Technical Document LA25043

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	Application number	Legal land description
☐ Approval ☐ Registration ☒ Authorization ☐ Amendment	LA25043	Sec. 28-20-17 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.

August 29/25
Date of signing

[redacted]
Signature

1717868 AB Inc. (o/a Anchor J Ranches)
Corporate name (if applicable)

Greg Johnson
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)
enlarge existing catch basin (CB 1)	irregular dimensions Depth 3m See pages 2 and 16 final volume: 37,376 m^3

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

Existing facilities	Dimensions (m) (length, width, and depth)	NRCB USE ONLY
feedlot pens	212 m x 682 m + 216 m x 71 m ~~+ 176 m x 329 m~~ irregular shape	confirmed

NRCB USE ONLY

There are also tow interconnected catch basins along the south side of the feedlot pens to the south. Width 8 m. Catch basin 2 (east) is 112 m long, catch basin 3 is 156 m long. The area to the southwest is used as a runoff control catchment area. The dimensions of the area including depth are irregular.

Legend
N
500 m
CB
Catch basin 1
proposed to
be deepened
existing feedlot pens
catch basin 2
catch basin 3
Lathom Lake
Not
considered
to be a
common
body of water
Catchment
area
Untitled Map
Write a description for your map.
Google Earth
Image © 2025 Airbus

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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 _____

Additional information

AO comment: The applicant would like to start construction as soon as possible.

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**
Not determined in conjunction with this permit. Please see Decision Summary LA25043 for more details			

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

DECLARATION AND ACKNOWLEDGMENT OF APPLICANT CONCERNING *WATER ACT* LICENCE

issued by Alberta Environment and Protected Areas (EPA) for a confined feeding operation (CFO)

Date and sign one of the following four options

OPTION 1: Applying through the NRCB for both the AOPA permit and the *Water Act* licence

I **DO** want my water licence application coupled to my AOPA permit application.

Signed this _____day of _____, 20____. _____

Signature of Applicant or Agent

OPTION 2: Processing the AOPA permit and *Water Act* licence separately

1. I (we) acknowledge that the CFO will need a new water licence from EPA under the *Water Act* for the development or activity proposed in this AOPA application.
2. 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 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 the *Water Act* licence application.
5. I (we) acknowledge that any such construction or livestock populating 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 licence application number(s) _____

Signed this _____ day of _____, 20____. _____

Signature of Applicant or Agent

OPTION 3: Additional water licence not required

1. I (we) declare that the CFO will not need a new licence from EPA under the *Water Act* for the development or activity proposed in this AOPA application.
2. **Provide**: Water license number(s) or water conveyance agreement details _____

Signed this 29 day of August, 2025 _____

[redacted]

Signature of Applicant or Agent

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 ____ day of _____, 20____. _____

Signature of Applicant or Agent

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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: catch basin **Proposed 1:** _____

Proposed 2: _____ **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 in known floodplain
Surface water information	How many springs are within 100 m of the manure storage facility or manure collection area?	none				☒ YES ☐ NO ☐ YES with exemption	None observed during site visit
	How many water wells are within 100 m of the manure storage facility or manure collection area?	none				☒ YES ☐ NO ☐ YES with exemption	None observed during site visit
	What is the shortest distance from the manure collection or storage facility to a surface water body? (e.g., lake, creek, slough, seasonal)					☒ YES ☐ NO ☐ YES with exemption	18 m from existing pens to Lathom Lake
Groundwater information	What is the depth to the water table?					☐ YES ☐ NO ☒ YES with exemption	Between 1-2 m in catch basin area (see report)
	What is the depth to the groundwater resource/aquifer you draw water from?	not identified				☒ YES ☐ NO ☐ YES with exemption	No UGR identified in area

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

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NRCB USE ONLY

ENVIRONMENTAL RISK SCREENING INFORMATION

ERST for **proposed** facilities

Facility	Groundwater score	Surface water score	File number
catch basin	low	low	LA25043

ERST for **existing** facilities

Facility	Groundwater score	Surface water score	File number
feedlot pens	low	low	LA25043
catch basins 1-3	low	low	LA25043

ERST related comments:

Lathom Lake is not a common body of water and entirely surrounded by the Anchor J. Ranches land

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NRCB USE ONLY

WATER WELL AND SURFACE WATER INFORMATION

No water wells within a 1 mile radius

Well IDs: _____ _____ _____

_____ _____ _____

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

Groundwater or surface water related comments:

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

Neighbour name(s)	Legal land description	Distance (m)	NRCB USE ONLY: Zoning (LUB) category	MDS category (1-4)	Distance (m)	Waiver attached (if required)	Meets regulations
			AG	1	2056 m		yes
			AG	1	1100 m		yes

SW 29-20-17 2060m
NW 29-20-17 1100m

AG= Agricuture-General District

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

Name of land owner(s)*	Legal land description	Usable area** (ha)	Soil zone ***	NRCB USE ONLY: Usable area (ha)	Agreement attached (if required)
			Total	Not applicable. No increase in manure production	

* 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)

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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:_____ Category 2:_____ Category 3:_____ Category 4:_____

Technology factor: see comment in Decision Summary LA25043 ☐ YES ☐ NO

Expansion factor: ☐ YES ☐ NO

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

The modification of the catch basin does not change the overall footprint of the CFO and does not get closer to any of the neighbouring residences.

LAND BASE FOR MANURE AND COMPOST APPLICATION

Land base required: _____ Not applicable. No increase in annual manure production

Land base listed: _____

Area not suitable: _____

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 _____

See Decision Summary LA25043 for details

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NRCB USE ONLY

ALL SIGNATURES IN FILE ☒ YES ☐ NO

DATES OF APPROVAL OFFICER SITE VISITS

August 28, 2025	

CORRESPONDENCE WITH MUNICIPALITIES AND REFERRAL AGENCIES

Date deeming letters sent: September 12, 2025

Municipality: County of Newell

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

Alberta Health Services: NA

☐ 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: Eastern Irrigation District ☐ 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

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changed to compacted clay liner (see next page)

RUNOFF CONTROL CATCH BASIN: Naturally occurring protective layer

*(complete a copy of this section for **EACH proposed** runoff control catch basin with a naturally occurring protective layer)*

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

1. catch basin increase
2. _____
3. _____

Determination of runoff area

Provide a plan and show how you calculated the area contributing to runoff for each catch basin

See below

Catch basin capacity

	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)
1.			3	3	3:1	3:1	/	
					(as per email Sept 11, 2025)			
							TOTAL CAPACITY	

irregular shape volume: see next page

Layer details

Thickness of naturally occurring protective layer	_____(m)	Provide details (as required) see report attached	
Soil texture	_____% sand	_____% silt	_____% clay
Hydraulic conductivity - naturally occurring protective layer	Depth and type of soil tested	Hydraulic conductivity (cm/s)	Describe test standard used

Catch Basin – Design and management requirements can be found in Technical Guideline Agdex 096-101

If soil info differs per facility include additional soils page.

NRCB USE ONLY

Requirements met: ☐ YES ☐ NO

Condition required: ☐ YES ☐ NO

Report attached: ☐ YES ☐ NO

RUNOFF CONTROL CATCH BASIN: Compacted soil liner

*(complete a copy of this section for **EACH proposed** runoff control catch basin with a compacted soil liner)*

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

same dimensions
average hydraulic conductivity of the compacted soils is between 2.1x10-8 and 2.4x10-8 cm/sec (see report below).

1. catch basin
2. _____
3. _____

(Value before the adjustment for lab conditions)

Determination of runoff area

Provide a plan and show how you calculated the area contributing to runoff for each catch basin

see report and dimensions below. CB of irregular shape

Catch basin capacity

	Length (m)	Width (m)	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)
1.								37,376 m3
2.								
3.								
							TOTAL CAPACITY	37,376 m3

Compacted soil liner details

Thickness of compacted soil liner	_____(m)	Provide details (as required) see report below	
Soil texture	_____% sand	_____% silt	_____% clay
Atterberg limits	Plastic limit _____	Liquid limit _____	Plasticity index _____
Hydraulic conductivity	Hydraulic conductivity (cm/s)		
	Describe test standard used		

Catch Basin – Design and management requirements can be found in Technical Guideline Agdex 096-101

NRCB USE ONLY

Requirements met: ☒ YES ☐ NO

Condition required: ☒ YES ☐ NO

Report attached: ☒ YES ☐ NO

RUNOFF CONTROL CATCH BASIN: Compacted soil liner (cont.)

NRCB USE ONLY

Catch basin calculator (calculation attached). Total volume @ freeboard: 37,376 m^3

Runoff capacity requirements met: See calculation fo dimensions on page 16 below ☒ YES ☐ NO

Calculation of the volume attached: ☒ YES ☐ NO

Depth to water table: see comment below Requirements met: ☐ YES ☒ NO

Depth to Uppermost Groundwater Resource: _____ Requirements met: ☒ YES ☐ NO

No UGR identified in this area

ERST completed: ☒ see ERST page for details

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

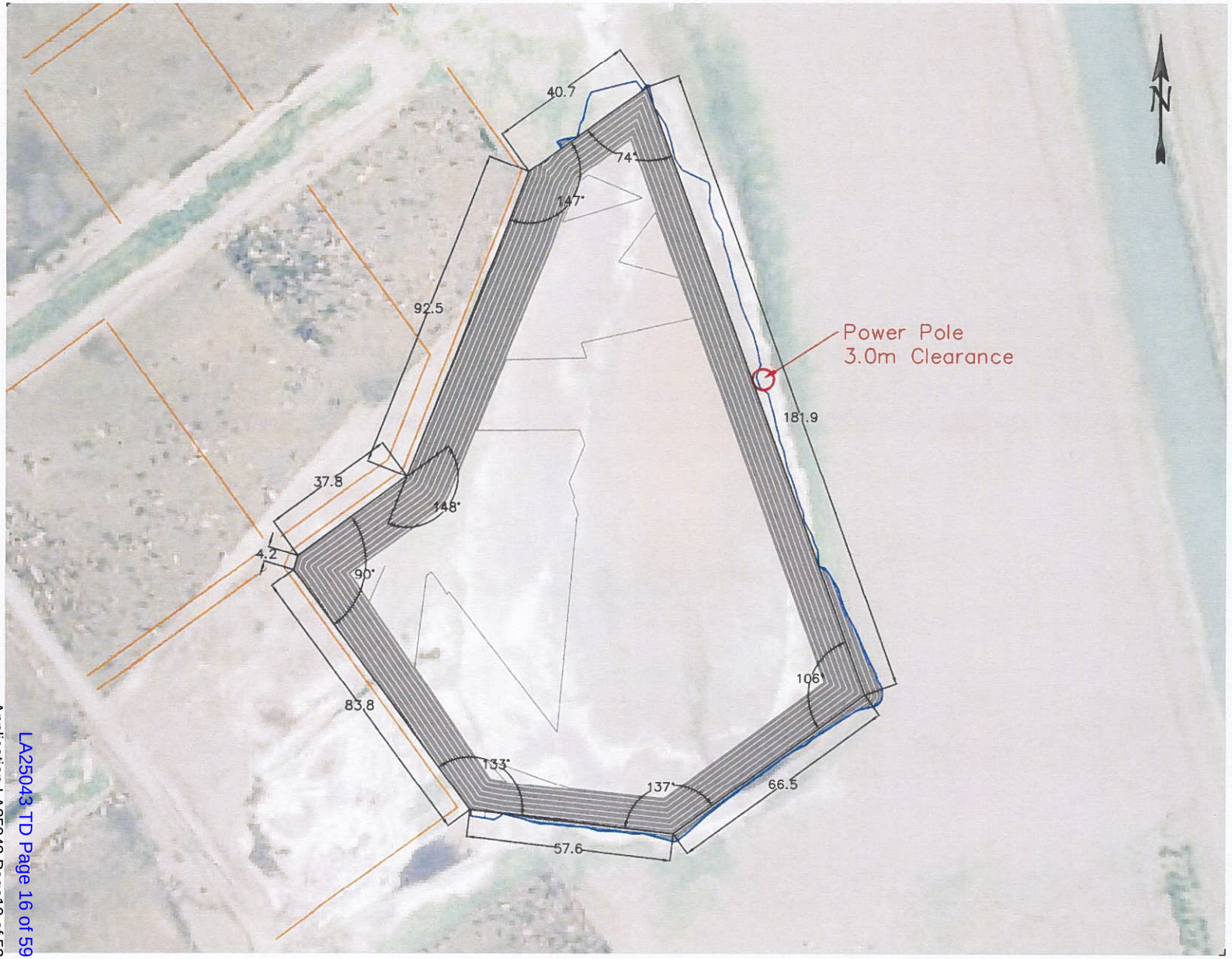
The watertable was recorded to be at 0.5 m in the area of the inlet of the catch basin (borehole 1), but below 6 m (borehole 2) or below drilling depth everywhere else in CB area (boreholes 3-6). It is likely that the shallow water table in this area is caused by recent runoff from the runoff contributing feedlot pens.

Generally, the area has very shallow bedrock (between 3-6 m blg) with a silty-sand clay till overlay in various depths.

The signing engineer proposed a thickness of 1.2 m for the compacted clay liner. The recommendation is based on an equivalency calculation comparing the compacted clay liner with the required hydraulic conductivity of a natural occurring protective layer. This calculation is not required. The requirement for a compacted clay liner for catch basins are 1 m of compacted clay with a hydraulic conductivity of $5x10^{-7}$ cm/sec. Therefore, a thickness of 1 m for the liner is sufficient.

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

NRCB USE ONLY **RUNOFF CONTROL CATCH BASIN CAPACITY SUMMARY (if applicable)**	
Facility 1	
Name / description: catch basin (modified dimensions)	Capacity: 37,376 m^3
Facility 2	
Name / description: catch basin 2 and 3	Capacity: 455 m^3
Facility 3	
Name / description: catchment area	Capacity: approximately 10,000 m^3
Facility 4	
Name / description	Capacity
TOTAL CAPACITY	47,831 m^3
RUNOFF VOLUME FROM CONTRIBUTING AREAS	approximately 14,000m^3
MEETS AOPA RUNOFF CONTROL VOLUME REQUIREMENTS	☒ YES ☐ NO



Notes:

1. Borrow Pond
   - -Irregular shape to facilitate connection to new design, power pole clearance and existing site.
   - -Estimated unsuitable of 1.0m from existing containment removed for earthwork calculations.
   - -Volumes calculated using Civil 3d flat plane at elevation specified and compared to design.
   - -All dimensions Metric Meters
   - -Survey in Nad83 No Trans, UTM Zone 12 North, Geoid HT2_0
   - -Highwater elevation is calculated at lowest invert of entry ditchs.
     - -Elevation 772.70
     - -Volume @ HW 10,127,824 Gal 46,042 m3
   - -Freeboard elevation in calculated 0.50m below Highwater
     - -Elevation 772.20
     - -Volume @ Free 8,221,680 Gal 37,376.50 m3

2. Fencelines
   - -Shown For Clarity

For Discussion Only

Dennis Dirtworx LTD	
Borrow Pond	
Date Sep 2025	Drawn Dan Dyck
Scale NTS	Job # 25-165 REV1

ROSEKE ENGINEERING

GEOTECHNICAL EVALUATION

Sundial Feedlot Expansion
Lathom, AB

Prepared For:
Sundial Livestock Feeders
173049 Highway 1
Lathom, AB T0J 0B0

Prepared By:
Roseke Engineering Ltd.
3614 – 18 Avenue N.
Lethbridge, AB T1H 5S7

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Appendix A – BOREHOLE LOGS

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Appendix D – GENERAL CONSTRUCTION GUIDELINES

1 Introduction

This project consists of the expansion of the existing catch basin and construction of new Roller Compacted Concrete (RCC) livestock pens at the Sundial Livestock Feeders (SLF) feedlot at 28-20-17-W4 near Lathom, AB. At the time of drilling, the site was vacant with some vegetation and was generally sloping north / northeast.

The intent of this geotechnical investigation was to confirm the subsurface conditions at the site in order to provide recommendations for the construction of the RCC livestock pens as well as recommendations for a compacted soil liner for the catch basin expansion, and new livestock pens in the vicinity of BH008 and BH009, in order to satisfy the Natural Resources Conservation Board (NRCB)'s groundwater protection requirements. In discussion with SLF personnel, it was understood that the proposed RCC livestock pens are covered under an existing NRCB permit and, as such, recommendations pertaining to NRCB groundwater protection requirements are limited only to the catch basin expansion and new livestock pens in the vicinity of BH008 and BH009. A site plan, including borehole locations, is included as Appendix B of this report.

2 Scope of Work

The scope of work for this geotechnical evaluation consisted of the drilling of thirteen (13) boreholes, a laboratory testing program to assist in soil classification and determination of engineering properties, hydraulic conductivity testing, and this report which summarizes the recommendations for the proposed expansion.

3 Geotechnical Work

The fieldwork for the geotechnical investigation was performed on July 2nd, 2025, to assess subsurface conditions at the site. A drill rig utilizing a 150 mm solid stem continuous flight auger from Chilako Drilling Services Ltd. of Coaldale, AB was used for drilling operations. Roseke (REL)'s field representative was Mr. Christopher Allard, C.E.T. Boreholes were advanced at select locations within the proposed expansion footprint to depths ranging from 3.1 m to 9.1 m below existing ground surface.

Field operations and sampling were completed under the supervision of REL's field representative. Soil samples were collected at intervals of 0.75 m maximum. The encountered subsurface soils were logged in the field using visual and tactile methods, and samples were placed in labelled plastic bags for transport, laboratory testing, and future reference. Open boreholes were checked for groundwater and general stability prior to backfilling.

BH001, BH006 to BH010, and BH013 were outfitted with a 25 mm diameter polyvinyl chloride (PVC) standpipe in order to determine the static groundwater elevation at the site. BH004 was outfitted with a machine slotted 51 mm PVC monitoring well to conduct field conductivity testing, if required. Monitoring wells were installed with screened sections of 1.5 m for catch basin with the screened sections beginning at the anticipated maximum depth of storage. Laboratory hydraulic conductivity testing was conducted on two (2) remoulded samples taken from cohesive layers in BH002 and BH006 in order to determine the minimum required thickness of a compacted clay liner in order to meet NRCB requirements for catch basin facilities.

Borehole logs summarizing soil and groundwater stratigraphy, conditions, and test information are located in Appendix A.

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3614 – 18th Avenue North
Lethbridge, AB T1H 5S3
www.roseke.com

Physical laboratory testing was performed on the collected soil samples to determine engineering properties of the site's soils. Laboratory testing included moisture content analysis, particle size distribution analysis, standard Proctor testing, and hydraulic conductivity testing (conducted at Solum Consultants Ltd.'s Calgary laboratory). Results are presented on the attached borehole logs in Appendix B.

4 Soil Stratigraphy

It should be noted that geological conditions are innately variable. At the time of preparation of this report, information on subsurface stratigraphy was available only at discrete borehole locations. In order to develop recommendations from this information, it is necessary to make some assumptions concerning conditions other than at the borehole locations. Adequate field reviews should be provided during construction to check that these assumptions are reasonable.

The general subsurface conditions at the site consisted predominantly of an upper layer of sand & silt, underlain by clay till and bedrock in descending order. The following sections provide a summary of the soils encountered in the borehole logs. The subsurface conditions encountered are summarized in the attached borehole logs in Appendix A.

4.1 Topsoil

A layer of topsoil was encountered at the surface in BH007 and BH011 and was approximately 100 mm in thickness.

4.2 Sand & Silt

An upper layer of sand & silt was encountered in all boreholes and ranged to depths of approximately 1.5 m to 4.6 m below existing ground surface. The sand & silt was described as clayey to containing some clay and was loose, moist to saturated, fine to medium grained, and ranged in colour from light brown to grey. The moisture content of the sand & silt layer ranged from 6.1% to 26.2%.

4.3 Clay Till

Clay till was encountered beneath the sand & silt layer in all boreholes, except for BH012, and was present to depths of approximately 3.3 m to 6.7 m below existing ground surface. The clay till was described as silty with some sand, and a trace of gravel and was firm to hard, very moist, low to medium plastic, and ranged in colour from olive, olive brown, to grey. White precipitates, oxide staining, and coal specks were noted throughout the clay till. The moisture content of the clay layer ranged from 11.1% to 27.4%.

4.4 Bedrock

Bedrock was encountered below the clay till in BH001 through BH006 and was present to the maximum depth drilled. The bedrock was described as mudstone and was weak, friable, damp, and grey. The moisture content of the bedrock layer ranged from 7.8% to 20.3%.

5 Groundwater Conditions

At the time of drilling, some sloughing and/or seepage was encountered in each borehole. The depth to groundwater was measured by REL personnel on August 7th, 2025. The following table summarizes the groundwater monitoring data.

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Borehole ID	Depth of Standpipe Below Ground Surface (m)	Depth to Groundwater from Ground Surface (m)
BH001	9.15	0.50
BH006	7.93	Destroyed
BH007	3.05	0.52
BH008	3.05	0.72
BH009	3.05	1.60
BH010	3.05	Inaccessible
BH013	3.51	Destroyed

It appears that shallow groundwater is likely to impact the expansion of the catch basin and that dewatering during construction will be required. It should be noted that soil moisture and groundwater levels at the site may fluctuate in response to climatic events. Given the unseasonably heavy and frequent rain events encountered during the months both prior to and after field drilling activities, temporarily elevated groundwater levels may also be a contributor to the shallow groundwater levels encountered. Groundwater levels should be monitored prior to development. The intent is to confirm the presence of shallow groundwater and provide an early indication of dewatering requirements.

6 Recommendations

The following recommendations are based on borehole information and are intended to assist designers. Recommendations should not be construed as providing instructions to contractors, who should form their own opinions about site conditions. It is possible that subsurface conditions beyond the borehole locations may vary from those observed. If significant variations are found before or during construction, REL should be contacted so that we can reassess our findings, if necessary.

During the course of groundwater monitoring, shallow groundwater was encountered throughout the site that may impact the construction of the catch basin expansion. Per NRCB's requirements, a 1 m vertical separation must be maintained from groundwater during construction. Therefore, it is recommended to monitor the depths to ground water in the remaining standpipes in order to ensure this separation is maintained. If this required groundwater separation cannot be maintained, alternatives may need to be considered for construction and additional advice should be sought. Some potential alternatives are as follows; 1) raising the maximum depth of storage of the catch basin, 2) carrying out construction activities during seasons of low groundwater elevation, 3) obtaining a variance from NRCB permitting construction activities within 1 m of groundwater, though it should be noted these variances are not commonly granted.

All recommendations presented in this report are based on the assumption that an adequate level of monitoring will be provided during construction and that all construction will be carried out by suitably qualified contractors, experienced in earthworks construction. An adequate level of monitoring is considered to be:

- For earthworks, full-time monitoring and compaction testing.

All such monitoring should be carried out by suitably qualified persons, independent of the contractor. One of the purposes of providing an adequate level of monitoring is to check those recommendations, based on information collected at discrete borehole locations, are applicable to other areas of the site.

6.1 Trench Excavations

Excavations should be carried out in accordance with the Alberta Occupational Health and Safety (OH&S) Regulations. For this project, the depth for the majority of the excavations is assumed to be less than 3.0 m below existing ground surface. Excavations to deeper depths may require special considerations. The following recommendations notwithstanding, the responsibility of trench and all excavation cutslopes resides with the Contractor and should take into consideration site-specific conditions concerning soil stratigraphy and groundwater. All excavations should be reviewed by a geotechnical engineer prior to personnel working within the base of the excavation.

Temporary excavations within the loose sand & silt soils which are to be deeper than 1.5 m should have the sides shored and braced or the slopes should be cut back no steeper than 1.0 horizontal to 1.0 vertical (1H:1V) from the bottom of the excavation.

Flatter sideslopes may be required in some areas if groundwater is encountered. In these instances, the excavation configuration design should be reviewed by experienced personnel, prior to allowing personnel to enter the base of the excavation.

Any encountered groundwater seepage should be directed towards sumps for removal. Conventional construction sump pumps should be capable of groundwater control.

Temporary surcharge loads, such as spill piles, should not be allowed within a distance equal to the depth of the excavation from an unsupported excavation face or 3.0 m, whichever is greater, while mobile equipment should be kept back at least 3.0 m. All excavation sideslopes should be checked regularly for signs of sloughing, especially after rainfall periods. Small earth falls from the sideslopes are a potential source of danger to workmen and must be guarded against.

6.2 RCC Livestock Pens

6.2.1 Frost Susceptible Soil

The near-surface sand & silt soils noted throughout the site are considered to be highly frost susceptible. These soils are location within the frost zone and as such may be subject to frost heave. Therefore, uniformity of moisture conditioning and compaction as well as material depths will be crucial to minimize damaging frost heave that may affect the RCC livestock pen floor.

6.2.2 Subgrade Preparation and RCC Pen Construction

For RCC construction the upper 300 mm of the sand & silt soils should be scarified and uniformly moisture conditioned to 0% to +2% of Optimum Moisture Content (OMC). The subgrade should then be uniformly compacted to a minimum of 98% Standard Proctor Maximum Dry Density (SPMDD). Efforts should be made to achieve compaction by way of static rolling. Due to the sandy and silty nature of the subgrade soils, vibratory compaction equipment is likely to have a “pumping” effect on the shallow groundwater, potentially resulting in excessive wetting of subgrade soils and overall difficulty achieving the required moisture condition and compaction standards.

Considering the presence of sandy & silty near-surface soils and shallow groundwater throughout the area, a granular base course (GBC) of well-graded, clean crushed gravel at least 300 mm in thickness is recommended in order to

provide a competent base for the placement and compaction of RCC surfacing. The GBC should be placed in uniform lifts not exceeding 150 mm in compacted thickness and compacted to a minimum of 98% SPMDD. Where possible, compaction should be achieved by static rolling so as not to undermine the subgrade soils, as discussed previously.

Proof rolling should also be conducted on subgrade and granular base to identify soft spots along the alignment prior to the placement of RCC. If problematic soft spots are encountered, additional geotechnical advice may be necessary and should be sought. Based on the high moisture content results of the in-situ subgrade soils, apparent shallow groundwater table, and based REL's experience with local soils, a provision for a non-woven geotextile should be included.

6.3 Groundwater Protection Recommendations

6.3.1 Hydraulic Conductivity Testing

Composite samples from clay till layer in both BH002 and BH006 were tested for particle size analysis and hydraulic conductivity (ASTM D5084) as per section 4 of the NRCB's *Technical Guidelines Agdex 096-64* (Agdex 096-64). Particle size analyses were conducted at Down To Earth Labs Inc.'s Lethbridge laboratory and indicated a soil texture of loam to silty clay. Hydraulic conductivity testing was conducted by Solum Consultants Ltd.'s Calgary laboratory and indicated a hydraulic conductivity of 2.1×10^{-8} cm/s and 2.4×10^{-8} cm/s at 95% SPMDD for the samples from BH002 and BH006, respectively. As per Agdex 096-64, the most conservative (highest) of the hydraulic conductivity results is to be compared to regulations and, additionally, the design hydraulic conductivity (K_L) to be used in the calculation of the equivalent liner thickness is to be increased one order of magnitude in order to account for innate soil variability and what is achievable in-field. Therefore, a K_L value of 2.4×10^{-7} cm/s was determined for the clay till (loam to silty clay) borrow material.

6.3.2 Groundwater Protection Recommendations

The NRCB's *Technical Guideline Agdex 096-61* (Agdex 096-61)'s methodology was used to determine the required minimum thickness of the compacted soil layer in order to meet the minimum thickness and hydraulic conductivity requirements specified in the regulation of 5 m of material @ 1.0×10^{-6} cm/s for catch basins and 2 m of material @ 1.0×10^{-6} cm/s for solid manure storage facilities. The formula used to determine the minimum thickness of the compacted clay liner is as follows:

$$\frac{b_{req.}}{K_{req.}} = \frac{b_L}{K_L}$$

Where: $b_{req.}$ = required equivalent thickness (5 m for catch basins and 2 m for solid manure storage facilities)
$K_{req.}$ = required minimum hydraulic conductivity (1×10^{-6} cm/s)
b_L = required minimum thickness of compacted clay liner (m)
K_L = design hydraulic conductivity of compacted clay liner (2.4×10^{-7} cm/s)

Based on the in-situ hydraulic conductivity test results, laboratory test results, and the formula described in Agdex 096-61, it is determined that the minimum required thickness of a compacted clay liner is 1.2 m in thickness for the catch basin expansion in order to meet AOPA protective layer requirements. For the new livestock pens in the vicinity of BH008 and BH009, the minimum required compact clay liner of 0.5 m, per NRCB guidelines, will provide sufficient protection.

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If alternate borrow sources are desired, REL should be contacted in order to determine if the above recommendations are applicable and to conduct additional testing, if required.

6.3.3 Catch Basin Design & Construction

General recommendations are provided for the construction of the proposed ponds.

The low to medium clay till is considered suitable to use as a borrow material for a compacted clay liner and meets AOPA requirements. It is considered acceptable to reuse other materials, if encountered, for berm construction provided that the minimum thickness of compacted clay liner is maintained on the inside face of the ponds.

At all times, clay liner material should be visually inspected during placement to isolate any inclusions of silt or sand material which should be separated and removed from the compacted clay liner area.

The compacted clay liner should extend across the catch basin bases, as well as up the sideslopes for this development maintaining the minimum required thickness on the catch basin bottom and a thickness of 1.4 m on the sideslopes to allow for weathering, variations in actual thickness, and pockets of poor-quality material. The interior slopes should be no steeper than 3 horizontal to 1 vertical (3:1). The exterior slopes of the berms may range from 2.5:1 to 4:1.

Further recommendations regarding shallow foundations are presented in Appendix D.

All surficial vegetation, topsoil, and any organic material within the proposed catch basin areas should be stripped and removed. Following this removal, the area may be graded for catch basin construction.

Final design of this project should consider, in detail, the subgrade preparation of the proposed catch basins so that the base of the catch basin liner is founded on competent materials. A minimum 300 mm subgrade preparation should be conducted prior to installation of compacted clay liner, including scarifying the subgrade soil, moisture conditioning, and recompacting to a minimum of 95% of SPMDD with moisture content within 0% to +2% of OMC. Approved liner material should be used for the compacted clay liner, placed in lifts of no greater than 150 mm compacted thickness, uniformly mixed, and compacted to the above-noted compaction standards. The subgrade surface below the compacted clay liner should be relatively level to control liner thickness, and proof-rolled to provide a proper base for compacting the first liner lift to the specified density. General recommendations for compaction can be found in Appendix D. Proof-rolling should be supervised by experienced geotechnical personnel, specific requirements and methods for proof-rolling should be prepared during construction in consultation with REL.

As discussed above, any excavated silty / sandy material not suitable as a liner may be used for the core and outer shell of the berms.

A remoulded clay liner should be constructed by placing controlled local clay soils up to the design elevation or thickness on the bottom of the catch basins and interior slopes of the berms. The clay liner soils should be uniformly moisture conditioned to the compaction standards noted above. At the completion of compaction, at final design grade, the base should be proof-rolled using a relatively large smooth-drum roller. This smooth rolled surface provides a much smoother base, which greatly reduces the surface area for water absorption and swelling.

In areas where an interior clay liner is being placed on an existing slope, it is important to specify that a system of 'notching' the existing subgrade be implemented. This notching technique ensures a good bond between the clay liner and adjacent material to minimize the risk of developing a failure plane parallel to the interior slope face.

It is recommended to fill the catch basins as soon as possible following completion of construction to prevent excessive drying and cracking of the clay liner. It is recommended to develop a construction Quality Assurance Control Plan (QACP) before construction, such that construction quality is monitored and maintained throughout the construction process and to demonstrate that the compacted clay liner met the minimum moisture condition / compaction requirements.

6.3.4 New Livestock Pen Construction

For the construction of the new livestock pens in the vicinity of BH008 and BH009, all surficial vegetation, topsoil, and any organic material should be stripped and removed. Following the stripping and removal, a proof-roll should be conducted on undisturbed native soil to ensure a competent base for the compacted clay liner. The approved liner material should be used for the compacted clay liner, placed in lifts of no greater than 150 mm compacted thickness, uniformly mixed, and compacted to at least 95% SPMDD at 0% to +2% OMC. The subgrade surface below the compacted clay liner should be relatively level to control liner thickness, and proof-rolled to provide a proper base for compacting the first liner lift to the specified density.

6.3.5 Liner Materials and Compaction

Impervious liner material should consist of low to medium plastic clay soils not containing organics or deleterious materials and should be compacted to the compaction standards noted in Section 6.3.3. Further requirements for select engineered fill can be found in Appendix D.

The low to medium plastic clay till encountered in the proposed catch basin expansion area is generally considered suitable for use as general engineered fill. It should be free of organic and deleterious material. As noted above, if alternate borrow sources are desired, REL should be contacted in order to confirm material suitability for use as a compacted soil liner.

Backfill density testing should be utilized to ensure the backfill compaction and moisture is sufficient wherever backfill is placed.

6.4 Estimated Shrinkage Factors

Based on the results of standard Proctor testing and in-situ density test results, the estimated shrinkage of the site soils ranged from 6.0% to 10.2% and averaged 7.2%. However, at the time of the field density testing, a lack of mechanical excavation equipment presented difficulties in advancing test pits deep enough for ideal density testing conditions. The site's subsoils are anticipated to increase in density somewhat as depth increases. Therefore, a shrinkage factor in the range of 7% to 8% is recommended. This shrinkage factor is considered appropriate for design purposes but should be confirmed during construction with field density testing.

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7 Closure

We trust that this report meets your current requirements, and we are pleased to provide assistance in the completion of this project. Please do not hesitate to contact me if you have any comments, questions, or concerns.

Respectfully submitted by:

[redacted]

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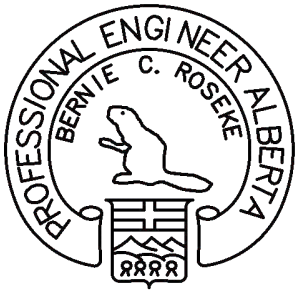

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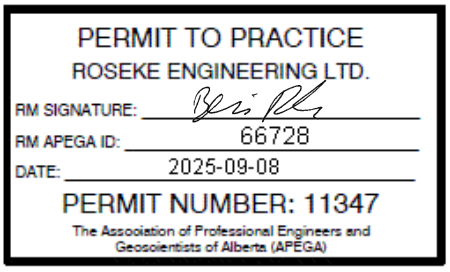

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Appendix A – BOREHOLE LOGS

TERMS USED ON BOREHOLE LOGS

TERMS DESCRIBING CONSISTENCY OR CONDITION

COARSE GRAINED SOILS (major portion retained on 0.075mm sieve): Includes (1) clean gravels and sands, and (2) silty or clayey gravels and sands. Condition is rated according to relative density, as inferred from laboratory or in situ tests.

DESCRIPTIVE TERM	RELATIVE DENSITY	N (blows per 0.3m)
Very Loose	0 TO 20%	0 to 4
Loose	20 TO 40%	4 to 10
Compact	40 TO 75%	10 to 30
Dense	75 TO 90%	30 to 50
Very Dense	90 TO 100%	greater than 50

The number of blows, N, on a 51mm O.D. split spoon sampler of a 63.5kg weight falling 0.76m, required to drive the sampler a distance of 0.3m from 0.15m to 0.45m.

FINE GRAINED SOILS (major portion passing 0.075mm sieve): Includes (1) inorganic and organic silts and clays, (2) gravelly, sandy, or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength, as estimated from laboratory or in situ tests.

DESCRIPTIVE TERM	UNCONFINED COMPRESSIVE STRENGTH (KPA)
Very Soft	Less than 25
Soft	25 to 50
Firm	50 to 100
Stiff	100 to 200
Very Stiff	200 to 400
Hard	Greater than 400

NOTE: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above, because of planes of weakness or cracks in the soil.

GENERAL DESCRIPTIVE TERMS

Slickensided - having inclined planes of weakness that are slick and glossy in appearance.
Fissured - containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical.
Laminated - composed of thin layers of varying colour and texture.
Interbedded - composed of alternate layers of different soil types.
Calcareous - containing appreciable quantities of calcium carbonate.;
Well graded - having wide range in grain sizes and substantial amounts of intermediate particle sizes.
Poorly graded - predominantly of one grain size, or having a range of sizes with some intermediate size missing.

MODIFIED UNIFIED SOIL CLASSIFICATION

MAJOR DIVISION			GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE-GRAINED SOILS More than 50% retained on 75 µm sieve*	GRAVELS 50% or more of coarse fraction retained on 4.75 mm sieve	CLEAN GRAVELS	GW	Well-graded gravels and gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines
		GRAVELS WITH FINES	GM	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	SANDS More than 50% of coarse fraction passes 4.75 mm sieve	CLEAN SANDS	SW	Well-graded sands and gravelly sands, little or no fines
			SP	Poorly graded sands and gravelly sands, little or no fines
		SANDS WITH FINES	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (by behavior) 50% or more passes 75 µm sieve*	SILTS Liquid limit <50		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands of slight plasticity
	SILTS Liquid limit >50		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
	CLAYS Above "A" line on plasticity chart negligible organic content Liquid limit <30		CL	Inorganic clays of low plasticity, gravelly clays, sandy clays, silty clays, lean clays
	CLAYS Above "A" line on plasticity chart negligible organic content Liquid limit 30-50		CI	Inorganic clays of medium plasticity, silty clays
	CLAYS Above "A" line on plasticity chart negligible organic content Liquid limit >50		CH	Inorganic clays of high plasticity, fat clays
	ORGANIC SILTS AND CLAYS Liquid limit <50		OL	Organic silts and organic silty clays of low plasticity
	ORGANIC SILTS AND CLAYS Liquid limit >50		OH	Organic clays of medium to high plasticity
HIGHLY ORGANIC SOILS			PT	Peat and other highly organic soils

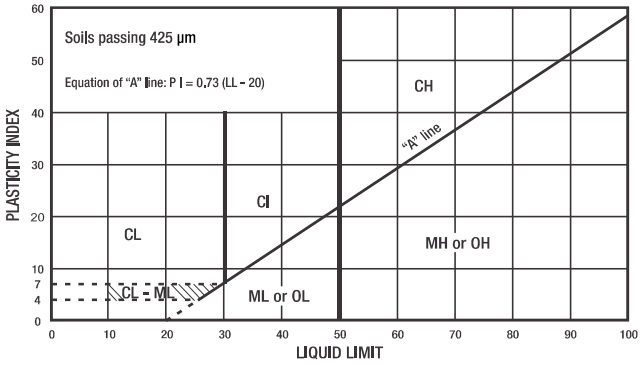
LABORATORY CLASSIFICATION CRITERIA

Classification on basis of percentage of fines

GW, GP, SW, SP GM, GC, SM, SC Borderline Classification requiring use of dual symbols	$C_U = D_{60} / D_{10}$ Greater than 4 $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3	
	Not meeting both criteria for GW	
	Atterberg limits plot below "A" line or plasticity index less than 4	Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols
	Atterberg limits plot above "A" line or plasticity index greater than 7	
Less than 5% Pass 75 µsieve More than 12% Pass 75 µsieve 5% to 12% Pass 75 µm sieve	$C_U = D_{60}/D_{10}$ Greater than 6 $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3	
	Not meeting both criteria for SW	
	Atterberg limits plot below "A" line or plasticity index less than 4	Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols
	Atterberg limits plot above "A" line or plasticity index greater than 7	

For classification of fine-grained soils and fine fraction of coarse-grained soils.

PLASTICITY CHART



*Based on the material passing the 75 mm sieve
Reference: ASTM Designation D2487, for identification procedure see D2488. USC as modified by PFRA

SOIL COMPONENTS

FRACTION	SIEVE SIZE PASSING	SIEVE SIZE RETAINED	DEFINING RANGES OF PERCENTAGE BY MASS OF MINOR COMPONENTS PERCENTAGE	DESCRIPTOR
GRAVEL				
coarse	75 mm	19 mm	>35 %	"and"
fine	19 mm	4.75 mm	21 to 35 %	"y-adjective"
SAND				
coarse	4.75 mm	2.00 mm	10 to 20 %	"some"
medium	2.00 mm	425 µm		
fine	425 µm	75 µm	>0 to 10 %	"trace"
SILT (non plastic) or CLAY (plastic)	75 µm		as above but by behavior	

OVERSIZE MATERIAL

Rounded or subrounded

COBBLES	75 mm to 300 mm
BOULDERS	> 300 mm

Not rounded

ROCK FRAGMENTS	>75 mm
ROCKS	> 0.76 cubic metre in volume

Project: Feedlot and Catch Basin Expansion		BOREHOLE NO: **BH001**
Client: Sundial Livestock Feeders		PROJECT NO: REL253037
	Solid Stem Auger	ELEVATION:

SAMPLE TYPE: SHELBY TUBE | CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m) Water Level	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	BLOWS /150 mm
0		Silt & Sand - clayey to some clay, loose, very moist, fine to medium grained, brown		B1	
1				B2	
2				B3	
3		Clay Till - silty, some sand, trace gravel, stiff, very moist, low to medium plastic, olive brown, coal inclusions and oxide stains		B4	
4				B5	
		Bedrock (mudstone) - damp, friable, grey		B6	
5				B7	
6				B8	
7				B9	
				B10	
8				B11	
9				B12	
		End of borehole at 9.15 m, some sloughing & seepage. Standpipe installed to 9.15 m.			
10					
11					
12					
13					
14					

PLASTIC — M.C. — LIQUID
20 40 60 80

▲ VANE SHEAR (kPa) ▲
100 200 300 400

■ N-VALUE ■
20 40 60 80

◆ UNCONF. SHEAR STR. (kPa) ◆
50 100 150 200

● POCKETPEN. (kPa) ●
100 200 300 400

OTHER DATA

SLOTTED PIEZOMETER

Elevation (m)

LOGGED BY: CA	COMPLETION DEPTH: 9.14 m
REVIEWED BY: BR	COMPLETION DATE: 25-7-2

AB TRANS BOREHOLE LOG SUNDIAL FEEDERS.GPJ AB_TRANS.GDT 25-9-4

Project: Feedlot and Catch Basin Expansion		BOREHOLE NO: **BH002**
Client: Sundial Livestock Feeders		PROJECT NO: REL253037
	Solid Stem Auger	ELEVATION:

SAMPLE TYPE ■ SHELBY TUBE ◪ CORE SAMPLE ☒ SPT SAMPLE ▤ GRAB SAMPLE ▥ NO RECOVERY

Depth (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	BLOWS /150 mm	PLASTIC M.C. LIQUID (20 40 60 80)	▲VANE SHEAR (kPa)▲ (100 200 300 400) ■N-VALUE■ (20 40 60 80) ◆UNCONF. SHEAR STR. (kPa)◆ (50 100 150 200) ●POCKETPEN. (kPa)● (100 200 300 400)	OTHER DATA	Elevation (m)
0		Silt & Sand - clayey to some clay, loose, moist, fine to medium grained, brown		B1					
1									
				B2					
2				B3					
		- grey, wet							
3				B4					
				B5					
4		Clay Till - silty, some sand, trace gravel, stiff, very moist, low to medium plastic, grey, coal inclusions and oxide stains		B6					
5				B7					
6		- freewater							
		Bedrock (mudstone) - damp, friable, grey		B8					
7				B9					
8				B10					
9				B11					
		End of borehole at 9.15 m, some sloughing & seepage. No standpipe installed.							
10									
11									
12									
13									
14									

LOGGED BY: CA	COMPLETION DEPTH: 9.14 m
REVIEWED BY: BR	COMPLETION DATE: 25-7-2

AB TRANS BOREHOLE LOG SUNDIAL FEEDERS.GPJ AB_TRANS.GDT 25-9-4

Project: Feedlot and Catch Basin Expansion		BOREHOLE NO: **BH003**
Client: Sundial Livestock Feeders		PROJECT NO: REL253037
	Solid Stem Auger	ELEVATION:

SAMPLE TYPE ■ SHELBY TUBE ◪ CORE SAMPLE ☒ SPT SAMPLE ▤ GRAB SAMPLE ▥ NO RECOVERY

Depth (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	BLOWS /150 mm	PLASTIC M.C. LIQUID (20 40 60 80)	▲VANE SHEAR (kPa)▲ (100 200 300 400) ■N-VALUE■ (20 40 60 80) ◆UNCONF. SHEAR STR. (kPa)◆ (50 100 150 200) ●POCKETPEN. (kPa)● (100 200 300 400)	OTHER DATA	Elevation (m)
0		Silt & Sand - clayey to some clay, loose, moist, fine to medium grained, brown		B1					
1				B2					
2				B3					
3				B4					
4		Clay Till - silty, some sand, trace gravel, firm to stiff, very moist, medium plastic, grey, coal inclusions and oxide stains		B5					
				B6					
5				B7					
6				B8					
7		Bedrock (mudstone) - damp, friable, grey		B9					
				B10					
8				B11					
9				B12					
		End of borehole at 9.15 m, some sloughing & seepage. No standpipe installed.							
10									
11									
12									
13									
14									

LOGGED BY: CA	COMPLETION DEPTH: 9.14 m
REVIEWED BY: BR	COMPLETION DATE: 25-7-2

AB TRANS BOREHOLE LOG SUNDIAL FEEDERS.GPJ AB_TRANS.GDT 25-9-4

Project: Feedlot and Catch Basin Expansion		BOREHOLE NO: **BH004**
Client: Sundial Livestock Feeders		PROJECT NO: REL253037
	Solid Stem Auger	ELEVATION:

SAMPLE TYPE: SHELBY TUBE | CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	BLOWS /150 mm
0		Silt & Sand - clayey to some clay, loose, moist, fine to medium grained, brown		B1	
1		- light brown		B2	
2				B3	
3		Clay Till - silty, some sand, trace gravel, stiff, very moist, low to medium plastic, grey, coal inclusions and oxide stains		B4	
4				B5	
5				B6	
6				B7	
7		Bedrock (mudstone) - damp, friable, grey		B8	
8				B9	
9				B10	
10		End of borehole at 9.15 m, some sloughing & seepage. Monitoring well installed to 8.23 m.		B11	
11				B12	
12					
13					
14					

PLASTIC — M.C. — LIQUID (20 40 60 80)

▲ VANE SHEAR (kPa) ▲ (100 200 300 400)

■ N-VALUE ■ (20 40 60 80)

◆ UNCONF. SHEAR STR. (kPa) ◆ (50 100 150 200)

● POCKETPEN. (kPa) ● (100 200 300 400)

OTHER DATA

WELL INSTALLATION

Elevation (m)

LOGGED BY: CA	COMPLETION DEPTH: 9.14 m
REVIEWED BY: BR	COMPLETION DATE: 25-7-2

AB TRANS BOREHOLE LOG SUNDIAL FEEDERS.GPJ AB_TRANS.GDT 25-9-4

Project: Feedlot and Catch Basin Expansion		BOREHOLE NO: **BH005**
Client: Sundial Livestock Feeders		PROJECT NO: REL253037
	Solid Stem Auger	ELEVATION:

SAMPLE TYPE ■ SHELBY TUBE ◪ CORE SAMPLE ☒ SPT SAMPLE ▤ GRAB SAMPLE ▥ NO RECOVERY

Depth (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	BLOWS /150 mm	PLASTIC M.C. LIQUID (20 40 60 80)	▲VANE SHEAR (kPa)▲ (100 200 300 400) ■N-VALUE■ (20 40 60 80) ◆UNCONF. SHEAR STR. (kPa)◆ (50 100 150 200) ●POCKETPEN. (kPa)● (100 200 300 400)	OTHER DATA	Elevation (m)
0		Silt & Sand - clayey to some clay, loose, moist, fine to medium grained, brown		B1					
1		- light brown		B2					
2		Clay Till - silty, some sand, trace gravel, very moist, low to medium plastic, grey, coal inclusions and oxide stains		B3					
3				B4					
4		Bedrock (mudstone) - damp, friable, grey		B5					
5				B6					
6				B7					
7				B8					
8				B9					
9				B10					
10				B11					
11				B12					
12		End of borehole at 9.15 m, some sloughing & seepage. No standpipe installed.							
13									
14									

LOGGED BY: CA	COMPLETION DEPTH: 9.14 m
REVIEWED BY: BR	COMPLETION DATE: 25-7-2

AB TRANS BOREHOLE LOG SUNDIAL FEEDERS.GPJ AB_TRANS.GDT 25-9-4

Project: Feedlot and Catch Basin Expansion		BOREHOLE NO: **BH006**
Client: Sundial Livestock Feeders		PROJECT NO: REL253037
	Solid Stem Auger	ELEVATION:

SAMPLE TYPE: SHELBY TUBE | CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	BLOWS /150 mm
0		Silt & Sand - clayey to some clay, loose, moist, fine to medium grained, brown		B1	
1					
				B2	
2		Clay Till - silty, some sand, trace gravel, stiff, very moist, low to medium plastic, grey, coal inclusions and oxide stains			
				B3	
3					
		Bedrock (mudstone) - damp, friable, grey		B4	
4					
				B5	
5					
				B6	
6					
				B7	
7					
				B8	
8		Practical auger refusal at 7.93 m, some sloughing & seepage. Standpipe installed to 7.93 m. Standpipe was destroyed and unlocatable during groundwater monitoring.		B9	
9					
10					
11					
12					
13					
14					

PLASTIC — M.C. — LIQUID (20 40 60 80)

▲ VANE SHEAR (kPa) ▲ (100 200 300 400)

■ N-VALUE ■ (20 40 60 80)

◆ UNCONF. SHEAR STR. (kPa) ◆ (50 100 150 200)

● POCKETPEN. (kPa) ● (100 200 300 400)

OTHER DATA

SLOTTED PIEZOMETER

Elevation (m)

LOGGED BY: CA	COMPLETION DEPTH: 7.92 m
REVIEWED BY: BR	COMPLETION DATE: 25-7-2

AB TRANS BOREHOLE LOG SUNDIAL FEEDERS.GPJ AB_TRANS.GDT 25-9-4

Project: Feedlot and Catch Basin Expansion		BOREHOLE NO: **BH007**
Client: Sundial Livestock Feeders		PROJECT NO: REL253037
	Solid Stem Auger	ELEVATION:

SAMPLE TYPE: SHELBY TUBE | CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m) Water Level	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	BLOWS /150 mm
0		Topsoil (100 mm)			
		Silt & Sand - clayey to some clay, loose, moist, fine to medium grained, brown		B1	
1				B2	
		Clay Till - silty, some sand, trace gravel, very stiff to hard, very moist, low to medium plastic, grey, coal inclusions and oxide stains		B3	
2					
3				B4	
		End of borehole at 3.05 m, some sloughing & seepage. Standpipe installed to 3.05 m.			
4					
4.5					

PLASTIC — M.C. — LIQUID (20 40 60 80)

▲ VANE SHEAR (kPa) ▲ (100 200 300 400)

■ N-VALUE ■ (20 40 60 80)

◆ UNCONF. SHEAR STR. (kPa) ◆ (50 100 150 200)

● POCKETPEN. (kPa) ● (100 200 300 400)

OTHER DATA | SLOTTED PIEZOMETER | Elevation (m)

LOGGED BY: CA	COMPLETION DEPTH: 3.05 m
REVIEWED BY: BR	COMPLETION DATE: 25-7-2

AB TRANS BOREHOLE LOG SUNDIAL FEEDERS.GPJ AB_TRANS.GDT 25-9-4

Project: Feedlot and Catch Basin Expansion		BOREHOLE NO: **BH008**
Client: Sundial Livestock Feeders		PROJECT NO: REL253037
	Solid Stem Auger	ELEVATION:

SAMPLE TYPE: SHELBY TUBE | CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m) Water Level	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	BLOWS /150 mm	PLASTIC M.C. LIQUID (20 40 60 80)	▲ VANE SHEAR (kPa) ▲ (100 200 300 400) ■ N-VALUE ■ (20 40 60 80) ◆ UNCONF. SHEAR STR. (kPa) ◆ (50 100 150 200) ● POCKETPEN. (kPa) ● (100 200 300 400)	OTHER DATA	SLOTTED PIEZOMETER	Elevation (m)
0		Silt & Sand - clayey to some clay, loose, very moist, fine to medium grained, brown		B1						
1				B2						
2		- wet to saturated		B3						
3		Clay Till - silty, some sand, trace gravel, stiff, very moist, low to medium plastic, olive brown, coal inclusions and oxide stains		B4						
4		End of borehole at 3.05 m, some sloughing & seepage. Standpipe installed to 3.05 m.								
4.5										

LOGGED BY: CA | COMPLETION DEPTH: 3.05 m

REVIEWED BY: BR | COMPLETION DATE: 25-7-2

AB TRANS BOREHOLE LOG SUNDIAL FEEDERS.GPJ AB_TRANS.GDT 25-9-4

Project: Feedlot and Catch Basin Expansion		BOREHOLE NO: **BH009**
Client: Sundial Livestock Feeders		PROJECT NO: REL253037
	Solid Stem Auger	ELEVATION:

SAMPLE TYPE: SHELBY TUBE | CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m) Water Level	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	BLOWS /150 mm	PLASTIC M.C. LIQUID (20 40 60 80)	▲ VANE SHEAR (kPa) ▲ (100 200 300 400) ■ N-VALUE ■ (20 40 60 80) ◆ UNCONF. SHEAR STR. (kPa) ◆ (50 100 150 200) ● POCKETPEN. (kPa) ● (100 200 300 400)	OTHER DATA	SLOTTED PIEZOMETER	Elevation (m)
0		Silt & Sand - clayey to some clay, loose, very moist, fine to medium grained, brown		B1						
1				B2						
2		Clay Till - silty, some sand, trace gravel, firm, very moist, low to medium plastic, olive brown, coal inclusions and oxide stains		B3						
3				ST1						
4		End of borehole at 3.05 m, some sloughing & seepage. Standpipe installed to 3.05 m.		B4						
4.5										

LOGGED BY: CA | COMPLETION DEPTH: 3.05 m

REVIEWED BY: BR | COMPLETION DATE: 25-7-2

Project: Feedlot and Catch Basin Expansion		BOREHOLE NO: **BH010**
Client: Sundial Livestock Feeders		PROJECT NO: REL253037
	Solid Stem Auger	ELEVATION:

SAMPLE TYPE: SHELBY TUBE | CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	BLOWS /150 mm	PLASTIC M.C. LIQUID (20 40 60 80)	▲ VANE SHEAR (kPa) ▲ (100 200 300 400) ■ N-VALUE ■ (20 40 60 80) ◆ UNCONF. SHEAR STR. (kPa) ◆ (50 100 150 200) ● POCKETPEN. (kPa) ● (100 200 300 400)	OTHER DATA	SLOTTED PIEZOMETER	Elevation (m)
0		Silt & Sand - clayey to some clay, loose, very moist, fine to medium grained, brown		B1						
1				B2						
2				B3						
3		Clay Till - silty, some sand, trace gravel, stiff, very moist, low to medium plastic, olive brown, coal inclusions and oxide stains		B4						
4		End of borehole at 3.05 m, some sloughing & seepage. Standpipe installed to 3.05 m.								
4.5										

LOGGED BY: CA	COMPLETION DEPTH: 3.05 m
REVIEWED BY: BR	COMPLETION DATE: 25-7-2

AB TRANS BOREHOLE LOG SUNDIAL FEEDERS.GPJ AB_TRANS.GDT 25-9-4

Project: Feedlot and Catch Basin Expansion		BOREHOLE NO: **BH011**
Client: Sundial Livestock Feeders		PROJECT NO: REL253037
	Solid Stem Auger	ELEVATION:

SAMPLE TYPE ■ SHELBY TUBE ◪ CORE SAMPLE ☒ SPT SAMPLE ▤ GRAB SAMPLE ▥ NO RECOVERY

Depth (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	BLOWS /150 mm	PLASTIC M.C. LIQUID (20 40 60 80)	▲VANE SHEAR (kPa)▲ (100 200 300 400) ■N-VALUE■ (20 40 60 80) ◆UNCONF. SHEAR STR. (kPa)◆ (50 100 150 200) ●POCKETPEN. (kPa)● (100 200 300 400)	OTHER DATA	Elevation (m)
0		Topsoil (100 mm)							
		Silt & Sand - clayey to some clay, loose, very moist, fine to medium grained, brown		B1					
1		- light brown		B2					
2				B3					
		Clay Till - silty, some sand, trace gravel, stiff, very moist, low to medium plastic, olive, coal inclusions and oxide stains		B4					
3		End of borehole at 3.05 m, some sloughing & seepage. No standpipe installed.							
4									
4.5									

LOGGED BY: CA	COMPLETION DEPTH: 3.05 m
REVIEWED BY: BR	COMPLETION DATE: 25-7-2

AB TRANS BOREHOLE LOG SUNDIAL FEEDERS.GPJ AB_TRANS.GDT 25-9-4

Project: Feedlot and Catch Basin Expansion		BOREHOLE NO: **BH012**
Client: Sundial Livestock Feeders		PROJECT NO: REL253037
	Solid Stem Auger	ELEVATION:

SAMPLE TYPE ■ SHELBY TUBE ◪ CORE SAMPLE ☒ SPT SAMPLE ▤ GRAB SAMPLE ▥ NO RECOVERY

Depth (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	BLOWS /150 mm	PLASTIC M.C. LIQUID (20 40 60 80)	▲VANE SHEAR (kPa)▲ (100 200 300 400) ■N-VALUE■ (20 40 60 80) ◆UNCONF. SHEAR STR. (kPa)◆ (50 100 150 200) ●POCKETPEN. (kPa)● (100 200 300 400)	OTHER DATA	Elevation (m)
0		Silt & Sand - clayey to some clay, loose, very moist, fine to medium grained, brown		B1					
1				B2					
2				B3					
3				B4					
		End of borehole at 3.05 m, some sloughing & seepage. No standpipe installed.							
4									
4.5									

LOGGED BY: CA | COMPLETION DEPTH: 3.05 m
REVIEWED BY: BR | COMPLETION DATE: 25-7-2

Project: Feedlot and Catch Basin Expansion		BOREHOLE NO: **BH013**
Client: Sundial Livestock Feeders		PROJECT NO: REL253037
	Solid Stem Auger	ELEVATION:

SAMPLE TYPE: SHELBY TUBE | CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	BLOWS /150 mm
0		Silt & Sand - clayey to some clay, loose, very moist, fine to medium grained, brown		B1	
1				B2	
2				B3	
3		Clay Till - silty, some sand, trace gravel, stiff, very moist, low to medium plastic, olive, coal inclusions and oxide stains		B4	
				ST1	
4		End of borehole at 3.51 m, some sloughing & seepage. Standpipe installed to 3.51 m.			
4.5					

PLASTIC — M.C. — LIQUID
20 40 60 80

▲ VANE SHEAR (kPa) ▲
100 200 300 400

■ N-VALUE ■
20 40 60 80

◆ UNCONF. SHEAR STR. (kPa) ◆
50 100 150 200

● POCKETPEN. (kPa) ●
100 200 300 400

OTHER DATA

SLOTTED PIEZOMETER

Elevation (m)

LOGGED BY: CA	COMPLETION DEPTH: 3.51 m
REVIEWED BY: BR	COMPLETION DATE: 25-7-2

AB TRANS BOREHOLE LOG SUNDIAL FEEDERS.GPJ AB_TRANS.GDT 25-9-4

Appendix B – BOREHOLE LOCATION PLAN

Figure 1 – Site Plan
Borehole Locations

Figure 1 – Site Plan
Borehole Locations

Appendix C – LABORATORY TEST RESULTS

MOISTURE CONTENT

JOB #	JOB DESCRIPTION	PROJECT
REL253037	Sundial Feeders Expansion	Evaluation

Borehole ID	Sample ID	Tare Mass (g)	Wet + Tare (g)	Dry + Tare (g)	Moisture %
BH001	1B1	8.3	263.6	241.0	9.7
	1B2	6.4	280.3	251.1	11.9
	1B3	6.5	316.5	254.6	24.9
	1B4	6.5	240.3	199.0	21.5
	1B5	8.3	228.2	198.1	15.9
	1B6	6.5	206.0	178.9	15.7
	1B7	6.5	261.9	231.4	13.6
	1B8	8.3	280.3	246.6	14.1
	1B9	6.4	237.8	211.1	13.0
	1B10	6.4	263.3	231.7	14.0
	1B11	8.3	284.4	245.5	16.4
	1B12	8.3	230.4	195.3	18.8
BH002	2B1	8.3	253.8	222.5	14.6
	2B2	6.5	270.8	229.8	18.4
	2B3	6.5	332.4	277.8	20.1
	2B4	6.5	282.9	235.0	21.0
	2B5	6.5	244.3	196.6	25.1
	2B6	6.5	277.2	229.1	21.6
	2B7	6.5	251.0	209.3	20.6
	2B8	8.3	243.6	212.7	15.1
	2B9	6.5	238.6	208.2	15.1
	2B10	6.4	244.9	213.9	14.9
	2B11	6.4	271.9	235.5	15.9
BH003	3B1	8.3	287.7	271.6	6.1
	3B2	8.3	276.7	241.4	15.1
	3B3	6.5	240.9	196.9	23.1
	3B4	6.5	253.4	202.1	26.2
	3B5	6.4	254.3	223.8	14.0
	3B6	8.3	288.2	253.0	14.4
	3B7	6.4	255.3	225.9	13.4
	3B8	8.3	295.0	261.1	13.4
	3B9	6.4	307.3	275.0	12.0
	3B10	6.4	257.4	232.0	11.3

MOISTURE CONTENT

JOB #	JOB DESCRIPTION	PROJECT
REL253037	Sundial Feeders Expansion	Evaluation

Borehole ID	Sample ID	Tare Mass (g)	Wet + Tare (g)	Dry + Tare (g)	Moisture %
BH003	3B11	8.3	266.9	245.5	9.0
	3B12	6.4	272.7	246.5	10.9
BH004	4B1	6.4	241.6	219.7	10.3
	4B2	6.4	294.0	247.9	19.1
	4B3	8.3	243.9	204.3	20.2
	4B4	8.3	232.9	184.6	27.4
	4B5	8.3	288.0	241.1	20.1
	4B6	6.4	254.5	226.1	12.9
	4B7	8.3	270.5	241.2	12.6
	4B8	8.3	250.6	224.2	12.2
	4B9	6.4	211.4	185.1	14.7
	4B10	6.4	304.2	275.0	10.9
BH005	5B1	6.4	248.2	219.2	13.6
	5B2	6.4	270.6	233.5	16.3
	5B3	6.4	213.4	175.7	22.3
	5B4	8.3	290.7	248.7	17.5
	5B5	6.4	199.8	178.7	12.2
	5B6	6.4	214.2	194.9	10.2
	5B7	6.4	296.5	275.5	7.8
	5B8	6.4	219.6	197.9	11.3
	5B9	6.4	239.9	208.5	15.5
	5B10	6.4	249.6	208.6	20.3
BH006	6B1	6.4	293.0	252.6	16.4
	6B2	6.4	338.3	309.7	9.4
	6B3	6.5	268.9	215.6	25.5
	6B4	6.4	199.0	179.7	11.1
	6B5	8.3	246.9	220.1	12.7
	6B6	6.4	240.4	216.3	11.5
	6B7	6.4	267.6	241.3	11.2
	6B8	6.4	222.3	201.5	10.7
	6B9	6.4	213.3	185.2	15.7
BH007	7B1	6.5	305.7	257.3	19.3
	7B2	6.5	259.6	216.3	20.6
	7B3	6.5	255.4	222.6	15.2

MOISTURE CONTENT

JOB #	JOB DESCRIPTION	PROJECT
REL253037	Sundial Feeders Expansion	Evaluation

Borehole ID	Sample ID	Tare Mass (g)	Wet + Tare (g)	Dry + Tare (g)	Moisture %
BH007	7B4	6.5	239.1	203.5	18.1
BH008	8B1	6.5	276.0	229.9	20.6
	8B2	6.5	282.7	232.7	22.1
	8B3	6.5	254.1	206.9	23.6
	8B4	6.5	263.4	218.4	21.2
BH009	9B1	6.5	248.3	214.8	16.1
	9B2	6.5	284.2	243.8	17.0
	9B3	6.5	266.7	219.7	22.0
	9B4	6.5	258.7	212.8	22.2
BH010	10B1	6.5	185.6	175.1	6.2
	10B2	6.5	228.2	210.3	8.8
	10B3	8.3	263.0	210.7	25.8
	10B4	6.4	281.8	231.3	22.5
BH011	11B1	6.5	259.7	225.6	15.6
	11B2	6.5	275.7	234.0	18.3
	11B3	6.5	259.2	220.8	17.9
	11B4	6.5	251.2	203.3	24.3
BH012	12B1	6.5	251.0	215.3	17.1
	12B2	6.5	270.2	229.5	18.3
	12B3	6.5	254.7	204.5	25.4
	12B4	6.5	271.7	218.2	25.3
BH013	13B1	6.4	250.6	218.9	14.9
	13B2	6.4	267.4	235.7	13.8

SOLUM™
CONSULTANTS LTD.
GEOTECHNICAL & MATERIAL
TESTING LABORATORY

Geo-Lab Report

Revision # 0

Report Date:	*August 7, 2025*
Client:	*Roseke Engineering Ltd.*
Address:	*3614 18 Ave. N, Lethbridge, AB T1H 5S7*
Attn:	*Chris Allard*
Project No:	*REL253037*
Project Name:	*Sundial Feeders Expansion*
Solum Job No.:	*18402250717(272)*

Sample Received Date: July 17, 2025

Sample Quantity: 2 bags

Test	Quantity	Destination
HYDRAULIC CONDUCTIVITY (Method A)(Flexible Wall)	2	D5084

President: Saad Farag

#9, 3620 29 ST NE, Calgary, AB T1Y 5Z8
phone: (403)250-3035
Cell: (403)619-7250
solum@mymts.net
solumconsultantsltd111@outlook.com
www.solumconsultantsltd.com

SOLUM CONSULTANTS LTD.
GEOTECHNICAL & MATERIAL TESTING LABORATORY

Hydraulic Conductivity Test (ASTM D5084- Method A)

Project Info: *REL253037 / Sundial Feeders Expansion* *Reviewed by:* *S. F.*

Client: *Roseke Engineering Ltd.*

Solum Job No.: *18402250717(272)*

Sample Info: ***2B7 4.5-6.0 m***

Test Parameters

Soil Type: Remoulded | Approx. Sat. Time (days): 8 | Test Fluids: tap water | Assumed Gs: 2.70

Sample Information							Remoulding Information			
	Height (cm)	Diameter (cm)	MC (%)	mass (g)	Dry BD (kg/m^3)	Est. Sat. Degree (%)	OPT MC(%)	MAXDD (kg/m^3)	Remoulding Percentage	Target Density (kg/m^3)
Pre-Test Data	7.42	7.00	15.4	552.3	1677	68	15.3	1775	95	1686
Post-Test Data	7.44	7.01	23.0	588.6	1667	100				

Test Results

Elapsed Time (h)	Test Time (h)	Temp (deg. C)	Rt	P_{cell} (kPa)	P_{Head} (kPa)	P_{Tail} (kPa)	(In + Out)/2 (mL)	Gradient	Hydraulic Conductivity K_{20} (cm/sec)
111	15	20.2	0.995	250.1	230.1	200.0	3.11	41.4	3.60E-08
139	15	19.7	1.008	250.0	230.1	200.1	2.75	41.2	3.23E-08
167	15	20.1	0.998	250.1	230.0	200.0	2.36	41.2	2.75E-08
192	15	19.8	1.005	250.1	230.1	200.1	1.82	41.2	2.13E-08
210	15	20.0	1.000	250.1	230.1	200.1	1.81	41.2	2.11E-08

Avg. K_{20} (cm/sec) **2.1E-08** **Avg. K_{20} (m/sec)** **2.1E-10**

Remarks:

SOLUM CONSULTANTS LTD.
GEOTECHNICAL & MATERIAL TESTING LABORATORY

Hydraulic Conductivity Test (ASTM D5084- Method A)

Project Info:	*REL253037 / Sundial Feeders Expansion*	*Reviewed by:*	*S. F.*
Client:	*Roseke Engineering Ltd.*		
Solum Job No.:	*18402250717(272)*		
Sample Info:	***6B3 1.5-3.0 m***		

Test Parameters

Soil Type	Remoulded	Approx. Sat. Time (days)	8	Test Fluids	tap water	Assumed Gs	2.70

Sample Information							Remoulding Information			
	Height (cm)	Diameter (cm)	MC (%)	mass (g)	Dry BD (kg/m^3)	Est. Sat. Degree (%)	OPT MC(%)	MAXDD (kg/m^3)	Remoulding Percentage	Target Density (kg/m^3)
Pre-Test Data	6.93	7.00	21.8	487.5	1500	74	23.0	1585	95	1506
Post-Test Data	6.96	7.02	30.2	521.3	1486	100				

Test Results

Elapsed Time (h)	Test Time (h)	Temp (deg. C)	Rt	P_{cell} (kPa)	P_{Head} (kPa)	P_{Tail} (kPa)	(In + Out)/2 (mL)	Gradient	Hydraulic Conductivity K_{20} (cm/sec)
108	15	19.8	1.005	250.0	230.1	200.1	3.61	44.1	3.96E-08
137	15	19.6	1.010	250.0	230.1	200.0	3.09	44.3	3.39E-08
168	15	20.1	0.998	250.1	230.0	200.0	2.60	44.1	2.83E-08
195	15	20.0	1.000	250.1	230.1	200.0	2.23	44.3	2.42E-08
217	15	20.1	0.998	250.0	230.0	200.0	2.21	44.1	2.41E-08

Avg. K_{20} (cm/sec) **2.4E-08** **Avg. K_{20} (m/sec)** **2.4E-10**

Remarks:

SOLUM™
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GEOTECHNICAL & MATERIAL
TESTING LABORATORY

STANDARD LABORATORY TERMS AND CONDITIONS

1.0 Description of Services to be Performed by Solum Consultants Ltd. (Solum)
Solum shall provide geotechnical and material laboratory testing services on samples in accordance with these terms and conditions and executed Laboratory Testing Request Forms. Solum shall perform its work in accordance with accepted laboratory standards, such as ASTM, CSA or client's specific specs, as well as accepted standard operating procedures. Solum reserves the right to modify methods as necessary based upon experience and/or current scientific literature. If the Client requests a manner of analysis that varies from standard operating or recommended procedures, the Client shall not hold Solum responsible for the results. Such variations of analysis will be noted on the reports. Solum reserves the right to subcontract laboratory testing if a particular test cannot be performed by Solum.

2.0 Reports, Confidentiality and Third Parties
Laboratory reports provided by Solum will be composed of a cover page, tables and figures if applicable. Reports will be e-mailed in PDF format to the individual(s) specified on the Laboratory Testing Request Forms. Laboratory reports may also be faxed or mailed to the Client upon request. Except as required by law, Solum shall not disclose testing results or reports to any party other than the Client, unless the Client, in writing, requests information to be provided to a third party. Solum shall abide by any additional confidentiality requirements requested by the Client provided that such requirements are provided to Solum at or before execution of the testing.
Information provided by Solum is intended for Client use only. Any use by a third party, of reports or documents authored by Solum, or any reliance on or decisions made by a third party based on the findings described in said documents, are the sole responsibility of such third parities, and Solum accepts no responsibility of damages suffered by any third party as a result of decisions made or actions conducted.

3.0 Laboratory Testing Request Form (Chain of Custody)
The laboratory testing request form must be completed by the Client and be accompanied with the samples. Other form of COC may be accepted; however, the condition of Solum COC is still applied. Testing will not commence until the laboratory testing request form has been completed. If requested by the Client, Solum shall provide a copy of the laboratory testing request form with the report.
No persons other than the designated representatives for each Laboratory Testing Request Form are authorized to act regarding changes to the testing request form. Any changes or amendments of the laboratory testing request form must be in writing and be completed by the originator.

4.0 Acceptance, Contamination and Disposal of Samples
Loss or damages to samples remains the responsibility of the Client until Solum representatives acceptance of samples by notation on the laboratory testing request form.
As to any samples that are suspected of containing hazardous substances, the Client will specify the suspected or known substance and level of contamination. This information is to be stated on the laboratory testing request form and be accompanied with the samples before testing can commence. Solum may refuse acceptance of samples if it determines they present a risk to health and safety.
Samples accepted by Solum shall remain the property and liability of the Client while in the custody of Solum. Solum will discard all non-contaminated samples after two weeks of submitting lab report or a month from the date of receiving the samples without additional retention period at a fixed disposal charge, or if requested by the Client, samples may be returned to the Client at no cost to Solum. If requested by client, Solum will store samples provided the client agrees to pay for the storage charge. Contaminated material may be returned/shipped to the Client at the Client's expense or Solum will discard samples with disposal rates varying for samples containing higher levels of contamination, refer to price list.
Soil samples requested to be stored will be stored inside the lab up to the expiration of storage period. Soil samples will be discarded upon the expiration date of the storage period unless client requests either extending storage period or return samples back to client at no cost to Solum.

5.0 Indemnification/Hold Harmless
Solum shall protect, indemnify and save harmless Client, and its directors, officers, employees, agents, representatives, invitees and subcontractors, and at Client's request, investigate and defend such entities form and against all claims, demands and causes of action, of every kind and character, without limitation, arising in favour of or made by third parties, on account of bodily injury, death or damage to or loss of their property resulting from any negligent act or wilful misconduct of Solum.
The Client shall protect, indemnify and save harmless Solum, and its directors, officers, employees, agents, representatives, invitees and subcontractors, and at Solum's request, investigate and defend such entities form and against all claims, demands and causes of action, of every kind and character, without limitation, arising in favour of or made by third parties, on account of bodily injury, death or damage to or loss of their property resulting from any negligent act or wilful misconduct of Client.

6.0 Limitation of Liability
The total liability of Solum or its staff whether based in contract or tort, will be limited to the lesser of the fees paid or actual damages incurred by the Client. Solum will not be responsible for any consequential or indirect damages even if caused by negligence of Solum. Solum will only be liable for damages resulting form negligence of Solum. All claims by the Client shall be deemed relinquished if not made within one year after the testing date. No warranty is either expressed or implied, or intended by any agreement or by furnishing oral or written reports or findings.

7.0 Termination of Testing Work Order
The Client may order work suspended or terminated upon seven days advance written notice. If work is suspended, Solum shall receive, upon resumption, an adjustment in the cost of services to compensate for additional costs incurred due to the interruption of services. Upon suspension or termination, Solum shall preserve samples provided that the Client agrees to pay the sample storage charge.

8.0 Pricing, Payments and Invoicing
Invoices will be based on most current Solum laboratory testing rates; rates may change without notice. Solum invoices shall be paid within thirty (30) days of receipt of the invoice. Amounts not paid when due shall bear interest at the rate of 18% per annum from the date due until the date of payment.

Down To Earth Labs Inc.
The Science of Higher Yields

Roseke Engineering Ltd.
3614 18 Ave N
Lethbridge, T1H 5S7
Canada

Report #: 211452
Report Date: 2025-07-17
Received: 2025-07-16
Completed: 2025-07-17
Test Done: ST

Project : REL253037
PO:

3510 6th Ave North
Lethbridge, AB T1H 5C3
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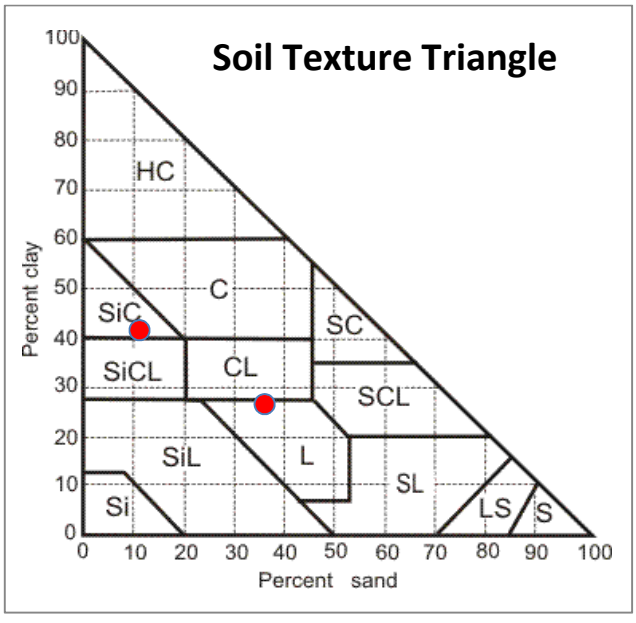
www.downtoearthlabs.com
info@downtoearthlabs.com

		Sample ID:	250716P023	250716P024
		Cust. Sample ID:	2B7	6B3
Analyte	**Units**		4.5-6.0	1.5-3.0
Sand	%		36.3	11.3
Silt	%		37.5	47.5
Clay	%		26.3	41.3
Soil Texture	-		Loam	Silty Clay



Raygan Boyce - Chemist

Appendix D – GENERAL CONSTRUCTION GUIDELINES

Backfill Materials and Compaction

1.0 Definitions

"Landscape fill" is typically used in areas such as berms and grassed areas where settlement of the fill and noticeable surface subsidence can be tolerated. "Landscape fill" may comprise soils without regard to engineering quality.

"General engineered fill" is typically used in areas where a moderate potential for subgrade movement is tolerable, such as asphalt (i.e., flexible) pavement areas. "General engineered fill" should comprise clean, granular or clay soils.

"Select engineered fill" is typically used below slabs-on-grade or where high volumetric stability is desired, such as within the footprint of a building. "Select engineered fill" should comprise clean, well-graded granular soils or inorganic low to medium plastic clay soils.

"Structural engineered fill" is used for supporting structural loads in conjunction with shallow foundations. "Structural engineered fill" should comprise clean, well-graded granular soils.

"Lean-mix concrete" is typically used to protect a subgrade from weather effects including excessive drying or wetting. "Lean-mix concrete" can also be used to provide a stable working platform over weak subgrades. "Lean-mix concrete" should be low strength concrete having a minimum 28-day compressive strength of 3.5 MPa. Standard Proctor Density (SPD) as used herein means Standard Proctor Maximum Dry Density (ASTM Test Method D698). Optimum moisture content is defined in ASTM Test Method D698.

2.0 General Backfill and Compaction Recommendations

Exterior backfill adjacent to abutment walls, basement walls, grade beams, pile caps and above footings, and below highway, street, or parking lot pavement sections should comprise "general engineered fill" materials as defined above. Exterior backfill adjacent to footings, foundation walls, grade beams and pile caps and within 600 mm of final grade should comprise inorganic, cohesive "general engineered fill". Such backfill should provide a relatively impervious surficial zone to reduce seepage into the subsoil against the structure.

Backfill should not be placed against a foundation structure until the structure has sufficient strength to withstand the earth pressures resulting from placement and compaction. During compaction, careful observation of the foundation wall for deflection should be carried out continuously. Where deflections are apparent, the compactive effort should be reduced accordingly.

In order to reduce potential compaction induced stresses, only hand-held compaction equipment should be used in the compaction of fill within 1 m of retaining walls or basement walls. If compacted fill is to be placed on both sides of the wall, they should be filled together so that the level on either side is within 0.5 m of each other.

All lumps of materials should be broken down during placement. Backfill materials should not be placed in a frozen state, or placed on a frozen subgrade.

Where the maximum-sized particles in any backfill, material exceed 50 percent of the minimum dimension of the cross-section to be backfilled (e.g., lift thickness), such particles should be removed and placed at other more suitable locations on site or screened off prior to delivery to site.

Bonding should be provided between backfill lifts. For fine-grained materials, the previous lift should be scarified to the base of the desiccated layer, moisture-conditioned, and recompacted and bonded thoroughly to the succeeding lift. For granular materials, the surface of the previous lift should be scarified to about a 75 mm depth followed by proper moisture-conditioning and re-compaction.

3.0 COMPACTION AND MOISTURE CONDITIONING

"Landscape fill" material should be placed in compacted lifts not exceeding 300 mm and compacted to a density of not less than 90 percent of SPD unless a higher percentage is specified by the jurisdiction.

"General engineered fill" and "select engineered fill" materials should be placed in layers of 150 mm compacted thickness and should be compacted to not less than 98 percent of SPD. Note that the contract may specify higher compaction levels within 300 mm of the design elevation. Cohesive materials placed as "general engineered fill" or "select engineered fill" should be compacted at 0 to 2 percent above the optimum moisture content. Note that there are some silty soils which can become quite unstable when compacted above optimum moisture content.

Granular materials placed as "general engineered fill" or "select engineered fill" should be compacted at slightly below (0 to 2%) the optimum moisture content. "Structural engineered fill" material should be placed in compacted lifts not exceeding 150 mm in thickness and compacted to not less than 100 percent of SPD at slightly below (0 to 2%) the optimum moisture content.

4.0 "GENERAL ENGINEERED FILL"

Low to medium plastic clay is considered acceptable for use as "general engineered fill," assuming this material is inorganic and free of deleterious materials. Materials meeting the specifications for "select engineered fill" or "structural engineered fill" as described below would also be acceptable for use as "general engineered fill."

5.0 "SELECT ENGINEERED FILL"

Low to medium plastic clay with the following range of plasticity properties is generally considered suitable for use as "select engineered fill":

Liquid Limit	=	20 to 40%
Plastic Limit	=	10 to 20%
Plasticity Index	=	10 to 30%

Test results should be considered on a case-by-case basis.

Construction Excavations

Construction should be in accordance with good practice and comply with the requirements of the responsible regulatory agencies.

All excavations greater than 1.5m deep should be sloped or shored for worker protection.

Shallow excavations up to about 3m depth may use temporary sideslopes of 1H:1V. A flatter slope of 2H:1V should be used if groundwater is encountered. Localized sloughing can be expected from these slopes.

Deep excavations or trenches may require temporary support if space limitations or economic considerations preclude the use of sloped excavations.

For excavations greater than 3m depth, temporary support should be designed by a qualified geotechnical engineer. The design and proposed installation and construction procedures should be submitted to Roseke for review.

The construction of a temporary support system should be monitored. Detailed records should be taken of installation methods, materials, in situ conditions and the movement of the system. If anchors are used, they should be load tested. Roseke can provide further information on monitoring and testing procedures if required.

Attention should be paid to structures or buried service lines close to the excavation. For structures, a general guideline is that if a line projected down, at 45 degrees from the horizontal from the base of foundations of adjacent structures intersects the extent of the proposed excavation, these structures may require underpinning or special shoring techniques to avoid damaging earth movements. The need for any underpinning or special shoring techniques and the scope of monitoring required can be determined when details of the service ducts and vaults, foundation configuration of existing buildings and final design excavation levels are known.

No surface surcharges should be placed closer to the edge of the excavation than a distance equal to the depth of the excavation, unless the excavation support system has been designed to accommodate such surcharge.

Proof Rolling

Proof-rolling is a method of detecting soft areas in an ‘as-excavated’ subgrade for fill, pavement, floor or foundations or detecting non-uniformity of compacted embankment. The intent is to detect soft areas or areas of low shear strength not otherwise revealed by means of test holes, density testing, or visual examination of the site surface and to check that any fill placed or subgrade meets the necessary design strength requirements.

Proof-rolling should be observed by qualified geotechnical personnel.

Proof-rolling is generally accomplished by the use of a heavy (15 to 60 tonne) rubber-tired roller having 4 wheels abreast on independent axles with high contact wheel pressures (inflation pressures ranging from 550 kPa (80psi) up to 1030 kPa (150 psi).

A heavily loaded tandem axle gravel truck may be used in lieu of the equipment described in the paragraph above. The truck should be loaded to approximately 10 tonnes per axle and a minimum tire pressure of 550 kPa (80 psi). Ground speed - maximum 8 km/hr recommended 4 km/hr.

The recommended procedure is two complete coverages with the proof-rolling equipment in one direction and a second series of two coverages made at right angles to the first series; one 'coverage' means that every point of the proof-rolled surface has been subjected to the tire pressure of a loaded wheel. Less rigorous procedures may be acceptable under certain conditions subject to the approval of an engineer.

Any areas of soft, rutted or displaced materials detected should be either recompacted with additional fill or the existing material removed and replaced with general engineered fill, or properly moisture conditioned as necessary.

The surface of the grade under the action of the proof-roller should be observed, noting visible deflection and rebound of the surface, formation of a crack pattern in the compacted surface or shear failure in the surface or granular soils as ridging between wheel tracks.

If any part of an area indicates significantly more distress than other parts, the cause should be investigated, by, for example, shallow auger holes.

In the case of granular subgrades, distress will generally consist of either compression due to insufficient compaction or shearing under the tires. In the first case, rolling should be continued until no further compression occurs. In the second case, the tire pressure should be reduced to a point where the subgrade can carry the load without significant deflection and subsequently gradually increased to it specified pressure as the subgrade increases in shear strength under this compaction.