Part 2 — Technical Requirements

NRCB Natural Resources Conservation Board

Application under the *Agricultural Operation Practices Act* for a confined feeding operation, manure collection area, and/or manure storage facility(ies)

NRCB USE ONLY

☐ Approval ☐ Registration ☑ Authorization ☐ Amendment

Application number: RA24039

Legal land description: NW 10-37-27 W4M

APPLICATION DISCLOSURE

This information is collected under the authority of the *Agricultural Operation Practices Act* (AOPA), and is subject to the provisions of the *Freedom of Information and Protection of Privacy Act*. This information is public unless the NRCB grants a written request that certain sections remain private.

Any construction prior to obtaining an NRCB permit is an offence and is subject to enforcement action, including prosecution.

I, the applicant, or applicant's agent, have read and understand the statements above, and I acknowledge that the information provided in this application is true to the best of my knowledge.

Sept 26 /24
Date of signing

[redacted]
Signature

Richards Farms Ltd.
Corporate name (if applicable)

Connor Richards
Print name

GENERAL INFORMATION REQUIREMENTS

Proposed facilities: list all proposed confined feeding operation facilities and their dimensions. Indicate whether any of the proposed facilities are additions to existing facilities. (attach additional pages if needed)

Proposed facilities	Dimensions (m) (length, width, and depth)
Expanded dairy barn Expansion dimensions: 52 m x 23 m	~~36, 78, 12~~ 109m / 23m, 3m
lagoon	76m / 76m / 4.5m
AO note: applicant has proposed to expand and re-line the existing dairy barn to convert into a liquid manure system. Final barn dimensions = 114 m x 23 m x 3.7 m deep	

Existing facilities: list **ALL** existing confined feeding operation facilities and their dimensions

Existing facilities	Dimensions (m) (length, width, and depth)	NRCB USE ONLY
dry cows barn	51 x 14 x 4	
Milk Cows loafing barn	60 x 23 x 6	
Calf barn	38 x 18 x 4	

NRCB USE ONLY

See following page for a complete list

NRCB Natural Resources Conservation Board

Authorization RA16041 – Appendix

Existing Permitted Facilities

To be expanded ↖
To be ← decommissioned

Facility	Dimensions	Permit
Dairy barn	23.8 m x 62.2 m	Municipal development permit D-201-99 (Deemed as built)
"EMS" (wash water pond)	24.4 m x 30.5 m x 3.7 m deep	
Dairy corrals	40.0 m x 29.0 m, 18.0 m x 7.0 m	Deemed
Dry cow barn	13.7 m x 51.2 m	
Dry cow pens	8.4 m x 43.7 m	
Calf barn	18.3 m x ~~18.3 m~~ 39.6m	
Solid manure storage pad (behind dairy barn)	9.1 m x 6.7 m	
Parlour – ancillary structure	20.7 m x 39.6 m	
Close-up shelter	23.0 m x 7.9 m	
Close-up pen	37.5 m x 12.5 m	

RA16041 permitted calf barn extension : 18.3m x 21.3m
and Solid manure storage pad : (7.6m x 24.4m)

RA17026 permitted a heifer shed extension : 14.6m x 7.3m
final = 40.2m x 7.3m

Part 2 — Technical Requirements

NRCB Natural Resources Conservation Board

Application under the *Agricultural Operation Practices Act* for a confined feeding operation, manure collection area, and/or manure storage facility(ies)

If a new facility is replacing an old facility, please explain what will happen to the old facility and when. ☒ N/A

Construction completion date for proposed facilities Oct. 20 / 2026

Additional information

decommissioning lagoon

AO note: existing EMS is currently used to hold wash water but will be decommissioned.

Livestock numbers: Complete only if livestock numbers are different from what was identified in the Part 1 application. Note: if livestock numbers increase in your Part 2 application, a new Part 1 application must be submitted which may result in a loss of priority for minimum distance separation (MDS).

Livestock category and type (Available in the Schedule 2 of the Part 2 Matters Regulation)	**Permitted number**	**Proposed increase or decrease in number (if applicable)**	**Total**
Milking Cows	200	0	200
No proposed increase in livestock			

OPTION 4: Uncertain if *Water Act* licence is needed; acknowledgement of risk (for existing CFOs only)

1. At this time, I (we) do not know whether a new water licence is needed from EPA under the *Water Act* for the development or activity proposed in this AOPA application.
2. If a new *Water Act* licence is needed, I (we) request that the NRCB process the AOPA application **independently of** EPA's processing of the CFO's application for a water licence.
3. In making this request, I (we) recognize that, if this AOPA application is granted by the NRCB, the NRCB's decision will not be considered by EPA as improving or enhancing the CFO's eligibility for a water licence under the *Water Act*.
4. I (we) acknowledge that any construction or actions to populate the CFO with additional livestock pursuant to an AOPA permit in the absence of a *Water Act* licence will **not** be relevant to EPA's consideration of whether to grant my *Water Act* licence application, if a new water licence is needed.
5. I (we) acknowledge that any such construction or livestock increase will be at the CFO's sole risk if the *Water Act* licence application is denied or if the operation of the CFO is otherwise deemed to be in violation of the *Water Act*. This risk includes being required to depopulate the CFO and/or to cease further construction, or to remove "works" or "undertakings" (as defined in the *Water Act*).
6. **AS RELEVANT:** I (we) acknowledge that the CFO is located in the South Saskatchewan River Basin and that, pursuant to the *Bow, Oldman and South Saskatchewan River Basin Water Allocation Order* [Alta. Reg. 171/2007], this basin is currently closed to new surface water allocations.
7. **Provide**: Water license number(s) or water conveyance agreement details _____

_____

Signed this 26 day of Sept., 2024. [redacted]

Signature of Applicant or Agent

ENVIROWEST ENGINEERING	Title: Borehole Locations Site and Soil Assessment NW¼-Sec.10-Twp.037-Rge.27-W4M Red Deer County, Alberta	Project No: 2411-43070	Date: February 26, 2025	Figure No.: 1.0
		Scale: 1:2700	Prepared By: L. Predy	
		Image Source: Google Earth Pro (February 22, 2024)		

Red Square is lagoon dimensions will be more to the ~~East~~ west though. (see next page for amended location)

2. barn extension
3. Surface water
4. water wells

AMENDMENT - SITE AND SOIL ASSESSMENT
THE FIGURE IS AN AMENDMENT TO THE PROVIDED REPORT
- LAGOON SIZING UPDATE -
76 M X 76 M [VOLUME: 17,851 M3; CAPACITY: 15,076 M3]

ALL OTHER DESIGN RECOMMENDATIONS ARE TO BE THE SAME AS OUTLINED IN THE PROVIDED REPORT

ENVIROWEST ENGINEERING

Title:

Borehole Locations
Site and Soil Assessment
NW¼-Sec.10-Twp.037-Rge.27-W4M
Red Deer County, Alberta

Project No: 2411-43070	**Date:** February 26, 2025	**Figure No.:** 1.2
Scale: 1:2700	**Prepared By:** L. Predy	
Image Source: Google Earth Pro (February 22, 2024)		

Part 2 — Technical Requirements

NRCB Natural Resources Conservation Board

Application under the *Agricultural Operation Practices Act* for a confined feeding operation, manure collection area, and/or manure storage facility(ies)

GENERAL ENVIRONMENTAL INFORMATION

(complete this section for the worst case of the existing facility which is the closest to water bodies or water wells and for each of the proposed facilities)

Facility description / name *(as indicated on site plan)*

Existing: dairy barn **Proposed 1:** expanded dairy barn

Proposed 2: new lagoon **Proposed 3:**

Facility and environmental risk information		Facilities				NRCB USE ONLY	
		Existing	Proposed 1	Proposed 2	Proposed 3	Meets requirements	Comments
Flood plain information	What is the elevation of the floor of the lowest manure storage or collection facility above the 1:25 year flood plain or the highest known flood level?	☒ >1 m ☐ ≤ 1 m	☒ >1 m ☐ ≤ 1 m	☒ >1 m ☐ ≤ 1 m	☐ > 1 m ☐ ≤ 1 m	☒ YES ☐ NO ☐ YES with exemption	Not located in flooplain
Surface water information	How many springs are within 100 m of the manure storage facility or manure collection area?	0	0	0		☒ YES ☐ NO ☐ YES with exemption	None identified
	How many water wells are within 100 m of the manure storage facility or manure collection area?	2	2	0		☐ YES ☐ NO ☒ YES with exemption	2 wells within 100 m of proposed barn renovation/ expansion
	What is the shortest distance from the manure collection or storage facility to a surface water body? (e.g., lake, creek, slough, seasonal)			111 m		☒ YES ☐ NO ☐ YES with exemption	Proposed barn expansion <30 m from seasonal slough (not a CBW)
Groundwater information	What is the depth to the water table?			4.93 mbgs		☒ YES ☐ NO ☐ YES with exemption	4.9 m from engineering report
	What is the depth to the groundwater resource/aquifer you draw water from?			120		☒ YES ☐ NO ☐ YES with exemption	8.5 m in WW ID 102129

Additional information (attach supporting information, e.g. borehole logs, records, etc. you consider relevant to your application)

Part 2 — Technical Requirements

Application under the *Agricultural Operation Practices Act* for a confined feeding operation, manure collection area, and/or manure storage facility(ies)

NRCB USE ONLY

WATER WELL AND SURFACE WATER INFORMATION

Well IDs: 102129, 298568, 166782 (reclaimed; not in use), 157776 (reclaimed)

Surface water related concerns from directly affected parties or referral agencies: ☐ YES ☒ NO

Groundwater related concerns from directly affected parties or referral agencies: ☐ YES ☒ NO

Water wells ☐ N/A

If applicable, exemption for 100 m distance requirements applied: ☒ YES ☐ NO Condition required: ☒ YES ☐ NO

Surface water ☒ N/A

If applicable, exemption for 30 m distance requirements applied: ☐ YES ☐ NO Condition required: ☐ YES ☐ NO

Water Well Exemption Screening Tool ☐ N/A

Water Well ID	Preliminary Screening Score	Secondary Screening Score	Facility
102129	33 = exemption less likely; continue to next section	8 = exemption more likely	Barn renovation/expansion
298568	13 = continue to next section	9 = exemption more likely	Barn renovation/expansion

Groundwater or surface water related comments:

Due to the results of the exemption tool, a water well monitoring condition will be included in Authorization RA24039 requiring water well ID 102129 to be sampled and tested annually.

Part 2 — Technical Requirements

Application under the *Agricultural Operation Practices Act* for a confined feeding operation, manure collection area, and/or manure storage facility(ies)

NRCB USE ONLY

ENVIRONMENTAL RISK SCREENING INFORMATION

ERST for **proposed** facilities

Facility	Groundwater score	Surface water score	File number
Barn renovation and expansion	Low	Low	RA24039
New EMS	Low	Low	RA24039

ERST for **existing** facilities

Facility	Groundwater score	Surface water score	File number
Solid manure storage pad	Low	Low	RA16041
Dry cow pens			
Dry cow barn			
Dairy corrals			
Dairy barn			
Close up shelter			
Close up pen			
Old EMS (to be decommissioned)			

ERST related comments:

Solid manure storage pad #2

Heifer barn

Part

Part 2 — Technical Requirements

Application under the *Agricultural Operation Practices Act* for a confined feeding operation, manure collection area, and/or manure storage facility(ies)

NRCB Natural Resources Conservation Board

DISTANCE OF ANY MANURE STORAGE FACILITY (EXISTING OR PROPOSED) TO NEIGHBOURING RESIDENCES

			NRCB USE ONLY				
Neighbour name(s)	**Legal land description**	**Distance (m)**	**Zoning (LUB) category**	**MDS category (1-4)**	**Distance (m)**	**Waiver attached (if required)**	**Meets regulations**
Nick Wyntjes	SE 15-37-27 W4	465	Ag	1	790	N/A	Yes
Michael Richards	NE 9-37-27 W4	965	↓	↓	928	N/A	Yes
Chris Wyntjes	SE 16-37-27 W4	965			760	N/A	Yes
Marley Hadden	SW 15-37-27 W4	965			728	N/A	Yes
Colin Richards	~~NE~~ NW 10-37-27 W4	320	↓	↓	160	Yes	Yes w waiver

LAND BASE FOR MANURE AND COMPOST APPLICATION (complete only if an increase in livestock or manure production will occur)

				NRCB USE ONLY	
Name of land owner(s)*	**Legal land description**	**Usable area** (ha)**	**Soil zone *** **	**Usable area (ha)**	**Agreement attached (if required)**
N/A for authorization applications					
			Total		

* If you are **not** the registered landowner, you must attach copies of land use agreements signed by all landowners.

** Available manure spreading area (excluding setback areas from residences, common bodies of water, water wells, etc. as identified in Agdex 096-5 Manure Spreading Regulations)

*** Brown, dark brown, black, grey wooded, or irrigated

Additional information (attach any additional information as required)

Minimum Distance Separation (MDS) Waiver (declaration)

Residence owner(s) information

ALL Names on land title: Colin Richards

Legal land location of residence(s): NW10-37-27-W4

Telephone number(s) [redacted] Email address(es)[1]: [redacted]

Address(es)[1] and Postal code(s) [redacted] Red Deer County

[redacted]

[1] ***Please note that personal contact information is for NRCB use ONLY and not publicly released***

I am/we are the legal landowner(s) of a residence(s) located at the above noted legal land location/address:

- I/we have read the NRCB Fact Sheet "Minimum Distance Separation (MDS) Waivers";
- I/we have discussed this application with the applicant and understand its potential impacts to our residence(s);
- I/we understand that the application **does not** meet the MDS requirement to my/our residence(s), under the *Agricultural Operation Practices Act* (AOPA);
- **I/we understand that this waiver is not valid unless signed by ALL parties identified on the land title as owners;**
- **I/we are not obligated to waive the MDS requirement to our residence(s);**
- I/we understand that if I/we choose to waive the MDS requirement, I/we can revoke the waiver, by providing written notice to the NRCB approval officer, as set out in the "Minimum Distance Separation (MDS) Waivers" Fact Sheet; and
- I/we understand that this waiver is a public document.

Having considered my/our rights, I/we hereby waive the MDS requirement to my/our residence, with respect to

Application number RA24039.

[redacted]

Signatures of **all** residence owner(s) on title

Colin Richards

Printed names of **all** residence owner(s) on title

Date: April 20/25

Minimum Distance Separation (MDS) Waiver (declaration)

Applicant information NRCB application number: RA 24039

Operator/operation name: Richards Farms Ltd.

Address [redacted] Red Deer County Postal Code: [redacted]

Legal land location of confined feeding operation: NW-10-37-27 W4

I have requested the residence owner(s) named below to waive the required minimum distance separation (MDS) to their residence for the *Agricultural Operation Practices Act* (AOPA) permit application identified above. In making this request, I have provided the owner(s) with an opportunity to review my permit application and a copy of the Natural Resources Conservation Board (NRCB) Fact Sheet "Minimum Distance Separation (MDS) Waivers" available on the NRCB website at www.nrcb.ca. I have also explained:

- The MDS requirement set out in section 3 of the Standards and Administration Regulation of AOPA. I have advised the owner(s) that section 3(6)(a) of the Standards and Administration Regulation allows this requirement to be waived by the owners of residences, if they agree in writing to grant a waiver;
- That my proposed development does not meet the required MDS to the owner's residence; and,
- That this waiver applies only to this application as described. An increase in livestock capacity, annual manure production, level of odour production, change to the site plan or change to a facility that would increase the MDS would require a new waiver.

Following is a summary of the proposed development:

- The current scope of my confined feeding operation (CFO), including the type, number, and category of livestock, if any, is:
  150 milking Cows
- My application for a new AOPA permit proposes the following changes to the existing livestock category, type and/or capacity at my CFO:
  200 milking cows, larger loafing barn, new larger lagoon.
- The proposed new CFO facility(ies), or changes to the existing CFO facilities, including manure storage, manure storage volume and any other pertinent details, if any, are (attach a site layout plan if available):
  double the length of loafing barn, 250'x250'x4.5m deep lagoon.

I the applicant understand that the waiver is not valid unless ALL registered owners of the residence sign this document.

Permit Applicant: [redacted] Signature Date: Apr. 20/25

Residence owner(s) to initial: CR

Part 2 — Technical Requirements

Application under the *Agricultural Operation Practices Act* for a confined feeding operation, manure collection area, and/or manure storage facility(ies)

NRCB USE ONLY

MINIMUM DISTANCE SEPARATION

Methods used to determine distance (if applicable): Google Earth

Margin of error (if applicable): +/- 3 m

Requirements (m): Category 1: 349 Category 2: 465 Category 3: 581 Category 4: 930

Technology factor: ☐ YES ☒ NO

Expansion factor: ☐ YES ☒ NO

MDS related concerns from directly affected parties or referral agencies: ☐ YES ☒ NO

AO note: MDS waiver required as the proposed construction will result in an increased footprint of the existing CFO.

LAND BASE FOR MANURE AND COMPOST APPLICATION

Land base required: _____

Land base listed: _____

Area not suitable: _____

N/A for authorization applications

Available area _____ Requirement met: ☐ YES ☐ NO

Land spreading agreements required: ☐ YES ☐ NO

Manure management plan: ☐ YES ☐ NO If yes, plan is attached: ☐

PLANS

Submitted and attached construction plans: ☒ YES ☐ NO

Submitted aerial photos: ☒ YES ☐ NO

Submitted photos: ☐ YES ☒ NO

GRANDFATHERING

Already completed: ☒ YES ☐ NO ☐ N/A

If already completed, see RA16041

LIQUID MANURE COLLECTION AND/OR STORAGE: In-barn - Concrete liner

*(complete a copy of this section for **EACH** proposed in-barn liquid manure storage facility with a concrete liner)*

Facility description / name *(as indicated on site plan)*

1. ~~expanded dairy barn~~ Liquid manure pit 1
2. Liquid manure pit 2
3. Expanded and re-lined barn (total dimensions)

Manure storage capacity *(use one row in the table for **EACH** in-barn storage. Attach additional pages if you require more rows)*

	Length (m)	Width (m)	Total depth (m)	Depth below ground level (m)	NRCB USE ONLY Calculated storage capacity (m^3)
1.	~~234.267m~~	~~64.267m~~	~~3~~ 3.658m	3.658m	21.9 m^3
2.	17.374	3.65m	1.829m	1.829 m	114.1 m^3
3.	114 m	23 m	0 m		
				TOTAL CAPACITY	136 m^3

Concrete liner details

Scrape alleys or unslatted portions of barn floors (if applicable)	Concrete thickness: 5"	Method of sulphate protection: type 50 cement	
	Concrete strength: 30 MPA	Concrete reinforcement size and spacing: 10mm / 18" 15" on center	
In-barn manure pit floors	Concrete thickness: 6" 30/32 MPA	Method of sulphate protection: Type 50 or type 10 with fly ash	
	Concrete strength: 32 MPa	Concrete reinforcement size and spacing: 10mm /12" on center	
In-barn manure pit walls	Concrete thickness: 8"	Method of sulphate protection: Type 50 or type 10 with fly ash	
	Concrete strength: 32 MPA	Horizontal reinforcement size and spacing: 15mm / 12" on center	Vertical reinforcement size and spacing: 15mm / 12" on center

Information in blue added by AO

LIQUID MANURE COLLECTION AND/OR STORAGE: In-barn - Concrete liner (cont.)

Describe how the joints at the junction of the pit walls, pit floors and any other joints will be sealed

Pit wall to floor connection will be 4" PVC water stop

~~Every~~ walls will be continous pour

Describe sealing practices for piping, etc. that penetrates the liner

bentonite seal

Concrete requirements can be found in Technical Guideline Agdex 096-93
Guideline minimums:
Solid manure: 25MPa (D)
Solid manure (wet): 30MPa (C)
Liquid manure: 32MPa (B)
Category A is required to be engineered
Method of sulphate protection:
Type 50 or Type 10 with fly ash or equivalent

NRCB USE ONLY

Requirements met: ☐ YES ☒ NO

Condition required: ☒ YES ☐ NO

Additional information

NRCB USE ONLY

Liquid manure storage volume calculator attached: ☒ YES ☐ NO

Depth to water table: 4.9 m

Requirements met: ☒ YES ☐ NO

Depth to uppermost groundwater resource: 8.5 m

Requirements met: ☒ YES ☐ NO

ERST completed: ☒ see ERST page for details

Concrete liner requirements

Leakage detection system required: ☐ YES ☒ NO If yes, please explain why

Part 2 — Technical Requirements

Application under the *Agricultural Operation Practices Act* for a confined feeding operation, manure collection area and/or manure storage facility(ies)

LIQUID MANURE STORAGE: Earthen manure storage (EMS): Compacted soil liner

*(complete a copy of this section for **EACH** proposed earthen liquid manure storage facility with a compacted soil liner)*

Facility description / name *(as indicated on site plan)*

1. New lagoon
2.

Manure storage capacity *(complete a separate row of this table for each cell of the EMS)*

	Length (m)	Width (m)	Total depth (m)	Depth below ground level (m)	Slope run:rise			NRCB USE ONLY	
					Inside end walls	Inside side walls	Outside walls	Calculated storage capacity (excl. 0.5 m freeboard) (m^3)	Filled in lower ¼? Y/N
1.	76	76	4.5	~~3.97~~	3:1	3:1	4:1		Y
2.				2.9 m					
							TOTAL CAPACITY	15,076 m^3	

Surface water control systems

Describe the run-on and runoff control system

Ground naturally lowers around proposed lagoon so run on will go around lagoon area, Run off will be Controlled by the dyke walls of 1.57m.

Sealing

Describe sealing practices for piping, etc. that penetrates the liner

The Annulus around pipe will be sealed with bentonite sealer.

NRCB USE ONLY

Requirements met: ☒ YES ☐ NO

Liner protection

Describe how the inside walls, bottom and outside walls are protected from erosion

~~Fencing~~ freeboard depth of 0.5m and outside walls will be covered with 0.1-0.2 m of topsoil and seeded.

Describe how the physical integrity of the liner will be maintained from other damage

keep shrubs, trees and deep-rooted plants from growing within 10 meters of lagoon

NRCB USE ONLY

Requirements met: ☒ YES ☐ NO

LIQUID MANURE STORAGE: Earthen manure storage (EMS): Compacted soil liner (cont.)

Compacted soil liner details

Thickness of compacted liner: 1.0 (m)		Provide compacted liner details (as required)	
Soil texture	25.4 % sand	29.1 % silt	45.3 % clay
Atterberg limits	Plastic limit: 25.42%	Liquid limit: 73.42%	Plasticity index: 47.99%
Hydraulic conductivity	Hydraulic conductivity (cm/s): 4.7×10^{-8}		
	Describe test standard used: Test method for hydraulic conductivity of saturated porous materials using a flexible wall permeameter.		

Additional information *(attach copies of soil test reports)*

NRCB USE ONLY

Requirements met: ☒ YES ☐ NO

Condition required: ☒ YES ☐ NO

Report attached: ☒ YES ☐ NO

NRCB USE ONLY

Liquid manure storage volume calculator attached: ☒ YES ☐ NO

Depth to water table: 4.9 m — Requirements met: ☒ YES ☐ NO

Depth to uppermost groundwater resource: 8.5 m — Requirements met: ☒ YES ☐ NO

ERST completed: ☒ see ERST page for details

Surface water control systems

Requirements met: ☒ YES ☐ NO Details/comments:

Compacted soil liner details

Liner specification comments (e.g. compaction, moisture content, thickness):

Leakage detection system required: ☐ YES ☒ NO If yes, please explain why.

NRCB USE ONLY **LIQUID MANURE STORAGE VOLUME CALCULATOR (if applicable)**	
Facility 1 New EMS	
Name / description	Capacity 15,076 m^3
Facility 2	
Name / description	Capacity
Facility 3	
Name / description	Capacity
Facility 4	
Name / description	Capacity
TOTAL CAPACITY	15,076 m3
REQUIRED 9 MONTH STORAGE CAPACITY	5,400 m^3
MEETS THE REQUIREMENTS FOR A MINIMUM OF 9 MONTHS STORAGE	☒ YES ☐ NO

Part 2 — Technical Requirements

Application under the *Agricultural Operation Practices Act* for a confined feeding operation, manure collection area, and/or manure storage facility(ies)

NRCB USE ONLY

ALL SIGNATURES IN FILE ☒ YES ☐ NO

DATES OF APPROVAL OFFICER SITE VISITS

Sept. 26, 2024	

CORRESPONDENCE WITH MUNICIPALITIES AND REFERRAL AGENCIES

Date deeming letters sent: March 5, 2025

Municipality: Red Deer County

☒ letter sent ☒ response received ☒ written/email ☐ verbal ☐ no comments received

Alberta Health Services: ☒ N/A

☐ letter sent ☐ response received ☐ written/email ☐ verbal ☐ no comments received

Alberta Environment and Parks: ☐ N/A

☒ letter sent ☒ response received ☒ written/email ☐ verbal ☐ no comments received

Alberta Transportation: ☐ N/A

☒ letter sent ☒ response received ☒ written/email ☐ verbal ☐ no comments received

Alberta Regulatory Services: ☐ N/A

☒ letter sent ☒ response received ☒ written/email ☐ verbal ☐ no comments received

Other: EQUS and Canadian Natural Resources Ltd. ☐ N/A

☒ letter sent ☐ response received ☐ written/email ☐ verbal ☒ no comments received

Other: _____ ☐ N/A

☐ letter sent ☐ response received ☐ written/email ☐ verbal ☐ no comments received

ENVIROWEST
ENGINEERING

SITE AND SOIL ASSESSMENT

Proposed Earthen Manure Storage Lagoon
NW¼-10-037-27-W4M

Red Deer County, Alberta

Site and Soil Assessment
Proposed Earthen Manure Storage Lagoon
NW¼-10-037-27-W4M
Red Deer County, Alberta

Prepared For: Connor Richards
Richards Farms Ltd.

Delivered via Email: [redacted]

Prepared By: Envirowest Engineering
Box 4248, Ponoka, AB, T4J 1R6
(403) 783-8229

Report Date: January 16, 2025

Project Number: 2411-43070

Private and Confidential

Table of Contents

List of Tables

Appendices

1.0 Introduction and Scope of Work

Envirowest Engineering (Envirowest) was retained by Connor Richards of Richards Farms Ltd. to conduct a Site and Soil Assessment for the proposed construction of an earthen manure storage (EMS) lagoon for the proposed expansion of an existing 200 milking cow (plus replacements and dries) dairy operation.

The assessment was completed to determine conditions beneath the proposed construction area and assess soil properties for construction of proposed facilities. The operation, herein referred to as "the Site," is located on NW-10-037-27-W4M in Red Deer County.

The assessment has been completed in accordance with the standards and regulations associated with the amended Agricultural Operation Practices Act and associated regulations which govern all new and modified confined feeding operations.

Scope of Work

Five investigative boreholes were drilled using a truck-mounted rotary auger and completed to a maximum depth of 6.0 m below ground surface (mbgs) on October 24, 2024. The boreholes were completed in the area proposed for a manure storage lagoon. The borehole locations are shown on Figure 1.0 (attached).

2.0 Assessment Results

The Site is in an area of relatively flat to gently rolling topography, sloping to the north. The Site is currently utilized as cropland.

Five investigative boreholes were drilled using a truck-mounted rotary auger and completed to a maximum depth of 6.0 mbgs on October 24, 2024. The boreholes were drilled in the area proposed for an earthen manure storage lagoon and are shown on Figure 1.0 (attached).

Potential liner construction material (noted in borehole logs as clay) was typically found beneath topsoil and intermittent clayey sand. Saturated sand seams were noted at 2.90 mbgs (as measured at 24BH01) and 3.75 mbgs (as measured at 24BH01 and 24BH02) approximately 5 to 8 centimeters thick. Bedrock was encountered at depths between 5.2 – 5.7 mbgs at boreholes 24BH01, 24BH02, and 24BH03.

Boreholes were backfilled with the material removed by back spinning the solid stem auger and compacting to depth of the borehole.

The results of the soil analysis completed by a third-party laboratory are presented in Table 1 below. The soil sample locations are presented on Figure 1, and borehole logs are attached. The composite sample was obtained from boreholes 24BH02, 24BH04, and 24BH05.

Table 1: Soil Properties Results

Parameter	24BH01-01	24BH02-01	Composite
Sample Depth (mbgs)	2.25	0.8	1.5 - 3.0
Particle Size (%sand)	21.7	29.1	9.4
Particle Size (%silt)	29.9	28.4	90.5
Particle Size (%clay)	48.4	42.2	
Texture Class	Clay	Clay	Clay
Plastic Limit (%)	-	-	25.42
Liquid Limit (%)	-	-	73.42
Plasticity Index (%)	-	-	47.99
Field Hydraulic Conductivity (cm/sec)	-	-	4.7×10^{-9}
Natural Moisture (%)	-	-	19.7

The soils were identified as clay. The suspected compacted liner material had an average clay content of 45.3%, ranging from 48.4 – 42.2%.

The composite soils were determined to be clay. The hydraulic conductivity was determined to be 4.7×10^{-9} cm/sec at 99% compaction. The maximum dry density was found to be 1,535 kg/m^3 with an optimum moisture content of 21.6%. Natural moisture of the sample was found to be 19.7%.

Conservatively a safety factor of 10 is to be applied to the hydraulic conductivity based on the NRCB Approvals Policy (2016-7), Section 8.7.2, stating "lab measurements of a sample of material taken from the field are not considered an accurate representation of the actual field hydraulic conductivity values. This is because of the potential variability of soils, differences in compaction methods and variances in compaction." Therefore, the field hydraulic conductivity of the composite material tested is determined to be 4.7×10^{-8} cm/sec.

A saturated water table was not encountered during the assessment to a maximum depth of 6.0 mbgs. It was concluded based on the field assessment that a standard water table is present and delineation was not required.

A piezometer was installed at borehole 24BH05, screened from 3.0 to 6.0 mbgs. Depth to water table was measured at 4.93 mbgs on January 14, 2025.

3.0 Liner Assessments

3.1 Compacted Earthen Liner Assessment (Liquid Manure Storage)

Based on the information obtained it was determined that the native clay within the proposed area of construction was found to have a minimum thickness of 1.0 meters (found in boreholes 24BH01, 24BH02, 24BH04 and 24BH05). The proposed liquid manure storage area is approximately 61 meters x 61 meters, as shown on Figure 1.0.

Minimum Required Liner Depth for EMS:

$$\frac{1\ \text{m}}{1 \times 10^{-7}\ \text{cm/sec}} = \frac{\mathbf{X}\ \text{m}}{4.7 \times 10^{-8}\ \text{cm/sec}}$$

$$\mathbf{X} = 0.5\ \text{m}$$

A compacted liner thickness of 0.5 m is required, however a **1.0 m** liner is recommended due to freeze thaw cycles and erosion.

4.0 Conclusions

The following conclusions are based on the discussed scope of the construction.

The composite soils were determined to be appropriate for the construction of a compacted clay liner for a liquid manure storage facility.

5.0 Design and Construction Considerations

5.1 Earthen Lined Lagoon

Earthen Lagoon Storage Sizing

The new liquid EMS facility was designed for 200 head including dries and replacements for a minimum 9 months storage. The manure storage lagoon is recommended to have the following specifications:

- To provide the required capacity the new EMS should be 61 m in length x 61 m in width. The overall depth has been designed as 4.5 m. The overall capacity of the new EMS will be 10,426 cubic metres (2.3 million imperial gallons) which accounts for the required 0.5 m of freeboard, a storage capacity of 8,656 cubic metres. The sizing is based on an inside end and side wall slope of 3:1 (run/rise)
- The overall depth of 4.5 m will be achieved through a below grade depth of 2.93 m as measured from borehole 24BH05.The bottom of the liner will measure 3.93 meters below grade.
- The above-grade dykes will measure 1.57 m. The outside dyke walls should be completed to at slope of 4:1. The crest of the dyke should be sloped slightly outward to direct rainfall away from the storage facility
- The below-grade depth of the EMS must maintain a minimum of a 1.0 m separation above the water table at the time of construction
- Construction of the clay liner on the north wall should be completed in approximately 0.15 m lifts. Preferably, compaction of each lift will be undertaken with a padfoot roller, or the like. The equipment being used for soil compaction must fully penetrate each lift.
- Lifts should continue to be added until the recommended liner thickness is achieved. Particular attention should be paid to ensuring that the liner is integrally connected to the lower soil strata and that the soil around the inlet pipe is compacted to the same standard as the remainder of the liner
- Sand pockets that may be encountered during construction should be removed prior to liner installation
- If any significant amount of coarse grained material is encountered, the NRCB or the engineer should be contacted prior to proceeding
- Control of liner moisture content is critical during the construction process. Liner material should not be allowed to become saturated or to become dry. Should a lift surface become dry, the lift should be scarified prior to the placement of the next lift. Lifts which are above the required moisture content due to precipitation etc. should be removed or allowed to dry and re-compacted. The liner should not be allowed to freeze during construction

- Topsoil, frozen soil or rocks larger than 6 inches should not be included in the liner material
- Construction of the lagoon should be supervised by a professional engineer
- The freeboard depth of 0.5 m and outside dyke walls should be covered with 0.1-0.2 m of topsoil and seeded to prevent soil erosion.
- The inlet pipe to the EMS should be located in the bottom 1/4 of the lagoon. The annulus around the inlet pipe should be sealed with a bentonite sealer.

Earthen Manure Storage Construction

The following general construction procedures are recommended, though some modifications may be required based on actual site conditions encountered during construction:

- The topsoil and overburden should be stripped from the area for construction. The topsoil can be reused on the freeboard area after construction completion
- Sand and gravel seams, if encountered, should be excavated during construction and should be removed
- Construction of the lagoon should be supervised by a professional engineer

Following completion of the lagoon the operator should:

- Ensure that shrubs, trees, and deep-rooted plants are not allowed to grow within 10 meters of the facility

6.0 Closure

Envirowest Engineering is pleased to submit the report to Connor Richards of Richards Farms Ltd. The information and conclusions contained in this report are for their sole use. No other party is to rely upon the information contained within the report without the express written authorization of Envirowest Engineering.

Envirowest Engineering is not responsible for any damages that may be suffered as the result of any unauthorized use of, or reliance on, this report. Envirowest Engineering has performed the work 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 environmental engineer profession practicing under similar conditions at the time the work was performed. Envirowest Engineering accepts no responsibility for any deficiency, misstatement or inaccuracy in this report resulting from misinformation from any individuals or parties that provided information as part of this report.

We trust that this report meets your present needs. Please feel free to contact the undersigned with any questions or should you require additional information.

Respectfully submitted,

January 16, 2025

Prepared by:
Emily J. Low, P.Eng.
Envirowest Engineering

Reviewed by:
Leah Predy, P.Ag.
Envirowest Engineering

PERMIT TO PRACTICE
2206165 ALBERTA LTD.

RM SIGNATURE: _____

RM APEGA ID #: 110373

DATE: January 16, 2025

PERMIT NUMBER: P014810
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

2206165 Alberta Ltd. o/a Envirowest Engineering
Association of Professional Engineers and Geoscientists of Alberta
Permit to Practice No. P14810

7.0 Qualifications of Assessors

Ms. Emily Low, B.Sc., P.Eng, is an Environmental Engineer with Envirowest Engineering and has approximately 15 years of environmental assessment, monitoring, and remediation experience in the agricultural, industrial, real estate and development, and oil and gas sectors. Ms. Low has a Bachelor of Science in Chemical Engineering from the University of Alberta and is a certified Professional Engineer in Alberta (Association of Professional Engineers and Geoscientists of Alberta).

Leah Predy, B.A., B.Sc., P.Ag., is a Professional Agrologist with Envirowest Engineering and has approximately 5 years of experience in the environmental field, both in field data collection and report preparation for environmental assessments, monitoring, and remediation, as well as agricultural projects. Prior to her employment with Envirowest Engineering, Leah had five years of experience managing rangelands and navigating legislation and regulations as a Rangeland Agrologist with the Government of Alberta. She is a Professional Agrologist in Alberta (Alberta Institute of Agrologists).

8.0 References

GOA (Government of Alberta). (January 2020). Agricultural Operation Practices Act and Regulations. Edmonton, AB: Author.

GOA (Government of Alberta). (2017). Agricultural Operation Practices Act: Standards and Administration Regulation. Edmonton, AB: Author.

Appendix A

Figure

ENVIROWEST ENGINEERING

Title:

Borehole Locations
Site and Soil Assessment
NW¼-Sec.10-Twp.037-Rge.27-W4M
Red Deer County, Alberta

Project No: 2411-43070	**Date:** January 9, 2025	**Figure No.:** 1.0
Scale: 1:2700	**Prepared By:** L. Predy	
Image Source: Google Earth Pro (February 22, 2024)		

Appendix B

Borehole Logs

ENVIROWEST ENGINEERING

LOG OF BORING 24BH01

Site and Soil Assessment
NW-10-37-27-W4M
Red Deer County, Alberta

Project Number: 2411-43070

Driller: : Ever Green Drilling
Drilling Method: : Truck Mounted Auger
Drill Date : October 24, 2024
Logged By: : Emily Low P.Eng.

Well:
Elev.:

Depth in Meters	Gastech Reading (ppm) 0 100 200 300 400 500	VOC Reading	GRAPHIC	DESCRIPTION	Water Level
0.0				TOPSOIL	
0.3				CLAY, olive brown, compact, dry	
0.5					
0.8					
1.0					
1.3					
1.5					
1.8				medium plasticity, damp	
2.0					
2.3					
2.5					
2.8				saturated seam (2.75)	
3.0					
3.3					
3.5				saturated seam (3.75)	
3.8					
4.0					
4.3					
4.5					
4.8					
5.0					
5.3					
5.5					
5.8				weathered bedrock	
6.0					

01-16-2025 Y:\Operations\Client Data\43070 Richards Farms Ltd. (Connor Richards)\24BH01.bor

ENVIROWEST ENGINEERING

LOG OF BORING 24BH02

Site and Soil Assessment
NW-10-37-27-W4M
Red Deer County, Alberta

Project Number: 2411-43070

Driller: : Ever Green Drilling
Drilling Method: : Truck Mounted Auger
Drill Date : October 24, 2024
Logged By: : Emily Low P.Eng.

Well:
Elev.:

Depth in Meters	Gastech Reading (ppm) 0 100 200 300 400 500	VOC Reading	GRAPHIC	DESCRIPTION	Water Level
0.0				TOPSOIL	
0.3					
0.5				CLAY, compact, low to high plasticity, damp	
0.8					
1.0					
1.3					
1.5					
1.8					
2.0					
2.3					
2.5				SAND	
2.8					
3.0					
3.3					
3.5				saturated sand seam (3.75)	
3.8					
4.0					
4.3					
4.5					
4.8					
5.0				weathered siltstone (5.2-5.4)	
5.3					
5.5					
5.8					
6.0					

01-16-2025 Y:\Operations\Client Data\43070 Richards Farms Ltd. (Connor Richards)\24BH02.boi

ENVIROWEST ENGINEERING

LOG OF BORING 24BH03

Site and Soil Assessment
NW-10-37-27-W4M
Red Deer County, Alberta

Project Number: 2411-43070

Driller: : Ever Green Drilling
Drilling Method: : Truck Mounted Auger
Drill Date : October 24, 2024
Logged By: : Emily Low P.Eng.

Well:
Elev.:

Depth in Meters	Gastech Reading (ppm) 0 100 200 300 400 500	VOC Reading	GRAPHIC	DESCRIPTION	Water Level
0.0				TOPSOIL	
0.3				CLAYEY SAND, olive brown, compact, dry	
0.5					
0.8					
1.0					
1.3					
1.5					
1.8					
2.0					
2.3					
2.5				CLAYEY SILT, olive brown, loose, dry	
2.8					
3.0					
3.3					
3.5					
3.8				SAND, loose, dry	
4.0					
4.3					
4.5					
4.8					
5.0					
5.3				bedrock	
5.5					
5.8					
6.0					

01-16-2025 Y:\Operations\Client Data\43070 Richards Farms Ltd. (Connor Richards)\24BH03.boi

ENVIROWEST ENGINEERING

LOG OF BORING 24BH04

Site and Soil Assessment
NW-10-37-27-W4M
Red Deer County, Alberta

Project Number: 2411-43070

Driller: : Ever Green Drilling
Drilling Method: : Truck Mounted Auger
Drill Date : October 24, 2024
Logged By: : Emily Low P.Eng.

Well:
Elev.:

Depth in Meters	Gastech Reading (ppm) 0 100 200 300 400 500	VOC Reading	GRAPHIC	DESCRIPTION	Water Level
0.0				TOPSOIL	
0.3				CLAYEY SAND, olive brown, compact, dry	
0.5					
0.8					
1.0					
1.3					
1.5					
1.8				CLAY, medium plasticity, damp	
2.0					
2.3					
2.5					
2.8				CLAYEY SILT, loose, low plasticity, damp	
3.0					
3.3					
3.5					
3.8				sand seam (3.65-3.95)	
4.0					
4.3					
4.5					
4.8					
5.0				compact, very hard	
5.3					
5.5					
5.8					
6.0					

01-16-2025 Y:\Operations\Client Data\43070 Richards Farms Ltd. (Connor Richards)\24BH04.boi

ENVIROWEST ENGINEERING

LOG OF BORING 24BH05

Site and Soil Assessment
NW-10-37-27-W4M
Red Deer County, Alberta

Project Number: 2411-43070

Driller: : Ever Green Drilling
Drilling Method: : Truck Mounted Auger
Drill Date : October 24, 2024
Logged By: : Emily Low P.Eng.

Well:
Elev.:

Depth in Meters	Gastech Reading (ppm) 0 100 200 300 400 500	VOC Reading	GRAPHIC	DESCRIPTION	Water Level
0.0				SILT, orange, loose, dry	
0.3					
0.5				CLAYEY SAND, compact, dry	
0.8					
1.0					
1.3					
1.5				CLAY, damp, medium to high plasticity	
1.8					
2.0					
2.3					
2.5					
2.8					
3.0				CLAYEY SILT, loose, low plasticity, damp	
3.3					
3.5				sand seam (3.65-3.95)	
3.8					
4.0					
4.3					
4.5					
4.8				compact, very hard	
5.0					
5.3					
5.5					
5.8					
6.0					

01-16-2025 Y:\Operations\Client Data\43070 Richards Farms Ltd. (Connor Richards)\24BH05.boi

Appendix C

Certificate of Analysis

Project Name:	2024 Materials Testing	Depth:	
Project Number:	USG2017	Testing Company:	Union Street Geo.
Client:	Envirowest Engineering	Field Technician:	EG
Testhole:		Sample Date:	November 19, 2024
Location:	Richards, Project No.43070	Lab Technician:	BB
Sample Number:	W610	Date Tested:	December 12, 2024

Flexible Wall Permeameter (ASTM D5084-10)

Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter

Material and Test Description

Material Description:

Clay, silty, trace sand

Test Type:	Constant Head
Mould Size:	Flexible Wall
Sample Source:	Re-moulded
Fluid Used:	Deaired Water
Fluid Reservoir:	Burrettes

Remoulding Details	
Max Dry Density (kg/m^3):	-
Proctor ID:	-
Percent Max (%):	-
Target Dry Density (kg/m^3):	-

Initial Sample Characteristics

Water Content	
Wet + Tare (g):	596.6
Dry + Tare (g):	488.9
Tare (g):	13.6
Water Content (%):	22.7%

Sample Size					
Trial	1	2	3	4	Average
Diameter (mm):	73.4	73.7	73.0	73.7	73.5
Length (mm):	78.4	78.6	78.9	78.8	78.7
Weight (g)	662.9				

Area (cm^2):	42.4
Volume (cm^3):	333.4
Wet Density (kg/m^3):	1989
Dry Density (kg/m^3):	1621

Specific Gravity (Note 2):	2.62
Void Ratio:	0.62
Saturation:	96.4%
Porosity:	38.1%

Final Sample Characteristics

Water Content	
Wet + Tare (g):	685.6
Dry + Tare (g):	553.1
Tare (g):	11.6
Water Content (%):	24.5%

Sample Size					
Trial	1	2	3	4	Average
Diameter (mm):	74.3	74.1	74	73.8	74.1
Length (mm):	78.8	78.7	78.9	78.8	78.8
Weight (g)	674.4				

Area (cm^2):	43.1
Volume (cm^3):	339.4
Wet Density (kg/m^3):	1987
Dry Density (kg/m^3):	1597

Specific Gravity (Note 1):	2.62
Void Ratio:	0.64
Saturation:	100.0%
Porosity:	39.1%

Note 1: Specific gravity for final sample characteristics calculation adjusted to result in 100.0% saturation.

Note 2: Specific gravity for initial sample characteristics calculation set equal to that of the final.

Project Name:	2024 Materials Testing	Depth:	
Project Number:	USG2017	Testing Company:	Union Street Geo.
Client:	Envirowest Engineering	Field Technician:	EG
Testhole:		Sample Date:	November 19, 2024
Location:	Richards, Project No.43070	Lab Technician:	BB
Sample Number:	W610	Date Tested:	December 12, 2024

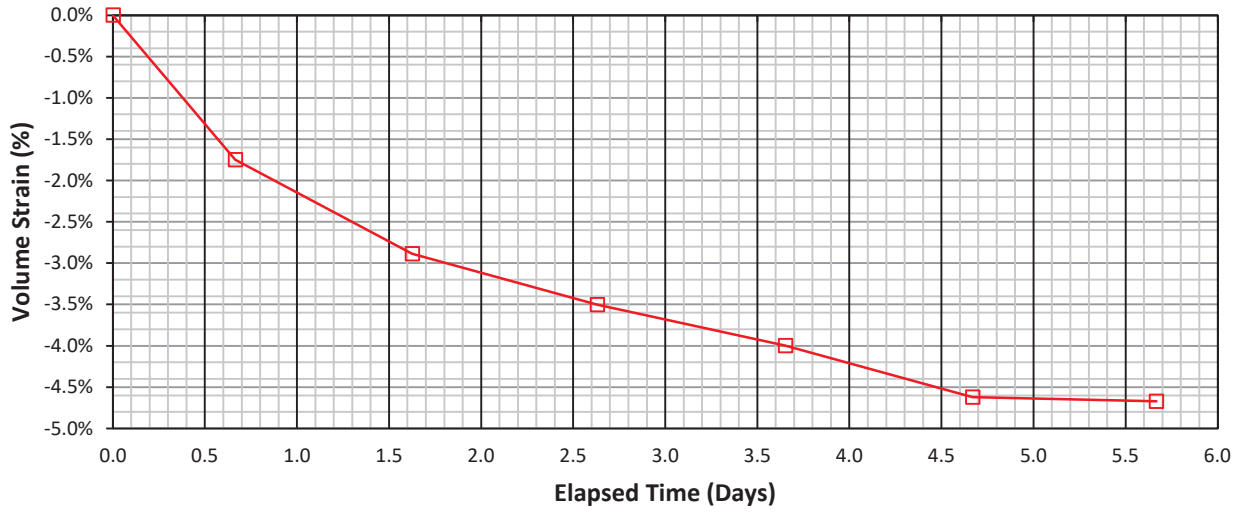
Flexible Wall Permeameter (ASTM D5084-10)

Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter

Saturation Data

Cell Pressure (kPa):	160.0	Top Pressure (kPa):	130.0
Bottom Pressure (kPa):	130.0	Pressure Difference (kPa):	-

Date & Time	Elapsed Time (Days)	Room Temp (°C)	Top Burret (mL)	Bottom Burret (mL)	Cell (mL)	Total Vol. Change (mL)	Volume Strain (%)
12/12/24 15:29	0.00	20.0	4.6	4.5	13.8	0	0.00%
12/13/24 7:26	0.66	20.0	5.4	5.1	18.2	-5.83	-1.75%
12/14/24 6:29	1.63	20.0	5.4	5.1	22.0	-9.62	-2.89%
12/15/24 6:35	2.63	20.0	5.4	5.5	23.7	-11.68	-3.50%
12/16/24 7:08	3.65	20.0	5.7	5.8	24.7	-13.33	-4.00%
12/17/24 7:32	4.67	20.0	5.7	5.7	26.9	-15.40	-4.62%
12/18/24 7:28	5.67	20.0	5.7	5.7	27.1	-15.57	-4.67%
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-



Project Name:	2024 Materials Testing	Depth:	
Project Number:	USG2017	Testing Company:	Union Street Geo.
Client:	Envirowest Engineering	Field Technician:	EG
Testhole:		Sample Date:	November 19, 2024
Location:	Richards, Project No.43070	Lab Technician:	BB
Sample Number:	W610	Date Tested:	December 12, 2024

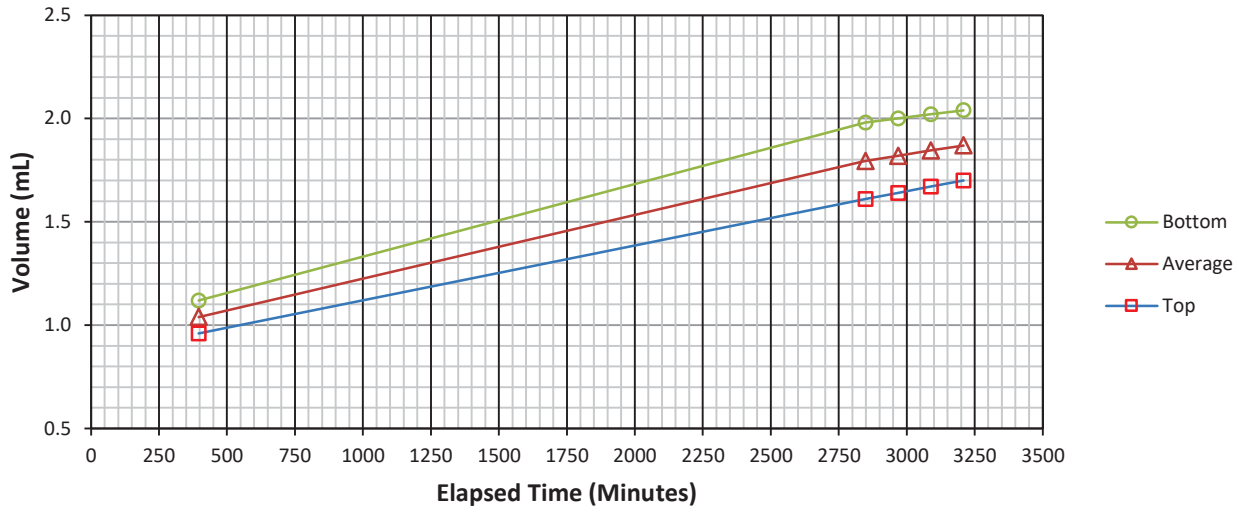
Flexible Wall Permeameter (ASTM D5084-10)

Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter

Permeation Data

Cell Pressure (kPa):	160.0	Top Pressure (kPa):	120.0
Bottom Pressure (kPa):	140.0	Pressure Difference (kPa):	20.0

Date & Time	Elapsed Time (Minutes)	Room Temp (°C)	Top Burret (mL)	Bottom Burret (mL)	Top Vol. Change (mL)	Bottom Vol. Change (mL)	Average Vol. Change (mL)
12/18/24 7:58	0	19.0	9.85	0.29	0.00	0.00	0.00
12/18/24 14:33	395	19.0	8.89	1.41	0.96	1.12	1.04
12/20/24 7:26	2848	19.0	8.24	2.27	1.61	1.98	1.80
12/20/24 9:26	2968	19.0	8.21	2.29	1.64	2.00	1.82
12/20/24 11:26	3088	19.0	8.18	2.31	1.67	2.02	1.85
12/20/24 13:26	3208	19.0	8.15	2.33	1.70	2.04	1.87
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-



Project Name:	2024 Materials Testing	Depth:	
Project Number:	USG2017	Testing Company:	Union Street Geo.
Client:	Envirowest Engineering	Field Technician:	EG
Testhole:		Sample Date:	November 19, 2024
Location:	Richards, Project No.43070	Lab Technician:	BB
Sample Number:	W610	Date Tested:	December 12, 2024

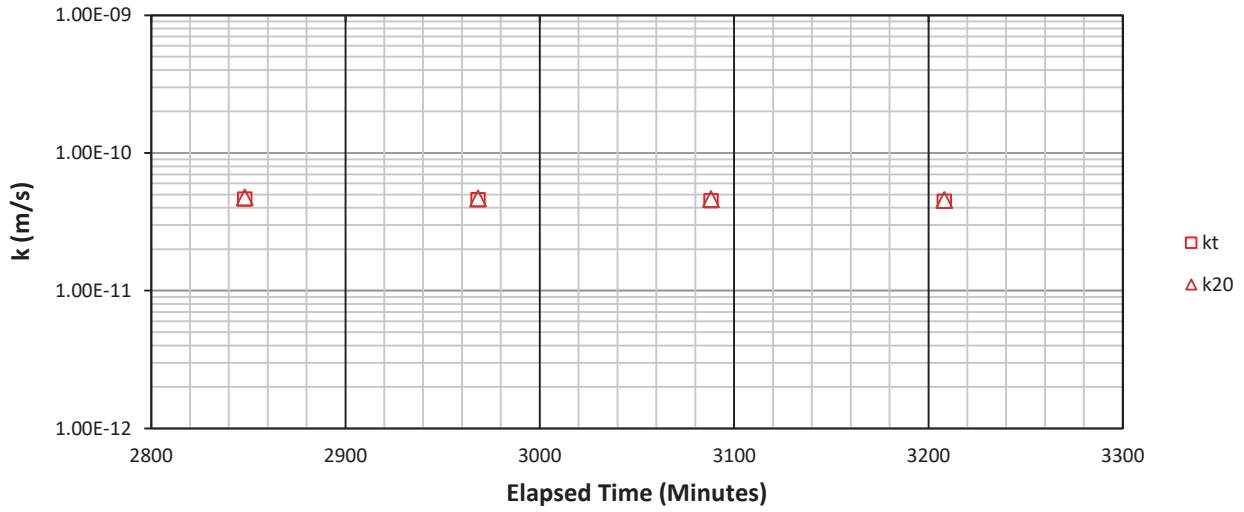
Flexible Wall Permeameter (ASTM D5084-10)

Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter

Permeation Data

Head Difference (m):	2.0	Area of Sample (m^2)	4.272E-03
Length of Sample (m):	7.874E-02	Gradient, i	2.590E+01

Elapsed Time (Minutes)	Average Volume Change (mL)	Average Temperature (°C)	k_t (m/s)	R_T	k_{20} (m/s)
2848	1.80	19.0	4.637E-11	1.025	4.753E-11
2968	1.82	19.0	4.567E-11	1.025	4.682E-11
3088	1.85	19.0	4.504E-11	1.025	4.616E-11
3208	1.87	19.0	4.445E-11	1.025	4.557E-11
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	AVERAGE	4.538E-11		4.652E-11



Laboratory Proctor — Sample No.: W610

Sample Information

Date: 19-Nov-24 **By:** E.L. **of:** Envirowest **Type:** Pail

Location: Richards, Project No. 43070 **Natural Moisture:** 19.7 %

Description: Clay, silty, trace sand.

Specfication: ASTM D 698 - Method A

Comments:

Proctor Results:

Test Number	1	2	3	4	5
Dry Density (Kg/m^3)	**1468**	**1492**	**1517**	**1535**	**1525**
Moisture Content (%)	**16.3**	**17.3**	**18.9**	**21.8**	**23.6**

Oversize Correction (Calculated using assumed Specific Gravity of 2.40)

Oversize (%)	5	10	15	20	25
Density	**1577**	**1618**	**1660**	**1701**	**1743**

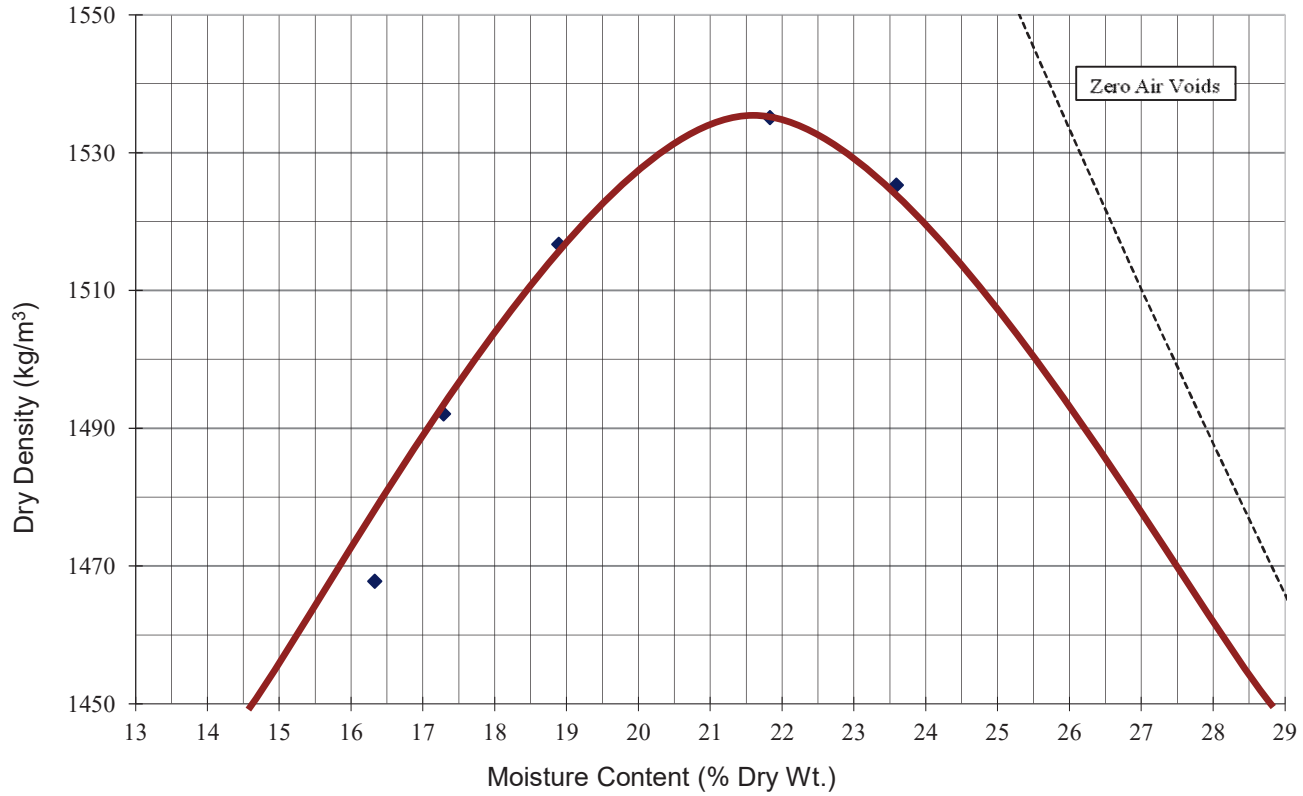
Optimum Results:

Moisture Content = **21.6** %

Dry Density = **1535** Kg/m^3

Corrected Density = **1535** Kg/m^3

Oversize Material = **0.0** %



Union Street Geotechnical

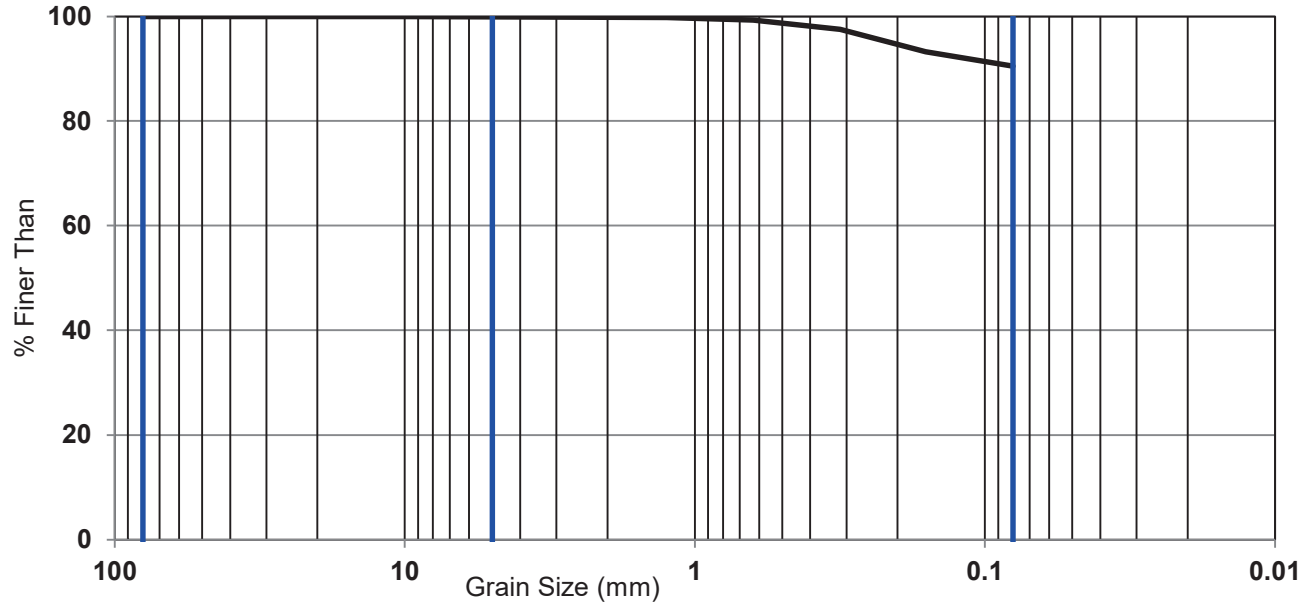
CLIENT:	Envirowest Engineering	**FILE No.:**	USG2017
PROJECT:	2024 Materials Testing	**DATE:**	28-Nov-24
LOCATION:	Red Deer, Alberta	**TECH:**	G.S.

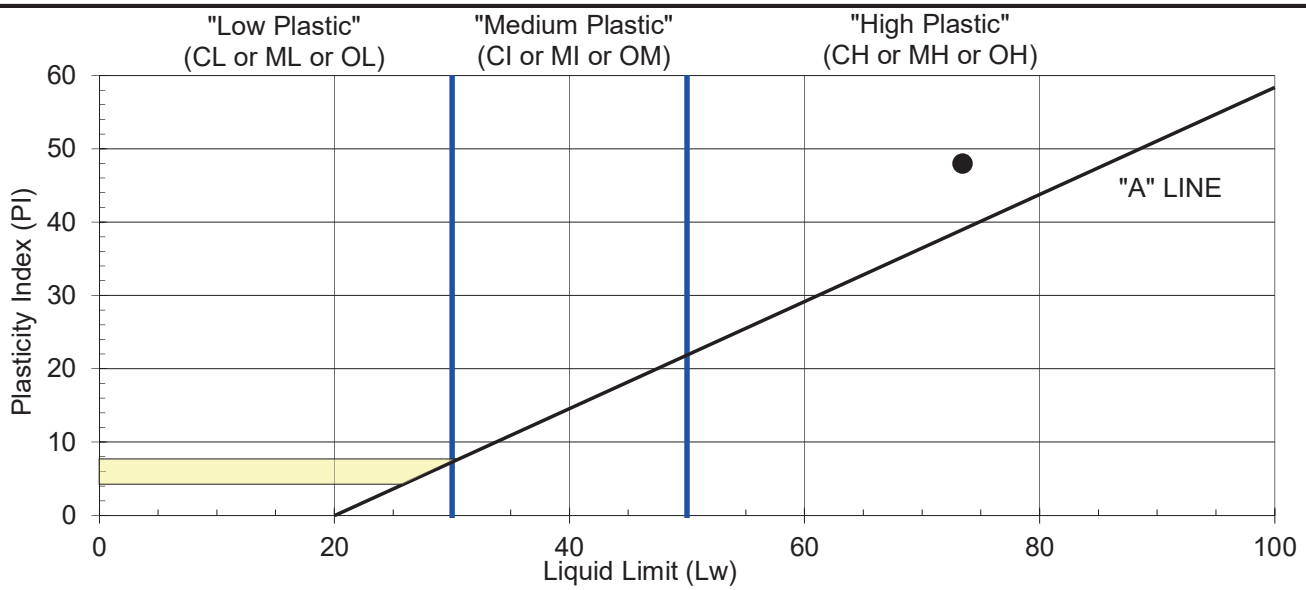
Lab Unified Soils Classification — Sample No.: W610

Sample Information

Classification: Clay, silty, trace sand	**Particle Size:** Gravel = 0.1%	**Borehole No.:** -	
	Sand = 9.4%	**Sample No.:** -	
	Silt & Clay = 90.5%	**Depth (m):** -	

Particle Size Analysis - Washed Sieve





Plastic Limit:	25.42%	**Group Index:**	49.0
Liquid Limit:	73.42%	**Soil Type:**	Inorganic
Plasticity Index:	47.99%	**Classification:**	CH : High Plastic Clay

Union Street Geotechnical

CLIENT:	Envirowest Engineering	**FILE No.:**	USG2017
PROJECT:	2024 Materials Testing	**DATE:**	22-Nov-24
LOCATION:	Red Deer, Alberta	**TECH:**	J.E.

Laboratory Hydrometer — Sample No.: W611

Sample Information

Date: 19-Nov-24 **By:** E.L. **of:** Envirowest **Type:** Pail / Bag

Location: Richards, Project No. 43070, BH101-01 **Specification:** ASTM D 422

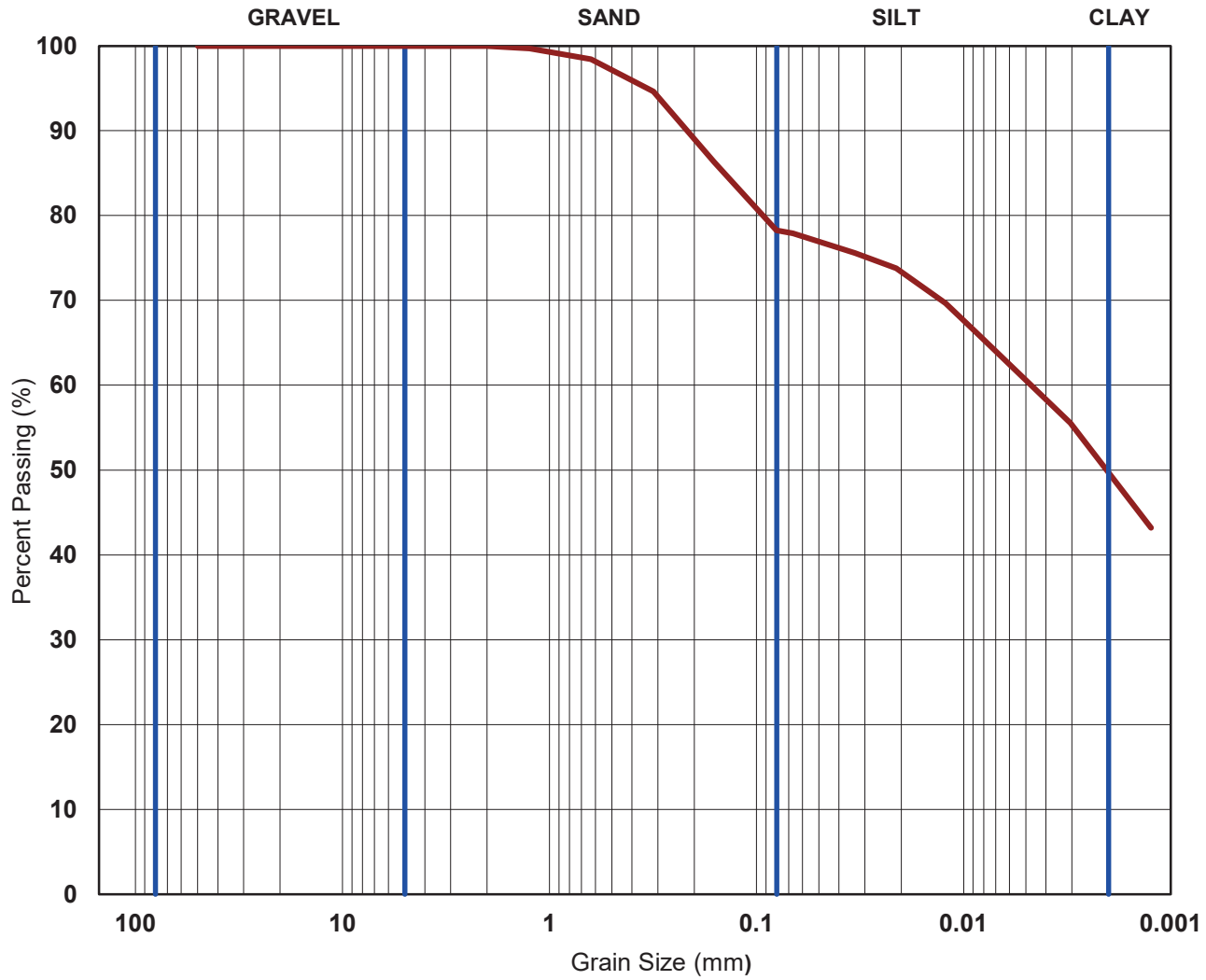
Description: Clay, silty, sandy

Specifications: Laboratory Specifications as per ASTM D 422.

Comments:

Sieve Results:

By Type (%): Gravel = **0.0** Sand = **21.7** Silt = **29.9** Clay = **48.4**



Union Street Geotechnical

CLIENT:	Envirowest Engineering	**FILE No.:**	USG2017
PROJECT:	2024 Materials Testing	**DATE:**	28-Nov-24
LOCATION:	Red Deer, Alberta	**TECH:**	G.S.

Laboratory Hydrometer — Sample No.: W612

Sample Information

Date: 19-Nov-24 **By:** E.L. **of:** Envirowest **Type:** Pail / Bag

Location: Richards, Project No. 43070, BH02-01 **Specification:** ASTM D 422

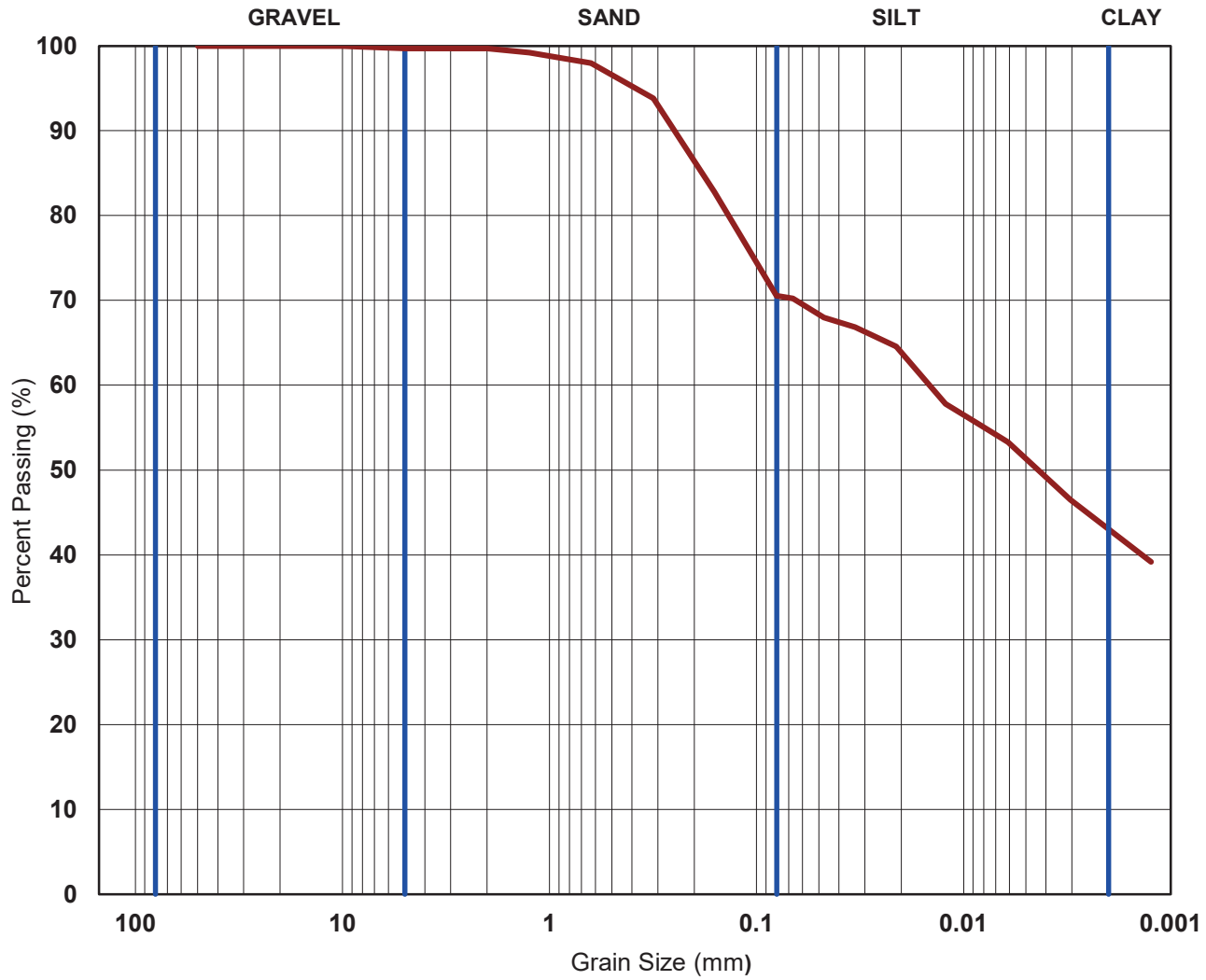
Description: Clay, sandy, silty, gravel inclusions

Specifications: Laboratory Specifications as per ASTM D 422.

Comments:

Sieve Results:

By Type (%): Gravel = **0.3** Sand = **29.1** Silt = **28.4** Clay = **42.2**



Union Street Geotechnical

CLIENT:	Envirowest Engineering	**FILE No.:**	USG2017
PROJECT:	2024 Materials Testing	**DATE:**	28-Nov-24
LOCATION:	Red Deer, Alberta	**TECH:**	G.S.