a secondary alternative location for the septic system (both with dimensions). For applicable Phase 3 lots, the site plan also needs to clearly show that the proposed septic system locations will meet the required 100m setback to the production well located within Plan 2511078, Block 8, Lot 44PUL. For applicable Phase 4 lots, the site plan also needs to clearly show that the proposed septic system locations will meet the required 100m setback to the production well located within Plan 1210671, Block 3, Lot 2; specific area identified under R/W Plan 1210675.
11. For Phase 2B lots (excluding the 3 lots listed in below point 12), a septic design that meets the requirements of the Level IV Assessment Report completed by SD Consulting Group – Canada, Inc. on August 12, 2019 (attached). **Effluent Level 4 and N-1 N-11 as per Table 5.1.1.1. of the current Alberta Standard of Practice must be achieved.**
12. For these Phase 2B lots – Plan 2210304, Block 6, Lots 8-10, a septic design that meets the requirements of the Level II Private Sewage Treatment System Assessment for Subdivision completed by Groundwater Resources Information Technologies Ltd. on August 26, 2021 (attached);
13. For Phases 3-5 lots, a septic design that meets the requirements of the Level IV Private Sewage Treatment System Assessment for Subdivision Report completed by Groundwater Resources Information Technologies Ltd. on September 8, 2022 (attached). **Effluent Level 4 and N-1 N-11 as per Table 5.1.1.1. of the current Alberta Standard of Practice must be achieved .**
14. Building designs, including floor plan(s) and elevation drawings.

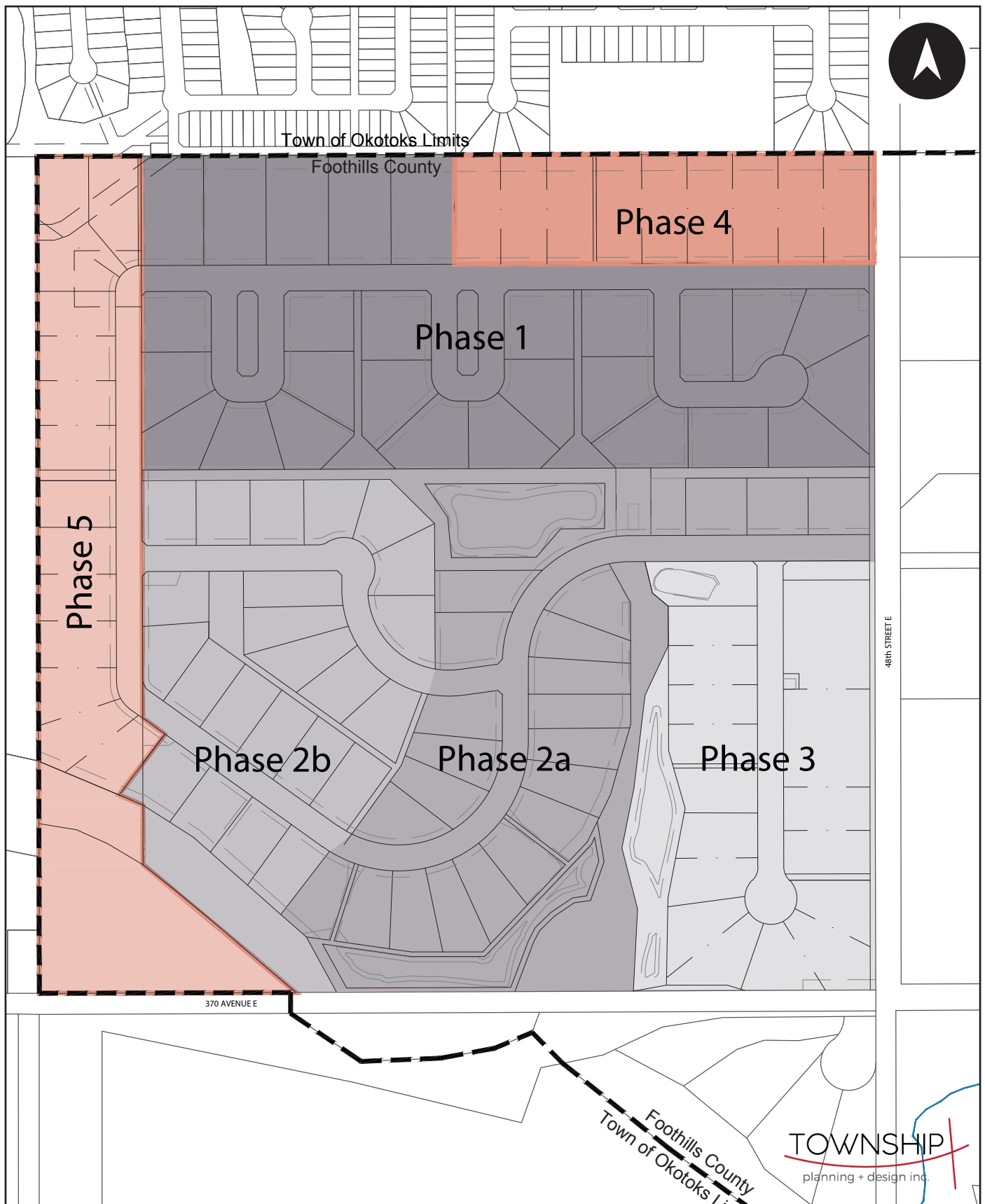
Ready to Submit?

Please submit a physical copy to our office OR email all materials to Planning@FoothillsCountyAB.ca. Emailed hard submissions must be legible.

General Disclaimers:

- It may be up to 20 days from the date of submission before you are contacted, as your file manager is assigned and reviews your materials
- Application materials and communications will be kept as part of a publicly available file
- Discretionary Use approvals will be publicly circulated and are subject to being appealed

Green Haven Estates - Phasing Plan





PRE-APPROVAL APPLICATION FORM
Municipal Water Servicing for Green Haven Estates

Foothills County
309 Macleod Trail, Box 5605, High River, AB T1V 1M7 Tel: 403-652-2341 Fax: 403-652-7880

The landowner(s) are responsible for contacting Kallum Umscheid or Patrick Antle (403-652-2341) of the County's Public Works department to obtain pre-approval for the proposed water connection(s) to service the proposed development.
This form is required to be completed in full and submitted with a site plan. Complete submission can be mailed in, hand delivered or emailed to planning@foothillscountyab.ca.
REGISTERED LANDOWNER(S) INFORMATION

Landowner(s) Name(s): _____

Applicant(s) Name(s) if different from Landowner(s): _____

Email(s): _____ Telephone: _____

Municipal Address: _____

Legal Description of Subject Parcel: Plan _____ Block _____ Lot _____
Quarter Section _____ Section _____ Township _____ Range _____ W ____ M

Description of proposed development: _____

☐ Site Plan attached, illustrating the subject parcel, the proposed location for the development, existing and proposed water connections internal to the site and existing and/or proposed curb stops.

☐ CONNECTION TO EXISTING WATER LINE WITHIN
SUBJECT PARCEL ☐ NEW CONNECTION TO WATER MAIN

FOR OFFICE USE ONLY

Public Works Has reviewed the submitted site plan for the proposed water connection required to service the proposed development and confirms the following:

☐ Pre-Approval of New Water Connection
Quote for Installation: _____
Comments:

☐ Refusal of new Water Connection
Reason(s):

Reviewed by: _____
Print Name Signature

Date: _____

Land Use Bylaw No. 60-2014

www.foothillscountyab.ca

309 Macleod Trail, Box 5605, High River, AB T1V 1M7 • Tel: 403-652-2341 Fax: 403-652-7880

FOR OFFICE USE ONLY

Fee Submitted: _____ Application No: _____

Receipt No.: _____ Tax Roll No: _____

Date Received: _____ Date Deemed Complete: _____

Applicant's Name: _____

Email: _____

Applicant's Mailing Address:

Telephone: _____

Legal Land Description: Plan _____, Block _____, Lot _____, LSD _____,

Quarter _____, Section _____, Township _____, Range _____, West of the _____ Meridian.

Registered Owner of Land:

Registered Owner Mailing Address: _____

Email: _____ Telephone: _____

Interest of Applicant if not owner of site:

I/We hereby make application in accordance with the plans and supporting information submitted herewith. (which forms part of this application). Please give a brief description of the proposed development, including name of development where applicable.

[illegible]

PART 3 SITE INFORMATION

Area Of Lot: (In Acres Or Hectares) _____

Size Of Proposed Building: _____ Height: _____

Is There A Dwelling (Residence) On The Site: Yes _____ No _____ If Yes, How Many? _____

Utilities Presently On Site: _____

Are There Sour Gas Or High Pressure Facilities On Site? _____

Utilities Proposed: _____

Other Land Involved In Application: _____

DISCLAIMER: Please note that the personal information collected on this form is authorized under the Municipal Government Act and is required for the purpose of the County's Planning and Development processes. This information may also be shared with appropriate government agencies and may also be kept on file by those agencies. The application and related file contents will become available to the public and are subject to the provisions of the Freedom of Information and Protection of Privacy Act (FOIP). if you have any questions about the collection and use of this information, please contact the FOIP Coordinator at 403-652-2341.

PART 4 DEVELOPMENT

Specify other supporting material attached that forms part of this application. (e.g., Site Plan, Plot Plan, Architectural Drawings, etc.):

Estimated Date of Commencement: _____ Estimated Date of Completion: _____

I, _____

hereby certify that I am:

☐ The Registered Owner; or☐ Authorized to act on behalf of the Registered Owner

Date: _____

RIGHT OF ENTRY

I, being the owner or person in possession of the above described land and any building thereon, hereby consent to an authorized person designated by Foothills County to enter upon the land for the purpose of inspection during the processing of this application.

Date

Signature of Owner or Authorized Agent

FOR OFFICE USE ONLY

1. Land use district: _____
2. Listed as a permitted/discretionary use: _____
3. Meets setbacks: _____ Yes _____ No If "NO", deficient in _____

4. Other information: _____

PART 5 DECISION

Date of Decision: _____ Date Application Accepted: _____

This Development Permit Application is:

- ☐ APPROVED
- ☐ APPROVED subject to the attached conditions
- ☐ REFUSED for the attached reasons

Notice of Decision Advertised: _____

Date of Issuance of Development Permit: _____

 Development Officer

NOTE: Development must commence within 12 months of the date of the Date of Issuance of the Permit and be completed within 24 months of the Date of Issuance, unless otherwise stated in the Development Officer's decision.



ABANDONED WELL SITES

Foothills County

309 Macleod Trail, Box 5605, High River, AB T1V 1M7 Tel: 403-652-2341 Fax: 403-652-7880

The location of oil and gas wells that are being drilled or are actively producing is evident, both from the surface and through a notation on the land title. Abandonment of an oil and gas well occurs by rendering the well incapable of flow and placing a cap over the casing approximately one meter below the surface. After surface reclamation is complete and a certificate is issued by Alberta Environment, the well site lease notation may be removed from the title. At this point, there is nothing visible on the surface or on the title to indicate the presence of an abandoned well.

Council and staff give serious consideration to information pertaining to abandoned well sites when evaluating applications for subdivision, land use amendment or redesignation, development permits, and building permits.



The Alberta government has recently introduced new requirements for developers and property owners relating to abandoned wells.

Effective November 1st 2012, subdivision and development applications must be accompanied by documentation from the Alberta Energy Regulator (AER) indicating the presence or absence of abandoned wells on-site. If abandoned wells do exist on-site, subdivision and development applications must show exactly where the wells exist, what the setback distances are (if setbacks are required) and how they have been taken into account. To assist applicants in collecting the required information, the AER has released an 'Abandoned Well Map Viewer' that provides the location, name of the licensee, and status of abandoned wells across Alberta. The viewer is available at:

<https://extmapviewer.aer.ca/AERAbandonedWells/Index.html>

Through use of the viewer, subdivision and development applications must now contain the following:

1. A map of the search area from the viewer and a statement that there are no wells in the project area or;
2. A list and map identifying the locations of abandoned wells within the search area, including the surface coordinates, as provided by the viewer or Information Services;
3. Written confirmation from the applicant that the licensee responsible for each well has been contacted and the exact well location confirmed;
4. A sketch of the proposed development incorporating the necessary setback area for each well;
5. If the development will result in construction activity within the setback area, a statement confirming that the abandoned wells will be temporarily marked with on-site identification to prevent contact during construction.

The AER Calgary Office can be contacted at:

AER Calgary (Head Office)

Suite 1000, 250 – 5th St. SW

Calgary, AB T2P 0R4

Phone: (403) 297-8311

Toll Free: 1-855-297-8377

Fax: (403) 297-7336

Email: inquiries@aer.ca

***This form shall accompany all applications for Land use,
Subdivisions, Development Permits and Building Permits.***

I, _____ being the registered
 Owner(s) or agent acting on behalf of the registered owner(s)
 of _____
 (Legal Description)

Do hereby confirm that I have done my due diligence as required by Alberta Municipal Affairs, Foothills County, and the AER by obtaining required information from the 'Abandoned Well Map Viewer" and/or through the AER Information Services, and hereby attach "Schedule A" containing a map of the search area from the viewer and a statement identifying that no abandoned well sites were noted on the above legal description.

 Owner/Agent
 DATED: this _____ day of _____, 20_____.

OR

If wells are listed on-site:

I, _____ being the registered
 Owner(s) or agents acting on behalf of the registered owner(s)
 of _____
 (Legal Description)

Do hereby confirm that I have done my due diligence as required by Alberta Municipal Affairs, Foothills County, and the AER, by obtaining required information from the 'Abandoned Well Map Viewer" and/or through the AER Information Services, and hereby attach "Schedule A" containing a list and map identifying the locations of abandoned wells within the search area, including the surface coordinates, written confirmation that I have contacted the licensee for each well and that the exact location of each well has been confirmed, a sketch of the proposed development incorporating the necessary setback area for each well, and a statement confirming that abandoned wells will be temporarily marked with on-site identification to prevent contact during construction, if the development will result in construction activity within the setback area.

 Owner/Agent
 DATED: this _____ day of _____, 20_____.

***This form shall accompany all applications for Land use,
 Subdivisions, Development Permits and Building Permits.***

(If Applicable)



LETTER OF AUTHORIZATION

I, (We)_____being the owner (s)

registered on the title of Lot_____Block_____Plan_____

NW/NE/SE/SW Section_____Township_____Range_____W_____M

give _____

permission to act on my (our) behalf for the purposes of the development permit application affecting the above noted property as submitted to Foothills County.

Date

Signature

Date

Signature

Date

Signature

Date

Signature

(If Applicable)

**Form 31.1
LAND TITLES ACT
AFFIDAVIT VERIFYING
CORPORATE SIGNING AUTHORITY**

I, _____ of _____ make oath and say:

1. I am an officer or a director of _____,
named in the within or annexed instrument (or caveat)
2. I am authorized by the corporation to execute the instrument (or caveat) without
affixing a corporate seal.

SWORN BEFORE ME at _____

in the Province of Alberta,

this _____ day of _____, 20____

(Signature)

A Commissioner for Oaths in and for the
Province of Alberta

Print Name _____

My commission expires _____, 20____



Credit Card Authorization Form

Foothills County

309 Macleod Trail, Box 5605, High River, AB T1V 1M7. Tel: 403-652-2341 Fax: 403-652-7880

www.foothillscountyab.ca

Visa

Mastercard

American Express
☐ **Assessment**
☐ **Gas**
☐ **Plumbing**
☐ **Business License**
☐ **Mapping**
☐ **PSDS**
☐ **Electrical**
☐ **Planning**
☐ **Other** _____

Card Holder Name:
Business Name:
Invoice #:
Amount:
VISA / MC / AMEX #:
Security Code # (back of card):
Expiry Date:
Phone:
Authorized Signature:

The personal information on this Credit Card Authorization form is collected for the purpose of processing payments. This information is being collected under the authority of section 33(c) of the Freedom of Information and Protection of Privacy Act (FOIP). Inquiries about the collection of this information should be directed to the Foothills County FOIP coordinator, P.O. Box 5605, High River, Alberta T1V 1M7. Telephone 403-652-2341.

For Foothills County Office Use Only	
Authorized by:	
Date:	
Receipt #:	



Credit Card Authorization Form

Foothills County

309 Macleod Trail, Box 5605, High River, AB T1V 1M7. Tel: 403-652-2341 Fax: 403-652-7880

www.foothillscountyab.ca

Visa

Mastercard

American Express
☐ **Assessment**
☐ **Gas**
☐ **Plumbing**
☐ **Business License**
☐ **Mapping**
☐ **PSDS**
☐ **Electrical**
☐ **Planning**
☐ **Other** _____

Card Holder Name:
Business Name:
Invoice #:
Amount:
VISA / MC / AMEX #:
Security Code # (back of card):
Expiry Date:
Phone:
Authorized Signature:

The personal information on this Credit Card Authorization form is collected for the purpose of processing payments. This information is being collected under the authority of section 33(c) of the Freedom of Information and Protection of Privacy Act (FOIP). Inquiries about the collection of this information should be directed to the Foothills County FOIP coordinator, P.O. Box 5605, High River, Alberta T1V 1M7. Telephone 403-652-2341.

For Foothills County Office Use Only	
Authorized by:	
Date:	
Receipt #:	



BUILDING GRADE
FORM

Project No: _____

Date: _____

MUNICIPAL ADDRESS		LOT	BLOCK	PLAN	
1/4 SECTION	TOWNSHIP	RANGE		MERIDIAN	
BUILDER		SUBDIVISION			PHASE
ADDRESS		DEVELOPER			
REPRESENTATIVE	PH.	CONSULTANT			

PROPOSED BUILDING GRADES

ALL ELEVATIONS ARE METRIC GEODETIC + _____

MAIN FLOOR ELEVATION _____
(TOP OF JOISTS)

FRONT ELEV. _____ REAR ELEV. _____
(FINISHED GRADE) (FINISHED GRADE)

FINISHED GRADE AT GARAGE _____

LOWEST ELEVATION OF WALKOUT CONCRETE WALL
(MAINTAIN MIN. 8 INCHES FROM FINISHED GRADE)

HIGHEST FINISHED GRADE AT WALKOUT (REAR ELEV.) _____

ACTUAL TOP OF FOOTING ELEVATION (ATF) _____

LOWEST PERMITTED TOP OF FOOTING ELEVATION (LTF)
(BOTTOM OF BASEMENT SLAB FROST WALLS ARE REQUIRED.) _____

SERVICES	FRONT	REAR	CENTER	REFER TO PLAN	SIZE (mm)	TYPE
WATER	☐	☐	☐	☐	_____	_____
SANITARY	☐	☐	☐	☐	_____	_____
STORM	☐	☐	☐	☐	_____	_____

COMMENTS	YES	NO
GROUNDWATER DRAIN TO STORM REQUIRED	☐	☐
GROUNDWATER DRAIN TO SUMP PUMP REQUIRED		
WATER PRESSURE REDUCING VALVE (PRV) REQUIRED	☐	☐
SERVICES INSTALLED TO ____m INSIDE PROPERTY	☐	☐
INSULATE SERVICES (PLASTISPAN HD OR DOW HI 40)	☐	☐
HIGH SULPHATE CONCENTRATIONS PRESENT IN THE SOIL SULPHATE RESISTANT CEMENT (TYPE 50) REQUIRED	☐	☐
ADDITIONAL SULPHATE REQUIREMENTS (SEE NOTE BELOW).	☐	☐
FOUNDATION SOIL BEARING INVESTIGATION CERTIFICATION REQUIRED	☐	☐
GEOTECHNICAL RESTRICTIONS APPLY (SEE GEOTECHNICAL REPORT)	☐	☐
UTILITY EASEMENTS AFFECT THIS LOT	☐	☐
ROAD, RAIL, AIRPORT NOISE HOUSE CONSTRUCTION REQUIREMENTS	☐	☐

FOOTING ELEVATION CHECK IS REQUIRED PRIOR TO POURING
ALL SUMP PUMPS TO BE CONNECTED TO STORM

NOTES

1. IT IS THE RESPONSIBILITY OF THE BUILDING TO ENSURE THE FOOTINGS ARE PLACED ON A PROPER BASE THAT IS FREE FROM FROST, EXCESSIVE MOISTURE AND DELETERIOUS MATERIALS AND HAVE APPROPRIATE FROST PROTECTION WHEN COMPLETED.

2. WHEN THE AIR TEMPERATURE IS BELOW 5 CELCIUS, IT IS THE RESPONSIBILITY OF THE BUILDER TO MAINTAIN NEWLY PLACED CONCRETE AT A TEMPERATURE OF NOT LESS THAN 10 CELCIUS FOR 72 HOURS AFTER PLACING.

3. THE INFORMATION CONTAINED HEREIN IS BASED ON THE APPROVED BUILDING GRADE PLAN FOR THIS SUBDIVISION. ANY DEVIATIONS FROM THIS PLAN MUST BE APPROVED. UN-AUTHORIZED DEVIATIONS WILL BE THE RESPONSIBILITY OF THE BUILDER.

4. THE SOIL IN THE TRENCHES BENEATH FOOTINGS FOR SEWER AND WATER MAINS SHALL BE COMPACTED BY TAMPING UP TO THE BASE OF FOOTING LEVEL, OR SHALL BE FILLED WITH CONCRETE HAVING A STRENGTH NOT LESS THAN 10 MPA TO SUPPORT THE FOOTINGS.

5. OTHER NOTES:

PLAN

LOT: _____ BLOCK: _____ PLAN: _____

LEGEND

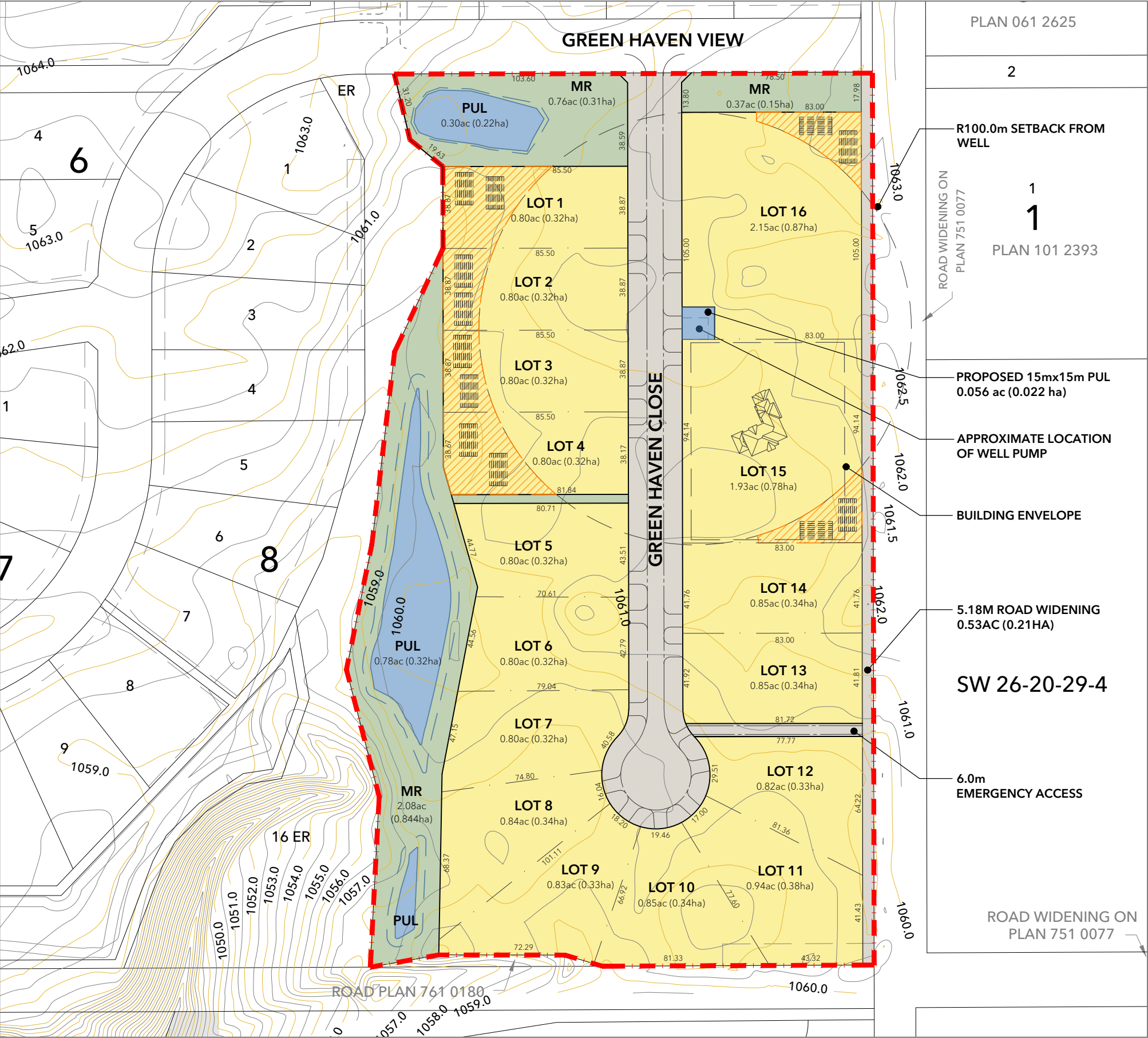
I, THE BUILDER'S REPRESENTATIVE, _____
CERTIFY THAT THE FINAL HOUSE PLANS PROVIDED IN THE BUILDING PERMIT APPLICATION ARE THE SAME AS PROCESSED UNDER THIS GRADE SLIP AND THAT I UNDERSTAND THE INFORMATION AND THE REQUIREMENTS CONTAINED HEREIN AND WILL BUILD ACCORDINGLY

AUTHORIZED BUILDER'S REPRESENTATIVE DATE

THE INFORMATION CONTAINED IN SECTIONS B, C, D, AND E IS BASED ON THE APPROVED BUILDING GRADE PLAN FOR THIS SUBDIVISION.

ISSUED BY DEVELOPER'S AUTHORIZED REPRESENTATIVE DATE

Phase 3 - Approximate 100m Setback to Production Well



STATISTICS		
Total Site Are	22.78ac	9.22ha
HR - Hamlet Residential District	15.53ac	6.30ha
MR - Municipal Reserve	3.11ac	1.25ha
PUL - Public Utility Lot	1.15ac	0.46ha
Roads & Road Widening	2.99ac	1.21ha
Possible Septic Location		
Possible Septic Field Location (field size 15.0m x 9.0m)		

CLIENT
2263582 ALBERTA LTD.

PROJECT NUMBER
20-042

LEGAL ADDRESS
SE ¼ SEC 27-20-29 W4M
FOOTHILLS COUNTY

DATE
January 20, 2022

PLAN 061 2625
2
1
PLAN 101 2393

PROPOSED 15mx15m PUL
0.056 ac (0.022 ha)

APPROXIMATE LOCATION
OF WELL PUMP

BUILDING ENVELOPE

5.18M ROAD WIDENING
0.53AC (0.21HA)

SW 26-20-29-4

6.0m
EMERGENCY ACCESS

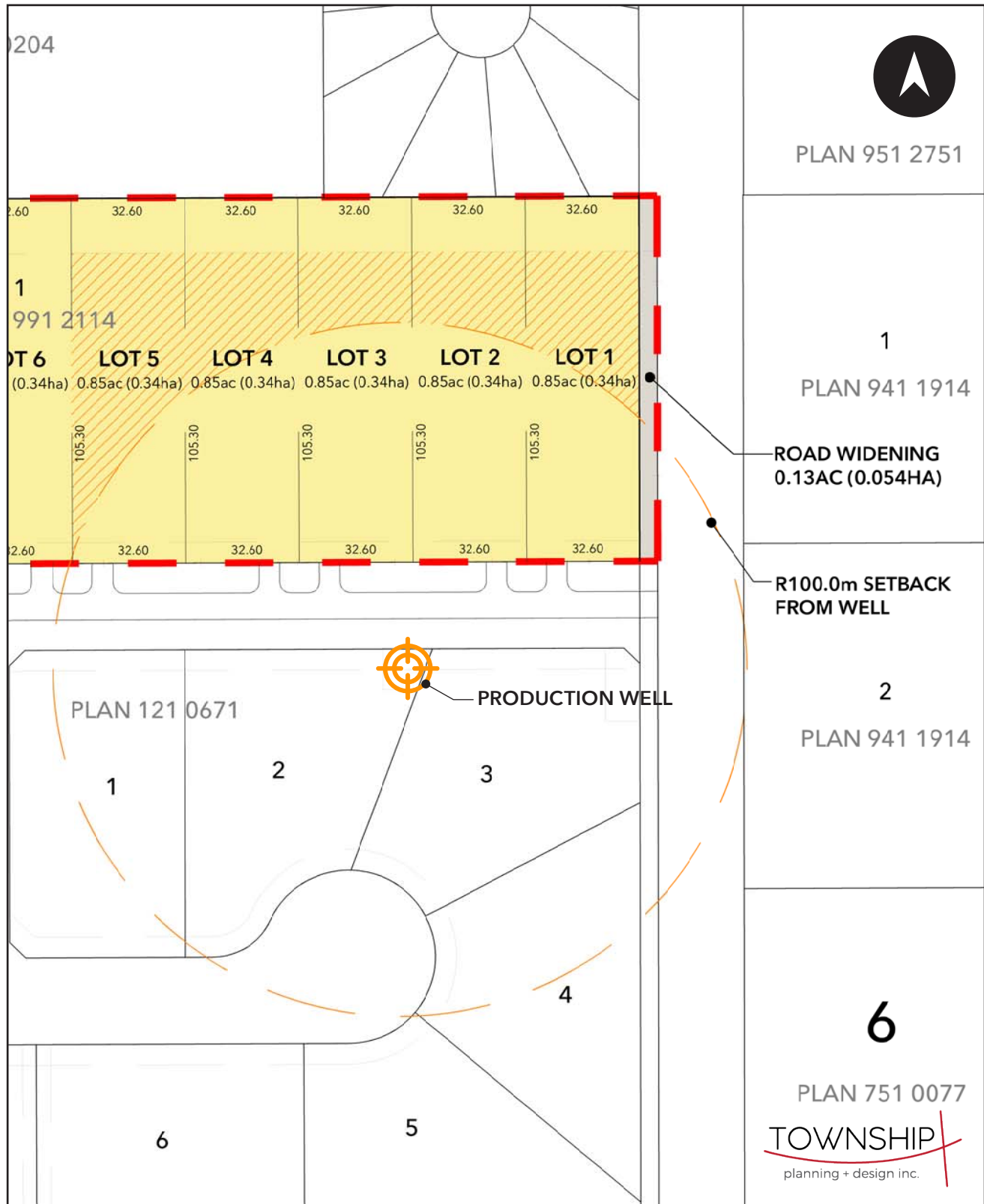
ROAD WIDENING ON
PLAN 751 0077

GREEN HAVEN PHASE 3
SUBDIVISION PLAN -19 LOT OPTION

SCALE
1:2000

SHEET
S1
OUTLINE PLAN

Phase 4 - Approximate 100m Setback to Production Well





LANDOWNER DECLARATION OF UNDERSTANDING

Wastewater Servicing

Green Haven Estates - SE 27-20-29 W4

Foothills County – planning@foothillscountyab.ca
309 Macleod Trail, Box 5605, High River, AB T1V 1M7. Tel: 403-652-2341 Fax: 403-652-7880

Landowners are required to review this Declaration of Understanding and then sign it before a Commissioner for Oaths. Commissioners are available at the County Office by appointment with the Planning Department.

REGISTERED OWNER(S) DECLARATION

This is to certify that the Landowner(s) namely:

Print Landowner Name

Print Landowner Name

I/(we) understand:

- a. A tertiary or equivalent package treatment plant to achieve Effluent Level 4 and N-1 N-11 as per Table 5.1.1.1. of the current Alberta Standard of Practice (section attached) must be the type of system installed to service our lot in Green Haven Estates. Further, for lots within the Phase 2B subdivision, the septic system must meet the requirements of the Level IV Assessment Report completed by SD Consulting Group – Canada, Inc. on August 12, 2019 (attached), and for lots within the Phases 3, 4 and 5 subdivisions, the septic system must meet the requirements of the Level IV Private Sewage Treatment System Assessment for Subdivision Report completed by Groundwater Resources Information Technologies Ltd. on September 8, 2022 (attached);
- b. Only applicable for Plan 2210304, Block 6, Lots 8-10 in the Phase 2B subdivision: the number of bedrooms within the Single-Family Dwelling shall not exceed 3, and the septic system must meet the requirements of the Level II Private Sewage Treatment System Assessment completed by Groundwater Resources Information Technologies Ltd. on August 26, 2021 (attached);
- c. Where an existing private sewage treatment system is being used for the proposed development, a certified septic designer/installer must confirm that the existing system can adequately manage the additional waste;
- d. Where a new private tertiary or equivalent package treatment plant is being proposed, or an addition to the existing system is proposed to service the proposed development, a certified septic designer/installer must confirm that the new or expanded system has been adequately sized to accommodate the additional waste, that the location is suitable, and that the proposed system meets the requirements of the reports noted above in points a. and b., if applicable. Effluent Level 4 and N-1 N-11 as per Table 5.1.1.1. of the current Alberta Standard of Practice must be achieved (section attached).

I/(we) declare to have read and understand the above requirements and have exercised due diligence to ensure that we meet these above noted requirements prior to making application for approval of the proposed development in Foothills County.

Sworn before me at the _____

of _____ in the Province

of Alberta this _____ day of _____, 20_____

Landowner Signature (Print Name Below)

A Commissioner for Oaths in and for the Province of Alberta

Sworn before me at the _____

of _____ in the Province

of Alberta this _____ day of _____, 20_____

Landowner Signature (Print Name Below)

A Commissioner for Oaths in and for the Province of Alberta



APPLICANT DECLARATION OF UNDERSTANDING
Wastewater Servicing
Green Haven Estates - SE 27-20-29 W4

Foothills County
309 Macleod Trail, Box 5605, High River, AB T1V 1M7. Tel: 403-652-2341 Fax: 403-652-7880

*Applicants are required to review this Declaration of Understanding and then sign it before a Commissioner for Oaths.
Commissioners are available at the County Office by appointment with the Planning Department.*

APPLICANT DECLARATION

This is to certify that the Applicant(s) namely:

Print Applicant Name

Print Applicant Name

I/(we) understand:

- a. A **tertiary or equivalent package treatment plant to achieve Effluent Level 4 and N-1 N-11 as per Table 5.1.1.1. of the current Alberta Standard of Practice (section attached)** must be the type of system installed to service the subject lot in Green Haven Estates. Further, for lots within the Phase 2B subdivision, the septic system must meet the requirements of the Level IV Assessment Report completed by SD Consulting Group – Canada, Inc. on August 12, 2019 (attached), and for lots within the Phases 3, 4 and 5 subdivisions, the septic system must meet the requirements of the Level IV Private Sewage Treatment System Assessment for Subdivision Report completed by Groundwater Resources Information Technologies Ltd. on September 8, 2022 (attached);
- b. **Only applicable for Plan 2210304, Block 6, Lots 8-10 in the Phase 2B subdivision:** the number of bedrooms within the Single-Family Dwelling shall not exceed 3, and the septic system must meet the requirements of the Level II Private Sewage Treatment System Assessment completed by Groundwater Resources Information Technologies Ltd. on August 26, 2021 (attached);
- c. Where an existing private sewage treatment system is being used for the proposed development, a certified septic designer/installer must confirm that the existing system can adequately manage the additional waste;
- d. Where a new private **tertiary or equivalent package treatment plant is being proposed**, or an addition to the existing system is proposed to service the proposed development, a certified septic designer/installer must confirm that the new or expanded system has been adequately sized to accommodate the additional waste, that the location is suitable, and that the proposed system meets the requirements of the reports noted above in points a. and b., if applicable. **Effluent Level 4 and N-1 N-11 as per Table 5.1.1.1. of the current Alberta Standard of Practice must be achieved (section attached).**

I/(we) declare to have read and understand the above requirements and have exercised due diligence to ensure that we meet these above noted requirements prior to making application for approval of the proposed development in Foothills County.

Sworn before me at the _____
of _____ in the Province
of Alberta this _____ day of _____, 20_____

Applicant Signature (Print Name Below)

A Commissioner for Oaths in and for the Province of Alberta

Sworn before me at the _____
of _____ in the Province
of Alberta this _____ day of _____, 20_____

Applicant Signature (Print Name Below)

A Commissioner for Oaths in and for the Province of Alberta

Part 5 Initial Treatment Components — Secondary Treatment

Section 5.1. Secondary Treatment

5.1.1. Secondary Treatment — Objectives and Design Standards

5.1.1.1. Secondary Effluent Treatment Qualities

- 1) Except as permitted in Sentence (2), an initial treatment component intended to produce secondary treated *effluent* shall, at least 80% of the time, produce an *effluent* quality that does not exceed the appropriate values set out in Table 5.1.1.1.¹

¹ Note: Sentence (1) — Level one treatment standard is equivalent to Primary Treatment. Thus, this table starts at Level 2.

Table 5.1.1.1. Secondary Treated Effluent					
Treatment Type ²	Maximum Concentration ¹ In Treated Effluent				
	Basic Treatment Level		Disinfection (D) ³	Phosphorus Reduction (P)	Nitrogen Reduction (N)
	TSS, mg/l	CBOD ₅ , mg/l	Fecal Coli, or E. coli, CFU/100 ml	Total Phosphorus, mg/l	Total Nitrogen
Level 2	30	25			
Level 3	15	15			
Level 4	10	10			
D-I			50 000		
D-II			200		
D-III			ND ⁴		
P-I				1	
P-II				0.3	
N-I					50% Reduction
N-II					75% Reduction

¹ No tolerances apply to these requirements, because the given values take into consideration the inaccuracy of the measurement.

² A system's overall treatment classification is denoted by the applicable treatment types written in sequence, i.e. Level 2-DII-NI.

³ Requirements for fecal coliform organisms or E. coli can be used for the purposes of Type D treatment. Reactivation after disinfection was not taken into consideration in establishing these requirements.

⁴ ND = non-detectable (median < 10 CFU/100 ml).



LEVEL IV ASSESSMENT REPORT

GREENHAVEN ESTATES

AUGUST 12, 2019

SD CONSULTING GROUP – CANADA, INC.

**Greenhaven Estates
MD of Foothills
Level IV Assessment Report
AAMDC Model Process**

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Introduction

At the request Scheffer Andrew and the Greenhaven Estates Development, SD Consulting Group-Canada, Inc (SD) has completed a Level IV assessment of Phase 2B of the Greenhaven Estates Development near Okotoks, Alberta. The goal of the assessment is to determine the suitability of each of the 23 lots for onsite wastewater treatment and disposal.

The proposed subdivision is in the SE 27, Twp. 20, Range 29, W4M. Specifically, Phase 2B is located within the existing Greenhaven Estates development, which is located NE of the intersection of 370 Ave and 48 St SE (See Figure 1). The development is located east of Seaman Stadium in Okotoks

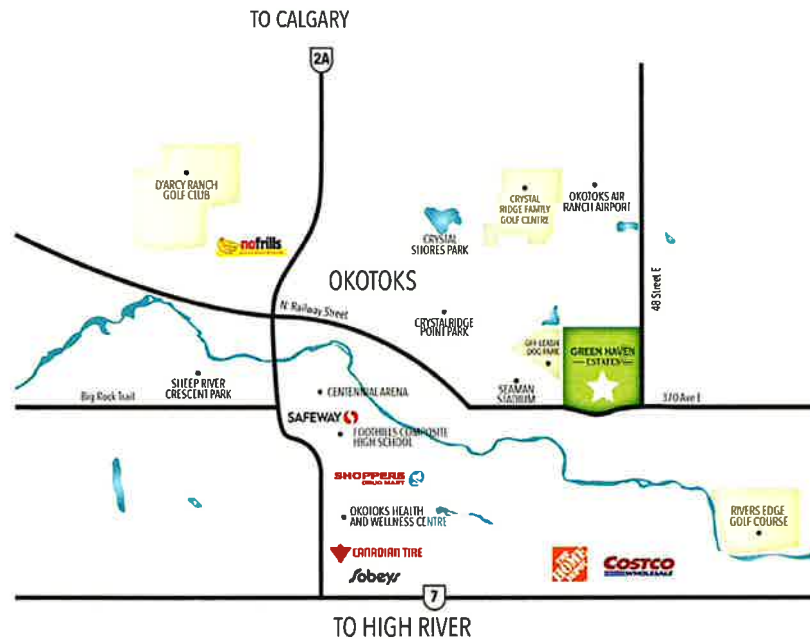


Figure 1: Location of Greenhaven Estates (Source: www.greenhavenokotoks.com)

Scope of Work and Methods

A Level IV Assessment involves field work activities, desktop studies and interpretation of data to determine the suitability of a particular development for the construction of individual onsite septic systems. The field work was completed on July 10th and 11th of 2019 and consisted of the following:

- Utility locates
- Site walkthrough and center lot staking (by others)
- Excavation and soil characterization of 23 backhoe pits (one on each lot)
- Soil samples for laboratory grain size analysis and textural classification
- Visual description of soil data, vegetation, topography, surface water/wetlands and general environmental site conditions

The suitability of the site was also assessed using the following resources:

- Alberta Private Sewage Systems Standard of Practice (Safety Codes Council, 2015) – The “SOP”

- The Model Process for Subdivision Approval and Private Sewage (AAMDC and Municipal Affairs, February 2011)
- Alberta Groundwater Information System
- Alberta Soil Information Viewer
- Soil Survey of the Calgary Urban Perimeter (Alberta Research Council Bulletin #54)
- Shallow Subsoil and Groundwater Investigation – Greenhaven Phases 2B, 4 and 5 (Almor Testing Services, June 2017)

Background Information

Greenhaven Estates is an existing development near Okotoks consisting of 49 single family homes in Phases 1 and 2. Phase 2B, which is specific to this report has 23 proposed lots, and there are three additional phases planned for later in the development process. Each of the existing lots is serviced by an onsite treatment and disposal system.

Potable water is provided to the development through two groundwater wells licensed by Alberta Environment and Parks (00383019-00-00). The wells are located at a depth of approximately 50 meters and are licensed to withdraw from an aquifer connected to the Sheep River. The location of the groundwater wells and water treatment plant is provided in **Figure 2**.

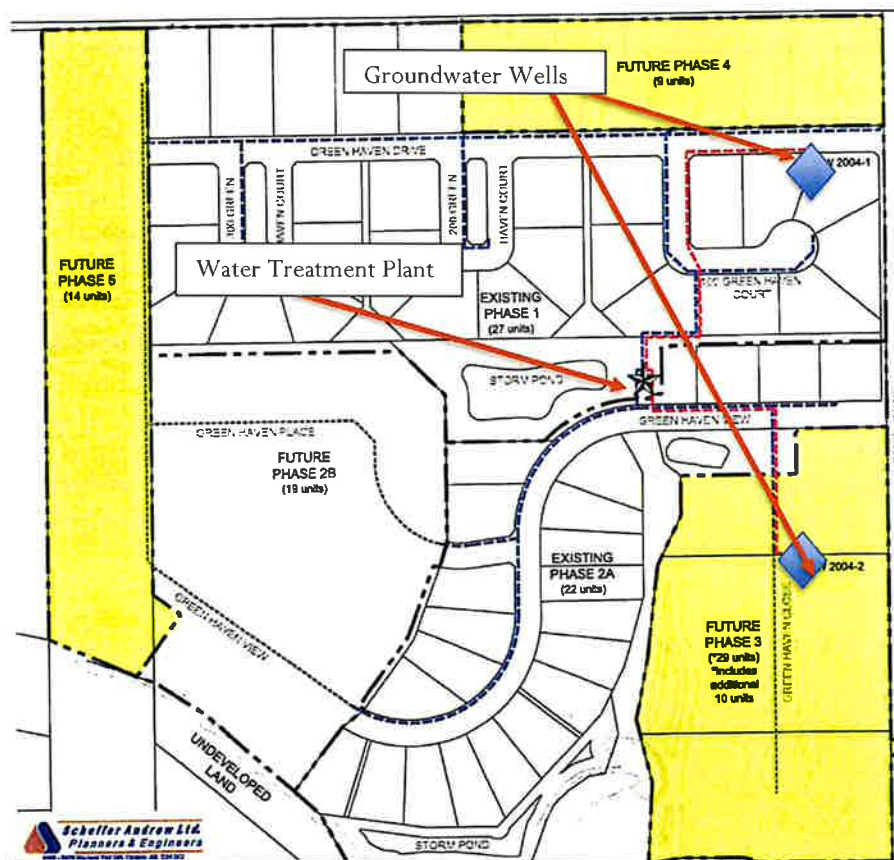


Figure 2: Groundwater Well Locations

Environmental Conditions

Vegetation

The natural areas in the proposed subdivision are dominated by prairie grasses and wildflowers. Invasive species, such as Canada Thistle, are also thriving in the disturbed areas.

Topography, Surface Water and Drainage

Phase 2B of the development is relatively level with no obvious drainage courses or wetlands. Immediately southwest of the Phase 2B development the site drops off steeply towards Okotoks, but this area is outside the development boundaries.

Nearby Groundwater Wells

According to Alberta's Groundwater Information System, 74 groundwater wells are located within 1.6 km of the proposed subdivision, including the two potable water supply wells mentioned previously in this report. A list of all the nearby groundwater wells is provided in **Attachment A** and additional information on the groundwater wells is provided in later sections of this report.

Density

The density of the proposed subdivision is consistent with surrounding developments. The nearby residences appear to be serviced by onsite septic systems or pump-outs. A regional sewer line is not located within the proximity to the proposed development.

Background Soil and Geologic Data

The geologic profile of the site was characterized by a review of local well logs and geotechnical reports previously completed for the subdivision. A typical surficial profile at the site consists of approximately 3-10 meters of glacial drift (mostly clay soils) over bedrock. The first bedrock unit encountered is the Dalehurst Member, which consists of shale and siltstone with sandstone seams.

According to Alberta's soil information viewer, soils on the site are characterized as orthic black chernozems of the Dunvargan Series. These soils are characterized by well drained black loamy soil that forms over till deposits in grassland areas. Topsoil is typically fertile and rich in humus while subsoils are lightly colored and lime-rich.

Soil Investigation and Suitability for Onsite Septic Systems

During the site investigation, 23 test pits were excavated on the site and soils were characterized according to their color, texture, structure, consistency, vegetative growth, and evidence of seasonal saturation (redoximorphic features). Soil pit locations are shown on the site plan in **Attachment B** and detailed soil characterization logs are provided in **Attachment C**.

Soils across the site are generally consistent and characterized by loam topsoil over clay loam subsoil. The subsoil, which is encountered at a minimum depth of 80 cm onsite is derived from glacial till with up to 20% coarse fragments. A summary of the conditions on the lots is provided below and represented visually in **Figure 3**.

A summary of soil conditions is presented below:

- Lots 8, 9 and 10 (Block 6) – These lots are entirely covered with disturbed fill soils, which is visible in the aerial photo shown in **Figure 4**. It appears that there must have been some laydown or construction activity in this area. These lots will require holding tanks for onsite wastewater management.
- Lots 6, 7 and 8 (Block 7) – There is a stockpile of some type of soil on these lots, but native soils were encountered on the northern half of these lots.
- The soils on the remaining 17 lots are in native condition and have no restrictions for onsite septic systems.

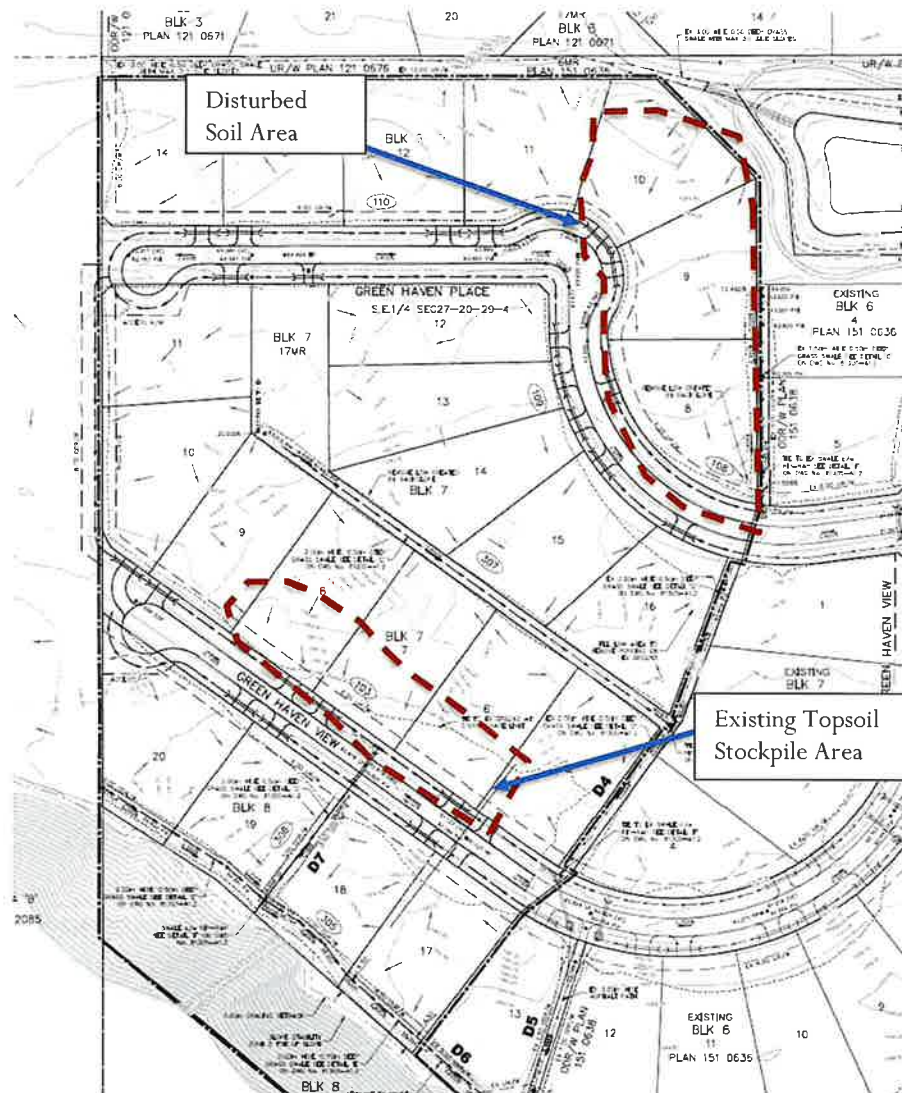


Figure 3: Phase 2B Soil Conditions



Figure 4: Aerial Photo of Phase 2B Development

Soil Lab Results

With the exception of the fill soils, soil samples were taken from most lots and taken to Element for grain size analysis and textural determination. The reports from the lab are provided in **Attachment D** and a summary of the lab results is provided in **Table 1**.

Table 1: Soil Texture Information

Test Pit	Block/Lot	Sample Depth (cm)	Soil Texture
66	B7/16	70	Loam
67	B7/15	70	Clay Loam
68	B7/14	70	Clay Loam
69	B7/13	70	Loam
70	B7/12	70	Loam
71	B7/11	70	Clay Loam
72	B7/10	70	Sandy Loam
74	B7/8	70	Sandy Loam
75	B7/7	70	Loam
76	B7/6	70	Loam
77	B7/5	70	Loam
78	B8/17	70	Loam
79	B8/18	70	Loam
80	B8/19	70	Sandy Loam
81	B8/20	70	Loam
82	B6/8	70	Loam
85	B6/11	70	Clay Loam
86	B6/12	70	Clay Loam
88	B6/14	70	Clay Loam

Hydraulic Conductivity Testing

The infiltration rate of the site was determined using the MPD (Modified Philip Dunne) Infiltrometer, which is a falling head test used to determine saturated hydraulic conductivity. Shallow trenches were dug on three of the lots, at a depth of approximately 40 cm, and the soils were analyzed to determine the in-situ infiltration rate. A summary of the test results is provided in **Table 2** and reports are provided in **Attachment E**.

Table 2: Infiltrometer Results

Test Name	Infiltration Rate
73	288 mm/hr. (6.9 m/day)
79	63 mm/hr. (1.5 m/day)
70	286 mm/hr. (6.86 m/day)

Preliminary Septic System Sizing

Four bedroom homes are proposed on each lot. Using standard sizing criteria specified in Alberta's Private Sewage Standard of Practice, this results in a population of 6 people per home. Using a design flow factor of 75 imperial gallons per day per person (also required in the SOP), a design flow of 450 igpd is calculated for each onsite wastewater system.

A soil loading rate of 0.45 igpd/ft is appropriate for the site considering the moderately well-structured loam and clay loam subsoils. Using this loading rate, a flow of 450 igpd and applying appropriate safety factors, a total area of 232 m² is required on each lot for subsurface disposal. An additional 232 m² is required for reserve area.

Example primary and reserve areas on each lot are shown on the site plan in **Attachment B**. With the exception of lots 6, 7, 8 (Block 7) and lots 8, 9, 10 (Block 6), the primary and reserve areas can be located anywhere on the lots. During the time of home construction, the designer/installer will locate these sites in the appropriate position pending the location of the home and driveway. The locations shown in Attachment are for reference only and should not be considered a final location.

Groundwater Conditions near Development

The Alberta Groundwater Information System was utilized to assess groundwater conditions in the vicinity of the development and the presence of any surficial aquifers that may be impacted by the proposed development. 74 domestic groundwater wells were identified within 1.6 km of the proposed project, two of which provide domestic water supply to the Greenhaven Development.

Based on this review of local well logs, a typical subsurface geological profile on this site consists of approximately 3-10 meters of surficial materials before alternating layers of shale and sandstone bedrock are encountered. Domestic use aquifers are present in the sandstone seams, which are often protected from surficial impacts by shale and clay aquitards. The review of nearby well logs did not identify the presence of any unconsolidated surficial aquifers that would be under the impact of surface waters or the proposed onsite wastewater systems.

Groundwater Mounding Potential

At the proposed disposal site, the soil profile is composed of loam and clay loam soils. A water table was not encountered during the recent soil investigation, and groundwater has not been identified in the standpipes that were installed to a depth of 2.5 meters. To effectively determine an estimated groundwater mound height without the presence of a water table, the Khan Equation is typically used.

The Khan Equation is summarized in a report by the Colorado School of Mines that is also referenced in the Alberta Standard of Practice ("Guidance for Evaluation of Potential Groundwater Mounding Associated with Cluster and High Density Wastewater Soil Adsorption Systems"). The theory behind the Khan method is that a groundwater mound will not form if the overall system loading is less than the saturated hydraulic conductivity of the limiting layer. In this case, the limiting layer is the clay loam horizon observed at approximately 1 meter below ground surface. According to the UNSODA Unsaturated Soil Hydraulic Database User's Manual published by the USEPA, the hydraulic conductivity of silty clay loam is 6.24 cm/day (Figure 5).

TABLE 4. Default Initial Estimates of Selected Parameters in Models for Unsaturated Hydraulic Functions [after Carsel and Parrish, 1988]

Texture class	θ_r	θ_s	α 1/cm	n	K_s cm/d
Sand	0.045	0.43	0.145	2.68	712.80
Loamy sand	0.057	0.41	0.124	2.28	350.16
Sandy loam	0.065	0.41	0.075	1.89	106.08
Loam	0.078	0.43	0.036	1.56	24.96
Silt	0.034	0.46	0.016	1.37	6.00
Silt loam	0.067	0.45	0.020	1.41	10.80
Sandy clay loam	0.100	0.39	0.059	1.48	31.44
Clay loam	0.095	0.41	0.019	1.31	6.24
Silty clay loam	0.089	0.43	0.010	1.23	1.68
Sandy clay	0.100	0.38	0.027	1.23	2.88
Silty clay	0.070	0.36	0.005	1.09	0.48
Clay	0.068	0.38	0.008	1.09	4.80

Figure 5: Soil Hydraulic Conductivity

Using the peak wastewater flow 450 imperial gallons per day, the overall loading to the each drainfield (approximately 232 m²) is 0.9 cm/day. Since the overall loading is less than the hydraulic conductivity of 6.24 cm/day, a groundwater mound is not predicted to form beneath the proposed drainfield on each lot.

It should also be noted that infiltrometer testing completed on the site resulted in hydraulic conductivity values ranging from 1.5 – 6.9 m/day. These values also exceed the overall loading and provide further evidence that each lot has the ability to adequately infiltrate effluent from onsite septic systems.

Due to the size of each lot, rapid hydraulic conductivity values and the limited volumes of water disposed of on each site, the onsite wastewater disposal fields are unlikely to interfere with each other, so a cumulative view of groundwater mounding is not necessary for this site.

Cumulative Nutrient Impacts

Each lot will be serviced by a secondary wastewater treatment system designed to reduce BOD and TSS levels in the effluent to levels less than 25 mg/l. Although some nutrient removal will occur in the septic tanks and the treatment system, most of the total nitrogen and ammonia in the wastewater will pass through treatment and reach the disposal system. Therefore, nitrogen and phosphorus removal must be accounted for in the assessment of the cumulative impacts.

Phosphorus is only mobile in saturated soils and will tend to bind to the subsurface soils in, or near, the drainfield. Phosphorus is also only mobile in the presence of shallow unconfined aquifers with rapid hydraulic conductivities. Since the soils at this development are primarily clay loams and an unconfined surficial aquifer is not present, it is expected that all the phosphorus in the effluent will bind to the soil surfaces. Surface water impacts from phosphorus are also not predicted from the onsite wastewater treatment systems.

Nitrogen loading from onsite wastewater systems can be assessed by a dilution mass balance approach. The following equation is used:

Equation 1: Nitrogen Concentration Mass Balance (Source: MN LSTS Guidance, 2013)

$$C_0 = (Q_B * C_B) + (Q_S * C_S) + (Q_I * C_I) / Q_B + Q_S + Q_I$$

Where C_0 = output concentration of nitrate

Q_B = flow entering the system across the upgradient (background) area

C_B = upgradient nitrate concentration

Q_S = flow entering the system from the septic system drainfield

C_S = concentration of total nitrogen in the septic effluent

Q_I = flow entering the system from infiltration of precipitation

C_I = concentration of nitrates in the infiltrate

A surficial aquifer is not present at this site, so Q_b and C_b have values of zero. Other variables are defined below:

- Q_x = 450 imperial gallons/day
- C_s = 40 mg/l (assumed total nitrogen concentration as required in Model Process Guidance Documents)
- Q_i = 1,230 m³, or 270,562 imperial gallons (assumed 40.6 cm/year of precipitation over 1.5 acres with a 50% infiltration rate) = 741 igpd.
- C_i = 1 mg/l (textbook value, Wehrman, 1983)

Based on these variables, the projected nitrogen concentration at each downstream lot boundary is 15 mg/l. It should be noted that this nitrogen value assumes peak flow every day at a peak nitrogen concentration of 40 mg/l. In reality, flows will be closer to 50% of the peak flow on most days and nitrogen concentrations could be lower than 20 mg/l depending on the selected treatment technology. Finally, this assessment technique does not account for evapotranspiration and denitrification in the soil profile. Both of these processes will further reduce nitrogen concentrations in the soil to a point where cumulative impacts are not likely.

Groundwater Level in the Soils

Groundwater was not observed in the soil pits and was also not observed in any of the piezometers that were installed to depths of 2.5 meters. However, groundwater was observed at depths of ~3 meters during the geotechnical investigation and redoximorphic features, or mottling, which both indicate the presence of a seasonal water table were present in the soils. These features were encountered at a minimum depth of 0.9 meters, which is still within the requirements of the Standard of Practice for onsite wastewater treatment systems utilizing secondary treatment. Therefore, the seasonal water table (when present) does not form a limiting condition for the construction of onsite wastewater systems in the development.

Surface Water Impacts

There are no wetlands in Phase 2B of the development. The nearest water body is a stormwater pond located northeast of Phase 2B (but still in the development) and the Sheep River, which is located approximately 700 meters south of the southern edge of Phase 2B. Any potential impacts to these water bodies are mitigated by the following:

- Each home will utilize secondary treatment technologies to produce a high quality effluent
- Phosphorus will be retained in the onsite soils and is not mobile without the presence of a surficial aquifer
- Nitrogen concentrations will be reduced by a combination of the following:
 - Secondary treatment technologies capable of partial nitrification
 - Denitrification
 - Evapotranspiration
 - Dilution with precipitation

Potable Water Characteristics – Long-Term Impact on Performance

Potable water will be provided to the development through a connection with the existing water system, which provides treated water originating from the Sheep River. With most potable water sources, the contaminant of concern to onsite wastewater soil disposal systems is the Sodium Adsorption Ratio (SAR). High SAR values in potable water will pass through the treatment process, reach the disposal system and then bind to fine textured soils. This chemical process will eventually cause smearing of the clay surfaces and a near, or total, loss of infiltrative capacity.

Source water quality data from the water treatment plant was analyzed and an SAR of 7.1 was calculated. This is a relatively high SAR and should be considered in the overall sizing of the wastewater system and potential point of use treatment requirements. However, it can also be assumed that the water treatment plant will reduce this SAR by the filtration process, and point of use reverse osmosis treatment can be installed in the home to further reduce SAR going into the wastewater system.

Parcel Suitability Review and Conclusions

Based on the site investigation, data review, hydraulic conductivity testing and lab analysis, a review of the parcel suitability was completed and is summarized in **Table 3**. In summary, the site is suitable for the development of onsite septic systems. Some lots are not suitable due to fill soils, but holding tanks would be acceptable options on these lots pending further investigation. The remainder of the lots can be serviced by individual onsite systems, which will provide a long term solution to the wastewater servicing of the development. However, individual designs will be required for each lot and a certified contractor will be required to install each system, per applicable requirements and regulations, at the time of home construction.

Table 3: Parcel Suitability per AAMDC Requirements for Level IV Assessment

Variable	Site Suitability Type	Description
Soil Structure	Type 2	Soils have moderate structure, but medium texture
Depth of Suitable Soil	Type 2	Soils are moderately suitable to a depth of 2.5 meters
Hydraulic Capacity of Soil	Type 2	Well drained soils
Soil Horizons	Type 1	Soil horizons are well developed, and soil testing indicates a relatively rapid downward movement of water through the horization.
Depth to Water Table	Type 3	Presence of seasonal saturation with 2.5 meters of surface cover

Topography	Type 1	Very level site with minor undulations
Flooding	Type 1	Site is well above floodplain of Sheep River
Density	Type 3	Density in surrounding development is >30 parcels per ¼
Encumbrances	Type 1	Sufficient setbacks are available on each lot for primary and reserve areas.
Parcel Size	Type 1	Parcels are of a sufficient size for primary and reserve drainfields.
Surface Water	Type 1	Limited surface waters in the area with the exception of the development's stormwater pond.

Summary

All 23 lots of Phase 2B of the Greenhaven Estates development are suitable for the construction of an onsite wastewater system. Onsite treatment and disposal is feasible on 20 of the lots and the remaining 3 are only suitable for holding tanks due to compacted and fill soils.

Of the 23 lots, only Lots 8, 9 and 10 (Block 6) present problematic conditions that make the construction of onsite septic systems difficult. Based on the results of this investigation, it has been determined that soils are not suitable on these lots. However, during home construction, the certified designer may identify areas for onsite septic that were not identified during our investigation. In the event that suitable soils can not be found on these lots, holding tanks would be the only suitable option.

Cumulative impacts are also not predicted on the site, primarily due to the well-drained nature of the soils and the high quality effluent that will be disposed into the soil from the secondary treatment systems. From a site suitability perspective, the site would be considered a Type1 or Type 2. The only Type 3 suitability factors are due to the density and the potential for seasonal groundwater saturation. However, both of these criteria can be addressed with secondary treatment system and/or the construction of mounds for soil disposal.

Corporate Authorization

This report titled "Level IV Assessment Report – Greenhaven Estates (August 12, 2019)" was prepared by SD Consulting Group – Canada for the sole use of the Greenhaven Estates Development. The information and conclusions in this report reflect's SD's best judgement based on information available at the time of the field investigation and report. I hereby certify that this report was completed by me, or under my direct supervision.



Digitally signed by Shane Sparks
 DN: cn=Shane Sparks, o=SD
 Consulting Group, ou,
 email=shane.sparks@sd-
 Consultinggroup.com, c=US
 Date: 2019.08.12 13:30:33 -06'00'

Attachment A – Groundwater Well Information



Reconnaissance Report

[View in Metric](#)
[Export to Excel](#)

Groundwater Wells

Please click the water Well ID to generate the Water Well Drilling Report

GIC Well ID	LSD	SEC	TWP	RGE	M	DRILLING COMPANY	DATE COMPLETED	DEPTH (ft)	TYPE OF WORK	USE	CHM	LT	PT	WELL OWNER	STATIC LEVEL (ft)	TEST RATE (gpm)	SC DIA (in)
125876	SW	26	20	29	4	UNKNOWN DRILLER		110.00	Chemistry	Domestic	1			MOORE, RON	100.00		0.00
125877	SW	26	20	29	4	UNKNOWN DRILLER		100.00	Chemistry	Domestic	1			STIRLING, J.M.			0.00
133756	8	22	20	29	4	UNKNOWN DRILLER		80.00	Chemistry	Unknown	1			RIVERCREST RANCHES			0.00
133762	NW	23	20	29	4	C.H. NELSON DRILLING LTD.	1976-04-27	98.00	New Well	Domestic		5		HERMAN, J.	75.00	5.00	0.00
133763	NW	23	20	29	4	UNKNOWN DRILLER		16.00	Chemistry	Domestic	1			RIVER BEND CAMPGROUND			0.00
133791	SW	26	20	29	4	GOODISON WATER WELL DRILLING	1975-04-01	130.00	New Well	Domestic	3	3		LANE ENT LTD	111.00	10.00	0.00
133791	SW	26	20	29	4	GOODISON WATER WELL DRILLING	1975-04-01	130.00	New Well	Domestic	3	3		LANE ENT LTD	110.00		0.00
133792	SW	26	20	29	4	GOODISON WATER WELL DRILLING	1975-04-01	143.00	New Well	Domestic		3		LANE, MILT	113.00	10.00	0.00
133793	SW	26	20	29	4	GOODISON WATER WELL DRILLING	1978-05-09	145.00	New Well	Domestic		8		BLOOME, L.	115.00	10.00	5.56
133794	NW	26	20	29	4	NORTHERN WATER SUPPLY CO.	1976-01-21	135.00	New Well	Domestic & Stock		8		SHARPE, J.G.	108.00	16.00	5.50
133795	NW	26	20	29	4	INTERPROVINCIAL DRILLING CONTRACTORS	1974-01-25	90.00	New Well	Domestic		8		MACKEVIC, TONY	50.00	10.00	0.00
133796	NW	26	20	29	4	UNKNOWN DRILLER		0.00	Chemistry	Domestic	1			ALLEN, LYNDA			0.00
133804	SE	27	20	29	4	ALLAN BROS	1973-12-01	112.00	New Well	Domestic & Stock		4		REWARD, R.	26.00	4.00	0.00
133805	SW	27	20	29	4	BIG INDIAN DRILLING CO. LTD.	1958-07-01	52.00	New Well	Industrial		4		TEXAS GULF #WELL 2	13.00	107.00	6.63
133806	5	27	20	29	4	BIG INDIAN DRILLING CO. LTD.	1958-06-01	50.00	New Well	Industrial		6		TEXAS GULF #WELL 1	11.80	107.00	0.00
133806	5	27	20	29	4	AARON DRILLING INC.	2009-09-23	90.00	Reconditioned	Irrigation		3	12	OKOTOKS, TOWN OF	15.00	12.00	6.62
133806	5	27	20	29	4	AARON DRILLING INC.	2010-05-17	90.00	Reconditioned	Irrigation		1	21	OKOTOKS, TOWN OF	18.20		
133807	NW	27	20	29	4	UNKNOWN DRILLER		137.00	Chemistry	Domestic	1			NUNKHOLM, M.	20.00		5.00
133808	NW	27	20	29	4	GEOSERVE DRLG	1975-08-19	135.00	New Well	Domestic & Stock		4		ROWLAND FARMS	57.00	12.00	6.63
133809	NW	27	20	29	4	GEOSERVE DRLG	1975-08-19	250.00	New Well- Decommissioned	Domestic & Stock		3		ROWLAND FARMS			0.00

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GIC Well ID	LSD	SEC	TWP	RGE	M	DRILLING COMPANY	DATE COMPLETED	DEPTH (ft)	TYPE OF WORK	USE	CHM	LT	PT	WELL OWNER	STATIC LEVEL (ft)	TEST RATE (l/gpm)	SC DIA (in)
133810	NW	27	20	29	4	NIEMANS DRILLING (1980) LTD.	1977-06-17	120.00	New Well	Domestic		5		ORVILLE ROWLAND FARMS	45.00	50.00	0.00
133811	NW	27	20	29	4	NIELSEN DRILLING COMPANY (1984) LTD.	1977-06-20	140.00	New Well	Domestic		4		ROWLAND, O. FARMS	38.00	28.00	5.50
133812	15	27	20	29	4	UNKNOWN DRILLER		0.00	Spring	Unknown	1			JONES, TOM			0.00
133823	8	28	20	29	4	WEBSTER DRILLING	1975-07-31	35.00	Test Hole	Municipal		2	34	OKOTOKS, TOWN OF TH#2	18.60	114.00	
147459	NW	22	20	29	4	AARON DRILLING INC.	1985-06-28	35.00	New Well	Domestic & Stock		2		VIRTUE, GORDON	10.00	5.00	6.62
147570	NW	26	20	29	4	AARON DRILLING INC.	1995-05-15	152.00	New Well	Domestic		9	13	ADKINS, JOHN/JUDY #2677	101.50	8.00	6.62
147661	NW	26	20	29	4	AARON DRILLING INC.	1997-02-27	105.00	New Well	Domestic		16	17	HYLAND, KEITH#3131	44.00	4.00	6.62
150739	NW	23	20	29	4	AARON DRILLING INC.	1990-03-19	120.00	New Well	Domestic		6		BLOMME, AL	70.00	8.00	6.62
155392	SW	27	20	29	4	UNKNOWN DRILLER		52.00	Chemistry	Domestic	3			CAN OCCIDENTAL GAS PLANT#UP19B			0.00
157439	SW	27	20	29	4	UNKNOWN DRILLER		50.00	Chemistry	Domestic	2			CAN OCCIDENTAL GAS PLANT			0.00
160703	NW	26	20	29	4	UNKNOWN DRILLER		0.00	Chemistry	Domestic	1			STONE, CHERYL/GARY			0.00
169297	NW	27	20	29	4	UNKNOWN DRILLER		0.00	Chemistry	Domestic				ROLLO, COLIN			0.00
229646	8	28	20	29	4	BIG ROCK WATER WELL DRILLING	1993-11-04	18.00	New Well	Domestic & Industrial		2	25	MILLER, ERVINE	9.00	10.00	0.00
239165	EH	22	20	29	4	ADAIR D	1967-11-20	167.00	Dry Hole	Unknown		9		WRIGHT, J.W.			0.00
241038	SW	26	20	29	4	KRIEGER DRILLING LTD.	1994-07-04	140.00	New Well	Domestic		4	23	NIVEN, JERRY	117.20	7.50	6.62
255127	16	21	20	29	4	BLACK DIAMOND WATER WELLS LTD	1976-04-01	32.00	New Well	Industrial		3		OKOTOKS, TOWN OF	16.30	9.00	
255216	1	28	20	29	4	BECKER DRILLS	1975-04-08	42.00	Test Hole- Decommissioned	Municipal		8	4	OKOTOKS, TOWN OF SITE 4			0.00
255218	1	28	20	29	4	ALBERTA ENVIRONMENT	1975-04-14	30.00	Old Well-Yield	Monitoring			29	OKOTOKS, CITY OF #3 SITE	9.00	52.00	0.00
255218	1	28	20	29	4	BECKER DRILLS	1975-04-09	26.00	Test Hole	Municipal		7		OKOTOKS, TOWN OF #SITE3	7.00	25.00	
258326	NW	22	20	29	4	UNKNOWN DRILLER		16.00	Chemistry	Municipal	2			OKOTOKS, TOWN OF #1			0.00



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GIC Well ID	LSD	SEC	TWP	RGE	M	DRILLING COMPANY	DATE COMPLETED	DEPTH (ft)	TYPE OF WORK	USE	CHM	LT	PT	WELL OWNER	STATIC LEVEL (ft)	TEST RATE (igpm)	SC DIA (in)
258327	NW	22	20	29	4	UNKNOWN DRILLER	1978-05-10	16.00	Chemistry	Municipal	1			OKOTOKS, TOWN OF #2			0.00
258328	NW	22	20	29	4	UNKNOWN DRILLER	1979-04-17	0.00	Chemistry	Domestic	1			HENDERSON, R			0.00
258329	NW	22	20	29	4	UNKNOWN DRILLER		15.00	Chemistry	Domestic	1			CAMP OKOTOKS SOCIETY			0.00
258330	NW	22	20	29	4	UNKNOWN DRILLER		0.00	Chemistry	Domestic	1			STUMPE, HARLEY			0.00
282140	NE	22	20	29	4	UNKNOWN DRILLER		16.00	Chemistry	Domestic	3			CAMP OKOTOKS SOCIETY			42.00
288346	3	26	20	29	4	BLACKWOOD DRILLING LTD.	1997-01-18	155.00	New Well	Domestic		6	13	CHANUT, D.	107.00	4.10	6.62
288347	8	27	20	29	4	BLACKWOOD DRILLING LTD.	1997-04-26	155.00	New Well	Domestic		6		REWARD, RON	102.00	4.10	6.62
289566	NE	22	20	29	4	PETER NIEMANS WATER WELL DRILLING	1998-06-03	220.00	New Well	Domestic		9		WIEBE, HENRY	87.00	9.50	6.00
289566	NE	22	20	29	4	PETER NIEMANS WATER WELL DRILLING	1998-06-03	220.00	New Well	Domestic		9	13	WIEBE, HENRY	87.00	6.50	6.00
294764	2	26	20	29	4	PETER NIEMANS WATER WELL DRILLING	2000-08-09	260.00	New Well	Domestic		22	27	KHAN, A.R.	121.00	3.00	5.56
294764	2	26	20	29	4	PETER NIEMANS WATER WELL DRILLING	2000-08-09	260.00	New Well	Domestic		22		KHAN, A.R.	121.00	4.00	5.56
294765	2	26	20	29	4	PETER NIEMANS WATER WELL DRILLING	2000-08-04	218.00	New Well	Domestic		20		KHAN, A.R.	112.00	18.50	5.56
294765	2	26	20	29	4	PETER NIEMANS WATER WELL DRILLING	2000-08-04	218.00	New Well	Domestic		20	32	KHAN, A.R.	112.00	8.00	5.56
294766	2	26	20	29	4	PETER NIEMANS WATER WELL DRILLING	2000-07-26	202.00	New Well	Domestic		11		KHAN, R.	112.00	8.50	5.56
294766	2	26	20	29	4	PETER NIEMANS WATER WELL DRILLING	2000-07-26	202.00	New Well	Domestic		11	37	KHAN, R.	112.00	6.80	5.56
294767	2	26	20	29	4	PETER NIEMANS WATER WELL DRILLING	2000-08-01	220.00	New Well	Domestic		8		KHAN, A.R.	110.00	20.00	5.56
294767	2	26	20	29	4	PETER NIEMANS WATER WELL DRILLING	2000-08-01	220.00	New Well	Domestic		8	37	KHAN, A.R.	110.00	8.10	5.56
294768	2	26	20	29	4	PETER NIEMANS WATER WELL DRILLING	2000-07-28	240.00	New Well	Domestic		8		KHAN, A.R.	115.00	5.00	5.56
294768	2	26	20	29	4	PETER NIEMANS WATER WELL DRILLING	2000-07-28	240.00	New Well	Domestic		8	31	KHAN, A.R.	115.00	4.00	5.56
1020070	NW	22	20	29	4	AARON DRILLING INC.	2000-03-20	55.00	New Well	Domestic		6	17	VIRTUE, LORNE	12.00	5.50	6.62

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GIC Well ID	LSD	SEC	TWP	RGE	M	DRILLING COMPANY	DATE COMPLETED	DEPTH (ft)	TYPE OF WORK	USE	CHM	LT	PT	WELL OWNER	STATIC LEVEL (ft)	TEST RATE (igpm)	SC DIA (in)
1020071	NE	22	20	29	4	AARON DRILLING INC.	1999-12-03	45.00	New Well	Domestic		10	10	ARSENAULT, ROBERT	10.50	13.00	6.62
1020072	NE	22	20	29	4	AARON DRILLING INC.	1999-06-21	100.00	New Well	Domestic		3	16	PRISTINE HOMES	85.00	5.50	6.62
1020073	NE	22	20	29	4	AARON DRILLING INC.	1999-06-18	100.00	New Well	Domestic		3	15	PRISTINE HOMES LTD.	85.62	7.00	6.62
1020074	NE	22	20	29	4	AARON DRILLING INC.	1999-06-24	100.00	New Well	Domestic		5	14	PRISTINE HOMES	81.75	7.00	6.62
1020076	NW	26	20	29	4	AARON DRILLING INC.	2005-02-17	110.00	New Well	Domestic		14	5	HYLAND, KEITH	43.20	5.00	6.62
1020078	SW	26	20	29	4	AARON DRILLING INC.	1999-11-02	140.00	New Well	Domestic		13	7	MARTENS, BOB	111.50	12.00	6.62
1020079	NW	27	20	29	4	AARON DRILLING INC.	2004-09-15	135.00	Existing Well- Decommissioned	Domestic		1		UNITED ACQUISITIONS	35.40		5.00
1021243	NW	26	20	29	4	AARON DRILLING INC.	2006-07-14	190.00	New Well	Domestic		7	5	ADKINS, JOHN	107.30	6.00	6.62
1021920	SW	26	20	29	4	AARON DRILLING INC.	2009-11-26	180.00	New Well	Domestic		6	8	CHANUT, KEVIN	108.50	3.00	6.62
1022097	3	27	20	29	4	AARON DRILLING INC.			Existing Well- Decommissioned	Unknown				OKOTOKS, TOWN OF / C/O EXP SERVICES			4.00
1140126	5	26	20	29	4	BLACKWOOD DRILLING LTD.	2005-01-25	160.01	New Well	Domestic		6	25	LAROCHE, VAL & MARTENS, JOHN	111.84	14.00	6.63
1600007	1	27	20	29	4	PEE WEE DRILLING (2004) LTD.	2006-10-27	200.00	Reconditioned	Industrial				KAPELLER, SHELLY			
1600007	1	27	20	29	4	PEE WEE DRILLING (2004) LTD.	2004-05-26	200.00	New Well	Domestic		9	25	KAPELLER, SHELLEY	86.10	8.00	5.56
1600008	8	27	20	29	4	PEE WEE DRILLING (2004) LTD.			New Well- Decommissioned	Unknown		3					
1600009	8	27	20	29	4	PEE WEE DRILLING (2004) LTD.	2006-11-07	210.00	Reconditioned	Industrial		1		KAPELLER, SHELLY			5.56
1600009	8	27	20	29	4	PEE WEE DRILLING (2004) LTD.	2004-06-04	200.00	New Well	Domestic		8	25	KAPELLER, SHELLEY	102.40	8.00	5.56
1600134	8	27	20	29	4	PEE WEE DRILLING (2004) LTD.	2006-10-10	215.00	New Well- Decommissioned	Industrial		7		KAPELLER, SHELLY			
1600135	8	27	20	29	4	PEE WEE DRILLING (2004) LTD.	2006-10-18	300.00	New Well	Industrial		8	28	KAPELLER, SHELLEY	110.70	8.60	6.62
2056050	11	22	20	29	4	MARTIN WATERWELLS LTD	2008-03-14	50.00	New Well	Industrial		10	25	CAMP OKOTOKS	12.91	10.00	6.63
2086218	7	22	20	29	4	BLACK DOG DRILLING & ENV SERV. LTD.	2019-06-26	37.00	New Well	Other		4	8	TOWN OF OKOTOKS	27.00	6.00	

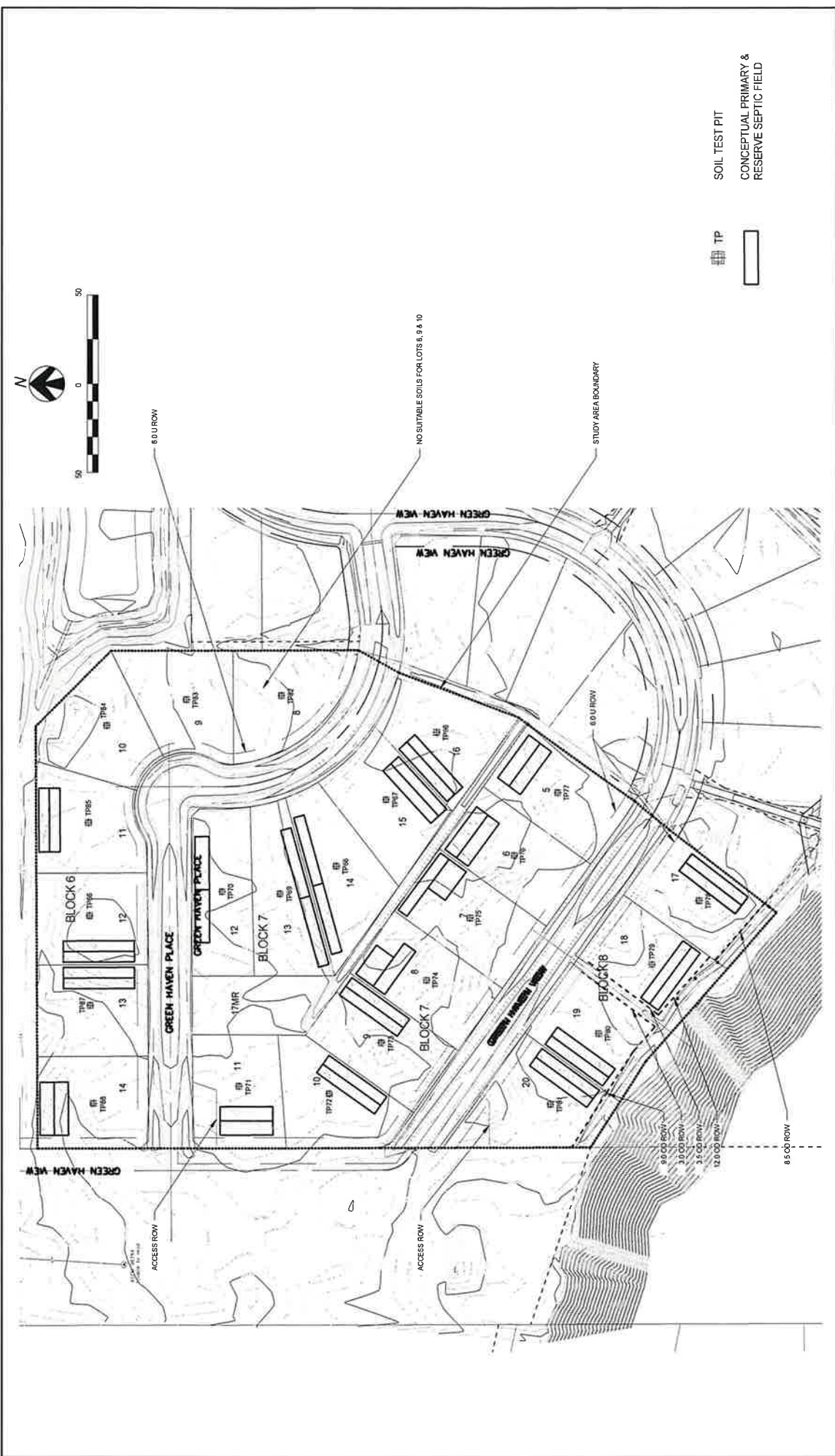


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GIC Well ID	LSD	SEC	TWP	RGE	M	DRILLING COMPANY	DATE COMPLETED	DEPTH (ft)	TYPE OF WORK	USE	CHM	LT	PT	WELL OWNER	STATIC LEVEL (ft)	TEST RATE (igpm)	SC DIA (in)
9544374	7	27	20	20	4	AQUACRE DRILLING INC.	2015-04-10	160.00	New Well	Commercial		7	13	GREEN HAVEN DEVELOPMENT	93.46	12.00	6.62

Attachment B – Site Plan



PERMIT TO PRACTICE No. P10913 COPYRIGHT RESERVED CONTRACTOR SHALL VERIFY AND BE RESPONSIBLE FOR ALL DIMENSIONS AND LOCATIONS OF ALL UTILITIES AND DIMENSIONS SHALL BE REPORTED TO SDCC WITHOUT DELAY FOR ANY DISCREPANCIES TO ALL DIMENSIONS DRAWINGS ARE THE PROPERTY OF SDCC AND SHALL NOT BE REPRODUCED OR COPIED IN ANY MANNER WITHOUT THE WRITTEN PERMISSION OF SDCC.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
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Attachment C – Soil Logs

Alberta Private Sewage Treatment System Soil Profile Log Form

Owner Name or Job ID – Greenhaven Estates										Test Pit GPS Coordinates					
Legal Land Location															
LSD-1/4	Sec	Twp	Rg	Mer	Lot	Block		Plan							
SE	27	20	29	4	NA	NA		NA		50°43'12'' N 113°56'08'' W					
Vegetation notes: Grass										Overall site slope %				0-0.5	
										Slope position of test pit:				Level	
Test hole No.	Soil Subgroup			Parent Material		Drainage		Depth of Lab sample #1		Depth of Lab sample #2					
66	Dunvargan			Glacial Till		Well Drained		85 cm		NA					
	Horizon	Depth (cm)	Texture	Colour	Gleying	Mottling	Structure	Consistence	% Coarse Fragments						
	A	0-40	Lo	10yr2/1			2Fgr	Mfr	0						
	B1	40-80	Lo	10yr3/2			2Fbk	Mfr	0						
	B2	80-200	Lo	10yr3/3			2Mbk	Mfr	0						
Depth to Groundwater		NA		Restricting Soil Layer Characteristic				NA							
Depth to Seasonally Saturated Soil		NA		Depth to restrictive Soil Layer				NA							
Site Topography		NA		Depth to Highly Permeable Layer Limiting Design				NA							
Key Soil Characteristics applied to system design effluent loading															
Comments: such as root depth and abundance or other pertinent observations:															

Alberta Private Sewage Treatment System Soil Profile Log Form

Owner Name or Job ID – Greenhaven Estates

LSD-1/4

Sec

Twp

Rg

Mer

Lot

Block

Plan

SE

27

20

29

4

NA

NA

NA

Test Pit GPS Coordinates

50°43'15'' N

113°56'09'' N

Vegetation notes: Grass

Overall site slope %

Slope position of test pit:

0-0.5

Level

Test hole No.

67

Soil Subgroup

Dunvargan

Parent Material

Glacial Till

Drainage

Well Drained

Depth of Lab sample #1

70 cm

Depth of Lab sample #2

NA

Hori-zon	Depth (cm)	Texture	Colour	Gleying	Mottling	Structure	Consistence	% Coarse Fragments
A	0-20	Lo	10yr2/1			2Fgr	Mfr	0
B1	20-58	Lo	10yr3/2			2Fbk	Mfr	0
B2	58-132	Lo	10yr4/2			2Fbk	Ds	5
B3	132-200	Cl Lo	7.5yr4/3		Yes	1Mbk	Mfi	20

Depth to Groundwater

NA

Depth to Seasonally Saturated Soil

150 cm

Site Topography

NA

Key Soil Characteristics applied to system design effluent loading

Redoximorphic Features

Restricting Soil Layer Characteristic

Depth to restrictive Soil Layer

Depth to Highly Permeable Layer Limiting Design

150 cm

NA

Comments: such as root depth and abundance or other pertinent observations:

Alberta Private Sewage Treatment System Soil Profile Log Form

Owner Name or Job ID – Greenhaven Estates									
Legal Land Location									
LSD-1/4		Sec	Twp	Rg	Mer	Lot	Block	Plan	Test Pit GPS Coordinates
SE		27	20	29	4	NA	NA	NA	Easting 50°43'16'' N 113°56'12'' W
Vegetation notes: Grass									
				Overall site slope %			0-0.5		
				Slope position of test pit:			Level		
Test hole No.	Soil Subgroup			Parent Material			Drainage	Depth of Lab sample #1	Depth of Lab sample #2
68	Dunvargan			Glacial Till			Well Drained	70 cm	NA
Hori- zon	Depth (cm)	Texture	Colour	Gleying	Mottling	Structure	Consistence	% Coarse Fragments	
A	0-28	Lo	10yr2/1			2Fgr	Mfr	0	
B1	26-67	Lo	10yr3/2			2Fbk	Mfr	0	
B2	67-110	Lo	10yr3/2		Yes	2Mbk	Mfr	10	
BS	110-	C1 Lo	7.5yr4/2		Yes	1Mbk	Mfi	20	
Depth to Groundwater		NA			Restricting Soil Layer Characteristic			Redoximorphic Features	
Depth to Seasonally Saturated Soil		124 cm			Depth to restrictive Soil Layer			124 cm	
Site Topography		NA			Depth to Highly Permeable Layer Limiting Design			NA	
Key Soil Characteristics applied to system design effluent loading									
Comments: such as root depth and abundance or other pertinent observations:									

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Legal Land Location					Test Pit GPS Coordinates				
LSD-1/4	Sec	Twp	Rg	Mer	Lot	Block	Plan	Easting	Northing
SE	27	20	29	4	NA	NA	NA	50°43'15" N	115°56'12" W
Vegetation notes: Grass					Overall site slope %		0-0.5		
					Slope position of test pit:		Level		

Test hole No.	Soil Subgroup	Parent Material	Drainage	Depth of Lab sample #1	Depth of Lab sample #2
69	Dunvargan	Glacial Till	Well Drained	70 cm	NA

Hori- zon	Depth (cm)	Texture	Colour	Gleying	Mottling	Structure	Consistence	% Coarse Fragments
A	0-29	Lo	10yr2/1			2Fgr	Mfr	0
B1	29-66	Lo	10yr3/2			2Fbk	Mfr	0
B2	66-115	Lo	10yr3/2		Yes	2Mbk	Mfr	10
BS	115-	C1 Lo	7.5yr4/2		Yes	1Mbk	Mfi	20

Depth to Groundwater	NA	Restricting Soil Layer Characteristic		Redoximorphic Features	
Depth to Seasonally Saturated Soil	70 cm	Depth to restrictive Soil Layer		70 cm	
Site Topography	NA	Depth to Highly Permeable Layer Limiting Design		NA	
Key Soil Characteristics applied to system design effluent loading					
Comments: such as root depth and abundance or other pertinent observations:					

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Owner Name or Job ID – Greenhaven Estates										
Legal Land Location										
LSD-1/4		Sec	Twp	Rg	Mer	Lot	Block	Plan	Test Pit GPS Coordinates	
SE		27	20	29	4	NA	NA	NA	Easting	Northing
Vegetation notes: Grass					Overall site slope %			0-0.5		
					Slope position of test pit:			Level		
Test hole No.	Soil Subgroup		Parent Material		Drainage		Depth of Lab sample #1		Depth of Lab sample #2	
70	Dunvargan		Glacial Till		Well Drained		70 cm		NA	
	Hori- zon	Depth (cm)	Texture	Colour	Gleying	Mottling	Structure	Consistence	% Coarse Fragments	
	A	0-19	Lo	10yr2/1			2Fgr	Mfr	0	
	B1	19-110	Lo	10yr3/2		Yes	2Fbk	Mfr	0	
	B2	110-200	Cl Lo	7.5yr4/4		Yes	1Mbk	Mfi	15	
Depth to Groundwater		NA		Restricting Soil Layer Characteristic			Redoximorphic Features			
Depth to Seasonally Saturated Soil		100 cm		Depth to restrictive Soil Layer			100 cm			
Site Topography		NA		Depth to Highly Permeable Layer Limiting Design			NA			
Key Soil Characteristics applied to system design effluent loading										
Comments: such as root depth and abundance or other pertinent observations:										

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Owner Name or Job ID – Greenhaven Estates									
Legal Land Location						Test Pit GPS Coordinates			
LSD-1/4	Sec	Twp	Rg	Mer	Lot	Block	Plan	Easting	Northing
SE	27	20	29	4	NA	NA	NA	50°43'16" N	113°56'12" W
Vegetation notes: Grass					Overall site slope %		0-0.5		
					Slope position of test pit:		Level		
Test hole No.	Soil Subgroup		Parent Material		Drainage		Depth of Lab sample #1		Depth of Lab sample #2
71	Dunvargan		Glacial Till		Well Drained		70 cm		NA
Hori- zon	Depth (cm)	Texture	Colour	Gleying	Mottling	Structure	Consistence	% Coarse Fragments	
A	0-30	Lo	10yr2/1			2Fgr	Mfr	0	
B1	30-69	Lo	10yr3/2			2Fbk	Mfr	0	
B2	69-110	Lo	10yr3/2		Yes	2Mbk	Mfr	10	
BS	110-200	C1 Lo	7.5yr4/2		Yes	1Mbk	Mfi	20	
Depth to Groundwater			NA		Restricting Soil Layer Characteristic		Redoximorphic Features		
Depth to Seasonally Saturated Soil			128 cm		Depth to restrictive Soil Layer		128 cm		
Site Topography			11		Depth to Highly Permeable Layer Limiting Design		NA		
Key Soil Characteristics applied to system design effluent loading									
Comments: such as root depth and abundance or other pertinent observations:									

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Legal Land Location					Test Pit GPS Coordinates				
LSD-1/4	Sec	Twp	Rg	Mer	Lot	Block	Plan	Easting	Northing
SE	27	20	29	4	NA	NA	NA	50°43'14'' N	113°56'18'' W
Vegetation notes: Grass					Overall site slope %		0-0.5		
					Slope position of test pit:		Level		

Test hole No.	Soil Subgroup	Parent Material	Drainage	Depth of Lab sample #1	Depth of Lab sample #2
72	Dunvargan	Glacial Till	Well Drained	90 cm	NA

Hori- zon	Depth (cm)	Texture	Colour	Gleying	Mottling	Structure	Consistence	% Coarse Fragments
A	0-35	Lo	10yr2/1			2Fgr	Mfr	0
B1	35-53	Lo	10yr3/2			2Fbk	Mfr	5
B2	53-85	Si Lo	10yr5/2			1Fbk	Dsh	10
B3	85-140	Fi Lo Sa	10yr4/3			2Fbk	Ds	20
B4	140-	Cl Lo	10yr4/2			1Mbk	Mfr	5

Depth to Groundwater	NA	Restricting Soil Layer Characteristic	Redoximorphic Features
Depth to Seasonally Saturated Soil	190 cm	Depth to restrictive Soil Layer	190 cm
Site Topography	NA	Depth to Highly Permeable Layer Limiting Design	NA
Key Soil Characteristics applied to system design effluent loading		Redoximorphic Features at 190 cm	
Comments: such as root depth and abundance or other pertinent observations:			

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Legal Land Location					Test Pit GPS Coordinates				
LSD-1/4	Sec	Twp	Rg	Mer	Lot	Block	Plan	Easting	Northing
SE	27	20	29	4	NA	NA	NA	50°43'13" N	113°56'17" W
Vegetation notes: Grass					Overall site slope %		0-0.5		
					Slope position of test pit:		Level		

Test hole No.	Soil Subgroup	Parent Material	Drainage	Depth of Lab sample #1	Depth of Lab sample #2
73	Dunvargan	Glacial Till	Well Drained	70 cm	NA

Hori- zon	Depth (cm)	Texture	Colour	Gleying	Mottling	Structure	Consistence	% Coarse Fragments
A	0-20	Lo	10yr2/1			2Fgr	Mfr	0
B1	20-39	Lo	10yr3/2			2Fbk	Mfr	5
B2	39-52	Cl Lo	10yr3/2			1Mbk	Dsh	10
B3	52-120	Lo	10yr4/2			2Mbk	Dsh	20
B4	120-	Cl Lo	10yr5/2		Yes	2Mbk	Mfr	20

Depth to Groundwater	NA	Restricting Soil Layer Characteristic		Redoximorphic Features	
Depth to Seasonally Saturated Soil	140 cm	Depth to restrictive Soil Layer		140 cm	
Site Topography	NA	Depth to Highly Permeable Layer Limiting Design		NA	
Key Soil Characteristics applied to system design effluent loading		Seasonal Saturation (Mottling) at 140 cm			
Comments: such as root depth and abundance or other pertinent observations:					

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Owner Name or Job ID – Greenhaven Estates

Legal Land Location						Test Pit GPS Coordinates			
LSD-1/4	Sec	Twp	Rg	Mer	Lot	Block	Plan	Easting	Northing
SE	27	20	29	4	NA	NA	NA	50°43'13" N	113°56'14" W
Vegetation notes: Grass						Overall site slope %		0-0.5	
						Slope position of test pit:		Level	

Test hole No.	Soil Subgroup	Parent Material	Drainage	Depth of Lab sample #1	Depth of Lab sample #2
74	Dunvargan	Glacial Till	Well Drained	70 cm	NA

Hori- zon	Depth (cm)	Texture	Colour	Gleying	Mottling	Structure	Consistence	% Coarse Fragments
A	0-13	Lo	10yr2/1			2Fgr	Mfr	0
B1	13-51	Lo	10yr3/2		Yes	2Fbk	Mfr	10
B2	51-200	Cl Lo	7.5yr4/3		Yes	1Mbk	Mfi	10

Depth to Groundwater	NA	Restricting Soil Layer Characteristic		Redoximorphic Features
Depth to Seasonally Saturated Soil	46 cm	Depth to restrictive Soil Layer		46 cm
Site Topography	NA	Depth to Highly Permeable Layer Limiting Design		NA
Key Soil Characteristics applied to system design effluent loading	Seasonal Saturation at 46 cm			
Comments: such as root depth and abundance or other pertinent observations: Back half of lot unusable due to fill soils.				

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Legal Land Location						Test Pit GPS Coordinates			
LSD-1/4	Sec	Twp	Rg	Mer	Lot	Block	Plan	Easting	Northing
SE	27	20	29	4	NA	NA	NA	50°43'12" N 113°56'12" W	
Vegetation notes: Grass					Overall site slope %		0-0.5		
					Slope position of test pit:		Level		
Test hole No.	Soil Subgroup		Parent Material		Drainage		Depth of Lab sample #1		Depth of Lab sample #2
75	Dunvargan		Glacial Till		Well Drained		70 cm		NA
	Horizon	Depth (cm)	Texture	Colour	Gleying	Mottling	Structure	Consistence	% Coarse Fragments
	A	0-20	Lo	10yr2/1			2Fgr	Mfr	0
	B1	20-42	Lo	10yr3/2			2Fbk	Mfr	0
	B2	42-90	Si Lo	10yr4/2			2Mbk	Mfr	5
	B3	90-	Cl Lo	7.5yr4/2		Yes	1Mbk	Mfi	15
Depth to Groundwater		Restricting Soil Layer Characteristic				Redoximorphic Features			
NA									
Depth to Seasonally Saturated Soil		109 cm				109 cm			
Site Topography		NA				NA			
Key Soil Characteristics applied to system design effluent loading		Redoximorphic Features at 109 cm							
Comments: such as root depth and abundance or other pertinent observations: Disturbed soils on south half of lot. The north half of the lot is suitable.									

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Legal Land Location					Test Pit GPS Coordinates				
LSD-1/4	Sec	Twp	Rg	Mer	Lot	Block	Plan	Easting	Northing
SE	27	20	29	4	NA	NA	NA	50°43'11" N	113°56'10" W
Vegetation notes: Grass					Overall site slope %				
					Slope position of test pit:				
					0-0.5				
					Level				

Test hole No.	Soil Subgroup	Parent Material	Drainage	Depth of Lab sample #1	Depth of Lab sample #2
76	Dunvargan	Glacial Till	Well Drained	70 cm	NA

Hori- zon	Depth (cm)	Texture	Colour	Gleying	Mottling	Structure	Consistence	% Coarse Fragments
A	0-29	Lo	10yr2/1			2Fgr	Mfr	0
B1	29-65	Lo	10yr3/2			2Fbk	Mfr	5
B2	65-200	Cl Lo	10yr4/2		Yes	1Mbk	Mfr	20

Depth to Groundwater	NA	Restricting Soil Layer Characteristic		Redoximorphic Features
Depth to Seasonally Saturated Soil	85 cm	Depth to restrictive Soil Layer		85 cm
Site Topography	NA	Depth to Highly Permeable Layer Limiting Design		NA
Key Soil Characteristics applied to system design effluent loading				
Comments: such as root depth and abundance or other pertinent observations: South half of lot is disturbed.				

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Owner Name or Job ID – Greenhaven Estates																	
Legal Land Location																	
LSD-1/4		Sec	Twp	Rg	Mer	Lot	Block	Plan	Test Pit GPS Coordinates								
SE		27	20	29	4	NA	NA	NA	Easting	Northing							
Vegetation notes: Grass								Overall site slope %		0-0.5							
								Slope position of test pit:		Level							
Test hole No.		Soil Subgroup			Parent Material			Drainage		Depth of Lab sample #1	Depth of Lab sample #2						
77		Dunvargan			Glacial Till			Well Drained		70 cm	NA						
Hori- zon		Depth (cm)		Texture		Colour		Gleying		Mottling		Structure		Consistence		% Coarse Fragments	
A		0-35		Lo		10yr2/1						2Fgr		Mfr		0	
B1		35-60		Lo		10yr3/2						2Fbk		Mfr		5	
B2		60-110		Si Lo		10yr3/2						1Fbk		Ds		0	
B3		110-		Fi Sa Lo		10yr4/2						2Mbk		Ds		10	
Depth to Groundwater		NA								Restricting Soil Layer Characteristic		Redoximorphic Features					
Depth to Seasonally Saturated Soil		150 cm								Depth to restrictive Soil Layer		150 cm					
Site Topography		NA								Depth to Highly Permeable Layer Limiting Design		NA					
Key Soil Characteristics applied to system design effluent loading																	
Comments: such as root depth and abundance or other pertinent observations:																	

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Owner Name or Job ID – Greenhaven Estates

Legal Land Location					Test Pit GPS Coordinates				
LSD-1/4	Sec	Twp	Rg	Mer	Lot	Block	Plan	Easting	Northing
SE	27	20	29	4	NA	NA	NA	50°43'07" N	113°56'13" W
Vegetation notes: Grass					Overall site slope %			0-0.5	
					Slope position of test pit:			Level	

Test hole No.	Soil Subgroup	Parent Material	Drainage	Depth of Lab sample #1	Depth of Lab sample #2
78	Dunvargan	Glacial Till	Well Drained	70 cm	NA

Hori- zon	Depth (cm)	Texture	Colour	Gleying	Mottling	Structure	Consistence	% Coarse Fragments
A	0-30	Lo	10yr2/1			2Fgr	Mfr	0
B1	30-62	Lo	10yr3/2			2Fbk	Mfr	0
B2	62-91	Lo	10yr3/2		Yes	1Mbk	Mfr	10
B3	91-	C1 Lo	7.5yr4/2		Yes	1Mbk	Mfr	20

Depth to Groundwater	NA	Restricting Soil Layer Characteristic		Redoximorphic Features
Depth to Seasonally Saturated Soil	100 cm	Depth to restrictive Soil Layer		100 cm
Site Topography	NA	Depth to Highly Permeable Layer Limiting Design		NA
Key Soil Characteristics applied to system design effluent loading		Mottling at 140 cm		
Comments: such as root depth and abundance or other pertinent observations:				

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Legal Land Location									
LSD-1/4	Sec	Twp	Rg	Mer	Lot	Block	Plan	Test Pit GPS Coordinates	
SE	27	20	29	4	NA	NA	NA	Easting	Northing
Vegetation notes: Grass							Overall site slope %		50°43'08'' N
							Slope position of test pit:		113°56'13'' W
							0-0.5		
							Level		
Test hole No.	Soil Subgroup			Parent Material			Drainage		Depth of Lab sample #1
79	Dunvargan			Glacial Till			Well Drained		70 cm
	Hori- zon	Depth (cm)	Texture	Colour	Gleying	Mottling	Structure	Consistence	% Coarse Fragments
	A	0-40	Si Lo	10yr2/1			2Fgr	Mfr	0
	B1	40-61	Si Lo	10yr3/2			2Fbk	Mfr	5
	B2	61-110	Lo	10yr5/2			2Fbk	Mfr	10
	B3	110-200	Lo	10yr5/2		Yes	1Fbk	Ds	20
Depth to Groundwater		NA			Restricting Soil Layer Characteristic			NA	
Depth to Seasonally Saturated Soil		160 cm			Depth to restrictive Soil Layer			160 cm	
Site Topography		NA			Depth to Highly Permeable Layer Limiting Design			NA	
Key Soil Characteristics applied to system design effluent loading		Mottling at 160 cm							
Comments: such as root depth and abundance or other pertinent observations:									

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Legal Land Location					Test Pit GPS Coordinates				
LSD-1/4	Sec	Twp	Rg	Mer	Lot	Block	Plan	Easting	Northing
SE	27	20	29	4	NA	NA	NA	50°43'09'' N	113°56'16'' W
Vegetation notes: Grass					Overall site slope %			0-0.5	
					Slope position of test pit:			Level	

Test hole No.	Soil Subgroup	Parent Material	Drainage	Depth of Lab sample #1	Depth of Lab sample #2
80	Dunvargan	Glacial Till	Well Drained	70 cm	NA

Hori- zon	Depth (cm)	Texture	Colour	Gleying	Mottling	Structure	Consistence	% Coarse Fragments
A	0-20	Si Lo	10yr4/1			2Fgr	Mfr	0
B1	20-46	Si Lo	10yr3/3			2Mbk	Mfr	0
B2	46-79	Lo	10yr4/2			2Fbk	Ds	0
B3	79-111	Lo	10yr4/2			1Mbk	Ds	0
B4	111-200	Fi Sa Lo	10yr4/2			2Fbk	Ds	0

Depth to Groundwater	NA	Restricting Soil Layer Characteristic	NA
Depth to Seasonally Saturated Soil	NA	Depth to restrictive Soil Layer	NA
Site Topography	NA	Depth to Highly Permeable Layer Limiting Design	NA
Key Soil Characteristics applied to system design effluent loading		NA	

Comments: such as root depth and abundance or other pertinent observations:

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Owner Name or Job ID – Greenhaven Estates									
Legal Land Location									
LSD-1/4	Sec	Twp	Rg	Mer	Lot	Block	Plan	Test Pit GPS Coordinates	
SE	27	20	29	4	NA	NA	NA	Easting	Northing
Vegetation notes: Grass							Overall site slope %		50°43'10" N 113°56'18" W
							Slope position of test pit:		0-0.5
							Level		
Test hole No.	Soil Subgroup			Parent Material		Drainage		Depth of Lab sample #1	Depth of Lab sample #2
81	Dunvargan			Glacial Till		Well Drained		70 cm	NA
Hori- zon	Depth (cm)	Texture	Colour	Gleying	Mottling	Structure	Consistence	% Coarse Fragments	
	A	0-27	Lo	10yr2/1		2Fgr	Mfr	0	
	B1	27-39	Lo	10yr3/2		2Fbk	Mfr	0	
	B2	39-92	Cl Lo	10yr3/2		1Mbk	Dsh	0	
	B3	92-122	Fi Sa Lo	10yr4/2		2Fbk	Ds	0	
B4	122-	Fi Lo Sa	10yr4/2		2Fbk	Ds	0		
Depth to Groundwater		NA		Restricting Soil Layer Characteristic			NA		
Depth to Seasonally Saturated Soil		NA		Depth to restrictive Soil Layer			NA		
Site Topography		NA		Depth to Highly Permeable Layer Limiting Design			NA		
Key Soil Characteristics applied to system design effluent loading									
Comments: such as root depth and abundance or other pertinent observations:									

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Legal Land Location					Test Pit GPS Coordinates				
LSD-1/4	Sec	Twp	Rg	Mer	Lot	Block	Plan	Easting	Northing
SE	27	20	29	4	NA	NA	NA	50°43'15" N	113°56'06" W
Vegetation notes: Grass					Overall site slope %				
					Slope position of test pit:				
					Level				

Test hole No.	Soil Subgroup	Parent Material	Drainage	Depth of Lab sample #1	Depth of Lab sample #2
82	Dunvargan	Glacial Till	Well Drained	70 cm	NA

Hori- zon	Depth (cm)	Texture	Colour	Gleying	Mottling	Structure	Consistence	% Coarse Fragments
A	0-41	Lo	10yr2/1			2Fgr	Mfr	0
B1	41-61	Lo	10yr3/2			2Fbk	Mfr	5
B2	61-110	Lo	10yr4/2		Yes	2Fbk	Dsh	10
B3	110-200	Cl Lo	7.5yr4/3		Yes	1Mbk	Dsh	20

Depth to Groundwater	NA	Restricting Soil Layer Characteristic		Redoximorphic Features
Depth to Seasonally Saturated Soil	100 cm	Depth to restrictive Soil Layer		100 cm
Site Topography	NA	Depth to Highly Permeable Layer Limiting Design		NA
Key Soil Characteristics applied to system design effluent loading	Compacted and disturbed soils present throughout entire lot. Holding tank required on this lot.			
Comments: such as root depth and abundance or other pertinent observations:				

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Owner Name or Job ID – Greenhaven Estates									
Legal Land Location						Test Pit GPS Coordinates			
LSD-1/4	Sec	Twp	Rg	Mer	Lot	Block	Plan	East ing	Northing
SE	27	20	29	4	NA	NA	NA	50°43'17" N 113°56'06" W	
Vegetation notes: Grass						Overall site slope %		0-0.5	
						Slope position of test pit:		Level	
Test hole No.	Soil Subgroup		Parent Material		Drainage		Depth of Lab sample #1		Depth of Lab sample #2
83	Dunvargan		Glacial Till		Well Drained		70 cm		NA
Horizon	Depth (cm)	Texture	Colour	Gleying	Mottling	Structure	Consistence	% Coarse Fragments	
Depth to Groundwater	NA		Restricting Soil Layer Characteristic			Redoximorphic Features			
Depth to Seasonally Saturated Soil	100 cm		Depth to restrictive Soil Layer			100 cm			
Site Topography	NA		Depth to Highly Permeable Layer Limiting Design			NA			
Key Soil Characteristics applied to system design effluent loading		Pit is 100% fill; No Topsoil present. Glacial Till. No Sample Taken. Holding tank required on this lot.							
Comments: such as root depth and abundance or other pertinent observations:									

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Legal Land Location					Test Pit GPS Coordinates				
LSD-1/4	Sec	Twp	Rg	Mer	Lot	Block	Plan	Easting	Northing
SE	27	20	29	4	NA	NA	NA	50°43'17" N	113°56'08" W
Vegetation notes: Grass							Overall site slope %		
							0-0.5		
		Slope position of test pit:					Level		

Test hole No.	Soil Subgroup	Parent Material	Drainage	Depth of Lab sample #1	Depth of Lab sample #2
84	Dunvargan	Glacial Till	Well Drained	70 cm	NA

Hori- zon	Depth (cm)	Texture	Colour	Gleying	Mottling	Structure	Consistence	% Coarse Fragments

Depth to Groundwater	NA	Restricting Soil Layer Characteristic	Redoximorphic Features
Depth to Seasonally Saturated Soil	100 cm	Depth to restrictive Soil Layer	100 cm
Site Topography	NA	Depth to Highly Permeable Layer Limiting Design	NA
Key Soil Characteristics applied to system design effluent loading		Fill/Disturbed Soils. No Sample. Holding tank required for this lot.	
Comments: such as root depth and abundance or other pertinent observations:			

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Owner Name or Job ID – Greenhaven Estates									
Legal Land Location						Test Pit GPS Coordinates			
LSD-1/4	Sec	Twp	Rg	Mer	Lot	Block	Plan	Easting	Northing
SE	27	20	29	4	NA	NA	NA	50°43'18" N 113°56'10" W	
Vegetation notes: Grass						Overall site slope %		0-0.5	
						Slope position of test pit:		Level	
Test hole No.		Soil Subgroup		Parent Material		Drainage		Depth of Lab sample #1	
85		Dunvargan		Glacial Till		Well Drained		70 cm	
Hori- zon	Depth (cm)	Texture	Colour	Gleying	Mottling	Structure	Consistence	% Coarse Fragments	
A	0-40	Lo	10yr2/1			2Fgr	Mfr	0	
B1	40-53	Lo	10yr3/2			2Fbk	Mfr	0	
B2	53-90	Cl Lo	10yr4/2			2Mbk	Mfr	5	
B3	90-200	Cl Lo	7.5yr4/3		Yes	1Mbk	Mfi	20	
Depth to Groundwater		NA		Restricting Soil Layer Characteristic			Redoximorphic Features		
Depth to Seasonally Saturated Soil		100 cm		Depth to restrictive Soil Layer			100 cm		
Site Topography		NA		Depth to Highly Permeable Layer Limiting Design			NA		
Key Soil Characteristics applied to system design effluent loading		Mottling at 100 cm							
Comments: such as root depth and abundance or other pertinent observations:									

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Owner Name or Job ID – Greenhaven Estates

Legal Land Location					Test Pit GPS Coordinates				
LSD-1/4	Sec	Twp	Rg	Mer	Lot	Block	Plan	Easting	Northing
SE	27	20	29	4	NA	NA	NA	50°43'18" N	113°56'13" W
Vegetation notes: Grass					Overall site slope %			0-0.5	
					Slope position of test pit:			Level	

Test hole No.	Soil Subgroup	Parent Material	Drainage	Depth of Lab sample #1	Depth of Lab sample #2
86	Dunvargan	Glacial Till	Well Drained	70 cm	NA

Hori- zon	Depth (cm)	Texture	Colour	Gleying	Mottling	Structure	Consistence	% Coarse Fragments
A	0-24	Lo	10yr2/1			2Fgr	Mfr	0
B1	24-56	Lo	10yr3/2			2Fbk	Mfr	5
B2	56-88	Lo	10yr5/2			1Mbk	Ds	5
B3	88-200	Cl Lo	10yr4/2			0M	Mefi	20

Depth to Groundwater	NA	Restricting Soil Layer Characteristic		Soil permeability
Depth to Seasonally Saturated Soil	NA	Depth to restrictive Soil Layer		88 cm
Site Topography	NA	Depth to Highly Permeable Layer Limiting Design		NA
Key Soil Characteristics applied to system design effluent loading	Limiting Layer at 88 cm. No evidence of mottling, mound required on this lot.			
Comments: such as root depth and abundance or other pertinent observations:				

Alberta Private Sewage Treatment System Soil Profile Log Form

Owner Name or Job ID – Greenhaven Estates										
Legal Land Location										
LSD-1/4	Sec	Twp	Rg	Mer	Lot	Block	Plan	Easting	Northing	
SE	27	20	29	4	NA	NA	NA	50°43'18" N 113°56'16" W		
Vegetation notes: Grass										
Overall site slope %										
Slope position of test pit:										
Level										
0-0.5										
Depth of Lab sample #1										
70 cm										
Depth of Lab sample #2										
NA										
Test hole No.	Soil Subgroup		Parent Material		Drainage		Mottling		Structure	
87	Dunvargan		Glacial Till		Well Drained				2Fgr	
	Horizon	Depth (cm)	Texture	Colour	Gleying				Consistence	% Coarse Fragments
	A	0-30	Lo	10yr2/1					Mfr	0
	B1	30-62	Lo	10yr3/2					Mfr	0
	B2	62-112	Lo	10yr3/2			Yes		Mfr	10
	B3	112-200	C1 Lo	7.5yr4/2			Yes		Mfr	20
Redoximorphic Features										
Restricting Soil Layer Characteristic										
Depth to restrictive Soil Layer										
100 cm										
Depth to Highly Permeable Layer Limiting Design										
NA										
Key Soil Characteristics applied to system design effluent loading										
Mottling at 115 cm										
Comments: such as root depth and abundance or other pertinent observations:										

Alberta Private Sewage Treatment System Soil Profile Log Form

Owner Name or Job ID -- Greenhaven Estates

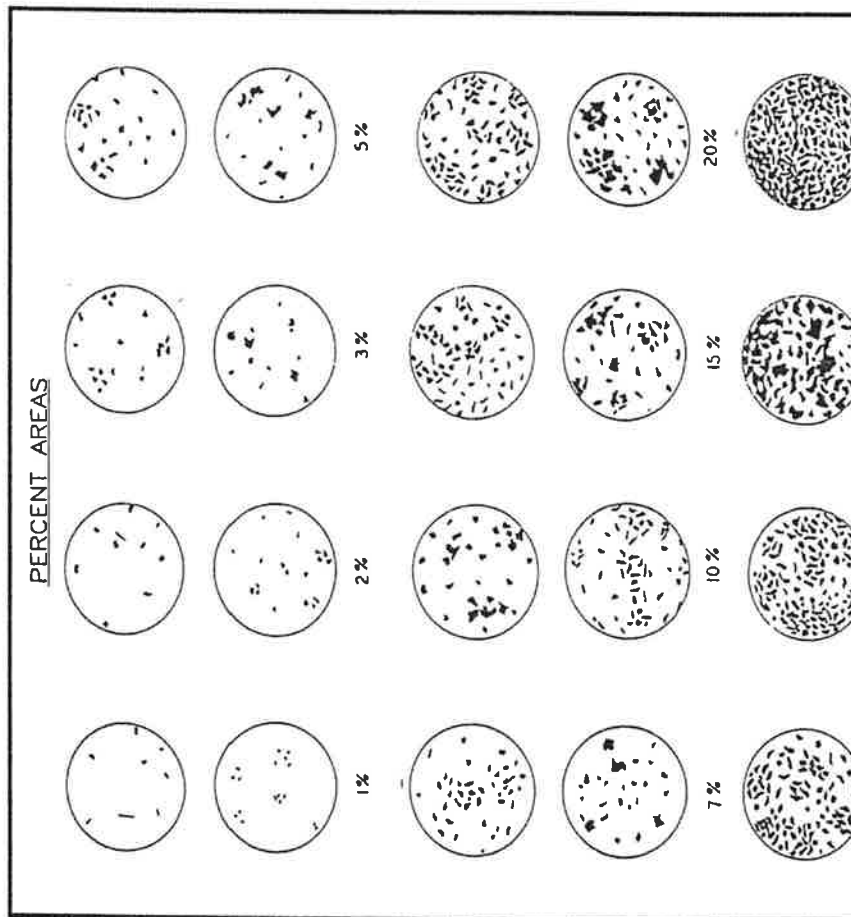
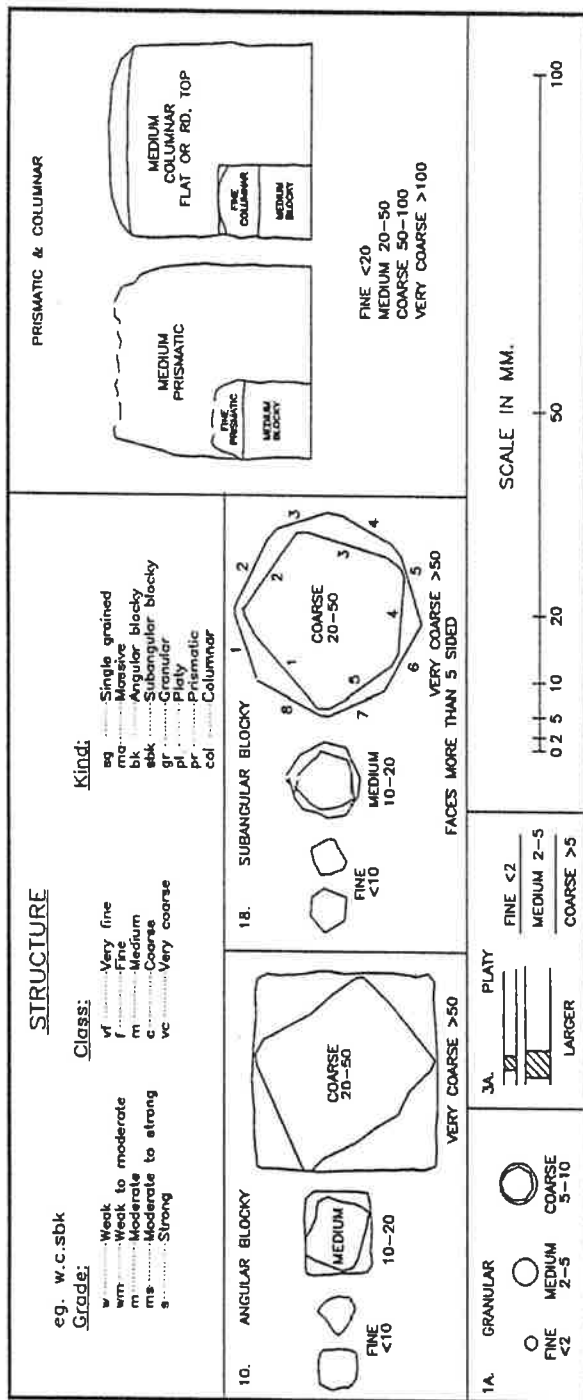
Legal Land Location						Test Pit GPS Coordinates			
LSD-1/4	Sec	Twp	Rg	Mer	Lot	Block	Plan	Easting	Northing
SE	27	20	29	4	NA	NA	NA	50°43'18" N	113°56'18" W
Vegetation notes: Grass						Overall site slope %		0-0.5	
						Slope position of test pit:		Level	

Test hole No.	Soil Subgroup	Parent Material	Drainage	Depth of Lab sample #1	Depth of Lab sample #2
88	Dunvargan	Glacial Till	Well Drained	70 cm	NA

Hori- zon	Depth (cm)	Texture	Colour	Gleying	Mottling	Structure	Consistence	% Coarse Fragments
A	0-9	Lo	10yr2/1			2Fgr	Mfr	0
B1	9-53	Lo	10yr3/2			2Fbk	Mfr	0
B2	53-110	Lo	10yr3/2		Yes	1Mbk	Mfr	10
B3	110-200	C1 Lo	7.5yr4/2		Yes	1Mbk	Mfr	20

Depth to Groundwater	NA	Restricting Soil Layer Characteristic		Redoximorphic Features	
Depth to Seasonally Saturated Soil	100 cm	Depth to restrictive Soil Layer		100 cm	
Site Topography	NA	Depth to Highly Permeable Layer Limiting Design		NA	
Key Soil Characteristics applied to system design effluent loading		Mottling at 110 cm			
Comments: such as root depth and abundance or other pertinent observations:					

Figure 4: Diagrammatic representation of soil structure



SLOPE CLASSES OF LOCAL LANDFORMS

Slope Class	Percent Slope	Approximate Degrees	Description
1	0-0.5	0	level
2	0.5-2.5	0.3-1.5	nearly level
3	2-5	1-3	very gentle slopes
4	6-9	3.5-5	gentle slopes
5	10-15	6-8.5	moderate slopes
6	16-30	9-17	strong slopes
7	31-45	17-24	very strong slopes
8	46-70	25-35	extreme slopes
9	71-100	35-45	steep slopes
10	>100	>45	very steep slopes

SURFACE STONINESS

	Surface Area	Distance Apart (cm)
S0 non-stony	<0.01%	>30
S1 slightly stony	0.01-0.1%	10-30
S2 moderately stony	0.1-3%	2-10
S3 very stony	3-15%	1-2
S4 exceedingly stony	15-50%	0.1-5
S5 excessively stony	50%	0.1

SLOPE POSITION

c	crest
u	upper slope
m	mid slope
l	lower slope
d	toe
i	depression
l	level

Table 10. Types, kinds and classes of soil structure.

Type	Kind (Kind Code)		Structure Class and Code	Size ¹ (mm)
Blocklike - soil particles arranged around a point and bounded by flat or rounded surfaces	Angular blocky (ABK)	pedes bounded by flattened, rectangular faces intersecting at relatively sharp angles	VF: very fine angular blocky F: fine angular blocky M: medium angular blocky C: coarse angular blocky VC: very coarse angular blocky	<5 5-10 10-20 20-50 >50
	BK			
PL	soil particles arranged around a horizontal plane and generally bounded by relatively flat horizontal surfaces	Subangular blocky (SBK): pedes bounded by slightly rounded, subrectangular faces with vertices ² of their intersections mostly subrounded	VF: very fine subangular blocky F: fine subangular blocky M: medium subangular blocky C: coarse subangular blocky VC: very coarse subangular blocky	<5 5-10 10-20 20-50 >50
		Granular (GR): spheroidal pedes bounded by curved or very irregular faces that do not adjoin those of adjacent pedes	VF: very fine granular F: fine granular M: medium granular C: coarse granular VC: very coarse granular	<1 1-2 2-5 5-10 >10
PR	soil particles arranged around a vertical axis and bounded by relatively flat vertical surfaces.	Platy (PL): pedes flat or platelike; horizontal planes more or less well developed	VF: very fine platy F: fine platy M: medium platy C: coarse platy VC: very coarse platy	<1 1-2 2-5 5-10 >10
		Prismatic (PR): vertical faces of pedes well defined and vertices ² angular (edges sharp); prism tops essentially flat	VF: very fine prismatic F: fine prismatic M: medium prismatic C: coarse prismatic VC: very coarse prismatic	<10 10-20 20-50 50-100 >100
MA	no observable aggregation of primary particles or no definite orderly arrangement around natural lines of weakness	Columnar (COL): vertical edges near top of columns not sharp (vertices ² subrounded); column tops flat, rounded, or irregular	VF: very fine columnar F: fine columnar M: medium columnar C: coarse columnar VC: very coarse prismatic	<10 10-20 20-50 50-100 >100
		Single grained (SGR): Massive (MA):	Loose, incoherent mass of individual particles, as in sands amorphous; a coherent mass showing no evidence of any distinct arrangement of soil particles; separates into clusters of particles; not pedes	primary
Cloddy (CDY): not a structure; used to indicate the condition of some ploughed surface, grade, class, and shape too varied to be described in standard terms.				

¹ The size limits refer to measurements in the smallest dimension of platy, prismatic, and columnar peds and to the largest of the nearly equal dimensions of blocky and granular peds.

² Definition of vertex (plural, vertices): the intersection of two planes of a geometrical figure.

Consistence – moist soil	
• Loose:	No intact sample can be obtained.
• Friable:	Structure breaks down with slight force between the fingers.
• Firm:	Structure breaks down with moderate force between the fingers.
• Extremely firm:	Structure breaks down with moderate force between the hands or slight foot pressure.
• Rigid:	Structure breaks down only with foot pressure.

Structure Grade Descriptions

Code	Massive /or single grained used to describe sands	Structure Grade Definition
0		This describes a soil that has no developed structure. There is no aggregation of primary particles or no definite orderly arrangement around natural lines of weakness.
1	Weak	Peds are either indistinct and barely evident in place, or observable in place but incompletely separated from adjacent peds. When disturbed, the soil material separates into a mixture of only a few entire peds, many broken peds and much unaggregated material.
2	Moderate	Peds are moderately durable, and are evident but not distinct in the undisturbed soil. When disturbed, the soil material parts into a mixture of many well formed, entire peds, some broken peds, and little unaggregated material. The peds may be handled without breaking and they part from adjoining peds to reveal nearly entire surfaces which have properties distinct from those caused by fracturing.
3	Strong	Peds are durable and evident in the undisturbed soil, adhere weakly to one another, withstand displacement and separate cleanly when the soil is disturbed. When removed, the soil material separates mainly into entire peds. Surfaces of unbroken peds have distinctive properties, compared to surfaces that result from fracturing.

Mottling Descriptions

Parameter	Code	Description
Abundance	Few	<2% of the exposed surface
	Common	2-20% of the exposed surface
	Many	>20% of the exposed surface
Size	Fine	< 5 mm
	Medium	5-15 mm
	Coarse	>15 mm
Contrast	Faint	Evident only on close examination. Faint mottles commonly have the same hue as the colour to which they are compared and differ by no more than 1 unit of chroma or 2 units of value. Some faint mottles of similar but low chroma and value can differ by 2.5 units of hue.

Parameter	Code	Description
	Distinct	Readily seen, but contrast only moderately with the colour to which they are compared. Distinct mottles commonly have the same hue as the colour to which they are compared, but differ by 2 to 4 units of chroma or 3 to 4 units of value; or differ from the colour to which they are compared by 2.5 units of hue but by no more than 1 unit of chroma or 2 units of value.
	Prominent	Contrast strongly with the colour to which they are compared. Prominent mottles are commonly the most obvious colour feature in a soil. Prominent mottles that have medium chroma and value commonly differ from the colour to which they are compared by at least 5 units of hue if chroma and value are the same; or at least 1 unit of chroma or 2 units of value if hue differs by 2.5 units.

Attachment D – Lab Reports



Element
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Edmonton, Alberta
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E: info.edmonton@element.com
W: element.com

Report Transmission Cover Page

Bill To: SD Consulting Group
796 Cherokee Ave
St. Paul, MN, United States
55107

Attn: Accounts Payable
Sampled By: Shane Sparks
Company:

Project ID: Greenhaven
Project Name: Estates
Project Location:
LSD:
P.O.: 1363412
Proj. Acct. code:

Lot ID: **1363412**
Control Number:
Date Received: Jul 12, 2019
Date Reported: Jul 18, 2019
Report Number: 2423254

Contact	Company	Address
Accounts Payable	SD Consulting Group	796 Cherokee Ave St. Paul, MN 55107 Phone: (612) 280-9128 Fax: Email:

<u>Delivery</u>	<u>Format</u>	<u>Deliverables</u>
Post	PDF	Invoice

Bryan DeSmet	SD Consulting Group	796 Cherokee Ave St. Paul, MN 55107 Phone: (612) 280-9128 Fax: Email: bryan.desmet@sd-consultinggroup.
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<u>Delivery</u>	<u>Format</u>	<u>Deliverables</u>
Email - Multiple Reports By Agreement	PDF	COC / Test Report

Shane Sparks	SD Consulting Group	796 Cherokee Ave St. Paul, MN 55107 Phone: (612) 209-7366 Fax: Email: shane.sparks@sd-consultinggroup.
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<u>Delivery</u>	<u>Format</u>	<u>Deliverables</u>
Email - Multiple Reports By Agreement	PDF	COA
Email - Multiple Reports By Agreement	PDF	COC / Test Report
Email - Multiple Reports By Agreement	PDF	COR
Email - Multiple Reports By Agreement	PDF	Invoice

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Analytical Report

Bill To: SD Consulting Group 796 Cherokee Ave St. Paul, MN, United States 55107	Project ID: Greenhaven Project Name: Estates Project Location: LSD: P.O.: 1363412 Proj. Acct. code:	Lot ID: 1363412 Control Number: Date Received: Jul 12, 2019 Date Reported: Jul 18, 2019 Report Number: 2423254
Attn: Accounts Payable Sampled By: Shane Sparks Company:		

		Reference Number	1363412-1	1363412-2	1363412-3
		Sample Date	Jul 11, 2019	Jul 11, 2019	Jul 11, 2019
		Sample Time	10:00	10:00	10:00
		Sample Location			
		Sample Description	72 / 70 / 23.1C / CM	74 / 70 / 23.1C / CM	80 / 70 / 23.1C / CM
		Matrix	Soil	Soil	Soil
Analyte	Units	Results	Results	Results	Nominal Detection Limit
Physical and Aggregate Properties					
Texture		Sandy Loam	Loam	Clay Loam	
Sand	50 µm - 2 mm	% by weight	68	37	25
Silt	2 µm - 50 µm	% by weight	21	38	44
Clay	<2 µm	% by weight	11	25	31

Analytical Report

Bill To: SD Consulting Group
796 Cherokee Ave
St. Paul, MN, United States
55107
Attn: Accounts Payable
Sampled By: Shane Sparks
Company:

Project ID: Greenhaven
Project Name: Estates
Project Location:
LSD:
P.O.: 1363412
Proj. Acct. code:

Lot ID: **1363412**
Control Number:
Date Received: Jul 12, 2019
Date Reported: Jul 18, 2019
Report Number: 2423254

		Reference Number	1363412-4	1363412-5	1363412-6
		Sample Date	Jul 11, 2019	Jul 11, 2019	Jul 11, 2019
		Sample Time	10:00	10:00	10:00
		Sample Location			
		Sample Description	70 / 70 / 23.1C / CM	71 / 70 / 23.1C / CM	79 / 70 / 23.1C / CM
		Matrix	Soil	Soil	Soil
Analyte	Units	Results	Results	Results	Nominal Detection Limit
Physical and Aggregate Properties					
Texture		Loam	Clay Loam	Loam	
Sand	50 µm - 2 mm	% by weight	27	28	32
Silt	2 µm - 50 µm	% by weight	47	43	46
Clay	<2 µm	% by weight	26	29	22

Analytical Report

Bill To: SD Consulting Group	Project ID: Greenhaven	Lot ID: 1363412
796 Cherokee Ave	Project Name: Estates	Control Number:
St. Paul, MN, United States	Project Location:	Date Received: Jul 12, 2019
55107	LSD:	Date Reported: Jul 18, 2019
Attn: Accounts Payable	P.O.: 1363412	Report Number: 2423254
Sampled By: Shane Sparks	Proj. Acct. code:	
Company:		

		Reference Number	1363412-7	1363412-8	1363412-9
		Sample Date	Jul 11, 2019	Jul 11, 2019	Jul 11, 2019
		Sample Time	10:00	10:00	10:00
		Sample Location			
		Sample Description	67 / 70 / 23.1C / CM	69 / 70 / 23.1C / CM	86 / 70 / 23.1C / CM
		Matrix	Soil	Soil	Soil
Analyte	Units	Results	Results	Results	Nominal Detection Limit
Physical and Aggregate Properties					
Texture		Clay Loam	Loam	Clay Loam	
Sand	50 µm - 2 mm	% by weight	34	40	25
Silt	2 µm - 50 µm	% by weight	38	43	44
Clay	<2 µm	% by weight	28	17	31

Analytical Report

Bill To: SD Consulting Group
796 Cherokee Ave
St. Paul, MN, United States
55107
Attn: Accounts Payable
Sampled By: Shane Sparks
Company:

Project ID: Greenhaven
Project Name: Estates
Project Location:
LSD:
P.O.: 1363412
Proj. Acct. code:

Lot ID: **1363412**
Control Number:
Date Received: Jul 12, 2019
Date Reported: Jul 18, 2019
Report Number: 2423254

		Reference Number	1363412-10	1363412-11	1363412-12
		Sample Date	Jul 11, 2019	Jul 11, 2019	Jul 11, 2019
		Sample Time	10:00	10:00	10:00
		Sample Location			
		Sample Description	66 / 70 / 23.1C / CM	68 / 70 / 23.1C / CM	75 / 70 / 23.1C / CM
		Matrix	Soil	Soil	Soil
Analyte	Units	Results	Results	Results	Nominal Detection Limit
Physical and Aggregate Properties					
Texture		Loam	Clay Loam	Loam	
Sand	50 µm - 2 mm	% by weight	37	34	39
Silt	2 µm - 50 µm	% by weight	37	36	35
Clay	<2 µm	% by weight	26	30	26

Analytical Report

Bill To: SD Consulting Group 796 Cherokee Ave St. Paul, MN, United States 55107	Project ID: Greenhaven Project Name: Estates Project Location: LSD: P.O.: 1363412 Proj. Acct. code:	Lot ID: 1363412 Control Number: Date Received: Jul 12, 2019 Date Reported: Jul 18, 2019 Report Number: 2423254
Attn: Accounts Payable Sampled By: Shane Sparks Company:		

		Reference Number	1363412-13	1363412-14	1363412-15
		Sample Date	Jul 11, 2019	Jul 11, 2019	Jul 11, 2019
		Sample Time	10:00	10:00	10:00
		Sample Location			
		Sample Description	76 / 70 / 23.1C / CM	81 / 70 / 23.1C / CM	78 / 70 / 23.1C / CM
		Matrix	Soil	Soil	Soil
Analyte	Units	Results	Results	Results	Nominal Detection Limit
Physical and Aggregate Properties					
Texture		Loam	Loam	Loam	
Sand	50 µm - 2 mm	% by weight	43	36	0.1
Silt	2 µm - 50 µm	% by weight	33	44	0.1
Clay	<2 µm	% by weight	24	20	0.1

Analytical Report

Bill To: SD Consulting Group 796 Cherokee Ave St. Paul, MN, United States 55107	Project ID: Greenhaven Project Name: Estates Project Location: LSD: P.O.: 1363412 Proj. Acct. code:	Lot ID: 1363412 Control Number: Date Received: Jul 12, 2019 Date Reported: Jul 18, 2019 Report Number: 2423254
Attn: Accounts Payable Sampled By: Shane Sparks Company:		

		Reference Number	1363412-16	1363412-17	1363412-18
		Sample Date	Jul 11, 2019	Jul 11, 2019	Jul 11, 2019
		Sample Time	10:00	10:00	10:00
		Sample Location			
		Sample Description	85 / 70 / 23.1C / CM	88 / 70 / 23.1C / CM	82 / 70 / 23.1C / CM
		Matrix	Soil	Soil	Soil
Analyte	Units	Results	Results	Results	Nominal Detection Limit
Physical and Aggregate Properties					
Texture		Clay Loam	Clay Loam	Loam	
Sand	50 µm - 2 mm	% by weight	32	33	0.1
Silt	2 µm - 50 µm	% by weight	33	38	0.1
Clay	<2 µm	% by weight	35	29	0.1

Analytical Report

Bill To: SD Consulting Group 796 Cherokee Ave St. Paul, MN, United States 55107	Project ID: Greenhaven Project Name: Estates Project Location: LSD: P.O.: 1363412 Proj. Acct. code:	Lot ID: 1363412 Control Number: Date Received: Jul 12, 2019 Date Reported: Jul 18, 2019 Report Number: 2423254
Attn: Accounts Payable Sampled By: Shane Sparks Company:		

Reference Number 1363412-19
Sample Date Jul 11, 2019
Sample Time 10:00
Sample Location
Sample Description 77 / 70 / 23.1C / CM

Matrix Soil

Analyte	Units	Results	Results	Results	Nominal Detection Limit
Physical and Aggregate Properties					
Texture			Loam		
Sand	50 µm - 2 mm	% by weight	30		0.1
Silt	2 µm - 50 µm	% by weight	45		0.1
Clay	<2 µm	% by weight	25		0.1

Approved by:



Murray Klutz
Senior Agronomist

Data have been validated by Analytical Quality Control and Element's Integrated Data Validation System (IDVS).
Generation and distribution of the report, and approval by the digitized signature above, are performed through a secure and controlled automatic process.

Methodology and Notes

Bill To:	SD Consulting Group	Project ID:	Greenhaven	Lot ID:	1363412
	796 Cherokee Ave	Project Name:	Estates	Control Number:	
	St. Paul, MN, United States	Project Location:		Date Received:	Jul 12, 2019
	55107	LSD:		Date Reported:	Jul 18, 2019
Attn:	Accounts Payable	P.O.:	1363412	Report Number:	2423254
Sampled By:	Shane Sparks	Proj. Acct. code:			
Company:					

Method of Analysis

Method Name	Reference	Method	Date Analysis Started	Location
Particle Size Analysis - GS	Carter	* Hydrometer Method, 55.3	Jul 16, 2019	Element Edmonton - Roper Road

** Reference Method Modified***References**

Carter	Soil Sampling and Methods of Analysis.
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Please direct any inquiries regarding this report to our Client Services group.

Results relate only to samples as submitted.

The test report shall not be reproduced except in full, without the written approval of the laboratory.

Attachment E – Infiltrometer Testing Reports

Infiltration Report

SD Consulting Group

Greenhaven 70 - Division No. 6, AB

K_{sat} best-fit site average: 286 mm/hr or 11.27 in/hr

GPS Infiltration Test Site Map



Map Pin #	Test #	Test Name	Ksat (mm/hr)	Ksat (in/hr)	C (mm)	RMS Error of Regression
1		Greenhaven 70	286	11.27	10.3	2.2939

*** Site Average could not be calculated from only 1 viable test

Infiltration Report

SD Consulting Group

Greenhaven 70 - Division No. 6, AB

This report summarizes the results of a set of Modified Philip Dunne (MPD) Infiltrometer tests performed at the above referenced site. SD Consulting Group personnel performed the field tests. The software used to compute saturated hydraulic conductivity (K_{sat}) and generate this report assumes that the field personnel used infiltrmeters manufactured by Upstream Technologies Inc. and followed the procedures outlined in "Manual – Modified Philip - Dunne Infiltrometer" by Ahmed, Gulliver, and Nieber.

The following paragraphs describe the individual tests, input values used in the analysis, and methods used to compute the K_{sat} value.

After individual K_{sat} values were calculated, the method used to determine the overall site K_{sat} value ($K_{best-fit}$) is described in "Effective Saturated Hydraulic Conductivity of an Infiltration-Based Stormwater Control Measure" by Weiss and Gulliver 2015, "A relationship to more consistently and accurately predict the best-fit value of saturated hydraulic conductivity used a weighted sum of 0.32 times the arithmetic mean and 0.68 times the geometric mean."

METHOD USED TO COMPUTE K_{sat}

The MPD Infiltrometer software uses the following procedure described in "The Comparison of Infiltration Devices and Modification of the Philip-Dunne Permeameter for the Assessment of Rain Gardens" by Rebecca Nestigen, University of Minnesota, November 2007.

The steps are as follows:

1. For each measurement of head, use the following equation to find the corresponding distance to the sharp wetting front.

$$[H_0 - H(t)]r_1^2 = \frac{\theta_1 - \theta_2}{3} [2[R(t)]^3 + 3[R(t)]^2 L_{max} - L_{max}^3 - 4r_0^3]$$

2. Estimate the change in head with respect to time and the change in wetting front distance with respect to time by using the backward difference for all values of $R(t)$ equal to or greater than the distance

$$\sqrt{r_1^2 + L_{max}^2}$$

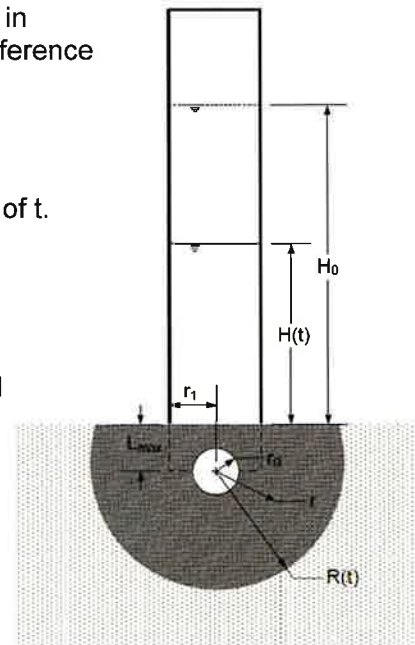
3. Make initial guesses for K and C .

4. Solve the following equations for $\Delta P(t)$ at each incremental value of t .

$$\Delta P(t) = \frac{\pi^2}{8} \left\{ \theta_1 - \theta_0 \frac{[R(t)^2] + [R(t)]L_{max}}{K} \frac{dr}{dt} - 2r_0^2 \right\} \frac{\ln \left[\frac{R(t)[r_0 + L_{max}]}{r_0[R(t) + L_{max}]} \right]}{L_{max}}$$

$$\Delta P(t) = C - H(t) - L_{max} + \frac{L_{max}}{K} \frac{dh}{dt}$$

5. Minimize the absolute difference between the two solutions found in Step 4 by adjusting the values of K and C .



Parameters for Equations

θ_0 = volumetric water content of soil before MPD test

θ_1 = volumetric water content of soil after MPD test

Infiltration Report

SD Consulting Group

Greenhaven 70 - Division No. 6, AB

Greenhaven 70

Date	7/11/2019
Time	1:23 PM
Latitude	50.721124
Longitude	-113.936819
Initial Volumetric Moisture	2.00 %
Final Volumetric Moisture	78.00 %
Cylinder Size	3 Liter

Greenhaven 70 Results

Map Pin #	1
Test Number	
Ksat - mm/hr	286
Ksat - in/hr	11.27
Capillary Pressure C mm	10.3
RMS Error of Regression	2.2939

Readings

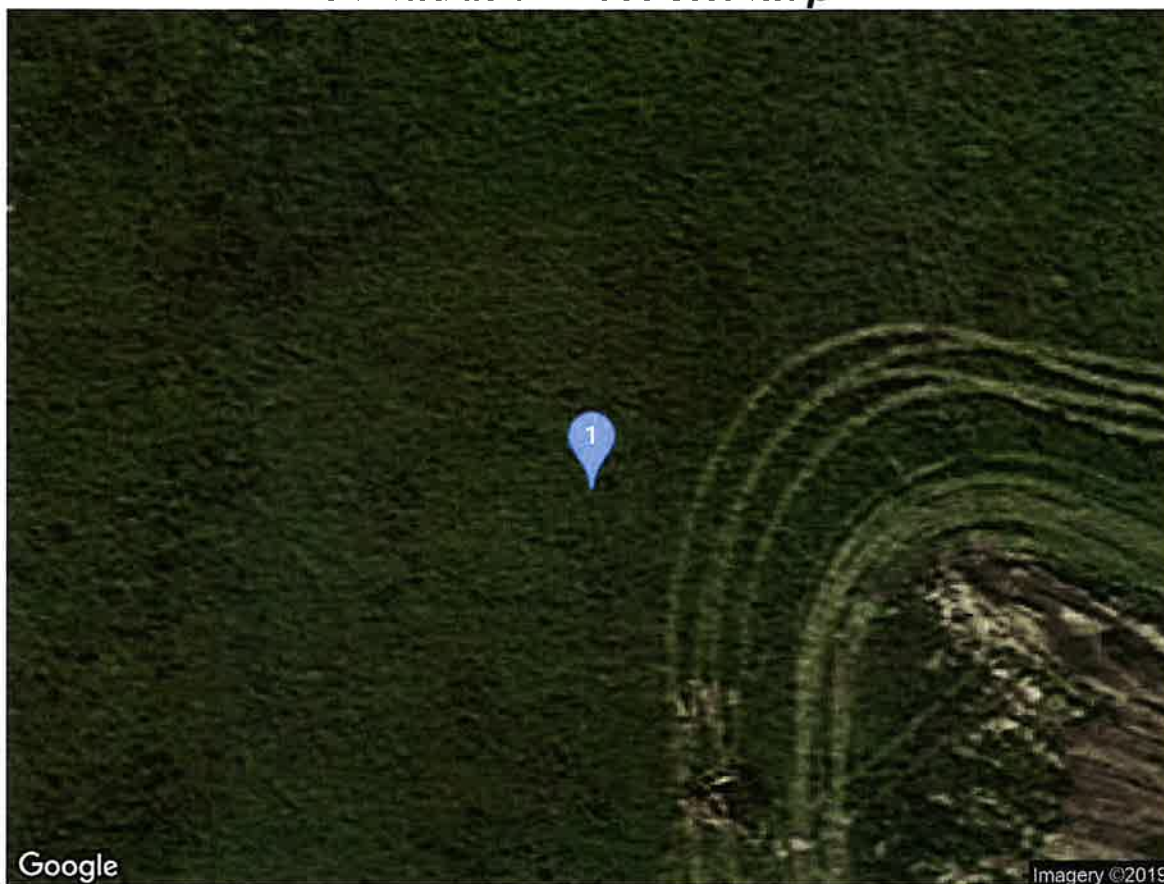
#	Time	Head	#	Time	Head	#	Time	Head
1	0 s	35.47 cm	26	739 s	15.7 cm	51	1482 s	6.26 cm
2	27 s	34.69 cm	27	769 s	15.04 cm	52	1511 s	5.35 cm
3	57 s	33.14 cm	28	799 s	14.27 cm	53	1541 s	5.09 cm
4	86 s	32.24 cm	29	829 s	13.49 cm	54	1571 s	6.64 cm
5	116 s	30.82 cm	30	858 s	13.11 cm	55	1601 s	4.83 cm
6	146 s	30.17 cm	31	889 s	12.33 cm	56	1630 s	6.64 cm
7	175 s	29.13 cm	32	918 s	11.55 cm	57	1660 s	4.96 cm
8	205 s	27.58 cm	33	947 s	10.91 cm	58	1690 s	4.58 cm
9	235 s	27.45 cm	34	977 s	10.27 cm			
10	264 s	25.64 cm	35	1007 s	10.14 cm			
11	294 s	25.64 cm	36	1036 s	9.1 cm			
12	324 s	24.61 cm	37	1066 s	9.75 cm			
13	354 s	23.57 cm	38	1096 s	8.2 cm			
14	383 s	23.06 cm	39	1125 s	8.97 cm			
15	413 s	21.63 cm	40	1155 s	7.03 cm			
16	443 s	21.12 cm	41	1185 s	7.03 cm			
17	472 s	20.09 cm	42	1215 s	7.42 cm			
18	502 s	20.09 cm	43	1244 s	7.03 cm			
19	532 s	19.82 cm	44	1274 s	6.0 cm			
20	561 s	18.67 cm	45	1304 s	5.22 cm			
21	591 s	18.28 cm	46	1333 s	5.35 cm			
22	621 s	16.98 cm	47	1363 s	6.13 cm			
23	650 s	17.11 cm	48	1393 s	5.73 cm			
24	680 s	15.83 cm	49	1424 s	6.9 cm			
25	710 s	16.08 cm	50	1452 s	4.83 cm			

Infiltration Report

SD Consulting Group
Greenhaven 73 - Division No. 6, AB

K_{sat} best-fit site average: 63 mm/hr or 2.47 in/hr

GPS Infiltration Test Site Map



Map Pin #	Test #	Test Name	Ksat (mm/hr)	Ksat (in/hr)	C (mm)	RMS Error of Regression
1		Greenhaven 73	63	2.47	-171.1	1.6254

*** Site Average could not be calculated from only 1 viable test

Infiltration Report

SD Consulting Group

Greenhaven 73 - Division No. 6, AB

Greenhaven 73

Date	7/11/2019
Time	11:59 AM
Latitude	50.720319
Longitude	-113.938057
Initial Volumetric Moisture	5.00 %
Final Volumetric Moisture	97.00 %
Cylinder Size	3 Liter

Greenhaven 73 Results

Map Pin #	1
Test Number	
Ksat - mm/hr	63
Ksat - in/hr	2.47
Capillary Pressure C mm	-171.1
RMS Error of Regression	1.6254

Readings

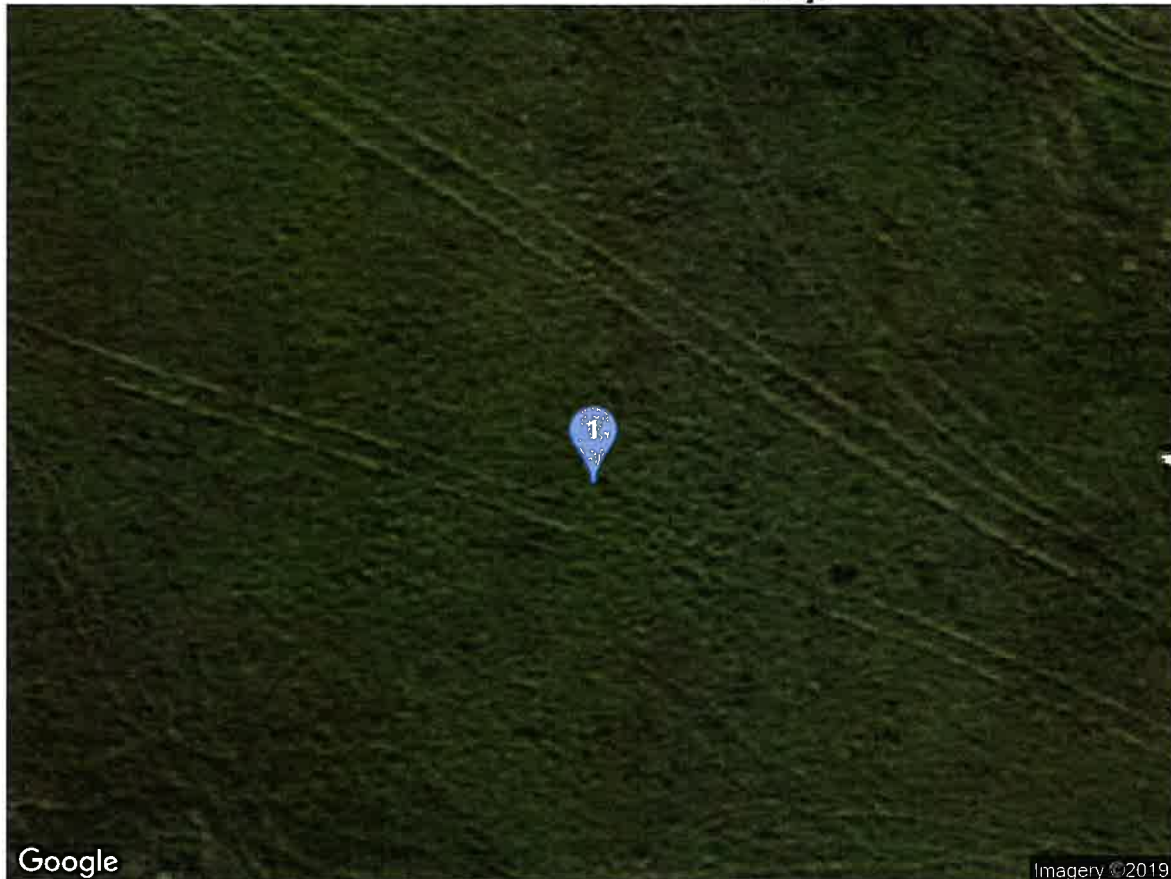
#	Time	Head	#	Time	Head	#	Time	Head	#	Time	Head
1	0 s	33.66 cm	26	740 s	21.38 cm	51	1482 s	13.89 cm	76	2225 s	7.29 cm
2	27 s	31.97 cm	27	770 s	20.22 cm	52	1512 s	13.76 cm			
3	57 s	30.69 cm	28	799 s	20.35 cm	53	1542 s	13.11 cm			
4	87 s	30.3 cm	29	829 s	19.05 cm	54	1571 s	11.95 cm			
5	116 s	29.39 cm	30	859 s	19.96 cm	55	1601 s	13.11 cm			
6	146 s	29.13 cm	31	888 s	19.05 cm	56	1631 s	12.59 cm			
7	176 s	28.88 cm	32	918 s	18.67 cm	57	1660 s	11.95 cm			
8	205 s	27.19 cm	33	948 s	19.18 cm	58	1690 s	11.95 cm			
9	235 s	28.23 cm	34	977 s	17.24 cm	59	1720 s	12.33 cm			
10	265 s	27.45 cm	35	1007 s	18.54 cm	60	1749 s	12.21 cm			
11	295 s	26.94 cm	36	1037 s	18.15 cm	61	1779 s	11.29 cm			
12	324 s	26.29 cm	37	1067 s	16.21 cm	62	1809 s	10.65 cm			
13	354 s	25.91 cm	38	1096 s	17.5 cm	63	1839 s	10.39 cm			
14	384 s	25.91 cm	39	1126 s	16.86 cm	64	1868 s	10.91 cm			
15	413 s	25.0 cm	40	1156 s	15.3 cm	65	1898 s	10.01 cm			
16	443 s	23.83 cm	41	1185 s	16.08 cm	66	1928 s	10.78 cm			
17	473 s	24.23 cm	42	1215 s	16.34 cm	67	1957 s	10.65 cm			
18	502 s	23.7 cm	43	1245 s	16.08 cm	68	1987 s	8.46 cm			
19	532 s	23.32 cm	44	1274 s	15.56 cm	69	2017 s	9.88 cm			
20	562 s	23.19 cm	45	1304 s	14.4 cm	70	2046 s	9.1 cm			
21	591 s	21.76 cm	46	1334 s	15.04 cm	71	2076 s	8.46 cm			
22	621 s	22.29 cm	47	1363 s	14.92 cm	72	2106 s	9.23 cm			
23	651 s	21.76 cm	48	1393 s	14.79 cm	73	2135 s	8.58 cm			
24	681 s	21.38 cm	49	1423 s	13.76 cm	74	2165 s	9.1 cm			
25	710 s	21.25 cm	50	1453 s	14.27 cm	75	2195 s	7.67 cm			

Infiltration Report

SD Consulting Group
Greenhaven 79 - Division No. 6, AB

K_{sat} best-fit site average: 282 mm/hr or 11.12 in/hr

GPS Infiltration Test Site Map



Map Pin #	Test #	Test Name	Ksat (mm/hr)	Ksat (in/hr)	C (mm)	RMS Error of Regression
1		Greenhaven 79	282	11.12	49.3	13.9841

*** Site Average could not be calculated from only 1 viable test

Infiltration Report

SD Consulting Group

Greenhaven 79 - Division No. 6, AB

Greenhaven 79

Date	7/11/2019
Time	10:57 AM
Latitude	50.719021
Longitude	-113.937312
Initial Volumetric Moisture	1.00 %
Final Volumetric Moisture	70.00 %
Cylinder Size	3 Liter

Greenhaven 79 Results

Map Pin #	1
Test Number	
Ksat - mm/hr	282
Ksat - in/hr	11.12
Capillary Pressure C mm	49.3
RMS Error of Regression	13.9841

Readings

#	Time	Head	#	Time	Head	#	Time	Head	#	Time	Head
1	0 s	37.53 cm	26	739 s	20.61 cm	51	1482 s	10.27 cm	76	2224 s	4.32 cm
2	27 s	36.5 cm	27	769 s	20.99 cm	52	1511 s	10.01 cm	77	2254 s	4.96 cm
3	57 s	35.72 cm	28	799 s	19.44 cm	53	1541 s	9.75 cm	78	2283 s	4.96 cm
4	86 s	34.95 cm	29	829 s	19.44 cm	54	1571 s	8.58 cm	79	2313 s	4.58 cm
5	116 s	33.66 cm	30	858 s	18.41 cm	55	1600 s	8.2 cm	80	2343 s	6.26 cm
6	146 s	32.75 cm	31	888 s	19.05 cm	56	1630 s	8.71 cm	81	2372 s	4.83 cm
7	175 s	32.5 cm	32	918 s	17.37 cm	57	1660 s	8.2 cm	82	2402 s	5.09 cm
8	205 s	30.82 cm	33	947 s	17.11 cm	58	1689 s	7.81 cm	83	2432 s	4.19 cm
9	235 s	30.69 cm	34	977 s	17.24 cm	59	1719 s	7.29 cm	84	2461 s	5.35 cm
10	264 s	29.78 cm	35	1007 s	16.73 cm	60	1749 s	6.52 cm	85	2491 s	5.09 cm
11	294 s	29.52 cm	36	1036 s	16.21 cm	61	1779 s	7.29 cm	86	2521 s	4.58 cm
12	324 s	27.98 cm	37	1066 s	15.56 cm	62	1808 s	5.73 cm	87	2550 s	6.0 cm
13	353 s	27.71 cm	38	1096 s	15.56 cm	63	1838 s	6.26 cm	88	2580 s	4.32 cm
14	383 s	26.94 cm	39	1125 s	14.92 cm	64	1868 s	5.62 cm	89	2610 s	5.62 cm
15	413 s	26.04 cm	40	1155 s	14.92 cm	65	1897 s	4.83 cm	90	2640 s	5.35 cm
16	443 s	25.91 cm	41	1185 s	14.14 cm	66	1927 s	5.35 cm	91	2669 s	5.62 cm
17	472 s	25.0 cm	42	1214 s	14.02 cm	67	1957 s	4.06 cm	92	2699 s	5.62 cm
18	502 s	24.61 cm	43	1244 s	13.23 cm	68	1986 s	5.48 cm	93	2729 s	4.96 cm
19	532 s	23.83 cm	44	1274 s	12.46 cm	69	2016 s	4.06 cm	94	2758 s	5.62 cm
20	561 s	23.7 cm	45	1304 s	12.98 cm	70	2046 s	4.58 cm	95	2788 s	4.58 cm
21	591 s	22.8 cm	46	1333 s	11.68 cm	71	2075 s	4.71 cm	96	2818 s	6.0 cm
22	621 s	22.67 cm	47	1363 s	12.33 cm	72	2105 s	4.19 cm	97	2847 s	4.83 cm
23	650 s	22.03 cm	48	1393 s	11.55 cm	73	2135 s	4.71 cm	98	2877 s	5.09 cm
24	680 s	21.12 cm	49	1422 s	11.42 cm	74	2165 s	4.58 cm	99	2907 s	4.96 cm
25	710 s	20.99 cm	50	1452 s	10.39 cm	75	2194 s	4.96 cm	100	2936 s	5.35 cm

Infiltration Report

SD Consulting Group
Greenhaven 79 - Division No. 6, AB

Greenhaven 79 Readings continued

#	Time	Head
101	2966 s	5.35 cm
102	2996 s	4.45 cm
103	3025 s	6.39 cm
104	3056 s	4.96 cm
105	3085 s	5.09 cm
106	3115 s	4.83 cm



Groundwater Resources
Information Technologies Ltd.

**Level II Private Sewage Treatment System
Assessment for Subdivision
SE – 27 – 20 – 29W4
Greenhaven Estates
Foothills County**

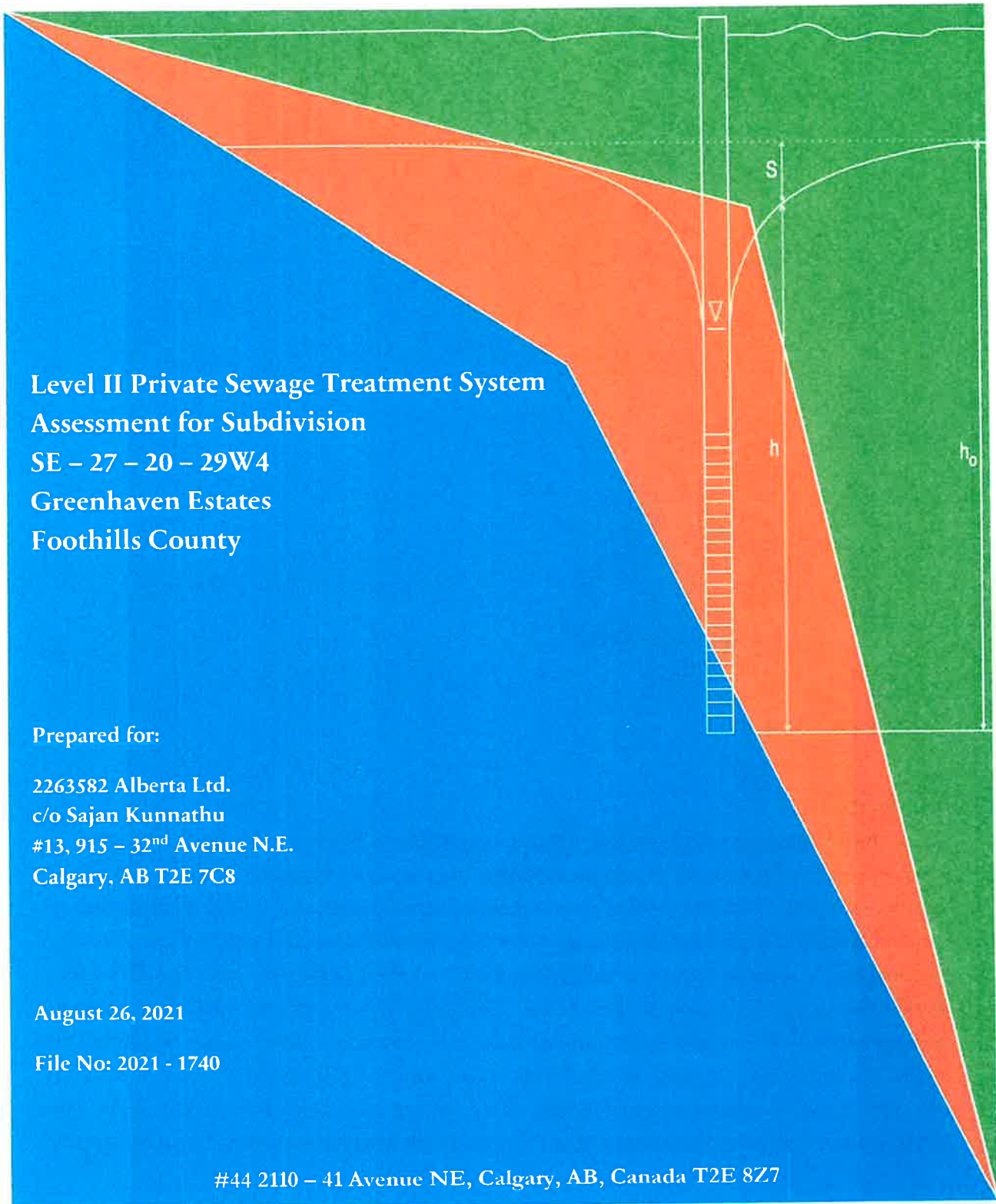
Prepared for:

2263582 Alberta Ltd.
c/o Sajan Kunnathu
#13, 915 – 32nd Avenue N.E.
Calgary, AB T2E 7C8

August 26, 2021

File No: 2021 - 1740

#44 2110 – 41 Avenue NE, Calgary, AB, Canada T2E 8Z7





Signatures

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Reviewed by:



Ken Hugo, P.Geol
Senior Hydrogeologist

Disclaimer

Groundwater Resources Information Technologies Ltd. (GRIT Ltd.) has performed the work as described below and made the findings and conclusions set out in the report in a manner consistent with the level of care and skill normally exercised by members of the geological science profession practicing under similar conditions at the time the work was performed. This report presents a reasonable review of information available to GRIT Ltd. Within the established scope, work schedule and budgetary constraints, GRIT Ltd. accepts no responsibility for any deficiency, misstatement or inaccuracy in this report resulting from misinformation from any individuals that provided information as part of this report. GRIT Ltd. appreciates the opportunity to present these findings on behalf of the Client. If you have any questions regarding the above report, please do not hesitate to contact the above signed.

Executive Summary

Groundwater Resources Information Technologies Ltd. (GRIT) was retained by 2263582 Alberta Ltd. to complete a Level II Private Sewage Treatment System (PSTS) assessment for a subdivision on land located within SE – 27 – 20 – 29W4M in Foothills County, Alberta (the “Site”). The PSTS assessment was completed following *the 2015 Alberta Private Sewage Systems Standard of Practice* (SOP) and the *Model Process for Subdivision Approval* (Alberta Association of Municipal District and Counties, 2011).

The Site is located on hummocky, gently southward sloping portion of land which is mostly covered by grasses with some small trees and shrubs grouped near the central east portion of the site. The area is currently undergoing development as a residential subdivision and some clearing has been conducted on the property. A farmstead was formerly on the property.

There are no major surface water bodies within the site boundaries but there are localized topographic lows containing water to the north of the site and along a small spring near the western property boundary. The larger water body within the north of the site is engineered for stormwater runoff. The parcel is located within an area of high development density, with the surrounding area comprising commercial properties, residential acreages and high-density residential housing. Quarter sections adjacent to the site in all directions have been developed with at least one residential property.

Review of the drilling logs for water supply wells within the surrounding area indicate that there is 32 – 34 meters of mixed, interbedded clay, sand and gravel overlying the deeper aquifers in the area, which are used as a drinking water source. The substantial thickness of overlying clay should serve as a barrier to the migration of septic field effluent as long as gravel content remains low enough. No water wells under the direct influence of surface water were identified at the Site or within a 150 m radius.

One test pit was dug on each of the proposed new parcels (three on Phase 2b side and 16 on Phase 3 side) to log the soil, collect soil samples for grain size analysis, and determine if any shallow water table is present. Strata underlying the site consists of a clay loam, loam, silt loam or occasionally sandy loam soil textures with 0 – 10% gravel and cobble coarse grains.

All soil types identified at the Site will support primary or secondary treated effluent disposal with conventional below grade treatment fields. There were indications of a shallow water table below 12 of the lots. These lots will require secondary treated effluent to meet the

required separation distance between the base of the septic field trench and the water table, or a mound system may be used.

The three lots in Phase 2B have fill to a depth of 0.9 – 1.2 meters. A septic field trench is typically installed to a depth of 0.9 meters and will be in native material in two of the three lots on the Phase 2B side. The one lot with fill to 1.2 meters may require the trench to be installed to a depth of 1.2 meters so that native material is encountered. Sufficient native material and loading capacity exists on all lots to accommodate a PSTS.

To allow for the design of the parcel size for the future acreage, total septic field areas have been provided based on the soil texture, grade and effluent type. Calculations assume that each parcel would be developed with a three bedroom house, which has a corresponding peak wastewater volume of 1,530 L/day. Approximations for the total field area are based on a 15 m long by 0.9 m wide lateral, with each lateral separated by 0.9 m.

Soil Texture	Effluent Type	Loading Rate (L/day/m ²)	Infiltration Area (m ²)	Total Field Area (m ²)
Loam	Primary	22.0	70	135
	Secondary	30.8	50	105
Clay Loam	Primary	13.2	116	225
	Secondary	22.0	70	135

Final siting of the PSTSs should maintain the required setback distances from the treatment field to property lines, water wells, water courses, buildings and septic tanks as outlined in the SOP.

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[1.0] Introduction

Groundwater Resources Information Technologies Ltd. (GRIT) was retained by 2263582 Alberta Ltd. to complete a Level II Private Sewage Treatment System (PSTS) assessment for a 19-lot residential subdivision within SE– 27 – 20 – 29W4 in Foothills County, Alberta (hereinafter referred to as the Site). The purpose of the investigation was to establish the soil texture and structure across the Site to establish the feasibility of a future PSTS installation on 16 new proposed residential lots and 3 existing residential lots. A site map of the proposed development area is provided in **Appendix A**.

The PSTS assessment was completed according to the *Alberta Private Sewage Systems Standard of Practice* (Safety Codes Council, 2015) or *SOP*. General reporting has been completed following *The Model Process for Subdivision Approval and Private Sewage* (2011).

[2.0] Background

[2.1] Site Description

The Site is located on hummocky, gently southward sloping portion of land which is mostly covered by grasses with some small trees and shrubs grouped near the central east portion of the site. The site has been partially cleared and a community water supply well installed towards the centre of the site, which will result in setback restrictions for some lots. A former farmstead was on the site and remnants of the farmstead are present, including a well in a pit which should be decommissioned.

There are no major surface water bodies within the site boundaries but there are localized topographic lows containing water to the north of the site and along a small spring near the western property boundary. The larger water body within the north of the site is engineered for stormwater runoff. There is an access road within the Site boundaries, and the property can be accessed from the east via 48 Street E.

The parcel is located within an area with high development density, with the surrounding area comprising commercial properties, residential acreages and high-density residential housing. There are currently 30 developed residential properties within the Site quarter section. Quarter sections adjacent to the site in all directions have been developed with at least one residential property.

As per our understanding, the investigated portions of the Site will be developed into a total of 22 residential lots as outlined in **Appendix A, Plate No. 1**. Three of the lots within Phase 3 (Lots 16 – 18) cannot have a septic field placed on them due to their proximity to the community supply well. The remaining lots are sized appropriately to allow for an alternate area for septic fields and to meet applicable setback distances from structures, water wells and property boundaries as outlined in the SOP and summarized in **Table 6, Section 5.0**.

2.2 Local Topography

The site elevation ranges from 1,066 meters above sea level (m asl) near the northwest corner of the property to 1,060 m asl near the southeast corner. The site slopes south at a variable grade, with many slopes less than 5%. The closest major surface water body is Sheep River which runs from west to east approximately 700 meters south of the site. An air photo showing topographic contours of the site and surrounding area is shown in **Appendix A, Plate No. 2**.

2.1 Regional Geology

According to the Alberta Research Council map entitled “Surficial Geology of the Calgary-Lethbridge Corridor” (G.M.D. Hartman, 2016) the area is covered by glacially derived till consisting of a mixture of clay, silt, sand and minor pebbles, cobbles and boulders. Locally can include some stratified sediments of glaciolacustrine or glaciofluvial origin. Topography is low to high relief with undulating, hummocky topography.

According to the Water Well Drillers Report for the wells within the site boundaries the surficial sediments consist of 32 – 34 meters of mixed, interbedded clay, sand and gravel. The presence of clay is favourable in preventing contamination from surface sources (such as septic field effluent) from entering lower aquifers.

The underlying bedrock geology consists of the early/lower Paleocene fluvial sandstones of the Paskapoo Formation. The Paskapoo Formation is a non-marine fluvial deposit consisting of interbedded sandstone channel bodies and overbank mudstone, siltstone and shale. Bedrock near the Site is located approximately 35 meters below ground surface based off Water Well Drilling Reports in the area.

3.4 Surface Soil Conditions

The Alberta Soils Information Viewer indicates that the soils underlying the Site are part of two separate soil polygons. The east half of the site is part of soil polygon 11854 and is composed of well drained Orthic Black Chernozem overlying moderately fine textured sand clay loam, clay loam and silty clay loam deposits. Soils belong to the Dunvargan soil series and are derived from medium textured surficial till sediments. The west half of the site is part of soil polygon 11870 and is composed of well drained Orthic Black Chernozem overlying moderately fine textured sand clay loam, clay loam and silty clay loam. Soils belong to the Dunvargan soil series and are derived from medium textured till sediments.

3.5 Water Wells and Groundwater Under the Direct Influence of Surface Water (GWUDI)

According to the Alberta Environment and Parks (AEP) water well database there are records for two water supply wells on the Site: GIC Well ID's 1600007 and 133804. The location of well #133804 is listed on the AEP water well database as sitting in the middle of the quarter section and thus does not accurately reflect the true location of this well. A well in a well pit was identified on the south centre portion of the site and another unused well in the north-west corner of the site. Both wells should be properly abandoned. The AEP water well database lists one water well within ~150 meters of the Site boundary. An aerial photo showing well locations as listed on the AEP database relative to the Site is provided in **Appendix A, Plate No. 3.**

The Water Well Drilling Reports for the wells located within 150 meters of the Site date from 1973 to 2006. All supply wells are completed within a single bedrock sandstone aquifer or across a water bearing surficial gravel layer.

Soil strata overlying the wells completed within bedrock or surficial gravel aquifers include 23 – 30 meters of a mixture of clay, sand and gravel overlying the screened interval. The clay and bedrock will serve as barriers to the migration of septic field effluent to the underlying aquifers.

3.6 Previous Geotechnical Investigation

No previous geotechnical reports were available for the Site.

[4.0] Field Assessment and Shallow Groundwater Conditions

On August 11, 2021, 19 test holes (TH – 1 to TH – 19) were excavated within the Site boundaries to give a general assessment of soil types underlying three lots on the Phase 2b side and 16 lots on the Phase 3 side of the development. The test holes were located in areas with slopes suitable for a septic field and where there was reasonable access for excavation equipment. Test holes were not dug on Lots 16-18 of the Phase 3 development as these lots are within the setback distance for a septic field from a community supply well.

Soils were logged by personnel from GRIT on August 11, 2021. Soils were logged according to the Canadian System of Soils Classification (1998). A summary of the test hole profiles, field observations and field tests are provided in **Table 1**. Test hole locations are illustrated in **Appendix A, Plate No. 4**. GPS location of the test holes were measured with a cellphone.

Table 1: Soil Profile and Observations

Horizon	Texture	Depth (m)	Colour	Gleying	Mottling	Structure	Grade	Consistency	Moisture	% Coarse	Lab Analysis	Notes
TH-1 – GPS Location: 50.7208246° N -113.9352256° E												
Fill	Silt Clay Loam	0.0 – 0.90	Olive Brown 2.5Y 4/4	No	No	-	-	Loose	Dry	5	No	-
C	Loam	0.90 – 2.70	Olive Brown 2.5Y 4/4	No	No	Blocky	Moderate	Loose	Moist	5	Yes	Gravel and cobble coarse grains, iron oxide and anhydrite inclusions
TH-2 – GPS Location: 50.7212327° N -113.9353349° E												
Fill	Silt Clay Loam	0.0 – 1.20	Olive Brown 2.5Y 4/4	No	No	-	-	Loose	Dry	5	No	-
C	Loam	1.20 – 2.70	Olive Brown 2.5Y 4/4	No	No	Blocky	Moderate	Loose	Moist	5 – 7	Yes	Gravel and cobble coarse grains
TH-3 – GPS Location: 50.7218169° N -113.9355199° E												
Fill	Silt Clay Loam	0.0 – 0.90	Olive Brown 2.5Y 4/3	No	No	-	-	Firm	Moist	7	No	-
C	Loam	0.90 – 3.00	Olive Brown 2.5Y 4/3	No	No	Blocky	Moderate	Firm	Moist	7	Yes	Gravel and cobble coarse grains
TH-4 – GPS Location: 50.7206898° N -113.9315664° E												
Fill	Clay Loam	0.0 – 0.75	Olive Brown 2.5Y 4/4	No	No	-	-	Firm	Dry	0	No	-

C	Clay Loam	0.75 – 3.00	Olive Brown 2.5Y 4/4	No	No	Blocky	Strong	Firm/Plastic	Moist	5 – 7	Yes	-
TH-5 – GPS Location: 50.7203221° N -113.9316284° E												
A	Silt Loam	0.0 – 0.30	Dark Brown 10YR 3/3	No	No	Blocky	Strong	Firm	Dry	0	No	Rooted
B	Silt Loam	0.30 – 0.35	Dark Yellowish Brown 10YR 4/4	No	No	Blocky	Strong	Loose	Dry	0	No	Rooted
C ₁	Silt Loam	0.35 – 0.50	Light Olive Brown 2.5Y 5/4	No	No	Blocky	Strong	Loose	Moist	0	No	-
C ₂	Clay Loam	0.50 – 2.90	Olive Brown 2.5Y 4/4	No	No	Blocky	Strong	Plastic	Moist	5	Yes	Iron oxide inclusions
TH-6 – GPS Location: 50.7201614° N -113.9317042° E												
A	Silt Loam	0.0 – 0.30	Dark Brown 10YR 3/3	No	No	Blocky	Strong	Firm	Dry	0	No	Rooted
B	Silt Loam	0.30 – 0.45	Dark Yellowish Brown 10YR 3/4	No	No	Blocky	Strong	Firm	Dry	0	No	-
C ₁	Silt Loam	0.45 – 0.70	Olive Brown 2.5Y 4/4	No	No	Blocky	Strong	Loose	Dry	0	No	-
C ₂	Clay Loam	0.70 – 3.00	Light Olive Brown 2.5Y 5/3	No	No	Blocky	Strong	Firm	Dry	5	Yes	Iron oxide inclusions, coal flecks
TH-7 – GPS Location: 50.7199579° N -113.9317320° E												
A	Silt Loam	0.0 – 0.35	Black 2.5Y 2.5/1	No	No	Blocky	Strong	Loose	Dry	0	No	Well rooted
B	Silt Loam	0.35 – 0.55	Dark Brown 10YR 3/3	No	No	Blocky	Strong	Loose	Dry	0	No	Well rooted
C ₁	Sandy Loam	0.55 – 0.95	Olive Brown 2.5Y 4/4	No	No	Blocky	Moderate	Loose	Moist	0	No	-
C ₂	Loam	0.95 – 3.00	Olive Brown 2.5Y 4/3	No	No	Blocky	Strong	Firm	Moist	5	Yes	-
TH-8 – GPS Location: 50.7196613° N -113.9318269° E												
A	Silt Loam	0.0 – 0.30	Very Dark Brown 10YR 2/2	No	No	Blocky	Strong	Firm	Dry	0	No	Well rooted
B	Silt Loam	0.30 – 0.50	Dark Olive Brown 2.5Y 3/3	No	No	Blocky	Strong	Loose	Dry	0	No	Well rooted
C ₁	Sandy Loam	0.50 – 0.90	Olive Brown 2.5Y 4/4	No	No	Blocky	Moderate	Loose	Moist	0	No	-
C ₂	Clay Loam	0.90 – 3.00	Olive Brown 2.5Y 4/3	No	No	Blocky	Strong	Firm/Plastic	Moist	5	Yes	Gravel coarse grains, iron oxide and coal inclusions



TH-9 – GPS Location: 50.7192052° N -113.9317860° E												
A	Silt Loam	0.0 – 0.20	Very Dark Brown 10YR 2/2	No	No	Blocky	Strong	Hard	Dry	0	No	Rooted
B	Silt Loam	0.20 – 0.50	Olive Brown 2.5Y 4/4	No	No	Blocky	Strong	Hard	Dry	0	No	Rooted
C ₁	Clay Loam	0.50 – 1.00	Light Yellowish Brown 2.5Y 6/3	No	No	Blocky	Strong	Firm	Dry	2 - 5	No	-
C ₂	Clay Loam	1.00 – 3.00	Dark Olive Brown 2.5Y 3/3	No	No	Blocky	Strong	Firm	Moist	7	Yes	Gravel coarse grains, iron oxide and coal inclusions
TH-10 – GPS Location: 50.7187917° N -113.9316136° E												
A	Silt Loam	0.0 – 0.20	Very Dark Brown 10YR 2/2	No	No	Blocky	Strong	Hard	Dry	0	No	Rooted
B	Silt Loam	0.20 – 0.30	Dark Brown 10YR 3/3	No	No	Blocky	Strong	Hard	Dry	0	No	-
C ₁	Silt Loam	0.30 – 0.80	Light Yellowish Brown 2.5Y 6/3	No	No	Blocky	Strong	Firm	Dry	2	No	-
C ₂	Loam	0.80 – 3.00	Olive Brown 2.5Y 4/4	No	No	Blocky	Strong	Firm	Moist	5	Yes	Gravel coarse grains, iron oxide and coal inclusions
TH-11 – GPS Location: 50.7183020° N -113.9312737° E												
A	Silt Loam	0.0 – 0.15	Very Dark Brown 10YR 2/2	No	No	Blocky	Strong	Hard	Dry	0	No	Rooted
B	Silt Loam	0.15 – 0.20	Dark Olive Brown 2.5Y 3/3	No	No	Blocky	Strong	Hard	Dry	0	No	Rooted
C ₁	Silt Loam	0.20 – 2.70	Black 2.5Y 2.5/1	No	No	Blocky	Strong	Firm	Moist	0	No	-
C ₂	Loam	2.70 – 3.00	Olive Brown 2.5Y 4/4	No	No	Blocky	Strong	Plastic	Moist	5	Yes	-
TH-12 – GPS Location: 50.7182383° N -113.9310034° E												
C	Loam	0.0 – 2.70	Very Dark Grayish Brown 2.5Y 3/2	No	No	Blocky	Strong	Hard	Dry	0	Yes	-
TH-13 – GPS Location: 50.7181171° N -113.9299463° E												
Fill	Gravelly Silt Loam	0.0 – 0.60	Dark Brown 10YR 3/3	No	No	-	-	Hard	Dry	15	No	-
A	Silt Clay Loam	0.60 – 0.80	Very Dark Brown 10YR 2/2	No	Yes	Blocky	Strong	Plastic	Moist	0	No	-
C	Loam	0.80 – 3.00	Olive Brown 2.5Y 4/4	Yes	Yes	Blocky	Strong	Plastic	Wet	0	Yes	-



TH-14 – GPS Location: 50.7181472° N -113.9296023° E												
Fill	Silt	0.0 – 0.30	Dark Brown 10YR 3/3	No	No	-	-	Hard	Dry	10	No	-
B	Silt Loam	0.30 – 0.50	Black 10YR 2/1	No	No	Blocky	Strong	Loose	Dry	0	No	-
C ₁	Silt Clay	0.50 – 1.20	Olive Brown 2.5Y 4/3	No	No	Blocky	Strong	Loose	Moist	0	No	-
C ₂	Clay Loam	1.20 – 3.00	Olive Brown 2.5Y 4/4	Yes @ 2m	Yes @ 2m	Blocky	Strong	Plastic	Wet	7	Yes	-
TH-15 – GPS Location: 50.7184917° N -113.9292691° E												
C ₁	Silt Loam	0.0 – 0.70	Light Olive Brown 2.5Y 5/3	No	No	Blocky	Strong	Hard	Dry	7	No	-
C ₂	Clay Loam	0.70 – 3.00	Olive Brown 2.5Y 4/4	No	No	Blocky	Strong	Plastic	Moist	5	Yes	-
TH-16 – GPS Location: 50.7194951° N -113.9297220° E												
C ₁	Silt Loam	0.0 – 0.95	Olive Brown 2.5Y 4/4	No	No	Blocky	Strong	Hard	Dry	10	No	-
C ₂	Loam	0.95 – 3.00	Olive Brown 2.5Y 4/4	No	No	Blocky	Strong	Firm/ Slight Plastic	Moist	10	Yes	Iron oxide inclusions
TH-17 – GPS Location: 50.7197664° N -113.9293696° E												
C ₁	Sandy Loam	0.0 – 1.10	Dark Olive Brown 2.5Y 3/3	No	No	Blocky	Strong	Loose	Dry	5	No	-
C ₂	Clay Loam	1.10 – 2.70	Dark Olive Brown 2.5Y 3/3	No	No	Blocky	Strong	Plastic	Moist	10	Yes	-
TH-18 – GPS Location: 50.7200768° N -113.9292007° E												
C ₁	Silt Loam	0.0 – 0.60	Dark Olive Brown 2.5Y 3/3	No	No	Blocky	Strong	Hard	Dry	10	No	-
C ₂	Clay Loam	0.60 – 3.00	Olive Brown 2.5Y 4/4	No	No	Blocky	Strong	Slight Plastic	Moist	5	Yes	-
TH-19 – GPS Location: 50.7210402° N -113.9292265° E												
C ₁	Silt Clay Loam	0.0 – 1.10	Olive Brown 2.5Y 4/4	No	No	Blocky	Strong	Hard	Dry	5	No	-
C ₂	Clay Loam	1.10 – 3.00	Olive Brown 2.5Y 4/4	No	No	Blocky	Strong	Firm	Dry	8	Yes	-

Horizons A and B were not present at the top of the soil profile in 11 of the 19 test holes, indicating the topsoil has been stripped off or fill has been brought in overtop of the existing

A and B horizons. Native material was identified in all 19 test holes no deeper than 1.2 meters with most holes containing native material to surface.

The C horizons across the site consist of clay loam, loam, silt loam or occasionally sandy loam soil textures with 0 – 10% gravel and cobble coarse grains. The C horizon is still always matrix supported.

There were visual indications of a shallow water table present in two of the pits in the form of gleying or mottling (TH-13 & TH-14). Most test holes showed increasing moisture with depth. No impervious soil conditions or bedrock were encountered.

4.1 Grain Size Analysis

Soil samples were collected by personnel from GRIT during the excavation of soil pits on August 11, 2021 for determination for grain size of the sand and finer portion of the soil. Sample depth, grain size distribution and texture are summarized in **Table 2**. Structure of the soil was determined during test hole logging by personnel from GRIT on August 11, 2021. Grain size analysis results are attached in **Appendix B**.

Table 2: Laboratory Determination of Grain Size – sand and finer component

Sample ID	Sample Depth (m)	% Sand	% Silt	% Clay	Texture	Grade/Structure
TH-1	1.0	44.0	32.0	24.0	Loam	Moderate/Blocky
TH-2	1.0	44.2	32.6	23.2	Loam	Moderate/Blocky
TH-3	1.0	38.0	36.1	25.9	Loam	Moderate/Blocky
TH-4	1.0	44.8	27.0	28.2	Clay Loam	Strong/Blocky
TH-5	1.2	36.2	35.8	28.0	Clay Loam	Strong/Blocky
TH-6	1.2	33.6	38.5	27.9	Clay Loam	Strong/Blocky
TH-7	1.2	36.2	36.5	27.3	Loam	Strong/Blocky
TH-8	1.1	36.0	36.3	27.7	Clay Loam	Strong/Blocky
TH-9	1.2	37.2	34.9	27.9	Clay Loam	Strong/Blocky
TH-10	1.0	36.8	37.1	26.1	Loam	Strong/Blocky
TH-11	2.7	44.4	31.8	23.9	Loam	Strong/Blocky
TH-12	1.0	32.6	42.2	25.2	Loam	Strong/Blocky
TH-13	1.0	42.8	30.6	26.6	Loam	Strong/Blocky
TH-14	1.3	38.0	29.3	32.7	Clay Loam	Strong/Blocky
TH-15	1.0	33.8	34.5	31.7	Clay Loam	Strong/Blocky
TH-16	1.2	41.0	34.8	24.2	Loam	Strong/Blocky
TH-17	1.2	36.8	23.2	40.0	Clay Loam	Strong/Blocky
TH-18	1.2	37.8	30.7	31.5	Clay Loam	Strong/Blocky
TH-19	1.2	38.4	32.4	29.2	Clay Loam	Strong/Blocky

Soil texture at 1.0 – 1.3 meters depth, near the typical installation depth for lateral trenches, indicate a clay loam or loam texture with moderate to strong blocky structure. During test pit logging soils near this depth also contained 0 – 10% coarse fragments.

The effluent loading rates acceptable for the soil texture for primary (five day Biochemical Oxygen Demand [BOD] 30 – 150 mg/L) and secondary treated (BOD of less than 30 mg/L) effluent for the areas sampled are summarized in **Table 3**.

Table 3: Laboratory Determination of Grain Size and Corresponding Effluent Loading Rates

Sample ID	Grain Size	Structure/Grade	Effluent Loading Rate (L/day/m ²)	
			Primary Treated	Secondary Treated
TH-1	Loam	Moderate/Blocky	22.0	30.8
TH-2	Loam	Moderate/Blocky	22.0	30.8
TH-3	Loam	Moderate/Blocky	22.0	30.8
TH-4	Clay Loam	Strong/Blocky	13.2	22.0
TH-5	Clay Loam	Strong/Blocky	13.2	22.0
TH-6	Clay Loam	Strong/Blocky	13.2	22.0
TH-7	Loam	Strong/Blocky	22.0	30.8
TH-8	Clay Loam	Strong/Blocky	13.2	22.0
TH-9	Clay Loam	Strong/Blocky	13.2	22.0
TH-10	Loam	Strong/Blocky	22.0	30.8
TH-11	Loam	Strong/Blocky	22.0	30.8
TH-12	Loam	Strong/Blocky	22.0	30.8
TH-13	Loam	Strong/Blocky	22.0	30.8
TH-14	Clay Loam	Strong/Blocky	13.2	22.0
TH-15	Clay Loam	Strong/Blocky	13.2	22.0
TH-16	Loam	Strong/Blocky	22.0	30.8
TH-17	Clay Loam	Strong/Blocky	13.2	22.0
TH-18	Clay Loam	Strong/Blocky	13.2	22.0
TH-19	Clay Loam	Strong/Blocky	13.2	22.0

4.2 Shallow Groundwater Conditions

The water level in the standpipes installed in TH – 1 to TH – 19 were measured on August 24, 2021. Depths to shallow groundwater, as measured on August 24, 2021, are summarized in **Table 4**.

Table 4: Depth to Shallow Groundwater

Standpipe ID	Depth to Shallow Groundwater (m below ground surface)
TH-1	Dry to 3.0
TH-2	Dry to 3.0
TH-3	Dry to 3.0
TH-4	2.00
TH-5	2.56
TH-6	2.40
TH-7	2.57
TH-8	2.67
TH-9	Dry to 3.0
TH-10	Dry to 3.0
TH-11	Dry to 3.0
TH-12	Dry to 3.0
TH-13	2.65
TH-14	2.66
TH-15	2.96
TH-16	2.68
TH-17	2.60
TH-18	2.68
TH-19	2.54

Seven of the standpipes were dry and 12 of the standpipes detected groundwater around 2.5 meters below surface. A shallow water table will be a consideration when installing a septic field on the lots where groundwater was detected above 3.0 meters. The lots with a shallow water table detected should employ secondary treated effluent systems (packaged sewage treatment systems) in order to meet the applicable setback distance between the base of the septic field trench and the water table. Alternatively a mound system could be utilized on these lots for septic effluent treatment.

Septic field effluent trenches are installed to a depth of 0.9 meters. Traditional below grade septic systems with primary treated effluent require a separation distance of 1.5 meters from the base of the effluent trench to the top of the water table. Traditional below grade septic systems with secondary treated effluent only require a separation distance of 0.9 meters from the base of the effluent trench to the top of the water table.

[5.0] Parcel suitability

Soil texture and structure within the areas investigated indicate that the Site is acceptable for traditional septic fields with primary treated effluent on lots where groundwater is below 3.0 meters and for traditional septic fields with secondary treated effluent or mound treatment on lots where groundwater was detected above 3.0 meters (see Table 4). No impervious soils or bedrock that would limit infiltration capacity were identified during the site assessment.

To aid in designing the final lot sizes for future residential development, approximate PSTS field areas have been calculated and are provided in **Table 5**. Total field areas have been provided based on the soil textures and structures reported for the locations sampled. Infiltration areas are based on a three-bedroom residence with a calculated peak effluent volume of 1,530 L/day. Calculations assume that the field has 15 m long by 0.9 m wide laterals, separated by 0.9 m.

Table 5: Infiltration Area and Total Field Area Based on Soil Texture and Effluent Type

Soil Texture	Effluent Type	Loading Rate (L/day/m ²)	Infiltration Area (m ²)	Total Field Area (m ²)
Loam	Primary	22.0	70	135
	Secondary	30.8	50	105
Clay Loam	Primary	13.2	116	225
	Secondary	22.0	70	135

Final siting of the treatment fields should take into consideration the setback distances for a treatment field, as measured from any part of a lateral trench, as outlined in **Table 6**. Parcels are of sufficient size to allow for a secondary area for installation of a PSTS.

Table 6: Minimum Recommended Setback Requirements for Treatment Field

Minimum Setback Distance (in meters)	Setback From
15	Water Source or Water Well
100	Licensed Municipal Water Well
15	Water Course
1.5	Property Line
10	Basement, Cellar or Crawl Space
1	Building without Permanent Foundation
5	Building with Permanent Foundation but no Basement
5	Septic Tank or Packaged Sewage Treatment Plant

A summary of the overall parcel suitability and limiting characteristics for the site can be described as follows:

Table 7: Parcel Suitability for Private Sewage Treatment System

Site Variable	Suitability	Description
Soil texture and structure	Very	Soil structure and texture suitable are for a traditional below grade septic field
Depth of Suitable Soil	Very	Suitable soil extends to a depth of at least 2.70 m
Hydraulic Capability	Moderate	Evidence of seasonal wetting in two of the 19 test pits, increasing moisture content with depth evident in several test pits
Soil Horizons	Very	No bedrock was encountered
Depth to Water Table	Moderate	Shallow groundwater was encountered in 12 of the 19 test pits. Depth to water table will require secondary treated effluent if below grade systems are to be utilized (as opposed to a mound)
Topography	Very	Site has rolling, sloping topography and future PSTS would be located on slopes less than 10%
Flooding	Moderate	The site is in close proximity to a natural water way so potential flooding cannot be eliminated as a risk
Density	Moderate	High development density within quarter section
Encumbrances	Very	Parcels are of sufficient size for an alternate PSTS location.
Parcel Size	Very	Parcels are of sufficient size for alternate PSTS location.
Surface Water	Moderate	Sheep River is located ~ 700 meters south of the site
Overall Suitability	Very	Good parcel size, acceptable soil type, and no shallow water table issues.
Recommendations	Suitable for conventional below grade treatment field with primary treated effluent on lots where the water table is located below 3.0 meters and for a below grade treatment field with secondary treated effluent on lots where the water table is located above 3.0 meters.	



[7.0] References

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Appendix A: Site Maps



LEGEND

- Approximate Lot Boundaries
- ★ Community Water Supply Well
- Approximate Setback for Septic Fields from Community Supply Well



Groundwater Resources
Information Technologies Ltd.

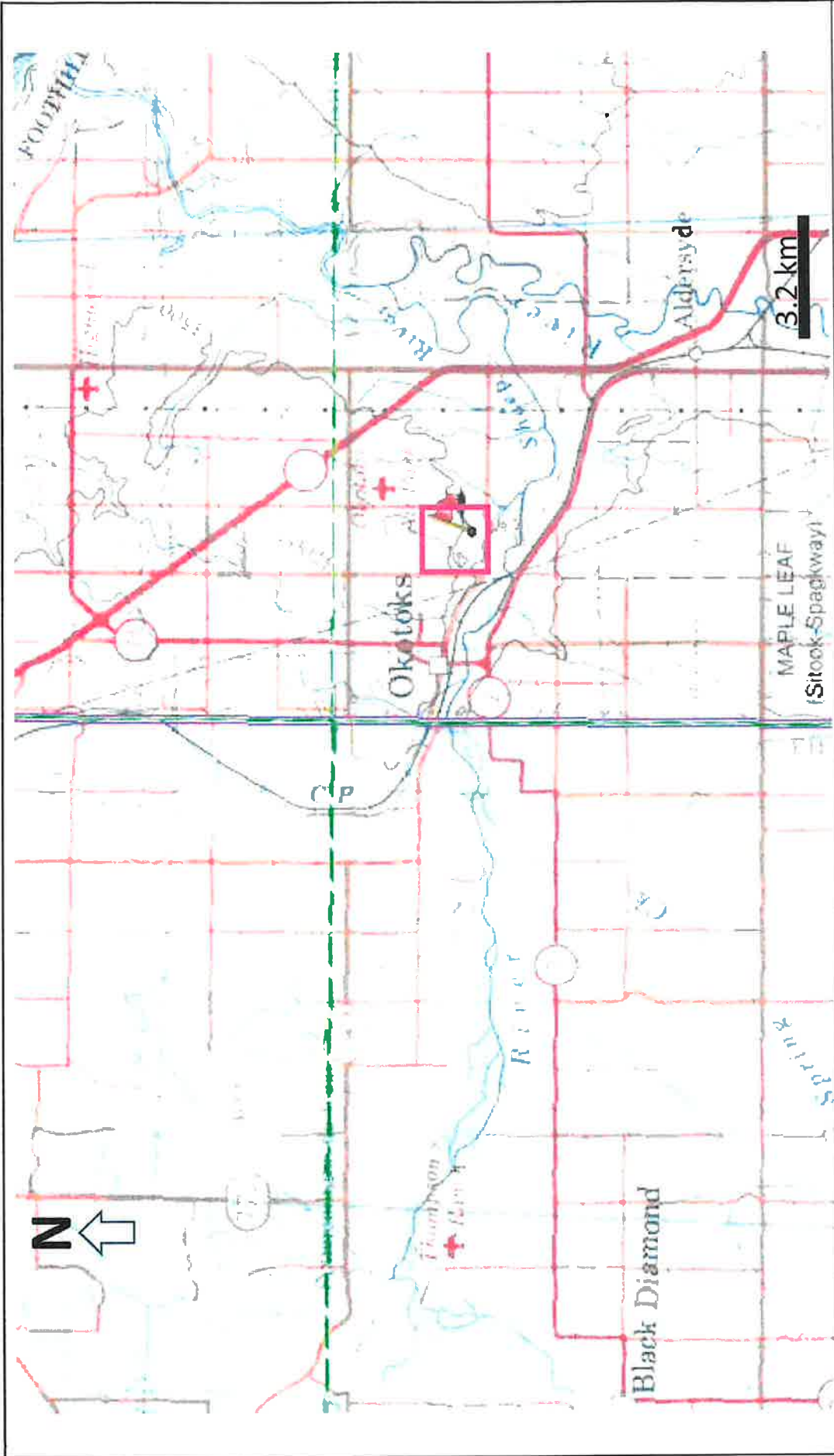
Greenhaven Estates

Site Location
SE – 27 – 20 – 29W4
Foothills County

Date: August 2021

Project: 2021-1740

Plate No. 1



LEGEND

Site Quarter Section

Greenhaven Estates



Topographic Map
SE – 27 – 20 – 29W4
Foothills County

Date: August 2021

Project: 2021-1740

Plate No. 2



LEGEND

Investigated Site Boundary

~ 150m radius

● Water Well Location (with listed well ID)

Greenhaven Estates

Groundwater Resources
Information Technologies Ltd.

Water Wells within 150 m
SE – 27 – 20 – 29W4
Foothills County

Date: August 2021	Project: 2021-1740	Plate No. 3
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LEGEND

 Test Hole Location

 Approximate Lot Boundaries



Groundwater Resources
Information Technologies Ltd.

Greenhaven Estates

Test Hole Locations
SE - 27 - 20 - 29W4
Foothills County

Date: August 2021

Project: 2021-1740

Plate No. 4



Appendix B: Grain Size Analysis



Groundwater Information Technologies
(GRIT) LTD.

ATTN: Alanna Felske
#44, 2110 - 41 Avenue NE
Calgary AB T2E 8Z7

Date Received: 12-AUG-21
Report Date: 16-AUG-21 16:18 (MT)
Version: FINAL

Client Phone: 403-470-1237

Certificate of Analysis

Lab Work Order #: L2626265

Project P.O. #:	NOT SUBMITTED
Job Reference:	2021-1740 GREENHAVEN DEVELOPMENTS
C of C Numbers:	17-849625, 17-849626
Legal Site Desc:	

Alanna - a

Justine Buma-a
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2626265-1 TH-1 @ 1.0M Sampled By: CLIENT on 11-AUG-21 @ 12:00 Matrix: SOIL Particle Size % Sand % Silt % Clay Texture	44.0 32.0 24.0 Loam		1.0 1.0 1.0	% % %		14-AUG-21 14-AUG-21 14-AUG-21 14-AUG-21	R5550264 R5550264 R5550264 R5550264
L2626265-2 TH-2 @ 1.0M Sampled By: CLIENT on 11-AUG-21 @ 12:00 Matrix: SOIL Particle Size % Sand % Silt % Clay Texture	44.2 32.6 23.2 Loam		1.0 1.0 1.0	% % %		14-AUG-21 14-AUG-21 14-AUG-21 14-AUG-21	R5550264 R5550264 R5550264 R5550264
L2626265-3 TH-3 @ 1.0M Sampled By: CLIENT on 11-AUG-21 @ 12:00 Matrix: SOIL Particle Size % Sand % Silt % Clay Texture	38.0 36.1 25.9 Loam		1.0 1.0 1.0	% % %		14-AUG-21 14-AUG-21 14-AUG-21 14-AUG-21	R5550264 R5550264 R5550264 R5550264
L2626265-4 TH-4 @ 1.0M Sampled By: CLIENT on 11-AUG-21 @ 12:00 Matrix: SOIL Particle Size % Sand % Silt % Clay Texture	44.8 27.0 28.2 Clay loam / Sandy clay loam		1.0 1.0 1.0	% % %		14-AUG-21 14-AUG-21 14-AUG-21 14-AUG-21	R5550264 R5550264 R5550264 R5550264
L2626265-5 TH-5 @ 1.2M Sampled By: CLIENT on 11-AUG-21 @ 12:00 Matrix: SOIL Particle Size % Sand % Silt % Clay Texture	36.2 35.8 28.0 Clay loam		1.0 1.0 1.0	% % %		14-AUG-21 14-AUG-21 14-AUG-21 14-AUG-21	R5550264 R5550264 R5550264 R5550264
L2626265-6 TH-6 @ 1.2M Sampled By: CLIENT on 11-AUG-21 @ 12:00 Matrix: SOIL Particle Size % Sand % Silt % Clay	33.6 38.5 27.9		1.0 1.0 1.0	% % %		14-AUG-21 14-AUG-21 14-AUG-21	R5550264 R5550264 R5550264

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2626265-6 TH-6 @ 1.2M Sampled By: CLIENT on 11-AUG-21 @ 12:00 Matrix: SOIL Particle Size Texture	Clay loam					14-AUG-21	R5550264
L2626265-7 TH-7 @ 1.2M Sampled By: CLIENT on 11-AUG-21 @ 12:00 Matrix: SOIL Particle Size % Sand % Silt % Clay Texture	36.2 36.5 27.3 Loam / Clay loam		1.0 1.0 1.0	% % %		14-AUG-21 14-AUG-21 14-AUG-21 14-AUG-21	R5550264 R5550264 R5550264 R5550264
L2626265-8 TH-8 @ 1.1M Sampled By: CLIENT on 11-AUG-21 @ 12:00 Matrix: SOIL Particle Size % Sand % Silt % Clay Texture	36.0 36.3 27.7 Clay loam		1.0 1.0 1.0	% % %		14-AUG-21 14-AUG-21 14-AUG-21 14-AUG-21	R5550264 R5550264 R5550264 R5550264
L2626265-9 TH-9 @ 1.2M Sampled By: CLIENT on 11-AUG-21 @ 12:00 Matrix: SOIL Particle Size % Sand % Silt % Clay Texture	37.2 34.9 27.9 Clay loam		1.0 1.0 1.0	% % %		14-AUG-21 14-AUG-21 14-AUG-21 14-AUG-21	R5550264 R5550264 R5550264 R5550264
L2626265-10 TH-10 @ 1.0M Sampled By: CLIENT on 11-AUG-21 @ 12:00 Matrix: SOIL Particle Size % Sand % Silt % Clay Texture	36.8 37.1 26.1 Loam		1.0 1.0 1.0	% % %		14-AUG-21 14-AUG-21 14-AUG-21 14-AUG-21	R5550264 R5550264 R5550264 R5550264
L2626265-11 TH-11 @ 2.7M Sampled By: CLIENT on 11-AUG-21 @ 12:00 Matrix: SOIL Particle Size % Sand % Silt % Clay Texture	44.4 31.8 23.9 Loam		1.0 1.0 1.0	% % %		14-AUG-21 14-AUG-21 14-AUG-21 14-AUG-21	R5550264 R5550264 R5550264 R5550264
L2626265-12 TH-12 @ 1.0M Sampled By: CLIENT on 11-AUG-21 @ 12:00 Matrix: SOIL							

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2626265-12 TH-12 @ 1.0M Sampled By: CLIENT on 11-AUG-21 @ 12:00 Matrix: SOIL Particle Size % Sand % Silt % Clay Texture	32.6 42.2 25.2 Loam		1.0 1.0 1.0	% % %		14-AUG-21 14-AUG-21 14-AUG-21 14-AUG-21	R5550264 R5550264 R5550264 R5550264
L2626265-13 TH-13 @ 1.0M Sampled By: CLIENT on 11-AUG-21 @ 12:00 Matrix: SOIL Particle Size % Sand % Silt % Clay Texture	42.8 30.6 26.6 Loam / Clay loam		1.0 1.0 1.0	% % %		14-AUG-21 14-AUG-21 14-AUG-21 14-AUG-21	R5550264 R5550264 R5550264 R5550264
L2626265-14 TH-14 @ 1.3M Sampled By: CLIENT on 11-AUG-21 @ 12:00 Matrix: SOIL Particle Size % Sand % Silt % Clay Texture	38.0 29.3 32.7 Clay loam		1.0 1.0 1.0	% % %		14-AUG-21 14-AUG-21 14-AUG-21 14-AUG-21	R5550264 R5550264 R5550264 R5550264
L2626265-15 TH-15 @ 1.0M Sampled By: CLIENT on 11-AUG-21 @ 12:00 Matrix: SOIL Particle Size % Sand % Silt % Clay Texture	33.8 34.5 31.7 Clay loam		1.0 1.0 1.0	% % %		14-AUG-21 14-AUG-21 14-AUG-21 14-AUG-21	R5550264 R5550264 R5550264 R5550264
L2626265-16 TH-16 @ 1.2M Sampled By: CLIENT on 11-AUG-21 @ 12:00 Matrix: SOIL Particle Size % Sand % Silt % Clay Texture	41.0 34.8 24.2 Loam		1.0 1.0 1.0	% % %		14-AUG-21 14-AUG-21 14-AUG-21 14-AUG-21	R5550264 R5550264 R5550264 R5550264
L2626265-17 TH-17 @ 1.2M Sampled By: CLIENT on 11-AUG-21 @ 12:00 Matrix: SOIL Particle Size % Sand % Silt % Clay Texture	36.8 23.2 40.0 Clay loam / Clay		1.0 1.0 1.0	% % %		14-AUG-21 14-AUG-21 14-AUG-21 14-AUG-21	R5550264 R5550264 R5550264 R5550264

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2626265-17 TH-17 @ 1.2M Sampled By: CLIENT on 11-AUG-21 @ 12:00 Matrix: SOIL							
L2626265-18 TH-18 @ 1.2M Sampled By: CLIENT on 11-AUG-21 @ 12:00 Matrix: SOIL							
Particle Size							
% Sand	37.8		1.0	%		14-AUG-21	R5550264
% Silt	30.7		1.0	%		14-AUG-21	R5550264
% Clay	31.5		1.0	%		14-AUG-21	R5550264
Texture	Clay loam					14-AUG-21	R5550264
L2626265-19 TH-19 @ 1.2M Sampled By: CLIENT on 11-AUG-21 @ 12:00 Matrix: SOIL							
Particle Size							
% Sand	38.4		1.0	%		14-AUG-21	R5550264
% Silt	32.4		1.0	%		14-AUG-21	R5550264
% Clay	29.2		1.0	%		14-AUG-21	R5550264
Texture	Clay loam					14-AUG-21	R5550264

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
PSA-1-CL	Soil	Particle Size	CSSS 55.3 - Hydrometer
Particle Size analysis in soil using a hydrometer			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
CL	ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA

Chain of Custody Numbers:

17-849625 17-849626

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.

mg/kg - milligrams per kilogram based on dry weight of sample

mg/kg wwt - milligrams per kilogram based on wet weight of sample

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight

mg/L - unit of concentration based on volume, parts per million.

< - Less than.

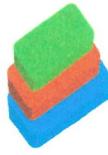
D.L. - The reporting limit.

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Groundwater Resources
Information Technologies Ltd.

Level IV Private Sewage Treatment System Assessment for Subdivision

Green Haven Estates – Phases 3, 4 & 5

SE – 27 – 20 – 29W4M

Foothills County

Prepared for:

2263582 Alberta Ltd.

c/o Sajan Kunnathu

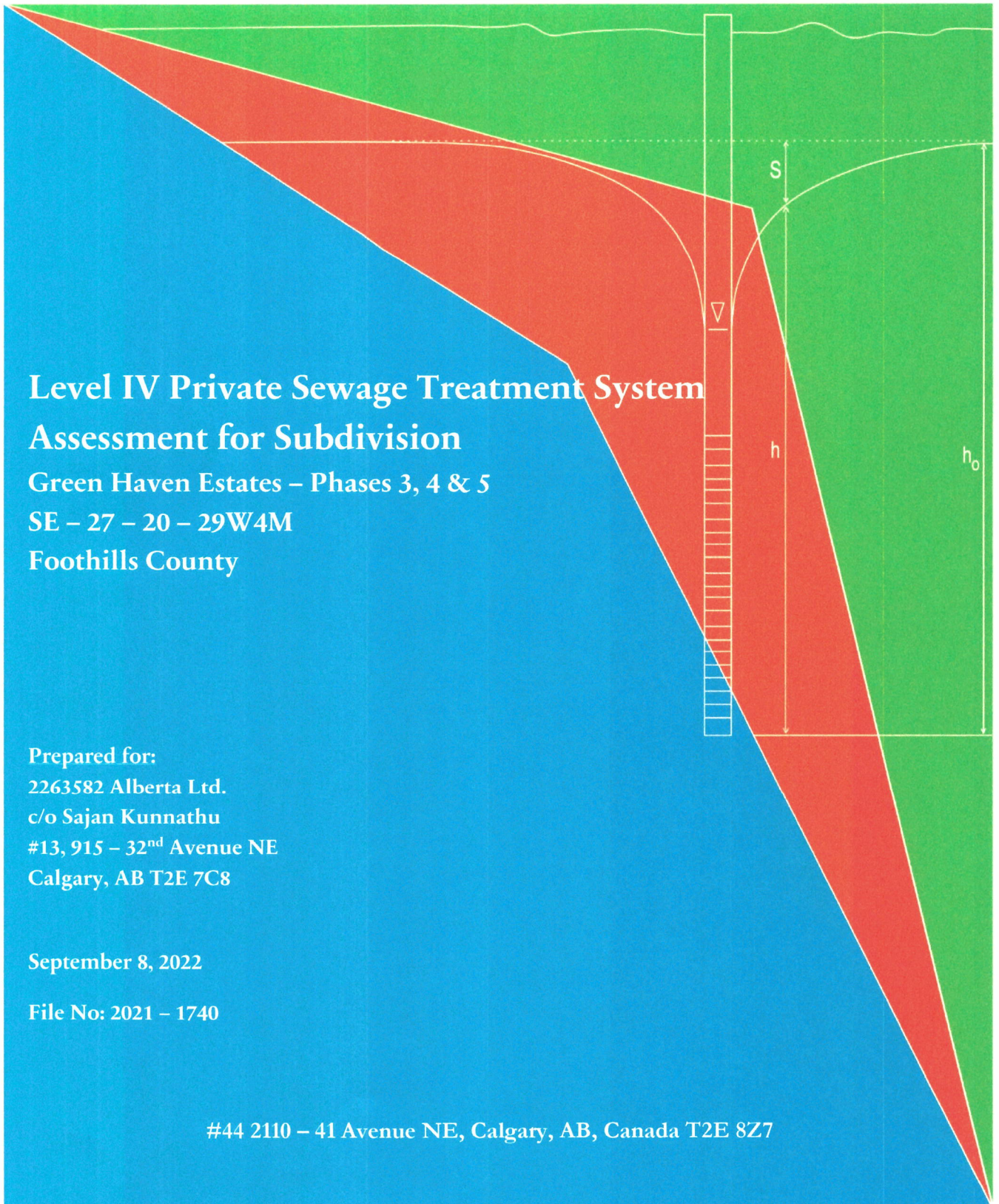
#13, 915 – 32nd Avenue NE

Calgary, AB T2E 7C8

September 8, 2022

File No: 2021 – 1740

#44 2110 – 41 Avenue NE, Calgary, AB, Canada T2E 8Z7



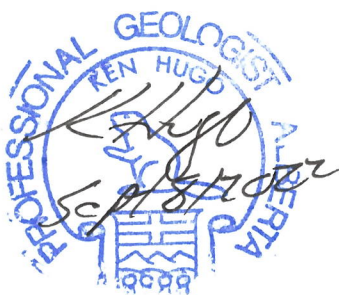
Signatures

Prepared by:



Alanna Felske, GIT
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Senior Hydrogeologist

Disclaimer

Groundwater Resources Information Technologies Ltd. (GRIT Ltd.) has performed the work as described below and made the findings and conclusions set out in the report in a manner consistent with the level of care and skill normally exercised by members of the geological science profession practicing under similar conditions at the time the work was performed. This report presents a reasonable review of information available to GRIT Ltd. Within the established scope, work schedule and budgetary constraints, GRIT Ltd. accepts no responsibility for any deficiency, misstatement or inaccuracy in this report resulting from misinformation from any individuals that provided information as part of this report. GRIT Ltd. appreciates the opportunity to present these findings on behalf of the Client. If you have any questions regarding the above report, please do not hesitate to contact the above signed.

Executive Summary

Groundwater Resources Information Technologies Ltd. (GRIT) was retained by 2263582 Alberta Ltd. to complete a Level IV Private Sewage Treatment System (PSTS) assessment for a three phase subdivision on land for country residential use located within the SE ¼ – 27 – 20 – 29W4M in Foothills County, Alberta (the “Site”). The purpose of the investigation was to add to existing Level II PSTS assessments completed at the site to satisfy the hydrological and cumulative impacts assessments required for the Level IV PSTS assessment. The PSTS assessment was completed following the 2021 *Alberta Private Sewage Systems Standard of Practice* (SOP) and the *Model Process for Subdivision Approval* (Alberta Association of Municipal District and Counties (2011)).

A drilling investigation was undertaken to evaluate the underlying aquifer conditions and enable collection of water quality samples and measurements of hydraulic conductivity. Two pairs of nested monitoring wells were completed. An existing bedrock supply well within the development was used to evaluate the thickness of surficial sediments and drinking use aquifer conditions. The site is underlain by approximately 37 metres of surficial clay till which immediately overlies interbedded shale and sandstone bedrock. The substantial thickness of surficial sediments in the area and presence of shale overlying the drinking use aquifer protects the aquifer from septic effluent migration.

Testing of the silty clay overburden shows sufficiently low permeability to form an effective barrier to septic field effluent and risks of contamination of the underlying aquifers is at a sufficiently low risk. Average horizontal groundwater flow velocities are 0.04 m/year and results in slow migration of septic effluent in the subsurface. As such the risk of untreated septic effluent entering nearby the nearby surface water bodies is negligible.

The cumulative impact assessment shows low nitrate (~1.5 mg/L) and nutrient concentrations in the shallow clay till layer. For the 42 – lot development, given the lot sizes and average groundwater recharge, additional nitrate loading of 18.5 mg/L to the existing 1.5 mg/L in the overburden till layer results in a total nitrate concentration which exceeds the maximum nitrate concentration of 10 mg/L for drinking water. However, due to the fine grained nature and low hydraulic conductivity of the overburden sediments substantial interaction time exists for attenuation of nitrate by bacteria and additional uptake of nitrate by plants. Accounting for the denitrification processes, the resulting additional nitrate loading to the subsurface would only be 4.6 mg/L, well below the 10 mg/L limit.



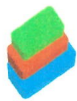
Existing low nitrate concentrations in the shallow till layer despite the development of 45 functioning PSTS provide further evidence for ongoing denitrification and attenuation of nitrate in the shallow unsaturated zone.

Nitrate loading to the subsurface from septic field effluent can be alleviated through the installation of tertiary treated effluent using N-I or N-II treatment types to reduce nitrogen concentration by 50% or 75%, respectively (Safety Codes Council, 2021). The installation of packaged sewage treatment systems which contain treatment for the reduction of nitrogen compounds can also be used to reduce the additional loading of nitrate to the subsurface. All future PSTS at the site use tertiary treated effluent or greater with recommendations that systems utilize additional nitrogen treatment options available or packaged sewage treatment systems which further reduce the bacteria and nutrient concentrations in septic effluent prior to discharge.

The results of the water table mounding calculations indicate that septic field mounds should be used on lots within Phase 3 and Phase 4 where the water table is located within 3.0 metres of surface to mitigate the chance of septic effluent breakthrough at surface. Lots located within Phase 5 of the development are not impacted by shallow water table conditions so either below grade treatment fields or mounded systems could be used.

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[1.0] Introduction

Groundwater Resources Information Technologies Ltd. (GRIT) was retained by 2263582 Alberta Ltd. to complete a Level IV Private Sewage Treatment System (PSTS) assessment for a 42 – lot residential subdivision within SE – 27 – 20 – 29W4 in Foothills County, Alberta (hereinafter referred to as the Site). The purpose of the investigation was to add to existing Level II PSTS assessments completed at the site to satisfy the hydrological and cumulative impacts assessments required for the Level IV PSTS assessment. A site map of the proposed development is provided in **Appendix A**.

The PSTS assessment was completed according to the *Alberta Private Sewage Systems Standard of Practice* (Safety Codes Council, 2021) or *SOP*. General reporting has been completed following *The Model Process for Subdivision Approval and Private Sewage* (2011).

[2.0] Background

As per our understanding, the Site will be developed into 42 residential lots as outlined in **Appendix A, Plate No. 1**. The development has three phases with Phase 3 comprising 16 lots, Phase 4 comprising 12 lots and Phase 5 comprising 14 lots. The lots are sized appropriately to allow for an alternate area for septic fields and to meet applicable setback distances from structures, water wells and property boundaries as outlined in the *SOP*.

Previous Level II PSTS reports were completed by personnel from GRIT for Phase 3 of the development in August 2021 and for Phase 4 and Phase 5 in January 2022. These reports consisted of subsurface excavations to assess the soil texture and structure across the site, determine depth to the water table and establish the feasibility of future PSTS installations on the new residential lots.

[3.0] Cumulative Impact Assessment

[3.1] Drilling Investigation

Four boreholes were drilled across the property on August 7, 2022, with the aid of an auger rig supplied and operated by All Service Drilling Inc (with the locations shown in Appendix A, Plate No. 1). The boreholes were completed as two sets of nested monitoring wells (MW-1S, MW-1D and MW-2S, MW-2D) and describe the soil to a maximum depth of 10.5 metres. Monitoring wells were installed to determine depth to the water table, allow for in-situ hydraulic conductivity tests, and allow for collection of groundwater samples for chemical analysis.

Test hole logs showing strata encountered, monitoring well design and depth to water table are included in Appendix B.

Surficial clay till deposits comprised of silty clay loam, silt loam, clay loam and loam deposits, of the same origin as encountered in the previously completed test pits, were encountered in all four boreholes to depths of up to 10.5 metres. No bedrock was encountered in any of the four monitoring wells completed by GRIT. Based on the Water Well Drilling Report for the water supply well located at the site (GIC Well ID 1600007) the bedrock surface is located approximately 37 metres below ground (Appendix A, Plate No. 1).

Water levels in the four monitoring wells were measured on August 15, 2022, eight days after the wells were installed. The measured water levels are included in the borehole logs in Appendix C and summarized in the table below. Water levels in the two sets of nested monitoring wells indicate vertical downward flow of groundwater and that the area is a location of groundwater recharge.

Table 1: Depth to Groundwater

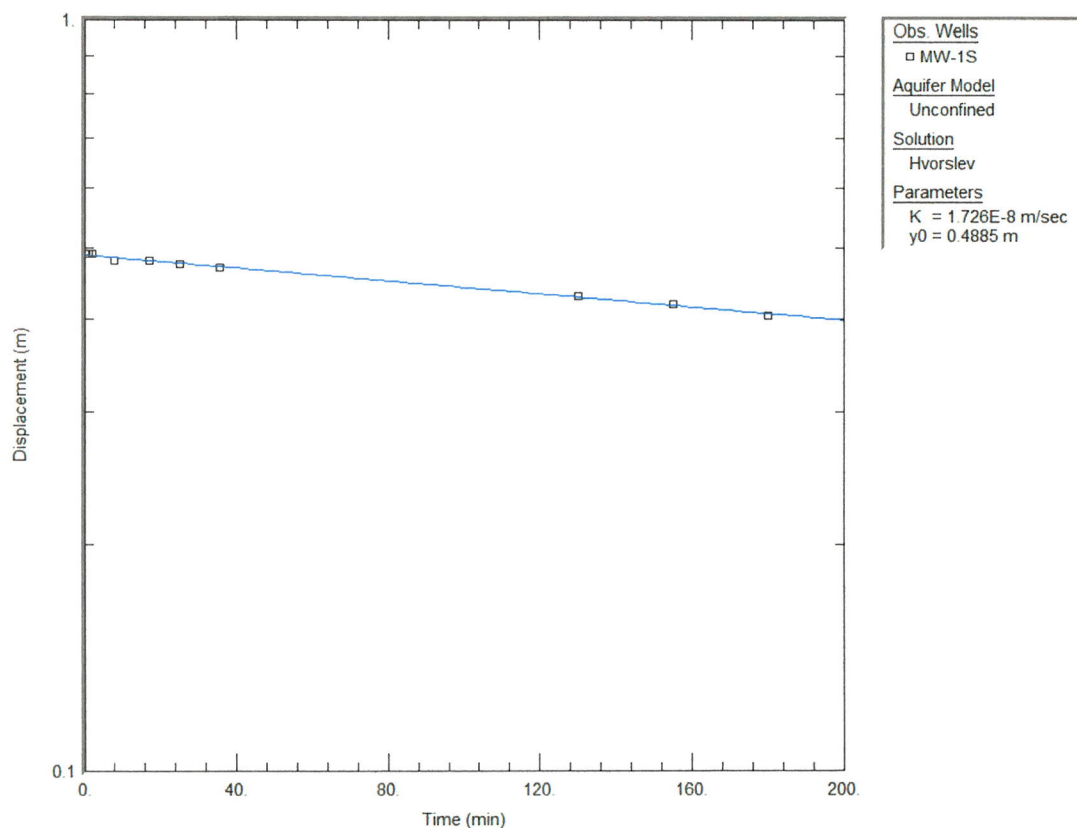
Well ID	Mid-point of Screen (m BGS ¹)	Depth to Groundwater (m, BGS)	Ground Elevation* (masl ²)	Groundwater Elevation (masl)
MW-1S	6.45	3.43	1,064	1060.57
MW-1D	9.75	3.44	1,064	1060.56
MW-2S	3.70	1.72	1,069	1067.28
MW-2D	9.05	3.22	1,069	1065.78

¹Below Ground Surface, ²meters above sea level, *elevations taken from topographic map

[3.2] Hydraulic Conductivity – Slug Tests

On August 15, 2022, slug tests were conducted on the four groundwater monitoring wells installed on August 7, 2022. The slug tests were interpreted with the AQTESOLV software developed by HydroSoft, using the Hvorslev solution. The results of the slug tests are shown in the figures below:

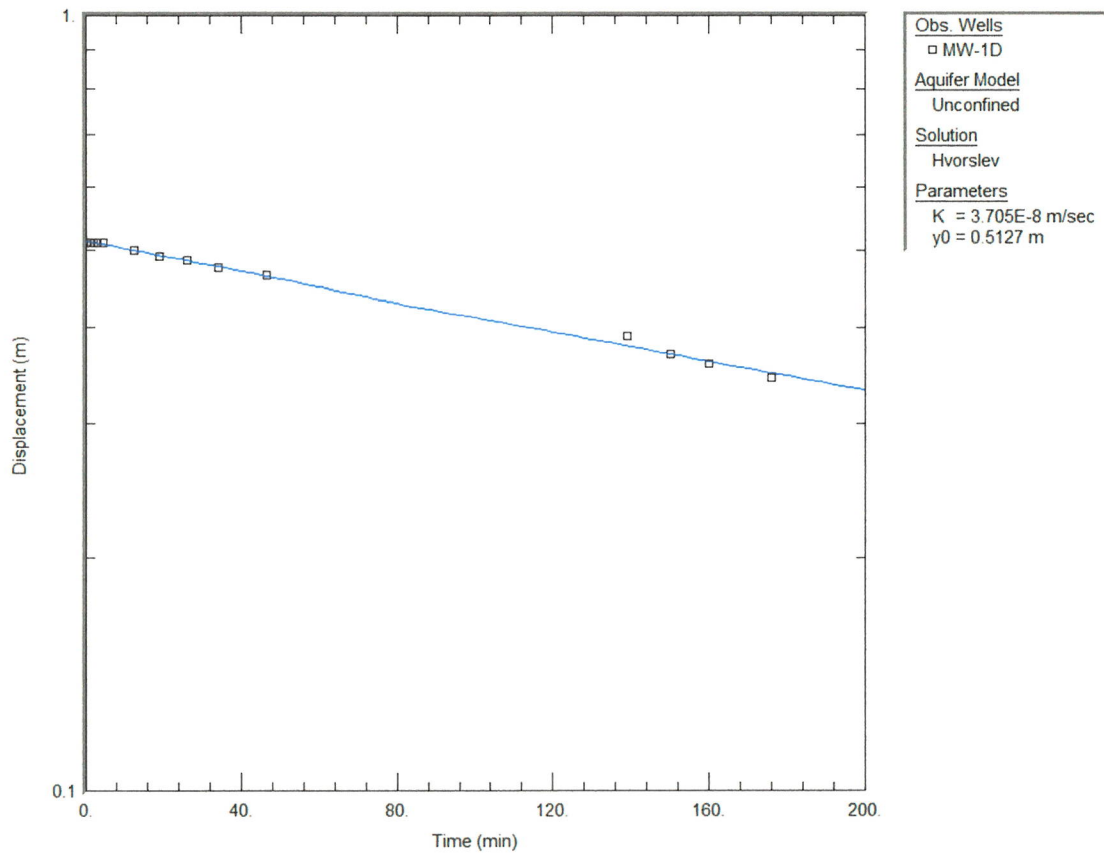
Figure 1. Hvorslev solution fit to slug test data from MW-1S



The hydraulic conductivity in MW-1S, completed within overburden loam deposits, is 1.7×10^{-8} m/s. This value is within the expected range for overburden till deposits.



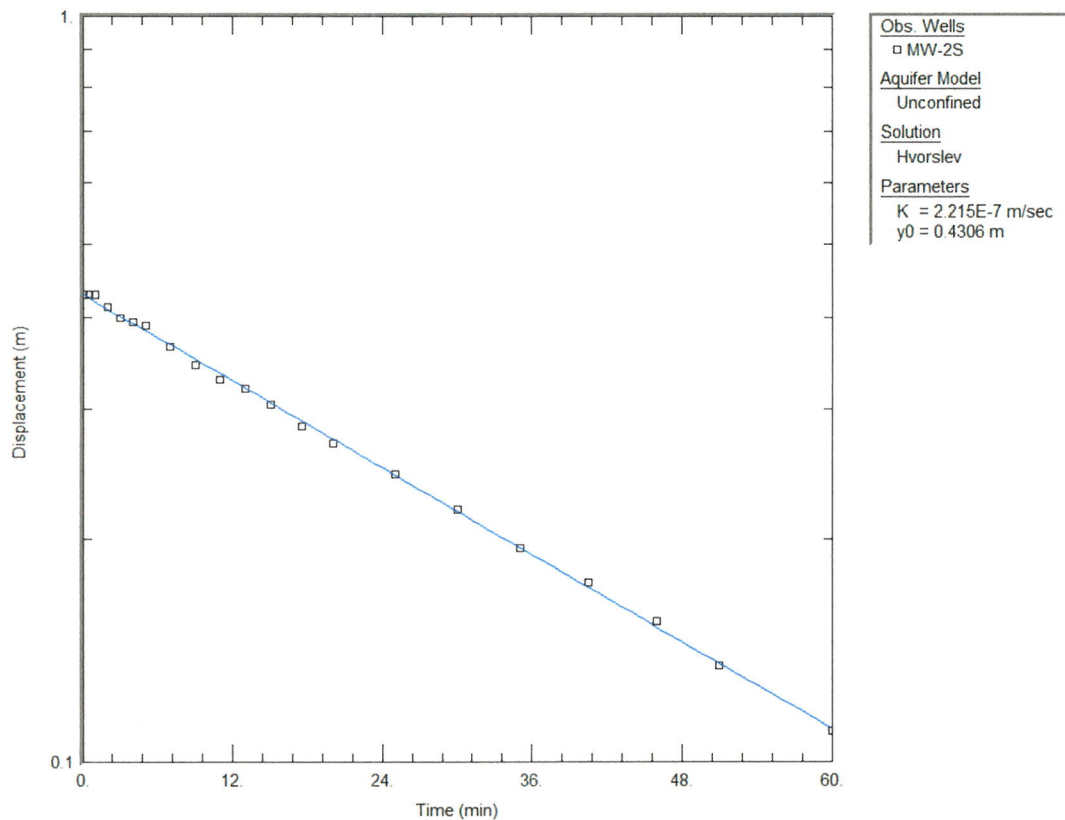
Figure 2. Hvorslev solution fit to slug test data from MW-1D



The hydraulic conductivity in MW-1D, completed within overburden clay loam and clay deposits, is 3.7×10^{-8} m/s. This is within the expected range for till deposits.

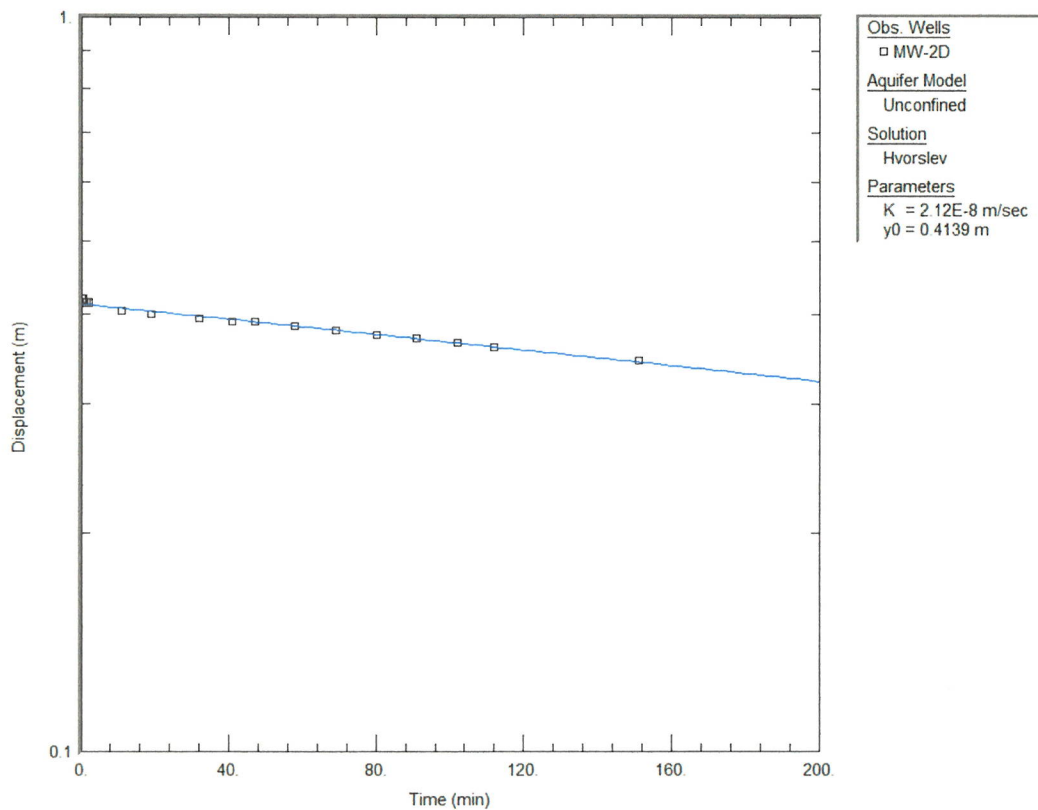


Figure 3. Hvorslev solution fit to slug test data from MW-2S



The hydraulic conductivity in MW-2S, completed within overburden clay loam deposits, is 2.2×10^{-7} m/s. This is within the expected range for till deposits.

Figure 4. Hvorslev solution fit to slug test data from MW-2D



The hydraulic conductivity in MW-2D, completed within overburden clay loam deposits, is $2.1 \times 10^{-8} \text{ m/s}$. This is within the expected range for till deposits.

The slug tests on the four monitoring wells produced very similar hydraulic conductivity values ranging from $2.2 \times 10^{-7} \text{ m/s}$ to $3.7 \times 10^{-8} \text{ m/s}$. The results are consistent with the expected permeability for wells completed within surficial clay till deposits. As the permeability of the overburden till is relatively low the layer will act as an effective barrier between the septic field systems on surface and underlying bedrock aquifers. According to Alberta Tier 2 Soil and Groundwater Remediation Guidelines (2019) a layer exceeding 5 meters in thickness with a permeability less than 10^{-7} m/s constitutes a barrier layer. The clay till layer will also limit groundwater flow from the new septic systems into the nearby surface water bodies (coulees) due to the units limited hydraulic capabilities.

It should be noted that these hydraulic conductivity reflect compacted till strata and near surface sediment, less compacted and with soil structure, would have higher conductivities.



[3.3] Groundwater Flow Velocity

[3.3.1] Horizontal Groundwater Flow

Horizontal groundwater flow velocity through the shallow surficial till layer was determined using the change in hydraulic head and average hydraulic conductivity in MW-1S and MW-2S as follows:

$$v = Ki$$

Where:

v = horizontal groundwater flow velocity

K = average hydraulic conductivity

i = hydraulic gradient (change in water level/distance between wells)

$$v = \left(1.4 \times 10^{-7} \frac{m}{s}\right) \left(\frac{6.71 m}{744 m}\right) = 1.3 \times 10^{-9} \frac{m}{s} = 0.04 m/year$$

The average horizontal groundwater flow velocity through the clay till layer is 0.04 metres per year. The horizontal groundwater flow velocity is low and results in slow horizontal migration of septic effluent in the subsurface. As such the risk of untreated septic effluent entering nearby surface water bodies within the site is negligible given the 15-metre setback required for septic fields from surface water bodies. The slow horizontal flow velocity will allow substantial time for interaction of effluent with bacteria in the subsurface to facilitate denitrification and greatly exceeds the time frame which e.coli and related coliforms can survive in the subsurface.

[3.3.2] Vertical Groundwater Flow

Vertical groundwater flow velocity through the surficial till layer was calculated for both monitoring wells nests and was determined using the change in hydraulic head and average hydraulic conductivity in MW-1S/MW-1D and MW-2S/MW-2D as follows:

$$v = Ki$$

Where:

v = vertical groundwater flow velocity

K = average hydraulic conductivity

i = hydraulic gradient (change in water level/distance between midpoint of well screens)

MW-1S/MW-1D:

$$v = \left(2.7 \times 10^{-8} \frac{m}{s}\right) \left(\frac{0.01 m}{3.3 m}\right) = 8.2 \times 10^{-11} \frac{m}{s} = 0.003 m/year$$

MW-2S/MW-2D:

$$v = \left(1.2 \times 10^{-7} \frac{m}{s}\right) \left(\frac{1.5 m}{5.35 m}\right) = 3.4 \times 10^{-8} \frac{m}{s} = 1.1 m/year$$

The vertical gradient measured in the nest well pair near the west of the site (MW-1S and MW-1D) is substantially lower than the vertical gradient between the nested pair of monitoring wells installed in the northeast of the site (MW-2S and MW-2D).

[3.4] Groundwater and Surface Water Chemistry

Four water samples were collected from the site, one from each monitoring well, on August 15, 2022. The water samples were analyzed for routine dissolved salts, total coliforms, E.coli and nutrients (including nitrates). The samples were analyzed by Element labs of Calgary and the lab report from Element labs is attached in Appendix C.

A summary of the results of the relevant septic field effluent parameters is as follows:

Table 2: Water Quality Parameters

Parameter	MW-1S	MW-1D	MW-2S	MW-2D
Nitrate	1.53	11.3	1.14	0.08
Nitrite	<0.005	<0.005	0.135	<0.02
Sulfate	98.3	170	524	2700
Total Dissolved Solids	532	733	1380	4290
Sodium	22.1	45.3	335	448
E. Coli	<1	<10	<100	<1
Total Coliforms	50	<10	<100	<10
All values in mg/L except coliforms in CFU/100mL				

The lab results show relatively low nitrate concentrations in both shallow monitoring wells and in one of the deep wells (MW-2D). Water from MW-1D had comparably higher nitrate concentration, exceeding the drinking water quality guideline for nitrate concentration of 10



mg/L. As the nitrate concentration from the two shallow wells is low this indicates that septic field effluent from existing septic systems within the subdivision are being treated properly prior to entering the water table and are not degrading shallow water quality. The lack of fecal coliforms (e.coli) in the monitoring wells also indicates that untreated septic field effluent is not encountering the water table.

The thick, low permeability surficial clay till present across the site would prevent untreated effluent and bacteria constituents migrating to drinking use aquifer depths (40 – 60 metres).

[3.5] Nitrate Loading to Groundwater and Surface Water

Effects of the septic field effluent on the nitrate concentration in the subsurface can be determined from the baseline water quality characteristics measured in the shallow groundwater, volume of recharge from septic field effluent and recharge from rainwater.

Baseline nitrate levels in the shallow till layer are up to 1.53 mg/L. Each of the 42 new septic fields has a maximum potential nitrate loading of 40 grams/day. According to maps published in the Alberta Geological Survey Report 91 (Regional Geological and Hydrogeological Characterization of the Calgary – Lethbridge Corridor in the South Saskatchewan Regional Planning Area, 2017) the area has an average annual evapotranspiration of 405 mm and precipitation of 500 mm, for an expected net groundwater recharge of 95 mm.

The residential lots range in size from 0.8 acres to 2.15 acres. The total area of the site including any environmental or municipal reserves, minus the area of the internal subdivision roadways is 46.31 acres. The total groundwater recharge volume across this area due to precipitation inputs on the land surface would be 17,806 m³ per year (with no nitrate concentration).

The impact of the 42 new PSTS systems on loading of nitrate to the subsurface was calculated as follows:

Evaluation Criteria:

Number of lots (P) = 42

Daily Effluent Flow per Lot (F) = 1,000 L/day

Subdivision Area (A) = 196,164 m²

Impervious Area (internal subdivision roads) (S) = 4,365 m²



Net Groundwater Recharge Rate (I) = 0.095 m/year

Nitrate Loading per Lot (N) = 40 grams/day

1. Calculation of on-site recharge (R)

$$\begin{aligned} &= [(A - S) \times I] + (P \times F) \\ &= [(196,164 \text{ m}^2 - 4,635 \text{ m}^2) \times 0.095 \text{ m/year}] + (42 \times 1,000 \text{ L/day}) \\ &= 18,195 \text{ m}^3/\text{year} + 42,000 \text{ L/day} \\ &= 49,849 \text{ L/day} + 42,000 \text{ L/day} = 91,849 \text{ L/day} \end{aligned}$$

2. Calculation of nitrate loading (L)

$$\begin{aligned} &= N \times P \\ &= 42 \text{ lots} \times 40 \text{ grams/day} \\ &= 1,680,000 \text{ mg/day} \end{aligned}$$

3. Resultant nitrate concentration to subsurface

$$\begin{aligned} &= L \div R \\ &= 1,680,000 \text{ mg/day} \div 91,849 \text{ L/day} \\ &= 18.3 \text{ mg/L} \end{aligned}$$

With the effluent from each of the new residential lots providing 365 m³/year at a concentration of 40 mg/L nitrate the resulting concentration of nitrate loading to the subsurface, due to dilution from infiltrating precipitation, would be 18.5 mg/L.

The additional nitrate concentration of 18.5 mg/L to the existing 1.53 mg/L in the overburden till layer results in a total nitrate concentration which exceeds the maximum nitrate concentration of 10 mg/L for drinking water. However, due to the fine grained nature and low hydraulic conductivity (barrier layer of $< 10^{-7}$ m/s – section 3.2) of the overburden sediments found at the site substantial interaction time exists for attenuation of nitrate by bacteria and additional uptake of nitrate by plants. According to the literature lower rates of denitrification are on the order of 20 kg of nitrate per hectare per year, which would account for approximately 75% of the nitrate discharged from the 42 PSTS systems (Brady, 1990). Taking into account the denitrification processes the resulting additional nitrate loading to the subsurface would be 4.6 mg/L.

There are also currently 45 existing residences within the subdivision which were developed in previous phases from 2012 to present. These residences are serviced by PSTS and there is

no evidence that nitrate from these 45 systems have accumulated in the shallow groundwater as the shallow groundwater concentrations from MW-1S and MW-2S have low nitrate concentrations ranging from 1.14 – 1.53 mg/L, well below 10 mg/L. These findings provide further evidence for ongoing denitrification and attenuation of nitrate in the shallow unsaturated zone.

Nitrate loading to the subsurface from septic field effluent can also be alleviated through the installation of tertiary treated effluent using N-I or N-II treatment types to reduce nitrogen concentration by 50% or 75%, respectively (Safety Codes Council, 2021). The installation of packaged sewage treatment systems which contain treatment for the reduction of nitrogen compounds can also be used to reduce the additional loading of nitrate to the subsurface.

[3.6] Water Table Mounding

[3.6.1] Guelph Permeameter Testing

To best estimate the saturated hydraulic conductivity of the shallow unsaturated sediments in which the septic trenches would be installed Guelph Permeameter tests were completed on each phase of the development. Testing was completed on soil horizons located 0.7 metres below surface. Results from the Guelph Permeameter testing are summarized below:

Table 3: Guelph Permeameter saturated hydraulic conductivity results

Testing Location ID	K _{sat} (m/s)
GP#1	5.0×10^{-7}
GP#2	6.2×10^{-7}
GP#3	1.0×10^{-6}

The average saturated hydraulic conductivity is 7.1×10^{-7} m/s.

[3.6.2] Water Table Mounding Results

The average saturated hydraulic conductivity measured from the Guelph Permeameter tests was used to estimate the height of water table rise due to septic effluent discharge to the subsurface. The mounding calculations were completed using MOUNDSOLV software developed by HYDROSOFT Inc. The MOUNDSOLV program uses the Zlotnik (2017)

solution. The resulting maximum water table rise calculated after one year and 20 years of PSTS use are summarized in the table below.

Table 4: Water table mounding results

Elapsed Time (years)	Water Table Rise (m)	Water Table Rise (feet)
1	1.1	3.5
20	1.8	6

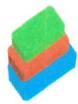
Contour maps detailing the extent of water table mounding from the centre of the treatment field after one year and 20 years are included in Appendix D. A graph showing water table rise as a function of time is also included in Appendix D.

The results of the water table mounding calculations indicate that septic field mounds should be used on lots within Phase 3 and Phase 4 where the water table is located within 3.0 metres of surface to mitigate the chance of septic effluent breakthrough at surface. Lots located within Phase 5 of the development are not impacted by shallow water table conditions as the depth to groundwater in this area is approximately 3.4 metres, so either traditional below grade treatment fields or mounded treatment fields can be used.

[4.0] Parcel Suitability Updated Based on Level IV PSTS Findings

Within Phase 3 of the development lots where the water table is located below 3.0 meters are suitable for conventional below grade treatment field with tertiary treated effluent. Lots where the water table is located above 3.0 metres are suitable for mounded treatment fields with tertiary treated effluent. Information on the depth to water table on each lot are included in the Level II PSTS assessment completed by GRIT for Phase 3 of the development in August 2021.

Due to shallow water table conditions and seasonal variability in water table depth it is highly suggested that mounded treatment fields with tertiary treated effluent be used on lots within Phase 4 to reduce the risk of septic system failure and flow of effluent to surface. Details of depth to water table below the lots in Phase 4 are included in the Level II PSTS assessment completed by GRIT in January 2022.



Shallow water table was not measured beneath any of the lots in Phase 5 of the development so the lots are suitable for traditional below grade treatment fields with tertiary treated effluent.

Future PSTS systems on all lots could also use packaged sewage treatment systems or tertiary treated systems with N-I or N-II treatment packages added in order to reduce the nitrogen concentration in the septic system effluent.

[5.0] References

Alberta Association of Municipal Districts and Counties. 2011. *The Model Process for Subdivision Approval and Private Sewage*.

Alberta Environment and Parks Groundwater Well Information Database, available at:
<http://groundwater.alberta.ca/WaterWells/d/>.

Alberta Geological Survey. *Regional Geological and Hydrogeological Characterization of the Calgary - Lethbridge Corridor in the South Saskatchewan Regional Planning Area*. AER/AGS Report 91, 2017

Brady, Nyle C., 1990. *The Nature and Properties of Soils*. Tenth Edition. Macmillan Publishing Company.

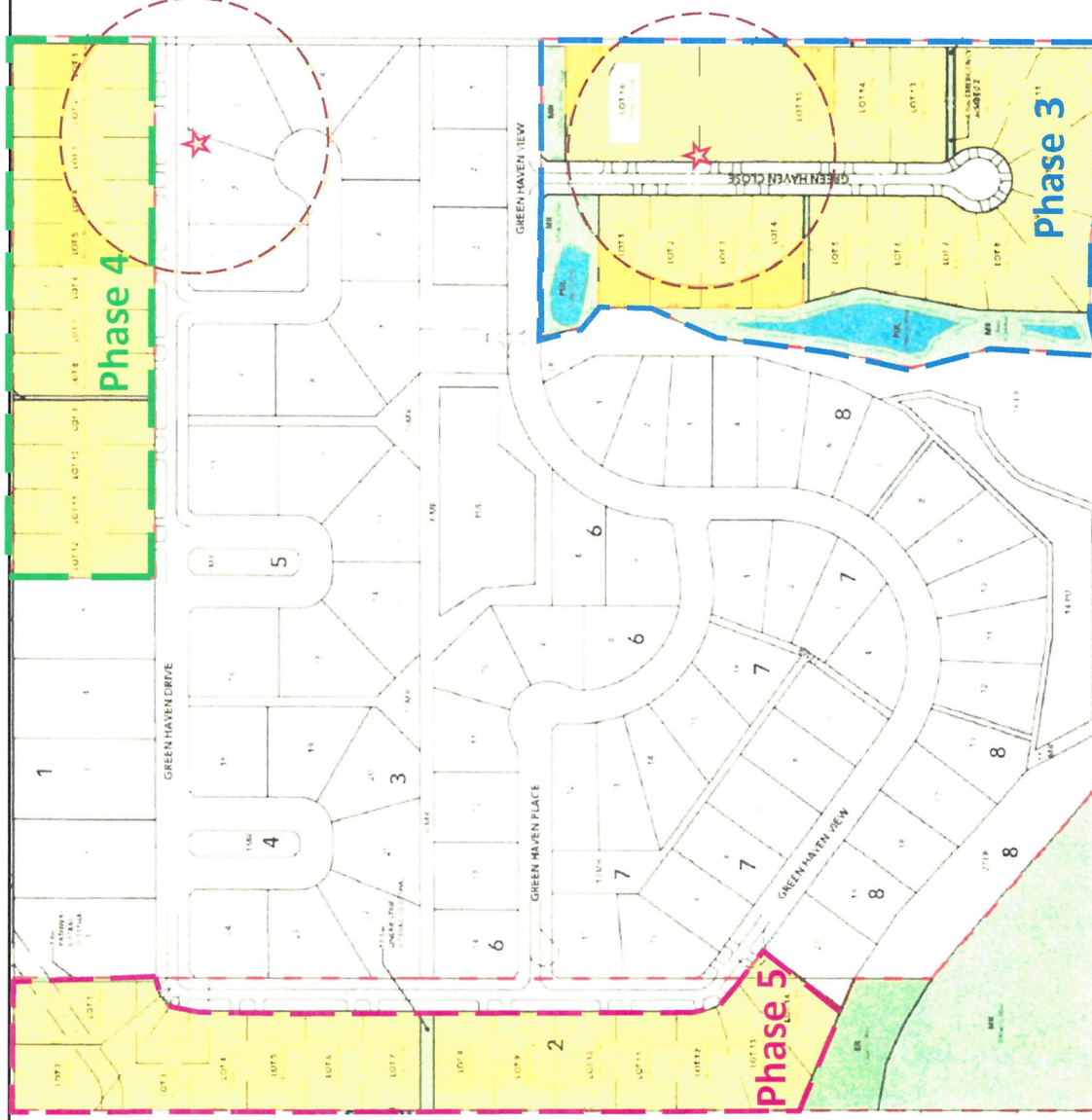
Safety Codes Council. 2021. *Alberta Private Sewage System Standard of Practice 2021*. 1000, 10665 Jasper Avenue, Edmonton, AB Canada.

Soil Classification Working Group. 1998. *The Canadian System of Soil Classification*, 3rd Ed. Agriculture and Agri-Food Canada Publication.

Zlotnik, V.A., Kacimov, A. and A. Al-Maktoumi. 2017. *Estimating groundwater mounding in sloping aquifers for managed aquifer recharge*. Groundwater. Vol 55: No 6 pp. 797 – 810



Appendix A: Site Maps



LEGEND



Approximate Lot Boundaries



Community Water Supply Well



Approximate Setback for Septic Fields from Community Supply Well



Groundwater Resources
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Green Haven Estates

Site Location – Phase's 3, 4 & 5
SE – 27 – 20 – 29W4
Foothills County

Date: September 2022

Project: 2021-1740

Plate No. 1



LEGEND



Monitoring Well



Bedrock Water Supply Well (listed well ID)



Guelph Permeameter Testing Location

Green Haven Estates

Groundwater Resources
Information Technologies Ltd.

Well Locations and Guelph Permeameter
Test Locations
SE - 27 - 20 - 29W4
Foothills County

Date: September 2022

Project: 2021-1740

Plate No. 2



Appendix B: Test Hole Logs

Project: Green Haven Phase 3, 4 & 5

File No: 2022-1858

Test Hole ID: MW-1S

Address: Green Haven Drive, Okotoks AB

GPS Coordinates/Location: 50.7217086°N, 113.9398957°W
West side of Site

Drill Method: Solid Stem Auger

Ground Elevation:

N/A

Sample Type: Grab

Casing Elevation:

+0.86 metres

Driller: All Services Drilling Inc.

Water Elevation:

3.43 metres below ground

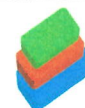
Logged By: AF

Water Sampling Date:

August 15, 2022

Test Hole Diameter: 0.15 metres

Drill Date: August 7, 2022

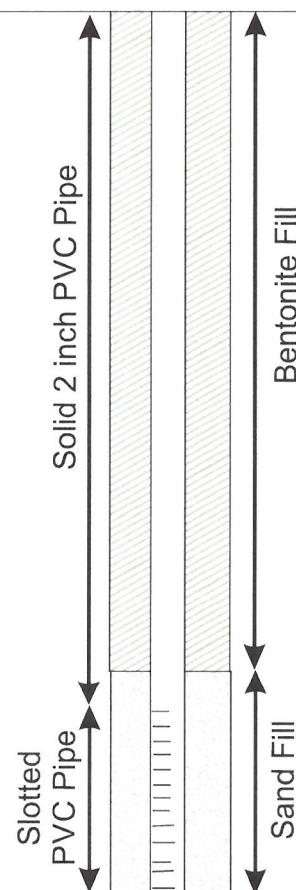


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Depth (m)	Sample Location	Lithology Log	Soil Description	Water Level	Well Construction Details
1			Silt Loam - up to 10% gravel - dry, loose		
2			Silt Clay Loam - trace gravel - slight plastic, moist		
3					
4					
5					
6					
7			Loam - loose, moist - grey color - wet at 7 metres (free water)		
8			Completed as Monitoring Well to 7.2 m		
9					
10					
11					



3.43 m
Aug 15



Project: Green Haven Phase 3, 4 & 5

File No: 2022-1858

Test Hole ID: MW-1D

Address: Green Haven Drive, Okotoks AB

GPS Coordinates/Location: 50.7217086°N, 113.9398956°W

West side of Site

Drill Method: Solid Stem Auger

Ground Elevation:

N/A

Sample Type: Grab

Casing Elevation:

+0.88 metres

Driller: All Services Drilling Inc.

Water Elevation:

3.44 metres below ground

Logged By: AF

Water Sampling Date:

August 15, 2022

Test Hole Diameter: 0.15 metres

Drill Date: August 7, 2022



Groundwater Resources
Information Technologies Ltd.

Depth (m)	Sample Location	Lithology Log	Soil Description	Water Level	Well Construction Details
1			Silt Loam - up to 10% gravel - dry, loose		
2			Silt Clay Loam - trace gravel - slight plastic, moist		
3					
4					
5					
6					
7			Loam - loose, moist - grey color - wet at 7 metres (free water)		
8			Clay Loam - trace gravel - wet, plastic - grey		
9					
10			Clay - wet, plastic - grey		
11			Completed as Monitoring Well to 10.5 m		

Project: Green Haven Phase 3, 4 & 5

File No: 2022-1858

Test Hole ID: MW-2S

Address: Green Haven Drive, Okotoks AB

GPS Coordinates/Location: 50.7244157°N, 113.9302473°W
NE side of Site

Drill Method: Solid Stem Auger

Ground Elevation:

N/A

Sample Type: Grab

Casing Elevation:

+0.95 metres

Driller: All Services Drilling Inc.

Water Elevation:

1.72 metres below ground

Logged By: AF

Water Sampling Date:

August 15, 2022

Test Hole Diameter: 0.15 metres

Drill Date: August 7, 2022



Groundwater Resources
Information Technologies Ltd.

Depth (m)	Sample Location	Lithology Log	Soil Description	Water Level	Well Construction Details
			Topsoil		
1			Clay Loam - slight plastic - trace gravel		
2					
3					
4					
5					
			Completed as Monitoring Well to 5.2 m		

Project: Green Haven Phase 3, 4 & 5

File No: 2022-1858

Test Hole ID: MW-2D

Address: Green Haven Drive, Okotoks AB

GPS Coordinates/Location: 50.7244157°N, 113.9302474°W
NE side of Site

Drill Method: Solid Stem Auger

Sample Type: Grab

Driller: All Services Drilling Inc.

Logged By: AF

Test Hole Diameter: 0.15 meters

Drill Date: August 7, 2022

Ground Elevation: N/A

Casing Elevation: +0.75 metres

Water Elevation: 3.22 metres below ground

Water Sampling Date: August 15, 2022



Groundwater Resources
Information Technologies Ltd.

Depth (m)	Sample Location	Lithology Log	Soil Description	Water Level	Well Construction Details
1			Topsoil Clay Loam - slight plastic - trace gravel		
2					
3					
4					
5					
6					
7					
8			- gleying starts - plastic, moist		
9			- grey color at 9 m		
10					
11					
			Completed as Monitoring Well to 9.8 m		



Water Well Drilling Report

View in Imperial **Export to Excel**

GIC Well ID 1600007
GoA Well Tag No.
Drilling Company Well ID
Date Report Received

GOWN ID

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

Well Identification and Location										Measurement in Metric									
Owner Name		Address			Town		Province		Country		Postal Code								
KAPELLER, SHELLEY		P.O. BOX 1315			OKOTOKS		AB		CA		T1S 1B3								
Location		1/4 or LSD		SEC		TWP		RGE		W of MER		Lot		Block		Plan		Additional Description	
1				27		20		29		4								NORTH HOUSE WELL	
Measured from Boundary of						GPS Coordinates in Decimal Degrees (NAD 83)						Elevation							
_____ m from						Latitude 50.720470 Longitude -113.929060						_____ m							
_____ m from						How Location Obtained						How Elevation Obtained							
						Not Verified						Not Obtained							

Drilling Information	
Method of Drilling	Type of Work
Rotary	New Well
Proposed Well Use	
Domestic	

Formation Log			Measurement in Metric		
Depth from ground level (m)	Water Bearing	Lithology Description			
3.66		Clay & Rocks			
11.28		Gravel			
29.87		Clay & Rocks			
32.61		Gravel			
37.80		Shale			
43.89		Sandstone			
49.07		Shale			
57.30	Yes	Water Bearing Sandstone			
60.96		Shale			

Yield Test Summary				Measurement in Metric	
Recommended Pump Rate				36.37 L/min	
Test Date		Water Removal Rate (L/min)		Static Water Level (m)	
2004/06/12		36.37		26.24	

Well Completion				Measurement in Metric					
Total Depth Drilled		Finished Well Depth		Start Date		End Date			
60.96 m				2004/05/20		2004/05/26			
Borehole									
Diameter (cm)		From (m)		To (m)					
22.23		0.00		60.96					
Surface Casing (if applicable)				Well Casing/Liner					
Steel				Plastic					
Size OD :		14.12 cm		Size OD :		11.43 cm			
Wall Thickness :		0.478 cm		Wall Thickness :		0.544 cm			
Bottom at :		33.83 m		Top at :		12.19 m			
				Bottom at :		60.96 m			
Perforations									
From (m)		To (m)		Diameter or Slot Width (cm)		Slot Length (cm)		Hole or Slot Interval (cm)	
48.77		57.91		0.025				12.70	
Perforated by				Unknown					
Annular Seal				Driven & Bentonite					
Placed from		0.00 m		to		33.83 m			
Amount									
Other Seals									
Type				At (m)					
Screen Type									
Size OD :		_____ cm							
From (m)		To (m)				Slot Size (cm)			
Attachment									
Top Fittings				Bottom Fittings					
Pack									
Type		Unknown		Grain Size					
Amount		Unknown							

Contractor Certification		Certification No	
Name of Journeyman responsible for drilling/construction of well		9985A	
DWAYNE KONDRAT		Copy of Well report provided to owner	
Company Name		Date approval holder signed	
PEE WEE DRILLING (2004) LTD.			



Water Well Drilling Report

View in Imperial **Export to Excel**

GIC Well ID 1600007
GoA Well Tag No.
Drilling Company Well ID
Date Report Received

GOWN ID

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

Well Identification and Location										Measurement in Metric	
Owner Name		Address			Town		Province		Country	Postal Code	
KAPELLER, SHELLEY		P.O. BOX 1315			OKOTOKS		AB		CA	T1S 1B3	
Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description		
1		27	20	29	4				NORTH HOUSE WELL		
Measured from Boundary of					GPS Coordinates in Decimal Degrees (NAD 83)						
_____ m from					Latitude 50.720470 Longitude -113.929060					Elevation _____ m	
_____ m from					How Location Obtained					How Elevation Obtained	
					Not Verified					Not Obtained	

Additional Information										Measurement in Metric
Distance From Top of Casing to Ground Level 30.48 cm										
Is Artesian Flow _____										Is Flow Control Installed _____
Rate _____ L/min										Describe _____
Recommended Pump Rate 36.37 L/min										Pump Installed _____
Recommended Pump Intake Depth (From TOC) 51.82 m										Depth _____ m
Type _____										Make _____ H.P. _____
										Model (Output Rating) _____
Did you Encounter Saline Water (>4000 ppm TDS) _____										Depth _____ m
Gas _____										Well Disinfected Upon Completion _____
Remedial Action Taken _____										Geophysical Log Taken _____
										Submitted to ESRD _____
Additional Comments on Well										Sample Collected for Potability _____
BOREHOLE DIAMETER ALSO 5"										Submitted to ESRD _____

Yield Test			Taken From Ground Level	Measurement in Metric
Test Date	Start Time	Static Water Level	Depth to water level	
2004/06/12	12:00 AM	26.24 m		
			Pumping (m)	Elapsed Time
				Minutes:Sec
				Recovery (m)
Method of Water Removal			26.24	0:00
Type Pump			31.52	1:00
Removal Rate 36.37 L/min			32.92	2:00
Depth Withdrawn From 59.44 m			33.83	3:00
			34.41	4:00
			34.87	5:00
			35.20	6:00
			35.51	7:00
			35.72	8:00
			35.87	9:00
			36.00	10:00
			36.24	12:00
			36.48	14:00
			36.52	16:00
			36.61	20:00
			36.85	25:00
			37.00	30:00
			37.19	35:00
			37.61	40:00
			37.73	50:00
			37.80	60:00
			37.92	75:00
			38.04	90:00
			38.16	105:00
			38.25	120:00

Water Diverted for Drilling		
Water Source	Amount Taken	Diversion Date & Time
	L	

Contractor Certification	
Name of Journeyman responsible for drilling/construction of well	Certification No
DWAYNE KONDRAT	9985A
Company Name	Copy of Well report provided to owner
PEE WEE DRILLING (2004) LTD.	Date approval holder signed



Appendix C: ALS Water Chemistry Analysis

Analytical Report

Bill To: Groundwater Information Edmonton, AB, Canada	Project ID: 2021-1740	Lot ID: 1592132
Attn: Alanna Felske	Project Name: Green Haven Level IV	Control Number:
Sampled By: AF	Project Location:	Date Received: Aug 15, 2022
Company:	LSD:	Date Reported: Aug 19, 2022
	P.O.:	Report Number: 2777582
	Proj. Acct. code:	

		Reference Number	1592132-1	1592132-2	1592132-3	
		Sample Date	Aug 15, 2022	Aug 15, 2022	Aug 15, 2022	
		Sample Time	NA	NA	NA	
		Sample Location				
		Sample Description	MW1S / 13.1°C	MW1D / 13.1°C	MW2S / 13.1°C	
		Matrix	Water	Water	Water	
Analyte		Units	Results	Results	Results	Nominal Detection Limit
Metals Dissolved						
Subsample			Lab Filtered	Lab Filtered	Lab Filtered	
Microbiological Analysis						
Total Coliforms	Membrane Filtration	CFU/100 mL	50	<10	<100	1
Escherichia coli	Membrane Filtration	CFU/100 mL	<1	<10	<100	1
Routine Water						
pH			7.54	7.54	7.71	1
Temperature of observed pH		°C	20.2	20.3	20.3	
Electrical Conductivity	at 25 °C	µS/cm	876	1240	1980	1
Electrical Conductivity	at 25 °C	dS/m	0.876	1.24	1.98	0.001
Calcium	Dissolved	mg/L	123	144	103	0.2
Magnesium	Dissolved	mg/L	38.2	64.6	46.0	0.2
Sodium	Dissolved	mg/L	22.1	45.3	335	0.4
Potassium	Dissolved	mg/L	6.3	6.3	5.5	0.4
Iron	Dissolved	mg/L	<0.01	<0.01	<0.01	0.01
Manganese	Dissolved	mg/L	0.022	1.03	0.008	0.005
Chloride	Dissolved	mg/L	8.4	50.0	8.8	0.4
Nitrate - N		mg/L	1.53	11.3	1.14	0.01
Nitrite - N		mg/L	<0.005	<0.005	0.135	0.005
Nitrate and Nitrite - N		mg/L	1.53	11.3	1.28	0.01
Sulfate (SO4)	Dissolved	mg/L	98.3	170	524	0.9
Hydroxide		mg/L	<5	<5	<5	
Carbonate		mg/L	<6	<6	<6	
Bicarbonate		mg/L	478	513	738	
P-Alkalinity	as CaCO3	mg/L	<5	<5	<5	5
T-Alkalinity	as CaCO3	mg/L	392	421	605	5
Total Dissolved Solids	Calculated	mg/L	532	733	1380	1
Hardness	Dissolved as CaCO3	mg/L	465	625	446	
Ionic Balance	Dissolved	%	102	103	101	

Analytical Report

Bill To: Groundwater Information
Edmonton, AB, Canada
Attn: Alanna Felske
Sampled By: AF
Company:

Project ID: 2021-1740
Project Name: Green Haven Level IV
Project Location:
LSD:
P.O.:
Proj. Acct. code:

Lot ID: **1592132**
Control Number:
Date Received: Aug 15, 2022
Date Reported: Aug 19, 2022
Report Number: 2777582

Reference Number 1592132-4
Sample Date Aug 15, 2022
Sample Time NA
Sample Location
Sample Description MW2D / 13.1°C

Matrix Water

Analyte	Units	Results	Results	Results	Nominal Detection Limit
Metals Dissolved					
Subsample		Lab Filtered			
Microbiological Analysis					
Total Coliforms	Membrane Filtration	CFU/100 mL	<10		1
Escherichia coli	Membrane Filtration	CFU/100 mL	<1		1
Routine Water					
pH			7.31		1
Temperature of observed		°C	20.2		
Electrical Conductivity	at 25 °C	µS/cm	4680		1
Electrical Conductivity	at 25 °C	dS/m	4.68		0.001
Calcium	Dissolved	mg/L	525		0.2
Magnesium	Dissolved	mg/L	269		0.2
Sodium	Dissolved	mg/L	448		0.4
Potassium	Dissolved	mg/L	17		0.4
Iron	Dissolved	mg/L	<0.05		0.01
Manganese	Dissolved	mg/L	0.587		0.005
Chloride	Dissolved	mg/L	3.6		0.4
Nitrate - N		mg/L	0.08		0.01
Nitrite - N		mg/L	<0.02		0.005
Nitrate and Nitrite - N		mg/L	0.08		0.01
Sulfate (SO4)	Dissolved	mg/L	2700		0.9
Hydroxide		mg/L	<5		
Carbonate		mg/L	<6		
Bicarbonate		mg/L	672		
P-Alkalinity	as CaCO3	mg/L	<5		5
T-Alkalinity	as CaCO3	mg/L	551		5
Total Dissolved Solids	Calculated	mg/L	4290		1
Hardness	Dissolved as CaCO3	mg/L	2420		
Ionic Balance	Dissolved	%	102		

Approved by:

Randy Neumann, BSc
Division Director



Data have been validated by Analytical Quality Control and Element's Integrated Data Validation System (IDVS).
Generation and distribution of the report, and approval by the digitized signature above, are performed through a secure and controlled automatic process.

Methodology and Notes

Bill To: Groundwater Information Edmonton, AB, Canada	Project ID: 2021-1740	Lot ID: 1592132
Attn: Alanna Felske	Project Name: Green Haven Level IV	Control Number:
Sampled By: AF	Project Location:	Date Received: Aug 15, 2022
Company:	LSD:	Date Reported: Aug 19, 2022
	P.O.:	Report Number: 2777582
	Proj. Acct. code:	

Method of Analysis

Method Name	Reference	Method	Date Analysis Started	Location
Alkalinity, pH, and EC in water	APHA	* Alkalinity - Titration Method, 2320 B	Aug 17, 2022	Element Edmonton - Roper Road
Alkalinity, pH, and EC in water	APHA	* Conductivity, 2510 B	Aug 17, 2022	Element Edmonton - Roper Road
Alkalinity, pH, and EC in water	APHA	* pH - Electrometric Method, 4500-H+ B	Aug 17, 2022	Element Edmonton - Roper Road
Anions (Routine) by Ion Chromatography	APHA	* Ion Chromatography with Chemical Suppression of Eluent Cond., 4110 B	Aug 18, 2022	Element Edmonton - Roper Road
Approval-Edmonton	APHA	Checking Correctness of Analyses, 1030 E	Aug 18, 2022	Element Edmonton - Roper Road
Chloride in Water	APHA	* Automated Ferricyanide Method, 4500-Cl-E	Aug 17, 2022	Element Edmonton - Roper Road
Coliforms - Membrane Filtration	APHA	E. coli - MF Partition Procedures, 9222 I	Aug 15, 2022	Element Calgary
Coliforms - Membrane Filtration	APHA	E. coli - MF Partition Procedures, 9222 I	Aug 16, 2022	Element Calgary
Coliforms - Membrane Filtration	APHA	Standard Total Coliform Membrane Filter Procedure, 9222 B	Aug 15, 2022	Element Calgary
Coliforms - Membrane Filtration	APHA	Standard Total Coliform Membrane Filter Procedure, 9222 B	Aug 16, 2022	Element Calgary
Metals Trace (Dissolved) in water	APHA	Hardness by Calculation, 2340 B	Aug 18, 2022	Element Edmonton - Roper Road
Metals Trace (Dissolved) in water	APHA	* Inductively Coupled Plasma (ICP) Method, 3120 B	Aug 18, 2022	Element Edmonton - Roper Road

* Reference Method Modified

References

APHA Standard Methods for the Examination of Water and Wastewater

Comments:

- Aug 17, 2022 - Reduction of analytical volume was necessary for Total Coliforms and E. coli due to matrix /background effects for sample 2, 3 & 4. Detection limits have been adjusted accordingly.

Please direct any inquiries regarding this report to our Client Services group.

Results relate only to samples as submitted.

The test report shall not be reproduced except in full, without the written approval of the laboratory.



Appendix D: Water Table Mounding Plots

Water-Table Rise ($t=365$ d)

$$K = 0.2 \text{ ft/d}$$

$$S_y = 0.2$$

$$h_0 = 25 \text{ ft}$$

$$i = 0.01 \text{ ft/ft}$$

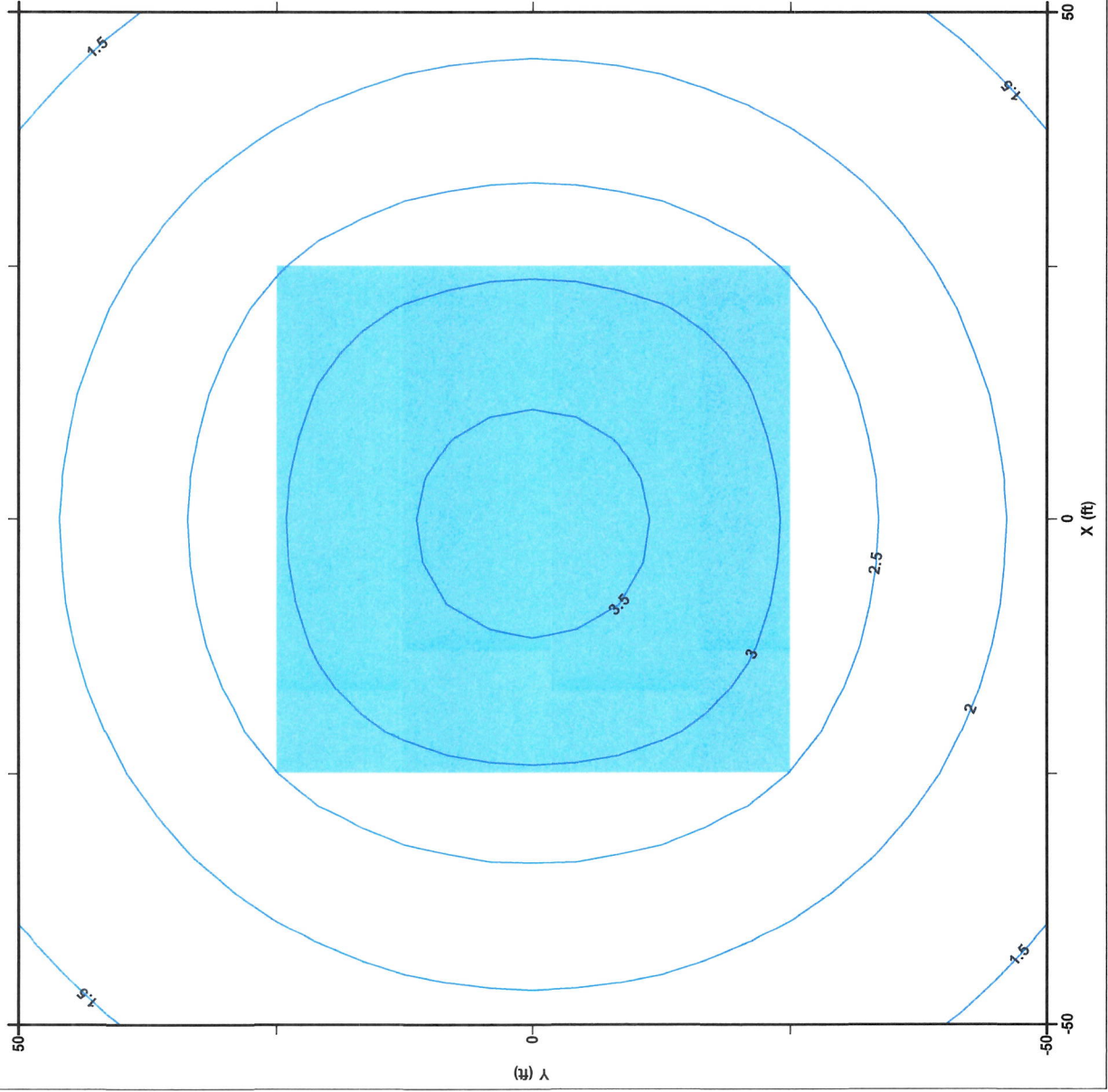
$$\gamma = 0^\circ$$

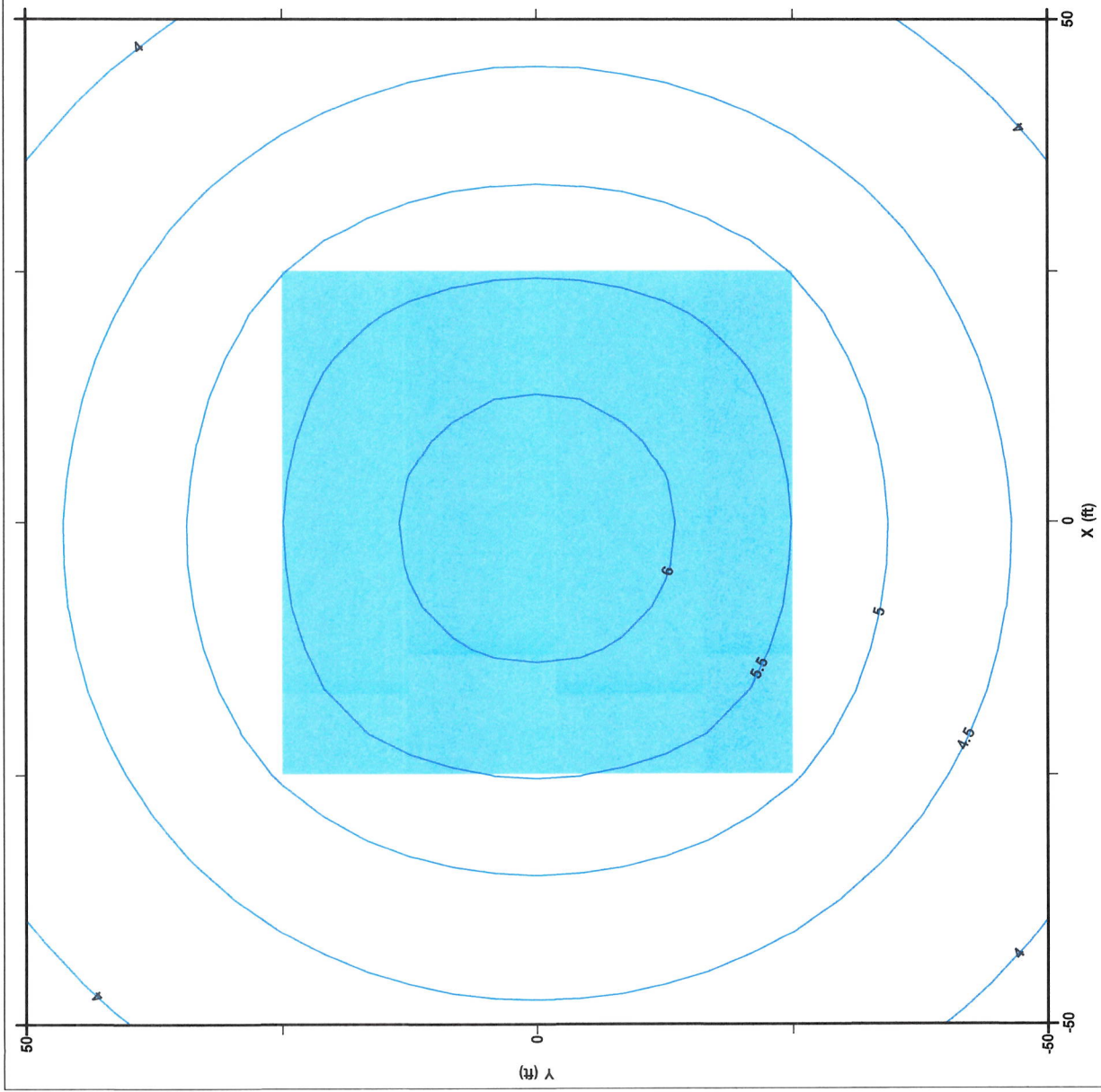
$$L = 50 \text{ ft}$$

$$W = 50 \text{ ft}$$

$$\phi = 0^\circ$$

$$Q = 54 \text{ ft}^3/\text{d}$$



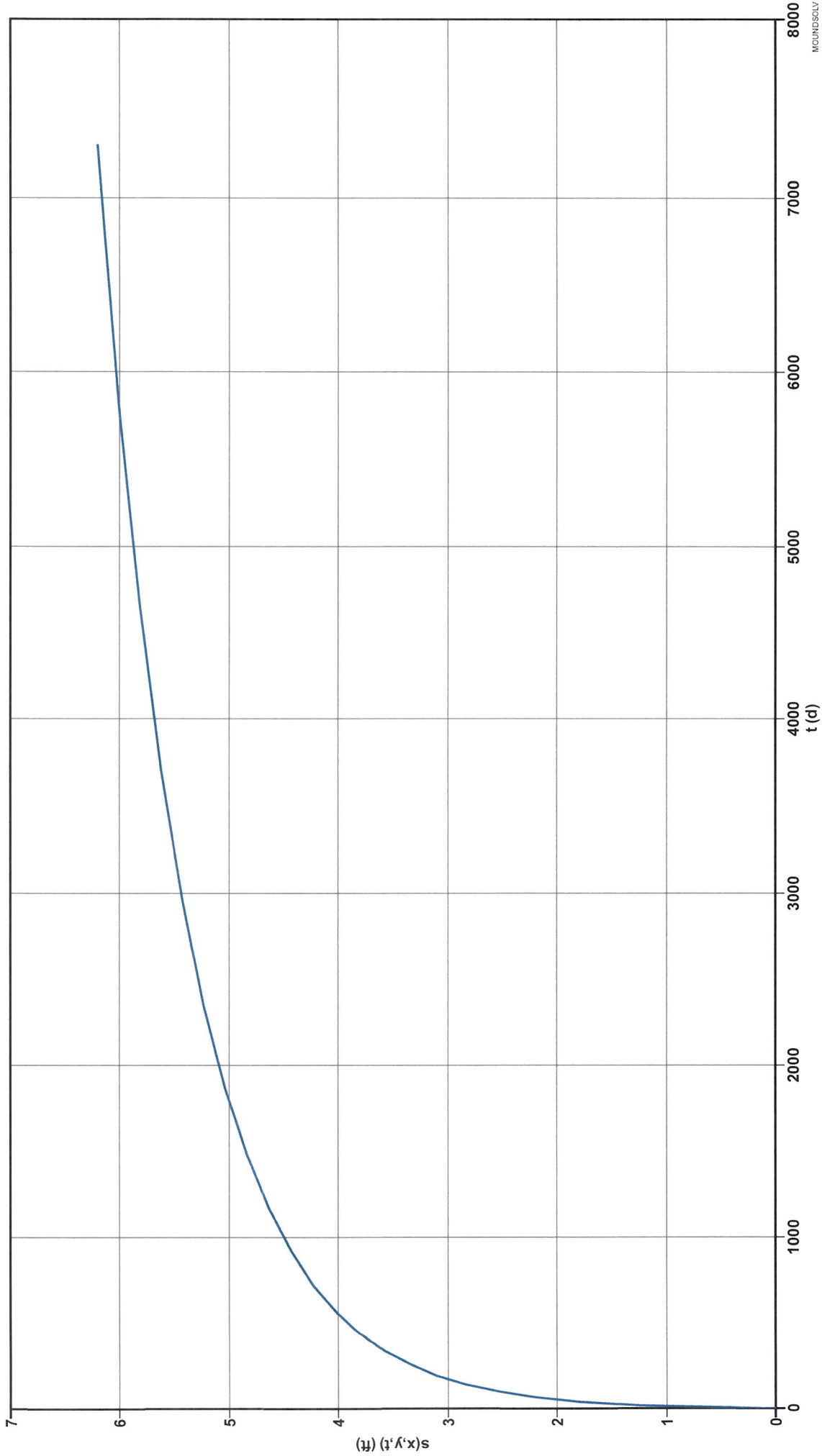


Water-Table Rise ($t=7305$ d)
 $K = 0.2$ ft/d
 $S_y = 0.2$
 $h_0 = 25$ ft
 $i = 0.01$ ft/ft
 $\gamma = 0^\circ$
 $L = 50$ ft
 $W = 50$ ft
 $\phi = 0^\circ$
 $Q = 54$ ft³/d



Water-Table Rise

Source



MOUNDSCLV



PRE-APPROVAL APPLICATION FORM
Municipal Water Servicing for Green Haven Estates

Foothills County
309 Macleod Trail, Box 5605, High River, AB T1V 1M7 Tel: 403-652-2341 Fax: 403-652-7880

The landowner(s) are responsible for contacting Wiaan Kruger (403-652-2341) of the County's Public Works department to obtain pre-approval for the proposed water connection(s) to service the proposed development. This form is required to be completed in full and submitted with a site plan. Complete submission can be mailed in, hand delivered or emailed to planning@foothillscountryab.ca.

REGISTERED LANDOWNER(S) INFORMATION

Landowner(s) Name(s): TIMBER STAR INC

Applicant(s) Name(s) if different from Landowner(s): Alliston Okotoks Ltd

Email(s): constructionadmin@allistongroup Telephone: _____

Municipal Address: _____

Legal Description of Subject Parcel: Plan _____ Block 1 Lot 6

Quarter Section SE Section 27 Township 26 Range 29 W 4 M

Description of proposed development: Proposed development is a single family home with attached garage and deck on lot #6. The site will also include a private tertiary treatment

septic system.

☐ Site Plan attached, illustrating the subject parcel, the proposed location for the development, existing and proposed water connections internal to the site and existing and/or proposed curb stops.

☐ CONNECTION TO EXISTING WATER LINE WITHIN SUBJECT PARCEL

☒ NEW CONNECTION TO WATER MAIN

FOR OFFICE USE ONLY

Public Works Has reviewed the submitted site plan for the proposed water connection required to service the proposed development and confirms the following:

☐ Pre-Approval of New Water Connection

Quote for Installation: _____

Comments:

☐ Refusal of new Water Connection

Reason(s):

Reviewed by: Albert Stark

Print Name

Date: January 20, 2026

Signature