HiTECH INSTALLATIONS
MAINTENANCE & CONSTRUCTION
1088 Fort Garry Road, St Andrews, Manitoba
Ph: (204) 482-1029 Fax: (204) 482-1030

July 7, 2025

Director, Environmental Approvals Branch
Environment and Climate Change
Box 35, 14 Fultz Blvd
Winnipeg MB R3Y 0L6

Dear Director,

Please consider this application for a Notice of Alteration to the License No: 1624 RRR.

Hi Tech Installations will be acting as the general contractor to Nutrien Ag Solutions (Canada) Ltd to build a new dry fertilizer storage plant at their Darlingford, MB site at 13005 PR 240 near Darlingford.

Please find enclosed:
-Notice of Alteration Application form.
-NoA report.
-Site plan including preliminary building drawings
-Development permit approval

Please advise if anything further is required.

Respectfully submitted,

[redacted]

Craig Senchuk, CEO

Notice of Alteration Form

Manitoba

File No. :	Environment Act Licence No. : 1624 RRR

Legal name of the Licensee: Nutrien Ag Solutions

Name of the development: New dry fertilizer storage building Darlingford

Category and Type of development per Classes of Development Regulation:

Agriculture <SELECT>

Licensee Contact Person: Tyler Buchinski Construction Manager, Nutrien Ag Solutions

Mailing address of the Licensee: 13005 PR 240

City: Darlingford Province: MB Postal Code: R0G0L0

Phone Number:(306) 744-7649 Fax: Email: tyler.buchinski@nutrien.com

Name of proponent contact person for purposes of the environmental assessment (e.g. consultant):

Craig Senchuk Hi Tech Installations Ltd.

Phone: (204) 761-6128	Mailing address: 1088 Fort Garry Road
Fax:	St. Andrews, MB, R1A3S5

Email address: csenchuk@hitechinstallations.ca

Short Description of Alteration *(max 90 characters):*

Addition of accessory building dry fertilizer storage building.

Alteration fee attached: Yes: ☐ No: ☑

If No, please explain: Can arrange for credit card or wire payment on advice from your office. Email application so no cheque attached but can be sent if that is only method of payment

Date: 2025-07-10	Signature: [redacted]
	Printed name: Craig Senchuk

A complete Notice of Alteration **(NoA)** consists of the following components:

- ☑ **Cover letter**
- ☑ **Notice of Alteration Form**
- ☑ **1 electronic copy of the NoA detailed report** (see "Information Bulletin - Alteration to Developments with Environment Act Licences")
- ☐ **$500 Application fee, if applicable** (Cheque, payable to the Minister of Finance)

Submit the complete NoA to:
Director, Environmental Approvals Branch
Environment and Climate Change
Box 35, 14 Fultz Blvd
Winnipeg MB R3Y 0L6
EABDirector@gov.mb.ca
For more information:
Toll-Free: 1-800-282-8069
Phone: 204-945-8321 Fax: 204-945-5229
https://www.gov.mb.ca/sd/permits_licenses_approvals/eal/ licence/index.html

Note: Per Section 14(3) of the Environment Act, Major Notices of Alteration must be filed through submission of an Environment Act Proposal Form (see "Information Bulletin – Environment Act Proposal Report Guidelines")

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1088 Fort Garry Road, St Andrews, Manitoba
Ph: (204) 482-1029 Fax: (204) 482-1030

July 7, 2025

Director, Environmental Approvals Branch
Environment and Climate Change
Box 35, 14 Fultz Blvd
Winnipeg MB R3Y 0L6

Dear Director,

Notice of Alteration Detailed Report
Re:
License No: 1624 RRR.

Hi Tech Installations will be acting as the general contractor to Nutrien Ag Solutions (Canada) Ltd to build a new dry fertilizer storage plant at their Darlingford, MB site at 13005 PR 240 near Darlingford.
Please see attached site plan and building plan detailing the new building placement on site.
Building and fertilizer handling.

This will be a positive effect in the improvement of the current handling of fertilizer at the existing facility. Currently, mobile conveyors are used to fill steel hopper bottomed bins which is prone to spillage and dust. The new facility will have stationary equipment to ensure minimal product escape including fully housed equipment with delivery of product directly into the building from the trucks resulting in less spill and less atmospheric dust. This will be a positive effect on the surrounding terrain, and on staff exposure.

The current blending equipment is largely exposed to the environment and prone to spill, wind movement and run off. All of the blending equipment in the new facility will be housed inside the facility and all pits/buildings with product will have containment curbs.

Building will be National Building code of Canada (2024) compliant.

The new facility will accommodate extra storage of fertilizer but throughput (in/out) of the facility will be the same as the last but spread out over the season, so there will be no additional traffic but too will be spread out more evenly over the year

Site.

HiTECH INSTALLATIONS
MAINTENANCE & CONSTRUCTION
1088 Fort Garry Road, St Andrews, Manitoba
Ph: (204) 482-1029 Fax: (204) 482-1030

The current site is prone to saturation in spring and rapid run off in heavy rains. A full civil site plan has been prepared including allowance for appropriate drainage, based on a geotechnical report and survey. The civil site plan as prepared by Landworks Civil Engineering is attached herein. The accommodation of appropriate grading for drainage as well as a gated culvert on the north side of the property as called for in the design will ensure that rainwater can be appropriately drained from the property with minimal impact to surrounding areas, better than has been in past.

We believe the proposed code compliant facility will ensure that a net environmental positive impact is achieved and would consider the effects of the alteration non-existent or insignificant.

Please find enclosed:
-Site plan including preliminary building drawings GA – 1.2
-Building Plan layout GA – 02
-Landworks Civil Engineering site and grading plan April 29, 2025
-Geotechnical Report P. Machibroda Engineering Ltd. June 7, 2024

Please advise if anything further is required.

Respectfully submitted,

[redacted]

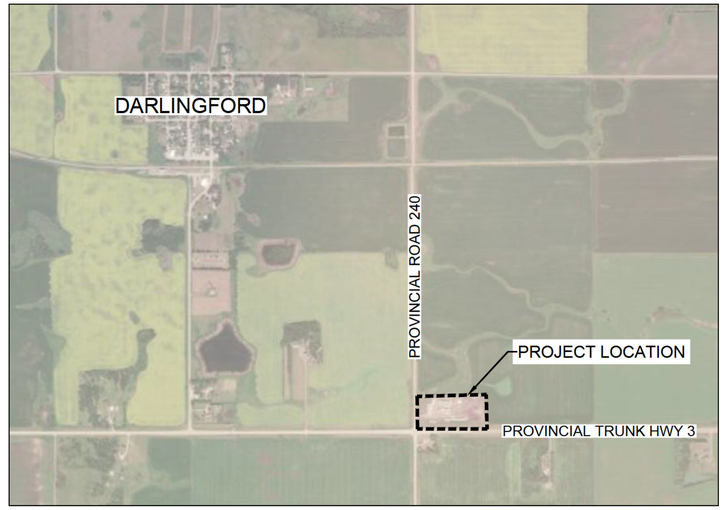
Craig Senchuk, CEO

NUTRIEN AG SOLUTION

NUTRIEN DARLINGFORD

ISSUE: FOR REVIEW

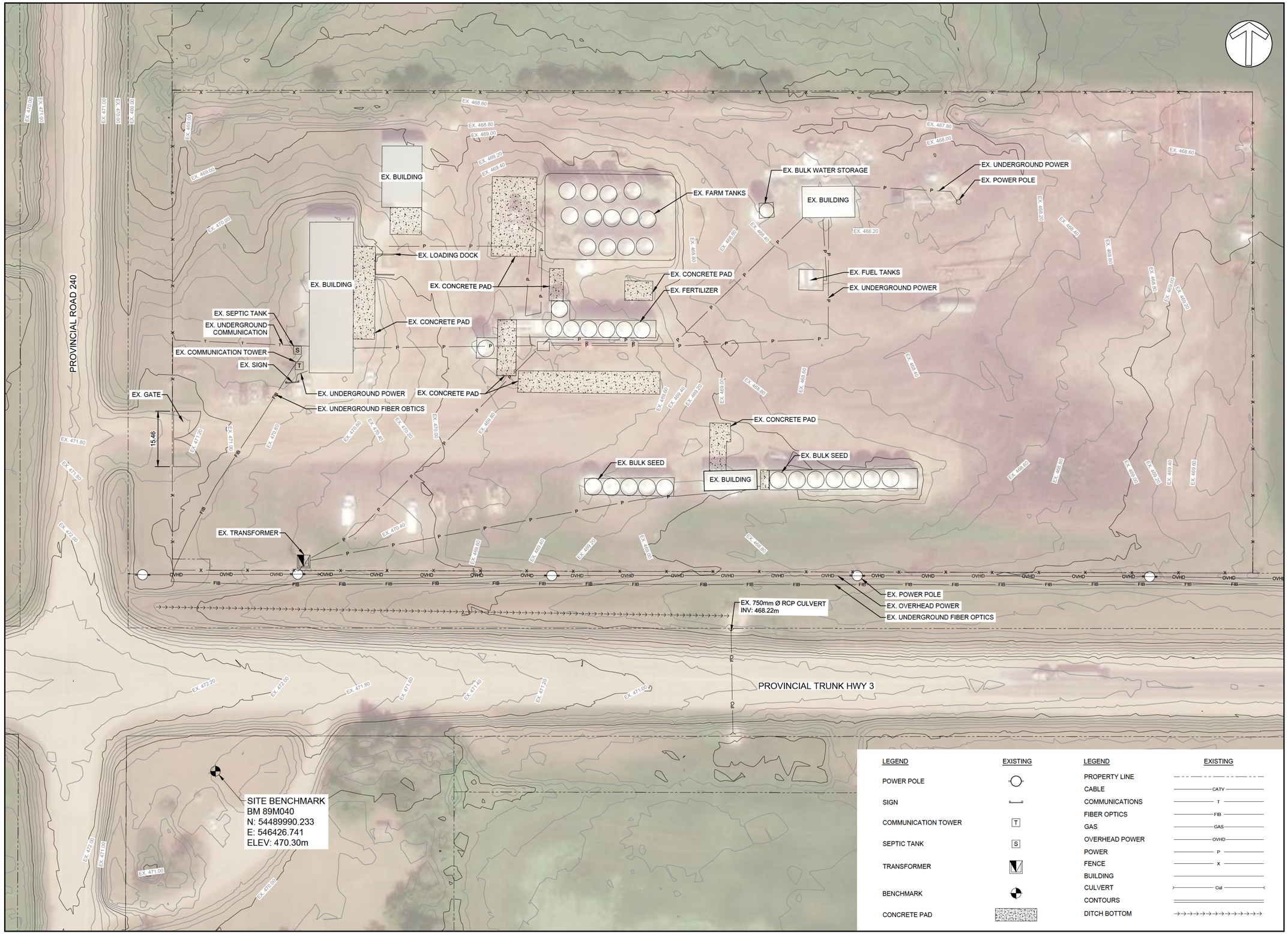
DATE: APRIL 29, 2025



LOCATION PLAN

LIST OF DRAWINGS

Landworks Civil Engineering Ltd.



LEGEND	EXISTING
POWER POLE	
SIGN	
COMMUNICATION TOWER	T
SEPTIC TANK	S
TRANSFORMER	
BENCHMARK	
CONCRETE PAD	

LEGEND	EXISTING
PROPERTY LINE	
CABLE	CATV
COMMUNICATIONS	T
FIBER OPTICS	FIB
GAS	GAS
OVERHEAD POWER	OVHD
POWER	P
FENCE	X
BUILDING	
CULVERT	Cul
CONTOURS	
DITCH BOTTOM	

OWNER

Nutrien Ag Solutions

NUTRIEN AG SOLUTION

YORKTON SK. S0A 3N0

CONSULTANT

Landworks Civil Engineering Ltd.

LANDWORKS CIVIL ENGINEERING LTD.
1815 RAE STREET UNIT 200
REGINA SK. S4T 2E3

SEAL

DATE:	SCALE:
APRIL 29, 2025	1:500
ISSUED BY: C. BIALOBZYSKI	
DRAWN BY: K. NARONGRITTHIKHUN	

ISSUED/REVISION

ISS	REV	DATE	DESCRIPTION
A	2	20250429	ISSUED FOR REVIEW
A	1	20250422	ISSUED FOR REVIEW
A	0	20250121	ISSUED FOR REVIEW

GENERAL NOTES:

1. SURVEY DATE: JANUARY 16, 2025
2. DIMENSIONS ARE IN METERS UNLESS OTHERWISE NOTED.
3. HORIZONTAL COORDINATES, NAD83 UTM ZONE 14N. VERTICAL COORDINATE SYSTEM CGVD2013. SEE DRAWING FOR BENCHMARK INFORMATION AND LOCATION.
4. UTILITY INFORMATION PROVIDED BY OTHERS. CONTRACTOR TO LOCATE ALL EXISTING UTILITIES PRIOR TO CONSTRUCTION.

PROJECT:

NUTRIEN DARLINGFORD EXPANSION

TITLE:

EXISTING FEATURES PLAN

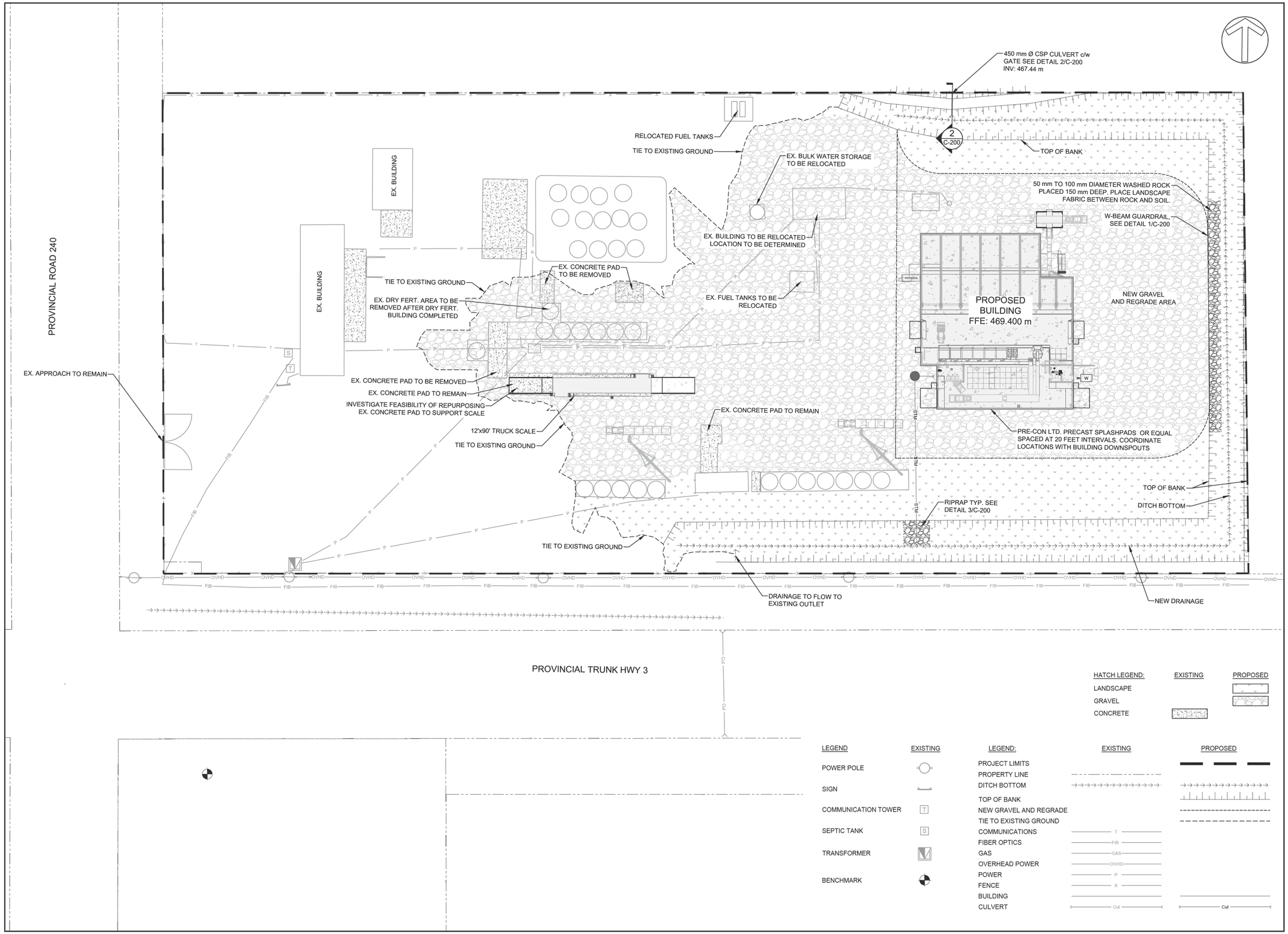
DWG No.: C-100

SHEET: 1 OF 6

ISSUE-REVISION A-2

Last Saved Date: April 29, 2025
Filename: C:\USERS\BRADT\SHARED\ONEDRIVE - LANDWORKS CIVIL ENGINEERING LTD\PROJECTS\20252501 - NUTRIEN DARLINGFORD\05 CAD\2501_C100.DWG

Last Plotted Date: April 29, 2025



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Filename: C:\USERS\BRADT\SHAREDONEDRIVE - LANDWORKS CIVIL ENGINEERING LTD\PROJECTS\2025\2501 - NUTRIEN DARLINGFORD\05 CAD\2501_C101-C104, C-200.DWG

Last Plotted Date: April 29, 2025

OWNER

NUTRIEN AG SOLUTION

YORKTON SK. S0A 3N0

CONSULTANT

LANDWORKS CIVIL ENGINEERING LTD.
1815 RAE STREET UNIT 200
REGINA SK. S4T 2E3

SEAL

DATE:	SCALE:
APRIL 29, 2025	1:500
ISSUED BY: C. BIALOBZYSKI	
DRAWN BY: K. NARONGRITTHIKHUN	

ISSUED/REVISION

ISS	REV	DATE	DESCRIPTION
A	1	20250429	ISSUED FOR REVIEW
A	0	20250422	ISSUED FOR REVIEW

GENERAL NOTES:

1. SEE DRAWING C-100 FOR BENCHMARK INFORMATION.
2. CONTRACTOR TO VERIFY LOCATION OF ALL UTILITIES PRIOR TO CONSTRUCTION.
3. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE NOTED.
4. CONTRACTOR TO RESTORE ALL DISTURBED AREAS TO BEFORE CONSTRUCTION CONDITION OR BETTER.

PROJECT:

NUTRIEN DARLINGFORD EXPANSION

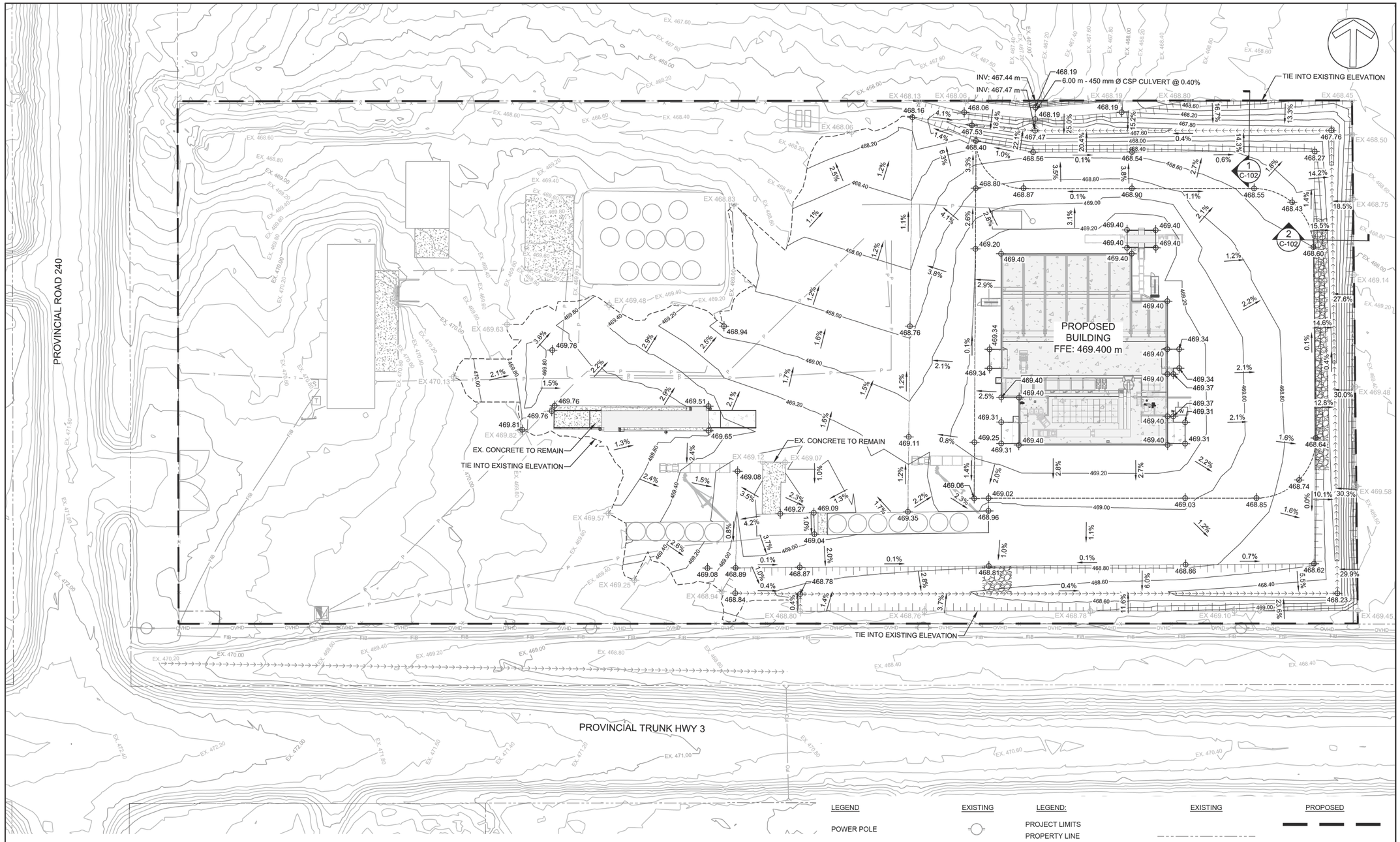
TITLE:

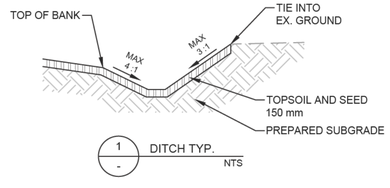
SITE PLAN

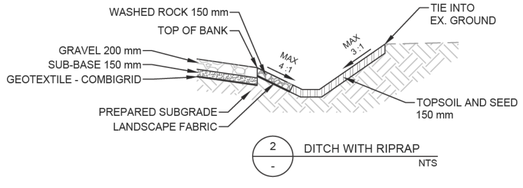
DWG No.: C-101

SHEET: 2 OF 6

ISSUE-REVISION A-1







LEGEND	EXISTING
POWER POLE	
SIGN	
COMMUNICATION TOWER	T
SEPTIC TANK	S
TRANSFORMER	
BENCHMARK	

LEGEND:	EXISTING	PROPOSED
PROJECT LIMITS		
PROPERTY LINE		
DITCH BOTTOM		
TOP OF BANK		
SURFACE BREAKLINE		
EDGE OF NEW GRAVEL		
TIE TO EXISTING GROUND		
CONTOURS		
COMMUNICATIONS	T	
FIBER OPTICS	FIB	
GAS	GAS	
OVERHEAD POWER	OVHD	
POWER	P	
FENCE	X	
BUILDING		
CULVERT	Cul	

OWNER

Nutrien Ag Solutions

NUTRIEN AG SOLUTION

YORKTON SK. S0A 3N0

CONSULTANT

Landworks Civil Engineering Ltd.

LANDWORKS CIVIL ENGINEERING LTD.
1815 RAE STREET UNIT 200
REGINA SK. S4T 2E3

SEAL

DATE:	SCALE:
APRIL 29, 2025	1:500
ISSUED BY:	C. BIALOBZYSKI
DRAWN BY:	K. NARONGRITTHIKHUN

ISSUED/REVISION

ISS	REV	DATE	DESCRIPTION
A	1	20250429	ISSUED FOR REVIEW
A	0	20250422	ISSUED FOR REVIEW

GENERAL NOTES:

1. SEE DRAWING C-100 FOR BENCHMARK INFORMATION
2. CONTRACTOR TO VERIFY LOCATION OF ALL UTILITIES PRIOR TO CONSTRUCTION.
3. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE NOTED.
4. CONTRACTOR TO RESTORE ALL DISTURBED AREAS TO BEFORE CONSTRUCTION CONDITION OR BETTER.

PROJECT:

NUTRIEN DARLINGFORD EXPANSION

TITLE:

GRADING PLAN

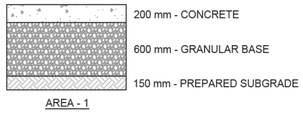
DWG No.: C-102

SHEET: 3 OF 6

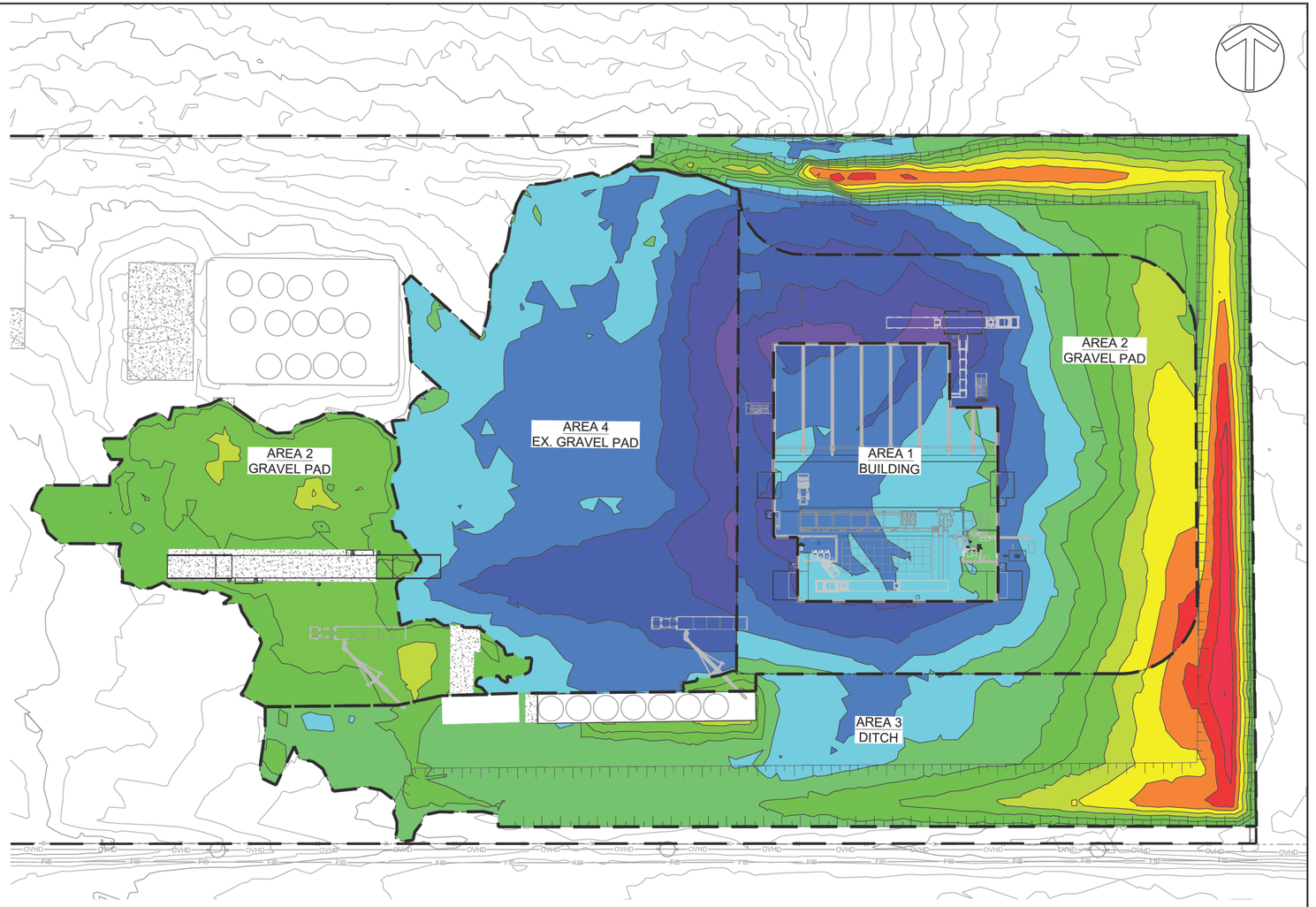
ISSUE-REVISION A-1

Last Saved Date: April 29, 2025
Filename: C:\USERS\BRADT\SHARED\ONEDRIVE - LANDWORKS CIVIL ENGINEERING LTD\PROJECTS\2025\2501 - NUTRIEN DARLINGFORD\05 CAD\2501_C101-C104, C-200.DWG

Last Plotted Date: April 29, 2025



LOCATION	STRUCTURE	AREA (m^2)	VOLUME WITHOUT FILL FACTOR (m^3)
AREA 1	CONCRETE - 200 mm	1918	384
	GRANULAR BASE - 600 mm		1151
	PREPARED SUBGRADE - 150 mm		288
	CUT REQUIRED		6
	FILL REQUIRED		381
AREA 2	GRANULAR BASE - 200 mm	7115	1423
	GRANULAR SUB-GRADE 150 mm		1067
	PREPARED SUBGRADE - 150 mm		1067
	CUT REQUIRED		2049
	FILL REQUIRED		1172
AREA 3	TOPSOIL AND SEED - 150 mm	7643	1146
	PREPARED SUBGRADE - 150 mm		1146
	CUT REQUIRED		3018
	FILL REQUIRED		310
AREA 4	GRANULAR FILL	5246	1660



AREA 1

Elevations Table					
Number	Minimum Elevation	Maximum Elevation	Color	Area	Volume
1	-1.600	-1.400		0.00	0.00
2	-1.400	-1.200		0.00	0.00
3	-1.200	-1.000		0.00	0.00
4	-1.000	-0.800		0.00	0.00
5	-0.800	-0.600		0.00	0.00
6	-0.600	-0.400		0.00	0.00
7	-0.400	-0.200		0.00	0.00
8	-0.200	0.000		157.70	5.57
9	0.000	0.200		767.91	285.17
10	0.200	0.400		889.44	92.87
11	0.400	0.600		103.03	2.52
12	0.600	0.800		0.00	0.00
13	0.800	1.000		0.00	0.00

AREA 2

Elevations Table					
Number	Minimum Elevation	Maximum Elevation	Color	Area	Volume
1	-1.600	-1.400		0.00	0.00
2	-1.400	-1.200		27.83	1.28
3	-1.200	-1.000		110.81	15.22
4	-1.000	-0.800		368.90	62.90
5	-0.800	-0.600		486.66	142.54
6	-0.600	-0.400		1561.94	324.60
7	-0.400	-0.200		1308.59	682.81
8	-0.200	0.000		488.36	819.55
9	0.000	0.200		559.39	497.38
10	0.200	0.400		663.53	375.06
11	0.400	0.600		871.49	221.68
12	0.600	0.800		544.84	72.15
13	0.800	1.000		123.01	5.92

AREA 3

Elevations Table					
Number	Minimum Elevation	Maximum Elevation	Color	Area	Volume
1	-1.600	-1.400		144.80	10.89
2	-1.400	-1.200		248.99	50.45
3	-1.200	-1.000		520.98	126.75
4	-1.000	-0.800		614.10	242.35
5	-0.800	-0.600		601.27	359.56
6	-0.600	-0.400		780.92	492.62
7	-0.400	-0.200		1183.19	681.37
8	-0.200	0.000		2189.47	1053.91
9	0.000	0.200		759.41	184.10
10	0.200	0.400		285.53	86.57
11	0.400	0.600		257.83	37.29
12	0.600	0.800		56.97	1.95
13	0.800	1.000		0.00	0.00

AREA 4

Elevations Table					
Number	Minimum Elevation	Maximum Elevation	Color	Area	Volume
1	-1.600	-1.400		0.00	0.00
2	-1.400	-1.200		0.00	0.00
3	-1.200	-1.000		0.00	0.00
4	-1.000	-0.800		0.00	0.00
5	-0.800	-0.600		0.00	0.00
6	-0.600	-0.400		0.00	0.00
7	-0.400	-0.200		0.00	0.00
8	-0.200	0.000		53.56	0.92
9	0.000	0.200		1622.91	892.07
10	0.200	0.400		1975.94	484.37
11	0.400	0.600		984.97	214.74
12	0.600	0.800		517.35	63.74
13	0.800	1.000		92.17	5.14

OWNER

Nutrien Ag Solutions

NUTRIEN AG SOLUTION

YORKTON SK. S0A 3N0

CONSULTANT

Landworks Civil Engineering Ltd.

LANDWORKS CIVIL ENGINEERING LTD.
1815 RAE STREET UNIT 200
REGINA SK. S4T 2E3

SEAL

DATE: APRIL 29, 2025
SCALE: 1:500
ISSUED BY: C. BIALOBZYSKI
DRAWN BY: K. NARONGRITTHIKHUN

ISSUED/REVISION

ISS	REV	DATE	DESCRIPTION
A	1	20250429	ISSUED FOR REVIEW
A	0	20250422	ISSUED FOR REVIEW

GENERAL NOTES:
1.

PROJECT:
NUTRIEN DARLINGFORD EXPANSION

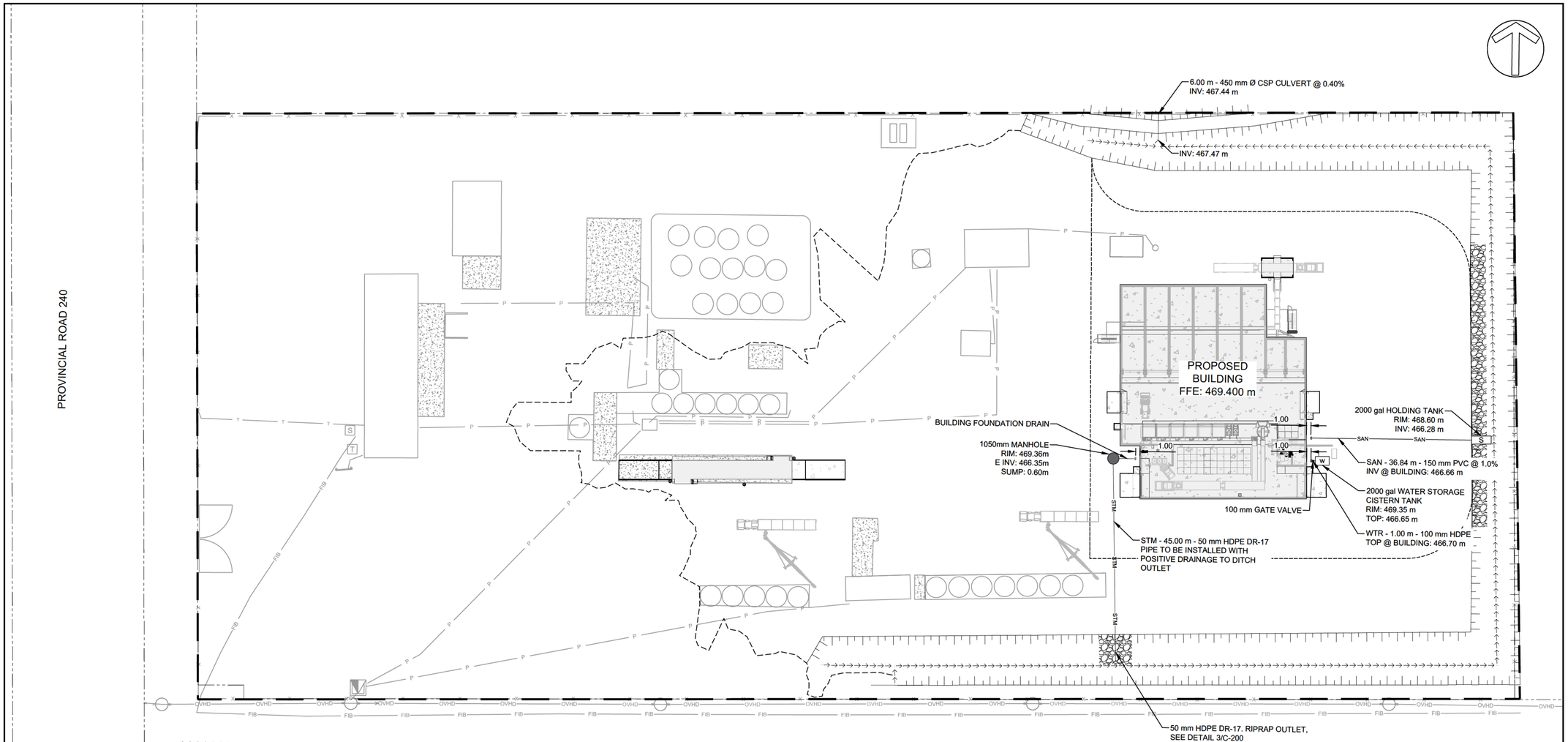
TITLE:
DESIGN SUBGRADE CUT/FILL PLAN

DWG No.: C-103

SHEET: 4 OF 6

ISSUE-REVISION
A-1

Last Saved Date: April 29, 2025
Filename: C:\USERS\BRADT\SHARED\ONEDRIVE - LANDWORKS CIVIL ENGINEERING LTD\PROJECTS\20252501 - NUTRIEN DARLINGFORD\05 CAD\2501_C101-C104, C-200.DWG
Last Plotted Date: April 29, 2025



HATCH LEGEND:	EXISTING
CONCRETE	

LEGEND	EXISTING	PROPOSED
POWER POLE		
SIGN		
COMMUNICATION TOWER	T	
SEPTIC TANK	S	S
WATER TANK		W
TRANSFORMER		
BENCHMARK		
MANHOLE		

LEGEND:	EXISTING	PROPOSED
PROJECT LIMITS		
PROPERTY LINE		
DITCH BOTTOM		
TOP OF BANK		
EDGE OF NEW GRAVEL		
TIE TO EXISTING GROUND		
COMMUNICATIONS	T	
FIBER OPTICS	FIB	
GAS	GAS	
OVERHEAD POWER	OVHD	
POWER	P	
FENCE	X	
BUILDING		
CULVERT	Culv	Culv
STORM		STM
SANITARY		SAN

OWNER

Nutrien Ag Solutions

NUTRIEN AG SOLUTION

YORKTON SK. S0A 3N0

CONSULTANT

Landworks Civil Engineering Ltd.

LANDWORKS CIVIL ENGINEERING LTD.
1815 RAE STREET UNIT 200
REGINA SK. S4T 2E3

SEAL

DATE:	SCALE:
APRIL 29, 2025	1:500
ISSUED BY: C. BIALOBZYSKI	
DRAWN BY: K. NARONGRITTHIKHUN	

ISSUED/REVISION

ISS	REV	DATE	DESCRIPTION
A	1	20250429	ISSUED FOR REVIEW
A	0	20250422	ISSUED FOR REVIEW

GENERAL NOTES:

1. SEE DRAWING C-100 FOR BENCHMARK INFORMATION
2. CONTRACTOR TO VERIFY LOCATION OF ALL UTILITIES PRIOR TO CONSTRUCTION.
3. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE NOTED.
4. CONTRACTOR TO RESTORE ALL DISTURBED AREAS TO BEFORE CONSTRUCTION CONDITION OR BETTER.

PROJECT:

NUTRIEN DARLINGFORD EXPANSION

TITLE:

UTILITY PLAN

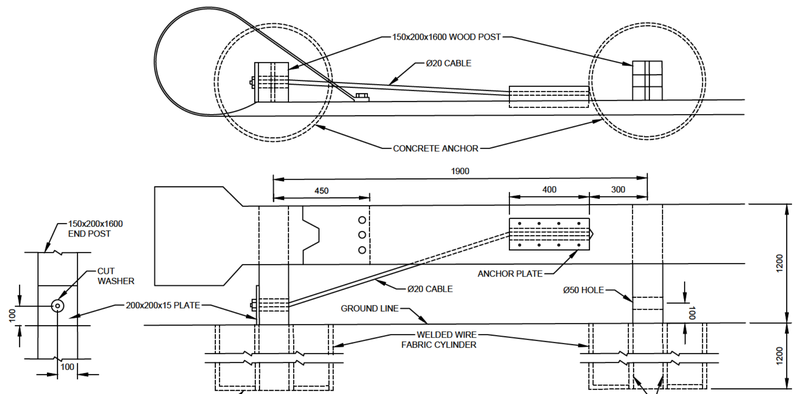
DWG No.: C-104

SHEET: 5 OF 6

ISSUE-REVISION A-1

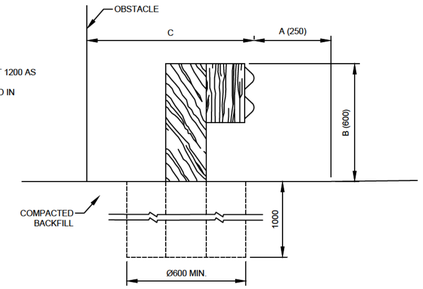
Last Saved Date: April 29, 2025
Filename: C:\USERS\BRADT\SHAREDVONEDRIVE - LANDWORKS CIVIL ENGINEERING LTD\PROJECTS\2025\2501 - NUTRIEN DARLINGFORD\05 CAD\2501_C101-C104, C-200.DWG

Last Plotted Date: April 29, 2025

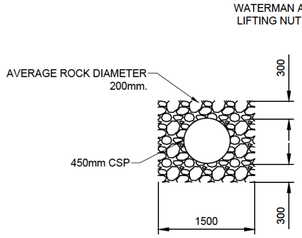


TERMINAL END DETAIL

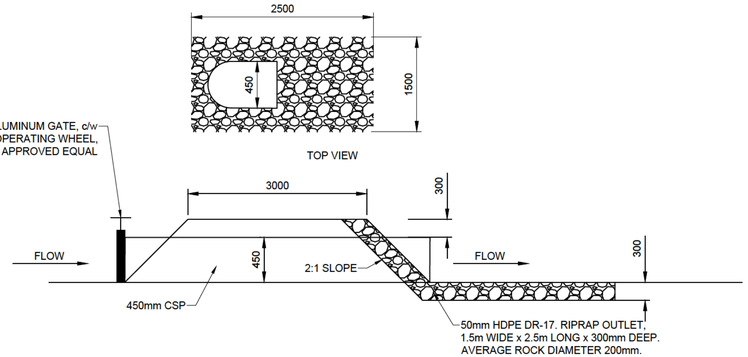
NOTES:
1. WHEN A>250mm, B=685mm
2. WHEN C>1500, POST SPACING 1905
   C<1500, POST SPACING 950
   C<850, POST SIZE 250 x 250
3. WHENEVER GUARDRAIL IS INTRODUCED, INITAL SECTION IS OFFSET 1200 AS SHOWN ABOVE, MINIMUM LENGTH OF TAPER IS 12.00m.
4. ALL GUARDRAIL STEEL AND HARDWARE TO BE GALVANIZED COATED IN ACCORDANCE WITH STELCO 50 OR APPROVED EQUAL



1 GUARDRAIL
NTS



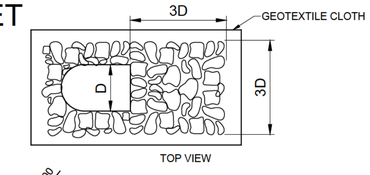
FRONT VIEW



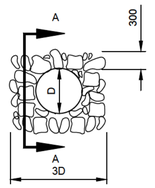
2 CULVERT
NTS

OUTLET

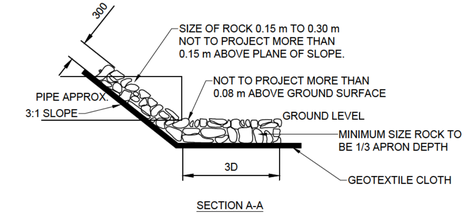
NOTE:
1. RIP RAP TO BE UNDERLAIN BY MEDIUM, THICKNESS GEO-TEXTILE FILTER CLOTH THAT IS KEYED INTO NATIVE MATERIAL AT ALL EDGES OF CLOTH.



TOP VIEW

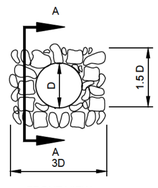


FRONT VIEW



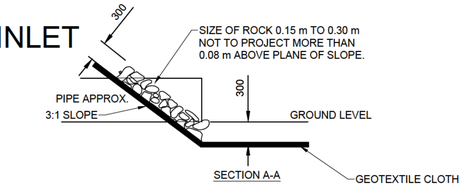
SECTION A-A

D (mm)	300	400	450	500	600	700	800	900	1000	1200	1400	1600	1800	2000
APRON DEPTH	0.45 m								0.60 m				0.75 m	



FRONT VIEW

INLET



SECTION A-A

TOTAL QUANTITIES OF RIP-RAP IN CUBIC METRES

D (mm)	300	400	450	500	600	700	800	900	1000	1200	1400	1600	1800	2000
INLET	0.32	0.56	0.71	0.88	1.27	1.73	2.26	2.85	3.52	5.07	6.91	9.02	11.42	14.10
OUTLET	0.76	1.42	1.73	2.08	2.86	3.77	4.80	5.95	8.65	12.19	16.32	21.05	30.89	37.86
TOTAL	1.08	1.98	2.44	2.96	4.13	5.50	7.06	8.80	12.17	17.26	23.23	30.07	42.31	51.96

3 EROSION CONTROL AT CULVERTS
NTS

OWNER

Nutrien Ag Solutions

NUTRIEN AG SOLUTION

YORKTON SK. S0A 3N0

CONSULTANT

Landworks Civil Engineering Ltd.

LANDWORKS CIVIL ENGINEERING LTD.
1815 RAE STREET UNIT 200
REGINA SK. S4T 2E3

SEAL

DATE: APRIL 29, 2025
SCALE: 1:500
ISSUED BY: C. BIALOBZYSKI
DRAWN BY: K. NARONGRITTHIKHUN

ISSUED/REVISION

ISS	REV	DATE	DESCRIPTION
A	1	20250429	ISSUED FOR REVIEW
A	0	20250422	ISSUED FOR REVIEW

GENERAL NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.

PROJECT:
NUTRIEN DARLINGFORD EXPANSION

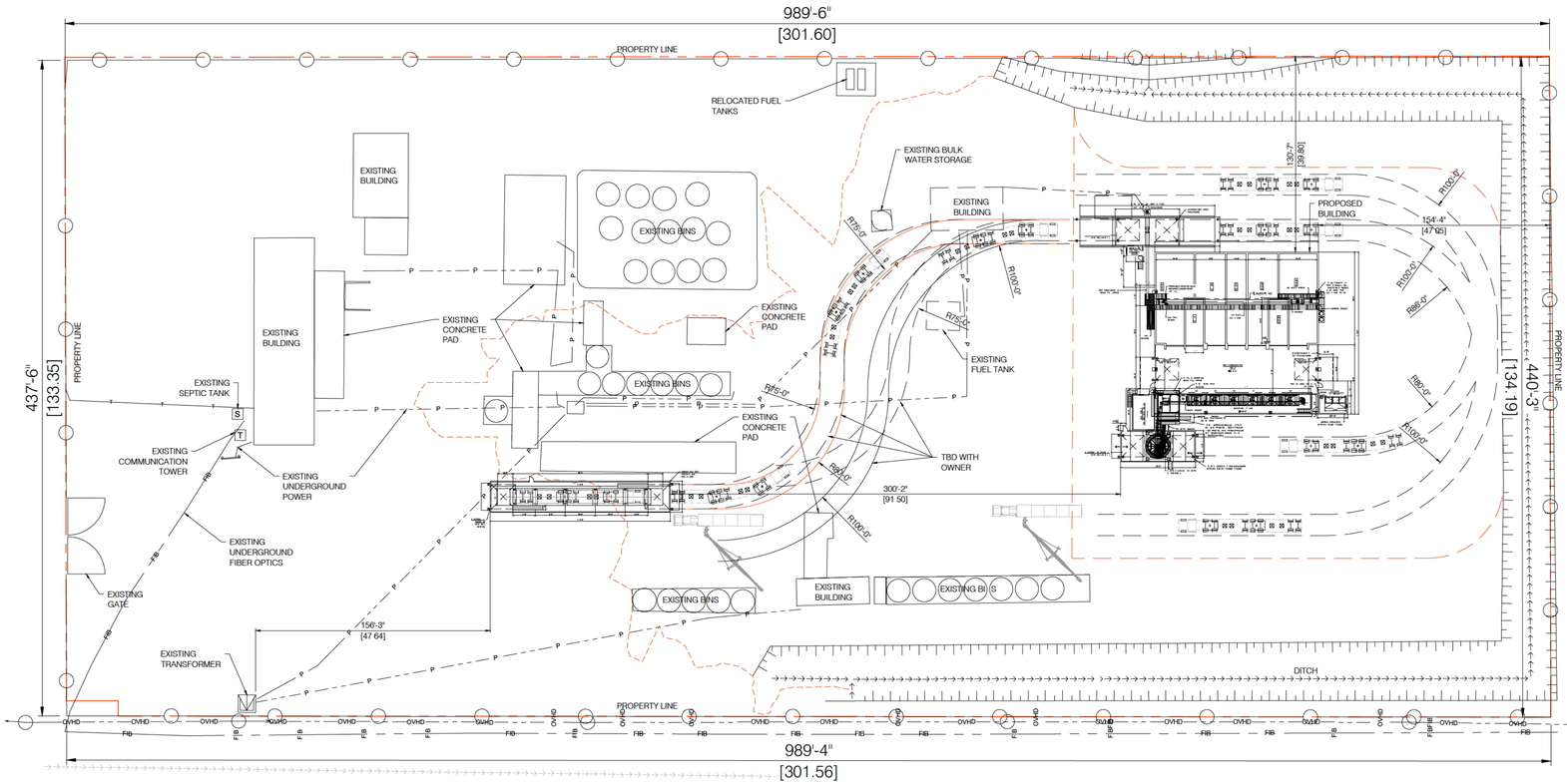
TITLE:
DETAILS

DWG No.: C-200

SHEET: 6 OF 6
ISSUE-REVISION A-1

Last Saved Date: April 29, 2025
Last Plotted Date: April 29, 2025
Filename: C:\USERS\BRADT\SHARED\ONEDRIVE - LANDWORKS CIVIL ENGINEERING LTD\PROJECTS\20252501 - NUTRIEN DARLINGFORD\05 CAD\2501_C101-C104, C-200.DWG

NORTH



1 GA-01 SITE PLAN
SCALE: N.T.S.

REVISIONS:

#	REVISION	DATE
A	ISSUED FOR INTERNAL REVIEW	30.MAY.25

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CHARLESON Engineering Ltd
STRUCTURAL CONSULTANTS
103B-1479 Buffalo Place, Winnipeg, MB R3T 1L7
Phone: (204) 895-1474 Fax: (204) 416-4606

HITECH INSTALLATIONS
1088 Fort Garry Road - St. Andrews, MB R1A 3S5
Ph: (204) 482-1029
www.hitechinstallations.ca

"WHEN CRAFTSMANSHIP COUNTS"

CLIENT:

NUTRIEN

Nutrien Ag Solutions

PROJECT:

4000MT DW SYSTEM FERTILIZER PLANT

LOCATION:

DARLINGFORD, MB

DRAWING TITLE:

GENERAL ARRANGEMENT
SITE LAYOUT

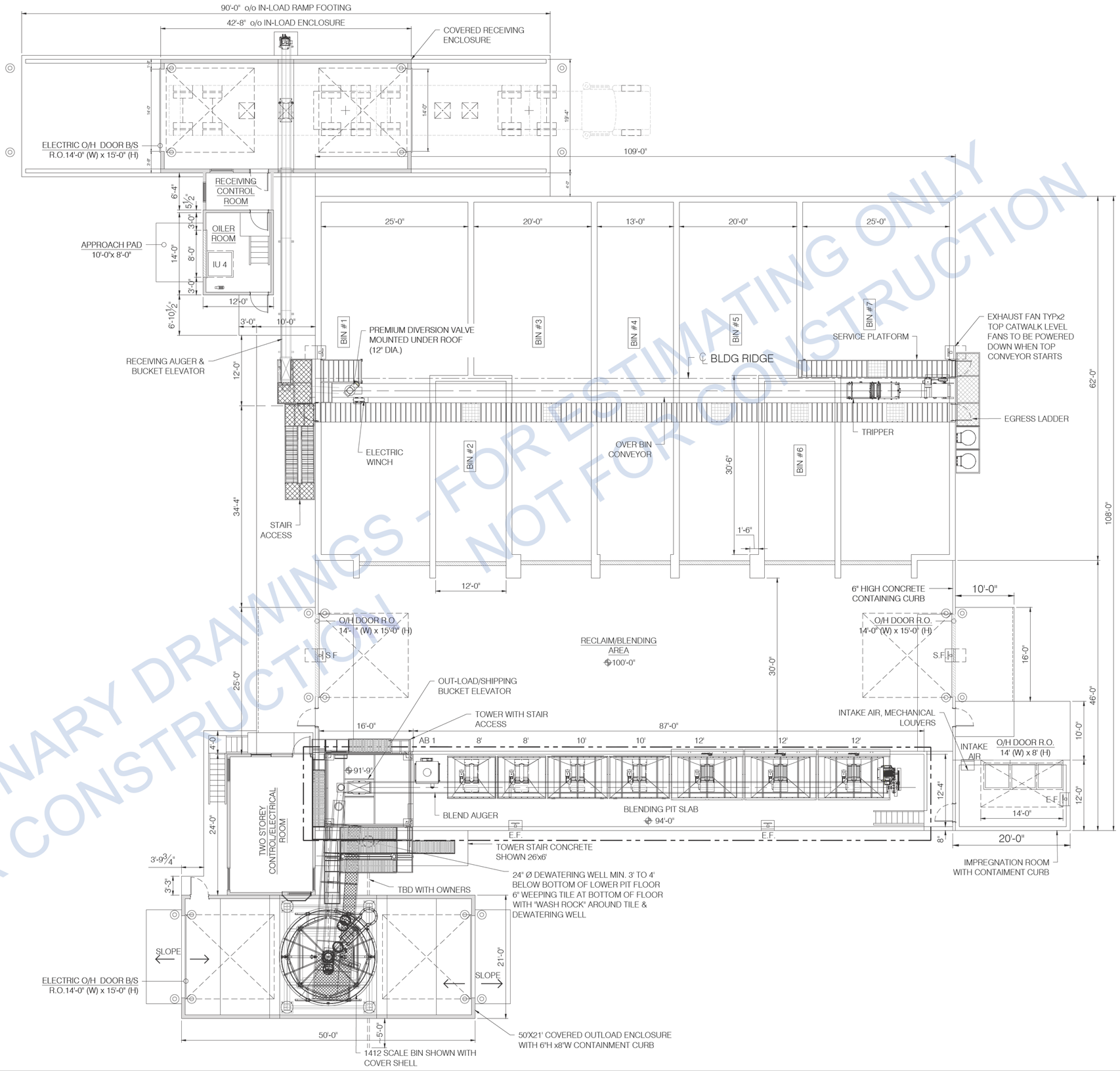
OPTION 4

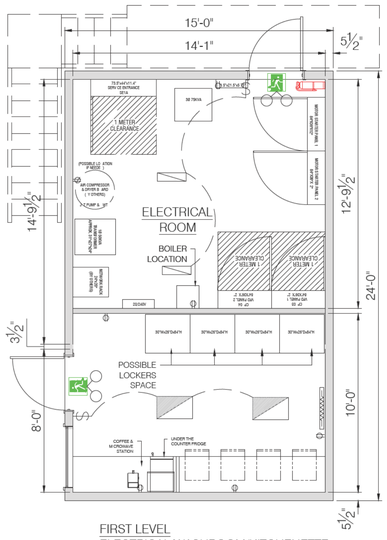
SCALE:	N.T.S.	DRAWN:	KA
DATE:	31 MARCH 2025	APPROVED:	SW
PROJECT:	SO# --	DESIGNED:	--

DRAWING No:

GA-01

NORTH





FIRST LEVEL
ELECTRICAL/WASHROOM/KITCHENETTE ROOMS

1 GA-02 PLAN VIEW
SCALE: 1/8"=1'-0"

REVISIONS:

#	REVISION	DATE
A	ISSUED FOR INTERNAL REVIEW	30.MAY.25
B	ADD OILER ROOM & BLEND PIT BINS CHANGE	05.JUNE.25

NOTES:

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STRUCTURAL CONSULTANTS
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Phone: (204) 895-1474 Fax: (204) 416-4606

PRELIMINARY
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Ph: (204) 482-1029
www.hitechinstallations.ca

"WHEN CRAFTSMANSHIP COUNTS"

CLIENT:

NUTRIEN

Nutrien™ Ag Solutions

PROJECT:

4000MT DW SYSTEM FERTILIZER PLANT

LOCATION:

DARLINGFORD, MB

DRAWING TITLE:

GENERAL ARRANGEMENT
PLAN VIEW

OPTION 4

SCALE:	NTS	DRAWN:	KA
DATE:	02 MAY 2025	APPROVED:	SW
PROJECT:	SO# --	DESIGNED:	--

DRAWING No:

GA-02

SHEET 1 OF 3 REV: B

GEOTECHNICAL INVESTIGATION

PROPOSED FERTILIZER FACILITY EXPANSION
DARLINGFORD, MANITOBA
PMEL FILE NO. 21401
JUNE 7, 2024

PREPARED FOR: Nutrien Ag Solutions (Canada) Inc.

ATTENTION: Devon Hillyer

P.MACHIBRODA ENGINEERING LTD.
DOWN TO EARTH SOLUTIONS

P.MACHIBRODA ENGINEERING LTD.

PROJECT: Geotechnical Investigation
Proposed Fertilizer Facility Expansion
Darlingford, Manitoba
PMEL File No. 21401
June 7, 2024

PREPARED FOR: Nutrien Ag Solutions (Canada) Inc.
13131 Lake Fraser Drive SE
Calgary, Alberta
T2J 7E8

ATTENTION: Devon Hillyer

DISTRIBUTION: Nutrien Ag Solutions (Canada) Inc.– Digital Copy
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806-48th Street East, Saskatoon, SK S7K 3Y4
P: 306.665.8444 | **F**: 306.652.2092 | **E**: pmel.sk@machibroda.com
www.machibroda.com

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1 INTRODUCTION

1.1 GENERAL

The following report has been prepared on the subsurface soil conditions existing at the site of the proposed fertilizer facility expansion to be constructed southeast of Darlingford, Manitoba. It is understood that the proposed expansion will consist of a dry fertilizer shed (5,000 MT), inload building and outload shipping tower.

The terms of reference for this investigation were presented in P. Machibroda Engineering Ltd. (PMEL) Proposal No. 21401, dated March 22, 2024. Authorization to proceed with this investigation was provided via the signed consulting agreement between Nutrien Ag Solutions (Canada) Inc. and PMEL, dated April 12, 2024.

1.2 SITE LOCATION AND DESCRIPTION

The proposed expansion will be located at the east end of the existing Nutrien Ag Solutions yard. The subject site was relatively level at the time of the field investigation, with an elevation difference of approximately 0.8 m measured between our boreholes. A Site Plan showing the location of the study area has been shown on Drawing No. 21401-1.

2 FIELD INVESTIGATION

2.1 FIELD DRILLING PROGRAM

The field investigation was conducted on May 6 and 7, 2024.

Six boreholes, located as shown on the Site Plan, Drawing No. 21401-1, were dry drilled using our truck-mounted, continuous flight auger drilling rig. The boreholes were 150 mm in diameter and were extended to depths of 6 to 20 m below the existing ground surface. Borehole logs, as shown on the attached Drawing Nos. 21401-2 to 6, inclusive, were compiled during test drilling to record the soil stratification, the groundwater conditions, the position of unstable sloughing soils and the depths at which cobblestones and/or boulders were encountered.

Disturbed auger cuttings and relatively undisturbed Shelby tube samples were collected during test drilling and sealed in plastic bags to minimize moisture loss. The Shelby tube and auger cutting soil samples were returned to our laboratory for analysis.

Standard penetration tests (SPT), utilizing a safety hammer with automatic trip were performed during test drilling.

Standpipe monitoring wells (slotted, 50 mm diameter PVC pipe) were installed in BH Nos. 24-1 and 24-6 to monitor the existing groundwater conditions.

2.2 FIELD SURVEY

The plan location of the boreholes was established using our handheld Global Positioning Equipment (Trimble, Model No. Geo 7X). The ground surface elevations were referenced to the top of an existing buildings floor slab, located approximately as shown on the Site Plan, Drawing No. 21401-1. A datum elevation of 100.00 m was assumed for the top of the floor slab.

3 SOIL AND GROUNDWATER CONDITIONS

3.1 SOIL PROFILE

The general soil profile consisted of clay fill, clay and/or silt (to a depth of 0.3 to 1.8 m below existing ground surface) followed by glacial till that extended to the maximum depth drilled during the field investigation (i.e., 20 m below existing ground surface). Inter/intra till layers of sand/silt were encountered during test drilling. The thickest sand layer was encountered at the location of BH No. 24-5 between depths of about 9.7 to 12.9 m below existing grade.

The clay fill, clay and silt were moist, medium plastic and firm to stiff. The glacial till was moist, medium plastic and initially stiff in consistency, becoming hard with depth. The Inter/intra till sand/silt was moist to wet, well graded and compact to dense/very dense.

3.2 GROUNDWATER CONDITIONS, SLOUGHING

Groundwater seepage and sloughing conditions were encountered during test drilling. The depths at which groundwater seepage and sloughing conditions were encountered have been shown on the borehole logs.

A summary of the groundwater levels recorded in the monitoring wells installed during this investigation has been presented in Table I.

TABLE I RECORDED GROUNDWATER LEVELS

Monitoring Well No.	Monitoring Well Rim Elevation (m)	Ground Surface Elevation (m)	Groundwater Depth (m)		Groundwater Elevation (m)	
			IAD[1]	May 29, 2024	IAD[1]	March 6, 2024
24-1	100.3	99.1	Dry	3.5	Dry	95.6
24-6	100.8	99.8	Dry	Dry	Dry	Dry

[1] Immediately After Drilled

Examination of Table I, revealed that the groundwater level was measured between depths of 3.5 and greater than 6 m below existing ground surface on May 29, 2024. It is possible that the monitoring wells did not achieve static equilibrium on the date measured. Additionally, groundwater levels can fluctuate in elevation during the course of the year, with the highest levels typically encountered during spring thaw and/or periods of precipitation.

3.3 COBBLESTONES AND BOULDERS

Glacial till consists of a heterogeneous mixture of gravel, sand, silt and clay-sized particles. Glacial till inherently contains sorted deposits of the above particle sizes as well as a random distribution of larger particle sizes in the cobblestone range (60 to 200 mm) and boulder-sized range (larger than 200 mm). Inter till/intra till deposits of cobblestones, boulders and isolated deposits of saturated gravel should be anticipated.

Cobblestones and/or boulders were encountered in the sand and glacial till deposits during test drilling. The frequency of encountering such deposits will increase proportionately with the number and depth of piles installed and/or volume of soil excavated.

4 LABORATORY ANALYSIS

The soil classification and index tests consisted of a visual classification of the soil, water contents, Atterberg limits, unit weights, grain size distribution analysis, water soluble sulphates, unconfined (UC) compressive strengths and one-dimensional consolidation testing.

The results of the soil classification and index tests conducted on representative samples of soil have been plotted on the borehole logs alongside the corresponding depths at which the samples were recovered, as shown on Drawing Nos. 21401-2 to 7, inclusive.

The results of the grain size distribution analyses have been shown plotted in Appendix B.

Laboratory oedometer (consolidation) testing was undertaken on a Shelby tube recovered from the subsurface soils to measure stress history and deformation characteristics. A summary of the consolidation test results has been presented in Table II and in Appendix B.

TABLE II SUMMARY OF CONSOLIDATION RESULTS

BH No.	Depth (m)	Soil Type	Compression Index, Cc	Recompression Index, Cr	Preconsolidation Pressure, σ_p' (kPa)	OCR
24-2	4.5-4.9	Glacial Till	0.19	0.03	400	5

Examination of Table II revealed that the tested soils were over-consolidated and low compressible.

5 DESIGN RECOMMENDATIONS

Based on the foregoing outline of soil test results, the following foundation considerations and design recommendations have been presented.

5.1 DESIGN CONSIDERATIONS

It is understood that the proposed expansion will consist of a dry fertilizer shed (5,000 MT), inload building and outload shipping tower.

The general soil profile consisted of clay fill, clay and/or silt within the upper 0.3 to 1.8 m of the soil profile followed by an extensive deposit of glacial till (containing inter/intra-till sand lenses/layers) that extended to the maximum depth explored during drilling (i.e., 20 m below existing ground surface).

The groundwater table was measured between depths of 3.5 and greater than 6 m below existing ground surface on May 29, 2024. It should be noted that groundwater levels can fluctuate in elevation during the course of the year, with the highest levels typically encountered during spring thaw and/or periods of precipitation.

The subgrade soils are considered frost susceptible, and the potential depth of frost penetration could range from approximately 1.7 to 2.2 m, depending on surface cover, severity of winter and heat loss affects beneath/adjacent buildings; the depth of frost penetration will be greater where granular fills are utilized.

An at-grade concrete raft foundation over a prepared subgrade surface should perform satisfactorily in support of the proposed storage shed at this site. The provision of a stabilizing layer of compacted granular fill (600 mm minimum) is recommended beneath the raft to provide uniform subgrade support. The anticipated settlement of the proposed storage shed raft foundation is in the order of approximately 40 to 70 mm.

The raft foundation will be exposed to potential differential movements associated with frost action. The provision of extruded polystyrene insulation beneath and adjacent to the foundation could be considered to minimize frost induced differential movements. Increasing the depth of non-frost susceptible granular fill beneath the raft could also be considered to minimize frost affects (minimum 1 m recommended).

Drilled, cast-in-place concrete straight shaft and/or belled piles should perform satisfactorily in support of the inload building and outload tower. Temporary casing may be required where saturated sand lenses/layers are encountered. The potential for encountering saturated sand deposits increases with depth penetrated. Belled piles based approximately 5 to 6 m below existing grade could be considered in lieu of long straight shaft piles to minimize the potential for encountering wet, caving conditions and the use of temporary casing.

Recommendations have been prepared for site preparation; limit states resistance factors and serviceability; storage shed foundation; deep foundations; foundation concrete and site classification for seismic site response.

5.2 SITE PREPARATION

All loose fill and deleterious materials should be removed from the construction area. Where required, a representative of the Geotechnical Consultant should inspect the site during excavation to verify the depth of unsuitable soil which should be removed in preparation of the site for construction.

The general intent of initial site preparation is to make the subgrade suitably stable for construction activities. It is recommended that the subgrade soils within the development footprint are compacted to the following densities.

Building Areas 96 percent standard Proctor density at optimum moisture content;
Landscape Areas 90 percent standard Proctor density at optimum moisture content.

Soils which meet the required compaction level should be stable to support construction activities. It is anticipated that conventional site preparation (scarifying, moisture conditioning and re-compacting the soils) will suffice at this site. In areas with variable subgrade soils, proof rolling may be an acceptable alternative to density testing and should be reviewed by the Geotechnical Consultant.

Soils which are unstable during site preparation and fail to achieve the required compaction will require additional treatment, which may include: over-excavation and replacement and/or geosynthetic stabilization. The need for additional treatment should be reviewed by the Geotechnical Consultant during the field construction with respect to the actual conditions and project requirements.

All proposed subgrade fill should be approved by the Geotechnical Consultant prior to placement. The fill should be placed in thin lifts (maximum 150 mm loose) and uniformly compacted to 96 percent of standard Proctor density at optimum moisture content.

Utility trench excavations are susceptible to settlement and should be adequately backfilled and compacted. The magnitude of settlement is directly related to the level of compaction of the backfill material. Well compacted fills will settle a small percentage of the fill thickness whereas poorly compacted fills can settle appreciably, particularly if frozen soils are incorporated in the backfill. Efforts should be made to meet the specified compaction level in areas sensitive to settlement.

The site should be graded to provide positive site drainage away from all work areas and structures prior to, during and following construction.

This report has been prepared on the premise that significant alterations to the site will not occur (i.e., appreciable cut/fill activities). If appreciable quantities of fill will be placed on the site, settlement of the fill and underlying soils will occur which may affect the long-term performance of foundations, slabs, pavements etc. If site alterations are planned as part of site development, PMEL should be contacted to assess the impact this may have on the design recommendations and proposed site development. Based on the magnitude of site alterations, the design recommendations may need to be amended.

5.3 LIMIT STATES RESISTANCE FACTORS AND SERVICEABILITY

The National Building Code of Canada (NBCC, 2020) require the use of limit states design for the design of buildings and their structural components, including the design of shallow and deep foundations. It is expected that the designer is familiar with the limit states design method and only a brief discussion will be presented. For a detailed discussion, it is recommended to review the NBCC (2020) and/or the Canadian Foundation Engineering Manual (CFEM, 2023).

Limit states are defined as those conditions under which a structure ceases to fulfill the function for which it was designed (i.e., unsatisfactory performance). In limit states design, two conditions are assessed with respect to performance, these are:

- ultimate limit states (ULS), and
- serviceability limit states (SLS)

Ultimate limit states are concerned with the collapse mechanisms of the structure (i.e., safety), whereas serviceability limit states consider mechanisms that restrict or constrain the intended use, function or occupancy of the structure.

As per NBCC (2020), the factored soil resistance utilized for foundation design may be determined using the following resistance factors applied to the ultimate resistance values presented in the following subsections of the report.

Shallow foundations:

- Compressive Resistance, $\Phi = 0.5$
- Sliding, Based on Friction (c=0), $\Phi = 0.8$

Deep foundations:

- Compressive Resistance, $\Phi = 0.4$
- Tensile Resistance, $\Phi = 0.3$

The above resistance factors have been provided to reflect that semi-empirical methods were used to derive the soil bearing resistances presented in this report using the laboratory and in-situ data collected during this investigation.

To satisfy serviceability limit states, a settlement analysis of the foundation must also be evaluated to ensure the structures are not negatively impacted by excessive settlement at the design load. Estimated foundation settlements have been provided in Sections 5.4 and 5.5.2.

Piles exposed to lateral loads are typically designed to restrict lateral deflection of the pile head to tolerable limits. Lateral pile head deflection can be determined using the concepts presented in Section 5.5.3.

5.4 STORAGE SHED FOUNDATION

An at-grade concrete raft bearing on a layer of compacted granular fill over undisturbed stiff soil should perform satisfactorily as a foundation support for the storage shed.

The following minimum provisions should be incorporated into the design of the raft foundation.

1. All deleterious and organic material shall be removed from the foundation footprint. After removal of any unsuitable material and/or overexcavation required to reach the design subgrade level, scarify and compact the surface of the subgrade to 96 percent of standard Proctor density at optimum moisture content. Overexcavate and replace soft areas with granular fill placed and compacted in thin lifts (150 mm loose) to 98 percent of standard Proctor density at optimum moisture content.

2. Subgrade fill, if required, may consist of imported granular fill/on-site glacial till soils, placed in thin lifts (maximum 150 mm loose) and compacted to 98/96 percent of standard Proctor density at optimum moisture content, respectively.

3. A minimum of 600 mm of crushed granular base course material is recommended beneath the raft. The granular base course fill should be placed in thin lifts (maximum 150 mm loose) and compacted to 98 percent of standard Proctor density at optimum moisture content.

4. The raft, bearing on compacted granular fill over the prepared subgrade soil, may be designed to exert an unfactored ULS bearing pressure of 450 kPa. The estimated foundation settlement (assuming long term loading conditions) has been presented in Table III.

TABLE III ESTIMATED STORAGE SHED SETTLEMENT

Structure	Unfactored Bearing Pressure (kPa)	Estimated Total Settlement (mm)
Storage Shed Raft Foundation	50 to 100	40-70

5. Reinforce the concrete slab and articulate the slab at regular intervals to provide for controlled cracking.

6. Provide positive site drainage away from the foundation.

7. The foundation should not be constructed on desiccated, wet, or frozen subgrade soil or base.

8. Frost should not be allowed to penetrate beneath the foundation just prior to, during or after construction.

9. Within human occupied areas, a soil gas membrane (i.e., radon gas and moisture resistant) should be installed between the underside of the floor slab and the granular fill. Care should be taken during and following installation to minimize damaging the membrane.

If potential differential movements due to frost action are not acceptable, the magnitude of frost-related movement could be minimized if the foundation is based below the depth of frost penetration or protected with strategically placed extruded polystyrene insulation. Increasing the depth of non-frost susceptible granular fill beneath the raft could also be considered to minimize frost affects (minimum 1 m recommended).

5.5 DEEP FOUNDATIONS

5.5.1 DRILLED, CAST-IN-PLACE CONCRETE PILES AND/OR BELLED PILES

Construction difficulties are expected due to the presence of wet, inter/intra-till sand lenses/layers. Temporary casing will be required where saturated sand lenses/layers are encountered. The potential for encountering saturated sand deposits increases with depth penetrated. Belled piles based approximately 5 to 6 m below existing grade could be considered in lieu of long straight shaft piles to minimize the potential for encountering wet, caving conditions and the use of temporary casing.

Drilled, cast-in-place, straight shaft concrete piles should be designed on the basis of shaft resistance only. Belled piles may be designed on the basis of shaft resistance and end bearing resistance. The ULS and SLS resistance values for design of drilled piles have been presented in Table IV and Table V.

TABLE IV SHAFT RESISTANCE (DRILLED PILES)

Zone / Depth (m)[1]	Shaft Resistance (kPa)	
	Unfactored ULS	SLS
Neglect Zone[2]	0	0
Neglect Zone to 6	55	22
6 to 13	65	26
Below 13	125	50

Notes:

1. For the purposes of this report, design depths have been referenced to existing grade. The structural engineer must consider finished grade elevation relative to existing grade. If existing grade is altered significantly, PMEL should be consulted to confirm the design parameters.
2. The shaft resistance in the zone from finished ground surface to a depth of 2 m below finished ground surface (i.e., neglect zone) should be ignored in terms of axial capacity.
3. Minimum pile lengths should take into account the depth required to resist frost action. Piles exposed to frost action should be designed to resist frost jacking forces and may require additional consideration (refer to Section 5.5.5).
4. Piles should be reinforced to withstand all axial and lateral forces within the pile.
5. A minimum pile diameter of 400 mm is recommended for the primary structural loads. Larger pile diameters may be required to allow for the removal of cobbles and boulders in some pile holes.
6. The pile holes should be filled with concrete as soon as practical after drilling.
7. Casing will be required where groundwater seepage and sloughing conditions are encountered to maintain the pile holes open for placing of the reinforcing steel and concrete. The annular space between the casing and drilled hole must be filled with concrete. As casing is extracted, concrete in casing must have adequate head to displace all water in the annular space.
8. A minimum centre-to-centre pile spacing of not less than three pile diameters is recommended.
9. A representative of the Geotechnical Consultant should inspect and document the installation of the drilled, cast-in-place concrete piles.

TABLE V END BEARING RESISTANCE (BELLED PILES)

Depth (m) / Bearing Strata [1]	End Bearing Resistance (kPa)	
	Unfactored ULS	SLS
5 to 6/stiff to very stiff glacial till	600	200

Belling depth may vary depending on the position of seepage, sloughing, cobbles and boulders.

The following additional recommendations should be considered in the design of belled piles:

Notes:

1. Bells must be formed a minimum of one (1) bell diameter into stiff to very stiff glacial till to develop the capacities presented in Table V.

2. When determining the compressive shaft resistance of the pile, the portion of pile shaft within 1 bell diameter above the base of the bell should be discounted to account for interaction effects between the shaft and the bell.

3. Belled piles designed to resist uplift loading should have a minimum embedment ratio (d/b) of 3, where d = embedment depth and b = bell diameter (m). For bells installed to a shallower depth, the uplift capacity should be reviewed by the Geotechnical Consultant.

4. When determining the uplift resistance of the bell component of the pile, the area used in design is equal to the area of the bell minus the cross-sectional area of the shaft. Due to the interaction between the bell and shaft, the uplift resistance along the shaft should be neglected for the portion of the shaft within two (2) bell diameters from the base of the bell.

5. Concrete should be placed as soon as practical after cleaning the bell. Water should not be allowed to collect at the base of the bell prior to placing concrete.

6. The maximum diameter of the bell shall not exceed three times the shaft diameter.

7. The height of the bell should be designed to provide adequate concrete to distribute the unit stresses into the concrete without over-stressing the outer, non-reinforced concrete within the bell.

8. If belled pile groups are used, the space between adjacent bells should be at least half of the largest bell diameter. Settlement analysis will ultimately dictate acceptance of spacing. Lesser spacings may be acceptable but should be reviewed by the Geotechnical Consultant.

9. Full time inspection by a representative of the Geotechnical Consultant, employed directly by the Owner, is required to confirm pile bearing capacities and to verify suitable pile base conditions, prior to placing steel and concrete, and to document the installation of each belled pile.

5.5.2 Pile Settlement

With regards to serviceability of pile foundations, assuming good construction practices are followed and the appropriate resistance factors are applied; the settlement of individual piles at the design load will be small and should be within tolerable limits. The estimated pile settlement at working loads should be in the order of 5 to 10 mm and 10 to 20 mm for drilled, straight shaft concrete piles and belled piles, respectively.

The above is applicable to individual piles and small pile groups. Although not anticipated, foundation settlement should be evaluated where large pile groups are employed to carry the foundation load (i.e., breadth of foundation or pile cap is a similar dimension as depth of piles) or large diameter belled piles are utilized (i.e., greater than 2.5 m).

Pile foundations designed utilizing the provided SLS bearing capacities would perform similarly to pile foundations designed using the provided ULS capacities.

5.5.3 Lateral Thrust Forces

Pile deflection typically governs the design of laterally loaded piles. Subgrade reaction theory may be utilized to estimate lateral pile deflection. The estimated coefficients of horizontal subgrade reaction of the subgrade soils have been presented in Table VI.

Table VI Estimated Coefficients of Horizontal Subgrade Reaction

Zone (m) [1]	Coefficient of Horizontal Subgrade Reaction, Ks, (kN/m^3)
0 to 1.5D	0
1.5D to 6	10,000/D
6 to 9.5	15,000/D
9.5 to 13	11,000z/D
Below 13	30,000/D

[1] Depth below existing ground level.
Where D = pile diameter and z = depth (m). For large diameter piles (i.e. exceeding 1.0 m) the zone of zero horizontal subgrade reaction should not exceed 1.5 m.

For the purposes of this report, design depths have been referenced to existing grade. The structural engineer must consider finished grade elevation relative to existing grade. If existing grade is altered significantly, PMEL should be consulted to confirm the design parameters.

The response of a pile to lateral loads is highly nonlinear. Methods that assume linear behaviour, such as horizontal subgrade reaction theory, are only applicable where pile deflections are small, loading is static and pile materials are linear; these conditions do not exist in most cases and soil-pile interaction modeling (i.e., p-y method) is required to accurately model the pile behaviour. If a more detailed lateral analysis is deemed warranted, PMEL can model the interaction between the soil and the pile, in accordance with the p-y method. Specific pile details (i.e., loading, type, diameter, length, etc.) will be required in order to perform the analysis.

5.5.4 GRADE BEAMS AND PILE CAPS

Grade beams and pile caps should be reinforced at both top and bottom throughout their entire length/cross section. Grade beams (and pile caps exposed to frost action) should be constructed to allow for a minimum of 100 mm of net void space between the underside of the grade beam/pile cap and the subgrade soil (compressible void form). The finished grade/floor finish adjacent to all pile caps and grade beams should be such that water runoff is not allowed to infiltrate and collect in the void space.

5.5.5 FROST JACKING OF DEEP FOUNDATIONS

Frost jacking is a process that can cause progressive upward movement of piles due to adfreeze bond stresses (adfreeze) between the soil and the pile shaft within the depth of frost penetration. Frost jacking requires exposure to freezing conditions and frost-susceptible soils. Silty, weak or wet soils and shallow groundwater conditions typically amplify the potential for and severity of frost jacking.

The subgrade soils are frost susceptible and the potential depth of frost penetration could range from about 1.7 m (lower bound) to 2.2 m (upper bound), depending on surface cover, severity of winter and heat loss effects beneath/adjacent to buildings.

Piles in unheated/intermittently heated areas (particularly those supporting negligible to light loads) are particularly suspectable to frost jacking and must be designed to resist frost jacking forces resulting from the upper bound frost penetration depth.

Interior piles below a heated space (i.e., installed during non-freezing conditions and installed below continually heated areas) will be unaffected by frost jacking.

Perimeter piles installed below continually heated areas will experience reduced frost jacking forces (as compared to unheated areas), provided that the building envelope is designed to allow heat loss to the foundation (i.e., where the floor slab is insulated, an uninsulated strip at least 1 m wide should be provided adjacent to the perimeter foundation). In this case, the perimeter piles should be designed to resist frost jacking forces resulting from the lower bound frost penetration depth (i.e., 1.7 m).

If heat loss to the foundation is not allowed (i.e., fully insulated building envelope), the perimeter piles should be designed to resist frost jacking forces due to the upper bound frost penetration depth (i.e., 2.2 m).

Adfreeze values are difficult to quantify accurately and can vary depending on many factors. For the purposes of this report, an adfreeze value of 100 kPa is recommended for concrete piles.

Piles subject to frost action can resist frost jacking in two ways:

1. Structural resistance due to pile self-weight plus sustained (unfactored) structural loading applied to the pile head; and,
2. Geotechnical resistance due to soil/pile interaction below the depth of frost penetration.

To determine the maximum frost jacking force, the structural designer should consider the maximum adfreeze value and the recommended design frost penetration depth, as discussed above. The frost jacking force that the pile should be designed to resist would be equal to the maximum frost jacking force minus the structural resistance (i.e., point 1 above).

To determine the geotechnical resistance of the pile to resist frost jacking (i.e., point 2 above), the structural designer should consider the unfactored ULS resistance values presented in the following sections of this report (i.e., resistance factor of 1.0) applied to the soils below the recommended design frost penetration depth.

The potential for frost jacking can be reduced through prudent design and good construction practices. Such measures may include:

- Provide adequate site drainage (overland and/or subsurface) to minimize water accumulation adjacent to foundations;
- Maintain uniform pile shaft cross sections; avoid enlarged/tapered pile tops which can increase the surface area for frost to act on;
- Reduce the potential depth of frost penetration by heating and/or insulating the area;
- Utilize bond breakers between the pile and the soil within the depth of frost penetration (e.g., Sonotube forms, polyethylene sleeves, plastic wrapping, low friction coatings etc.). It is noted that some bond breakers will not be suitable for piles subject to lateral loading due to a gap between the soil and the pile.

5.6 FOUNDATION CONCRETE

The results of water-soluble sulphate testing on soil samples recovered from the subject site have been summarized in Table VII.

TABLE VII WATER-SOLUBLE SULPHATE TEST RESULTS

Borehole No.	Depth (m)	Soil Type	Water Soluble Sulphate (%)	Class of Exposure	Degree of Sulphate Exposure
24-5	3.0	Glacial Till	<0.05	--	Negligible
24-5	10.5	Sand / Silt	<0.05	--	Negligible

An examination of Table VII revealed that the measured sulphate concentration of the tested soils was less than 0.05 percent, which is considered negligible in terms of potential degree of sulphate attack. However, higher sulphate concentrations could be encountered/are anticipated within the subgrade deposits. As such, sulphate resistant cement (S-3 rating) is recommended for all foundation concrete in contact with the subgrade soils. All concrete at this site should be manufactured in accordance with current CSA standards.

It should be recognized that water soluble sulphate salts, combined with moist soils or low pH soils could render the soil highly corrosive to some types of metals in contact with the soil.

5.7 SITE CLASSIFICATION FOR SEISMIC SITE RESPONSE

Based on the consistency of the subgrade soils encountered at this site and Table 4.1.8.4A of the 2015 National Building Code, the site classification for seismic site response falls within Class D.

6 LIMITATIONS

The presentation of the summary of the borehole logs and design recommendations has been completed as authorized. Six, 150 mm diameter boreholes were dry drilled using continuous flight solid stem auger drilling equipment.

Borehole logs were compiled during test drilling which, we believe, were representative of the subsurface conditions at the borehole locations at the time of test drilling. Variations in the subsurface conditions from that shown on the borehole logs at locations other than the exact test location should be anticipated. If conditions should differ from those reported here, then we should be notified immediately in order that we may examine the conditions in the field and reassess our recommendations in the light of any new findings.

The Terms of Reference for this investigation did not include any environmental assessment of the site. No detectable evidence of environmentally sensitive materials was detected during the actual time of the field test drilling program. If, on the basis of any knowledge, other than that formally communicated to us, there is reason to suspect that environmentally sensitive materials may exist, then additional boreholes should be drilled and samples recovered for chemical analysis.

The subsurface investigation necessitated the drilling of deep boreholes. The boreholes were backfilled at the completion of test drilling. Please be advised that some settlement of the backfill materials will occur which may leave a depression or an open hole. It is the responsibility of the client to inspect the site and backfill, as required, to ensure that the ground surface at each borehole location is maintained level with the existing grade.

It is recommended that all monitoring wells should be decommissioned once they are no longer needed. PMEL will not accept any future liability associated with inadequate decommissioning of monitoring wells. Costs for decommissioning monitoring wells can be provided by PMEL upon request.

This report has been prepared for the exclusive use of Nutrien Ag Solutions (Canada) Inc. and their agents for specific application to the proposed fertilizer facility expansion to be constructed within the southeast of Darlingford, Manitoba. It has been prepared in accordance with generally accepted geotechnical engineering practices and reflects PMEL's understanding of the project based on information available at the time of preparation of this report. No other warranty, expressed or implied, is made.

The report should be referenced in its entirety, in order to properly understand the suggestions, design considerations and recommendations provided in this report. Any use which a Third Party makes of this report, or any reliance on decisions to be made based on it, is the responsibility of such Third Party. Governing Agencies such as municipal, provincial, or federal agencies having jurisdictions with respect to this development and/or construction of the facilities described herein have full jurisdiction with respect to the described development. Any other unspecified subsequent development would be considered Third Party and would, therefore, require prior review by PMEL. PMEL accepts no responsibility for damages, if any, suffered by any Third Party as a result of decisions made or actions based on this report.

Prior to completion of the final design drawings/specifications, PMEL should be retained to review the geotechnical aspects of the project plans and documents to confirm that they are consistent with the intent of this report.

The acceptance of responsibility for the design/construction recommendations presented in this report are contingent on PMEL providing field documentation and review services at the time of construction. Field reviews are necessary for PMEL to provide letters of assurance in accordance with requirements of local regulatory authorities. PMEL will not accept any responsibility on this project for any unsatisfactory performance if adequate and/or full-time inspection is not performed by a representative of PMEL.

If this report has been transmitted electronically, it has been digitally signed and secured with personal passwords to lock the document. Due to the possibility of digital modification, only those reports sent directly by PMEL can be relied upon without fault.

We trust that this report fulfills your requirements for this project. Should you require additional information, please contact us.

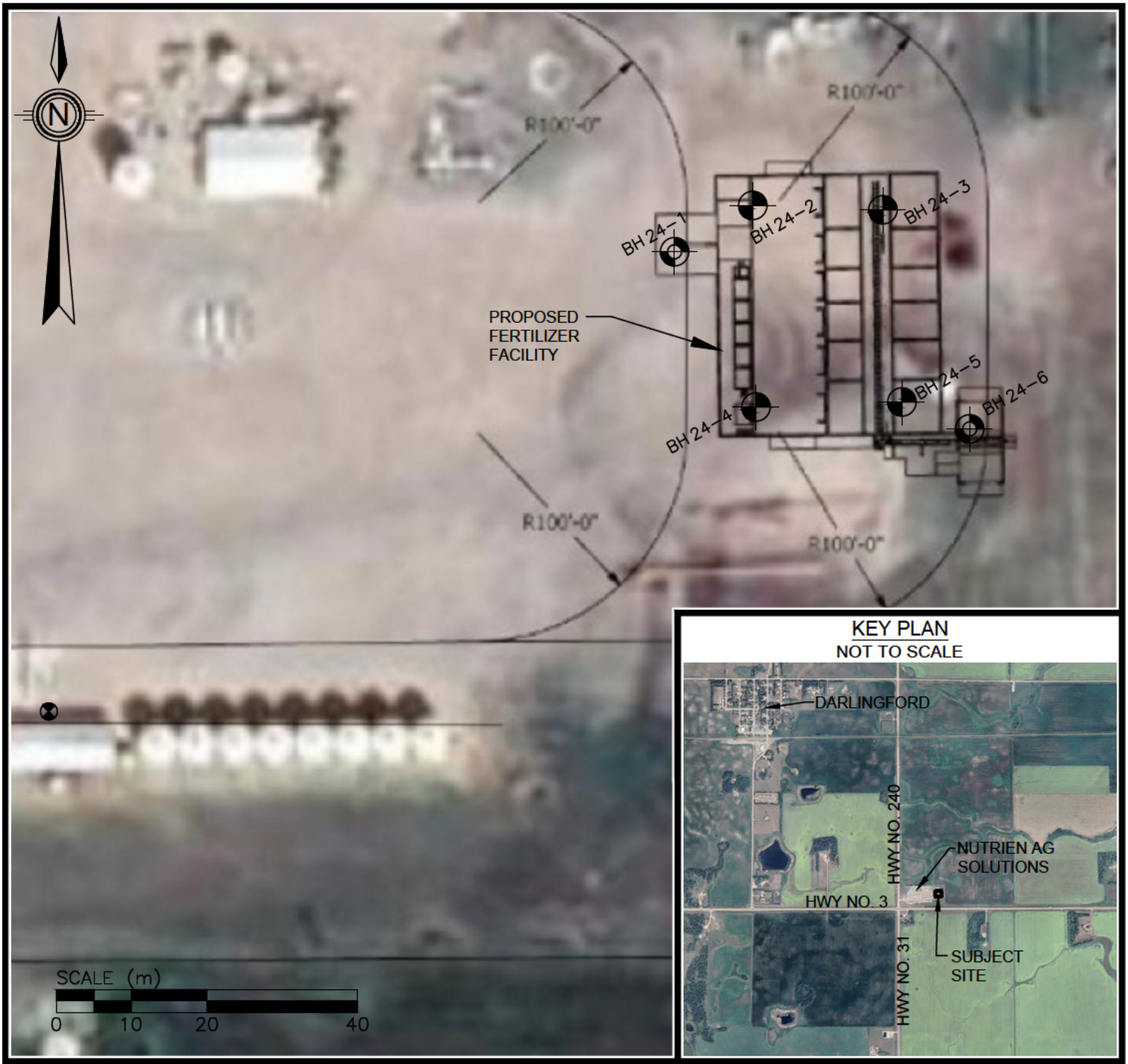
P. MACHIBRODA ENGINEERING LTD.

Eric Antymniuk, P.Eng. (SK)

Kelly Pardoski, P.Eng.
EA/KP:tbs

DRAWINGS

P.MACHIBRODA ENGINEERING LTD.



KEY PLAN
NOT TO SCALE

NOTE:
1. THIS DRAWING IS FOR CONCEPTUAL PURPOSES ONLY. ACTUAL LOCATIONS MAY VARY AND NOT ALL STRUCTURES ARE SHOWN.
2. THIS DRAWING WAS COMPILED FROM GOOGLE EARTH PRO ©2019, IMAGE ©2019 DIGITALGLOBE, (IMAGERY DATE:07/15/21).
3. THIS DRAWING (SITE PLAN) WAS COMPILED FROM DWG FROM NUTRIEN AG SOLUTIONS.
4. THIS DRAWING WAS COMPILED USING HANDHELD GPS EQUIPMENT (TRIMBLE, MODEL No. UNIT 3, GeoXH 6000).
5. BENCHMARK: TOP OF EXISTING BUILDING FLOOR SLAB. ASSUMED DATUM ELEVATION = 100.00 m.

LEGEND

– PMEL BOREHOLE

– PMEL BOREHOLE (PIEZOMETER INSTALLED)

– BENCHMARK

CONSULTING
GEOENVIRONMENTAL
GEOTECHNICAL
ENGINEERS

P. MACHIBRODA ENGINEERING LTD.

806 – 48th STREET EAST
SASKATOON, SK
S7K 3Y4

DRAWING TITLE:

SITE PLAN - BOREHOLE LOCATIONS

PROJECT:

PROPOSED FERTILIZER FACILITY EXPANSION
NUTRIEN AG SOLUTIONS, DARLINGFORD, MB

APPROVED BY:	DRAWN BY:	DRAWING NUMBER:
EA	BS	21401-1
DATE: MAY, 2024	SCALE: AS SHOWN	

P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 24-1

DRAWING NUMBER: 21401-2

PROJECT: PROPOSED FERTILIZER FACLITY EXPANSION

LOCATION: NUTRIEN AG SOLUTIONS, DARLINGFORD, MB

NORTHING (m): 5449139 **EASTING (m):** 546649 **ELEVATION (m):** 99.1 **DATE DRILLED:** MAY 6/24

SAMPLE TYPE: CUTTINGS SPLIT SPOON SHELBY TUBE

WATER LEVELS
- After Drilling
- During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/cm²)
0		CLAY, silty, trace sand, stiff, medium plastic,moist, brown.			26.4					1.5
1		SILT, some clay, trace sand, firm to stiff, medium plastic, moist to wet, brown. trace gravel below 1.2 m.			26.7					0.25
2		GLACIAL TILL, silt, some clay,some sand, trace gravel, stiff, medium plastic, moist, brown, oxide stained.		9	24.5			19.2		0.5
3					20.7					1.5
4		GLACIAL TILL, clay, some silt, some sand, trace gravel, stiff, medium plastic, moist, brown, oxide stained. very stiff below 4.3 m.		15	24.4			19.4		2.0
5		silty, stiff below 5.2 m.								
6					26.0	37	21			1.75

MONITORING WELL: BH24-1
ELEV.: 100.3 m

- BENTONITE SEAL
- 50 mm diam. SCH 40, PVC RISER PIPE
- CUTTINGS
- SANDPACKED ANNULUS
- 50 mm diam. MACHINE SLOTTED SCH 40 PVC WELL SCREEN

NOTES:
1. Borehole open and dry Immediately After Drilling.
2. Recorded Monitoring Well Groundwater Level at 3.5 m below grade (Elev 95.6 m) on May 29, 2024.

P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 24-2

DRAWING NUMBER: 21401-3

PROJECT: PROPOSED FERTILIZER FACILITY EXPANSION

LOCATION: NUTRIEN AG SOLUTIONS, DARLINGFORD, MB

NORTHING (m): 5449145 **EASTING (m):** 546659 **ELEVATION (m):** 99.0 **DATE DRILLED:** MAY 7/24

SAMPLE TYPE: CUTTINGS SPLIT SPOON SHELBY TUBE

WATER LEVELS
After Drilling
During Drilling

DEPTH (m)	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/cm²)
0	FILL, clay, silty, trace sand, stiff, medium plastic, moist, dark brown.	N		25.9					1.5
1	GLACIAL TILL, silt, sandy, clayey, trace gravel, stiff, medium plastic, moist, brown, oxide stained.	N		24.9					1.75
	stiff to very stiff 1.5 to 3 m.			24.3	41	22	19.2	240	2.0
2		N		25.2					2.0
3		N		26.5					1.75
4									
5				25.2	40	23	19.4	180	1.75
6		N		25.7					1.25
7	sand layer, moist to wet, trace seepage, trace sloughing 6.0 to 7.2 m. stiff to very stiff below 7.2 m.								
8				24.4			19.5	375	2.0
9	sand seam, wet, seepage, sloughing 8.7 to 9.2 m.	N		23.9					
10	SAND, trace gravel, trace silt, compact, well graded, fine to coarse grained, wet, dark brown, seepage, sloughing.								
11			18	31.0					
12	silty, grey below 11.7 m.	N		27.5					

CONTINUED ON NEXT PAGE

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BOREHOLE 24-2

DRAWING NUMBER: 21401-3A

PROJECT: PROPOSED FERTILIZER FACILITY EXPANSION

LOCATION: NUTRIEN AG SOLUTIONS, DARLINGFORD, MB

NORTHING (m): 5449145 **EASTING (m):** 546659 **ELEVATION (m):** **DATE DRILLED:** MAY 7/24

SAMPLE TYPE: ☐ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

WATER LEVELS
▼ After Drilling
▽ During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/cm²)	DEPTH (m)
12		SAND, silty, trace gravel, compact, well graded, fine to coarse grained, wet, grey, seepage, sloughing.									12
13		GLACIAL TILL, sand, silty, some clay, trace gravel, very stiff to hard, low to medium plastic, moist, grey.	N		27.3					4.0	13
14		hard below 14.3 m.									14
15			N		27.1					4.25	15
16			N		27.7					4.25	16
17											17
18			N		26.9					4.5	18
19											19
20			N		28.7					4.5	20
			N		25.4					4.5	
21											21
22											22
23											23
24											24

NOTES:
1. Borehole sloughed to 10.5 m immediately After Drilling.

P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 24-3

DRAWING NUMBER: 21401-4

PROJECT: PROPOSED FERTILIZER FACILITY EXPANSION

LOCATION: NUTRIEN AG SOLUTIONS, DARLINGFORD, MB

NORTHING (m): 5449145 **EASTING (m):** 546678 **ELEVATION (m):** 99.3 **DATE DRILLED:** MAY 7/24

SAMPLE TYPE: ☐ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

WATER LEVELS
▼ After Drilling
▽ During Drilling

DEPTH (m)	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/cm²)
0	SILT, clayey, trace sand, stiff, medium plastic, moist, dark brown.	N		27.1					1.0
0.2	brown below 0.2 m.								
1	GLACIAL TILL, silt, sandy, some clay, trace gravel, stiff, medium plastic, moist, brown.	N		25.8					1.5
		N		23.0					1.5
2		N		24.8					1.5
3		☒	13	23.3			20.1		1.75
4	clayey, stiff to very stiff below 4.2 m.	N		27.4					2.0
5									
6	very stiff below 6.0 m.	☒	19	24.2			19.5		2.0
7		N		28.9					2.5
8									
9		☒	18	24.4			19.4		
9.3	SAND, some silt, trace gravel, compact, well graded, fine to coarse grained, wet, dark brown, seepage, sloughing.								
10		N		30.7					
11									
12		N		30.2					

NOTES:
1. Borehole sloughed to 9.1 m Immediately After Drilling.

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BOREHOLE 24-4

DRAWING NUMBER: 21401-5

PROJECT: PROPOSED FERTILIZER FACILITY EXPANSION

LOCATION: NUTRIEN AG SOLUTIONS, DARLINGFORD, MB

NORTHING (m): 5449117 **EASTING (m):** 546659 **ELEVATION (m):** 99.2 **DATE DRILLED:** MAY 7/24

SAMPLE TYPE: CUTTINGS SPLIT SPOON SHELBY TUBE

WATER LEVELS
After Drilling
During Drilling

DEPTH (m)	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/cm²)
0	SILT, some clay, some sand, stiff, medium plastic, moist, dark brown.			23.1					1.0
0.2	brown below 0.2 m.			19.6					1.0
1	GLACIAL TILL, silt, some clay, some sand, trace gravel, stiff, medium plastic, moist, brown, oxide stained.								
1.3	clayey 1.3 to 3.3 m.		11	24.0					1.5
2									
3				24.2					1.25
4									
5	firm to stiff, moist to wet 5 to 8 m.		7	23.1			20.0		1.5
6				29.4					1.5
7									
8			6	28.8			18.7		1.5
9				26.0					
10	SAND, silty, some gravel, compact, well graded, fine to coarse grained, wet, dark brown, seepage, sloughing.								
11			23	32.0					
12				28.9					

NOTES:
1. Borehole sloughed to 9.5 m Immediately After Drilling.

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BOREHOLE 24-5

DRAWING NUMBER: 21401-6

PROJECT: PROPOSED FERTILIZER FACILITY EXPANSION

LOCATION: NUTRIEN AG SOLUTIONS, DARLINGFORD, MB

NORTHING (m): 5449117 **EASTING (m):** 546680 **ELEVATION (m):** 99.5 **DATE DRILLED:** MAY 6/24

SAMPLE TYPE: ☐ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

WATER LEVELS
▼ After Drilling
▽ During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	SULPHATE CONTENT (%)	POCKET PEN. (kg/cm²)
0		CLAY, some silt, stiff, medium plastic, moist, dark brown.	N		26.5	48	23			1.75
1		GLACIAL TILL, silt, sandy, some clay, trace gravel, stiff, medium plastic, moist, brown, oxide stained.	N		28.4					1.5
			N		26.0	40	21			1.5
2			N		23.9					1.5
3			N		24.7				<0.05	2.0
4			N		24.1					1.5
5										
6			N		25.7					1.5
7		sand seam, some gravel, wet, seepage, sloughing 7.3 to 7.8 m.	N		31.2					
8										
9		very stiff below 9.2 m.	☒	19	24.0			19.6	<0.05	1.5
10		SAND AND SILT, trace clay, trace gravel, stiff, low plastic, moist to wet, moist, trace seepage, trace sloughing.	N		31.9					
11										▽
12		SAND, some gravel, some silt, dense to very dense, well graded, fine to coarse grained, wet, brown, seepage, sloughing.								

CONTINUED ON NEXT PAGE

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BOREHOLE 24-5

DRAWING NUMBER: 21401-6A

PROJECT: PROPOSED FERTILIZER FACILITY EXPANSION

LOCATION: NUTRIEN AG SOLUTIONS, DARLINGFORD, MB

NORTHING (m): 5449117 **EASTING (m):** 546680 **ELEVATION (m):** **DATE DRILLED:** MAY 6/24

SAMPLE TYPE: ☒ CUTTINGS ☒ SPLIT SPOON ■ SHELBY TUBE

WATER LEVELS
▼ After Drilling
▽ During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/cm²)	DEPTH (m)
12		SAND, some gravel, some silt, dense to very dense, well graded, fine to coarse grained, wet, brown, seepage, sloughing. cobbles and boulders at 12.5 m.	☒	46	24.3						12
13		GLACIAL TILL, sand, silty, some clay, trace gravel, very stiff to hard, medium plastic, moist, grey.	N		24.3					4.0	13
14											14
15		hard below 15.1 m.	☒	50	24.2			18.4		4.25	15
16			N		28.5					4.5	16
17											17
18		cobbles and boulders at 17.6 m.	N		25.2	47	29			4.5	18
19											19
20		cobbles and boulders at 19.7 m.	N		16.0					4.5	20
			N		20.1					4.5	
21											21
22											22
23											23
24											24

NOTES:
1. Borehole sloughed to 15.0 m Immediately After Drilling.

P.MACHIBRODA ENGINEERING LTD.

BOREHOLE 24-6

DRAWING NUMBER: 21401-7

PROJECT: PROPOSED FERTILIZER FACLITY EXPANSION

LOCATION: NUTRIEN AG SOLUTIONS, DARLINGFORD, MB

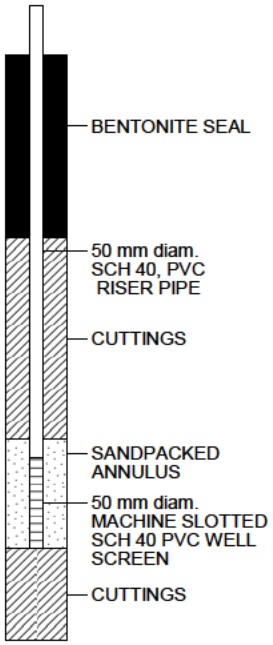
NORTHING (m): 5449114 **EASTING (m):** 546690 **ELEVATION (m):** 99.8 **DATE DRILLED:** MAY 6/24

SAMPLE TYPE: CUTTINGS | SPLIT SPOON | SHELBY TUBE

WATER LEVELS
After Drilling
During Drilling

DEPTH (m)	STRATIGRAPHY	DESCRIPTION	SAMPLE TYPE	SPT (N) BLOWS/ 300 mm	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	UNIT WEIGHT (kN/m³)	COMPRESSIVE STRENGTH (kPa)	POCKET PEN. (kg/cm²)
0		FILL, clay, some silt, some sand, trace gravel, stiff to very stiff, medium plastic, moist, dark brown.			26.2					1.75
1		GLACIAL TILL, silt, sandy, some clay, trace gravel, stiff, medium plastic, moist, brown, oxide stained.			27.2					1.5
2					25.6					1.5
3					27.5					1.5
4				15	25.5					1.5
5					25.3					1.5
6				11	25.9			19.2		1.75
7										
8										
9										
10										
11										
12										

MONITORING WELL: BH24-6
ELEV.: 100.8 m



NOTES:
1. Borehole open to 6.4 m and was dry Immediately After Drilling.
2. Recorded Monitoring Well Groundwater Level Dry on May 29, 2024.

SHEET 1 OF 1

06-07-2024 Y:\2024 Projects\21401 - Proposed Fertilizer Facility Expansion - Nutrien Ag Solutions - Darlingford, MB\Drafting\DWG\BH6-21401.bo

APPENDIX A

Explanation of Terms on
Borehole Logs

CLASSIFICATION OF SOILS

Coarse-Grained Soils: Soils containing particles that are visible to the naked eye. They include gravels and sands and are generally referred to as cohesionless or non-cohesive soils. Coarse-grained soils are soils having more than 50 percent of the dry weight larger than particle size 0.080 mm.

Fine-Grained Soils: Soils containing particles that are not visible to the naked eye. They include silts and clays. Fine-grained soils are soils having more than 50 percent of the dry weight smaller than particle size 0.080 mm.

Organic Soils: Soils containing a high natural organic content.

Soil Classification By Particle Size

Soil Type	Particles of Size
Clay	< 0.002 mm
Silt	0.002 – 0.060 mm
Sand	0.06 – 2.0 mm
Gravel	2.0 – 60 mm
Cobbles	60 – 200 mm
Boulders	>200 mm

TERMS DESCRIBING CONSISTENCY OR CONDITION

Coarse-grained soils: Described in terms of compactness condition and are often interpreted from the results of a Standard Penetration Test (SPT). The standard penetration test is described as the number of blows, N, required to drive a 51 mm outside diameter (O.D.) split barrel sampler into the soil a distance of 0.3 m (from 0.15 m to 0.45 m) with a 63.5 kg weight having a free fall of 0.76 m.

Compactness Condition	SPT N-Index (blows per 0.3 m)
Very loose	0-4
Loose	4-10
Compact	10-30
Dense	30-50
Very dense	Over 50

Fine-Grained Soils: Classified in relation to undrained shear strength.

Consistency	Undrained Shear Strength (kPa)	N Value (Approximate)	Field Identification
Very Soft	<12	0-2	Easily penetrated several centimetres by the fist.
Soft	12-25	2-4	Easily penetrated several centimetres by the thumb.
Firm	25-50	4-8	Can be penetrated several centimetres by the thumb with moderate effort.
Stiff	50-100	8-15	Readily indented by the thumb, but penetrated only with great effort.
Very Stiff	100-200	15-30	Readily indented by the thumb nail.
Hard	>200	>30	Indented with difficulty by the thumbnail.

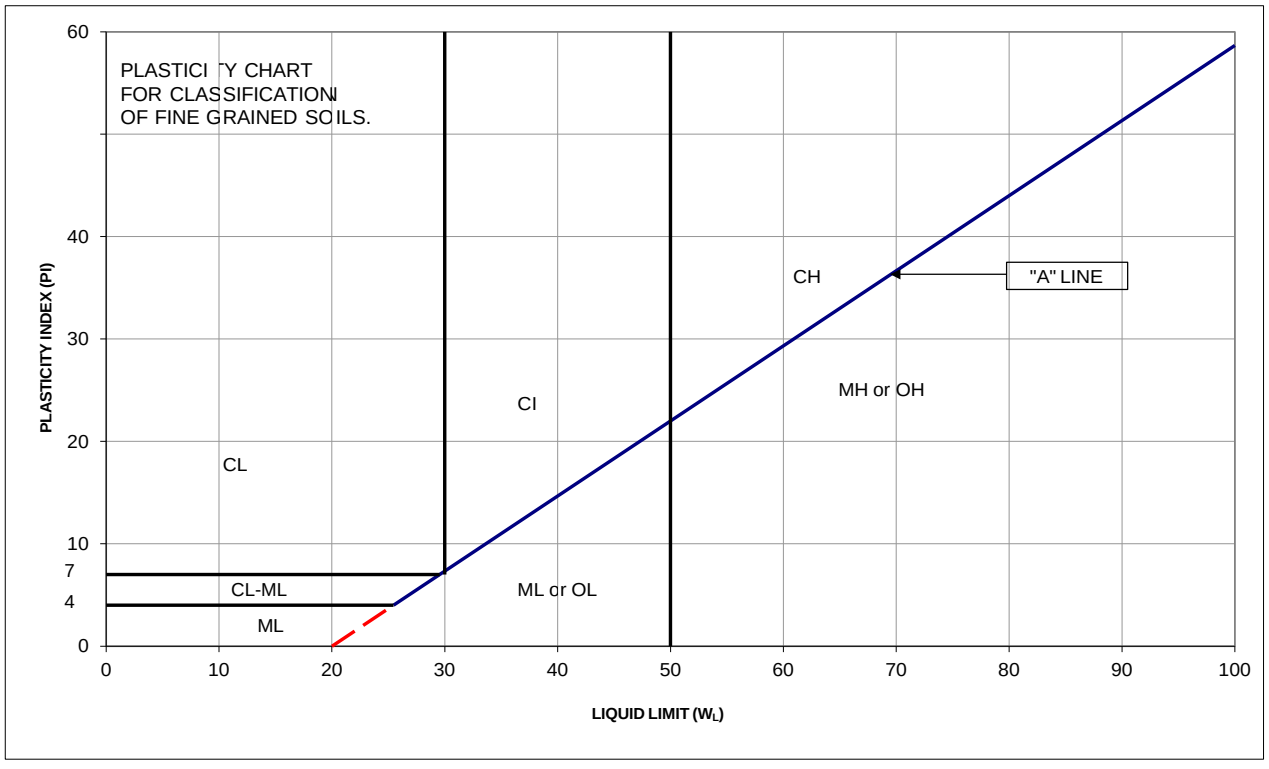
Organic Soils: Readily identified by colour, odour, spongy feel and frequently by fibrous texture.

DESCRIPTIVE TERMS COMMONLY USED TO CHARACTERIZE SOILS

Poorly Graded	- predominance of particles of one grain size.
Well Graded	- having no excess of particles in any size range with no intermediate sizes lacking.
Mottled	- marked with different coloured spots.
Nuggety	- structure consisting of small prismatic cubes.
Laminated	- structure consisting of thin layers of varying colour and texture.
Slickensided	- having inclined planes of weakness that are slick and glossy in appearance.
Fissured	- containing shrinkage cracks.
Fractured	- broken by randomly oriented interconnecting cracks in all 3 dimensions

SOIL CLASSIFICATION SYSTEM (MODIFIED U.S.C.)

MAJOR DIVISION			GROUP SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA
HIGHLY ORGANIC SOILS			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG COLOUR OR ODOUR AND OFTEN FIBROUS TEXTURE
COARSE-GRAINED SOILS(MORE THAN HALF BY WEIGHT LARGER THAN NO. 200 SIEVE SIZE)	GRAVELS More than half coarse fraction larger than No. 4 sieve size	CLEAN GRAVELS	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES <5% FINES	$C_u = \frac{D_{60}}{D_{10}} > 4 \quad C_c = \frac{(D_{30})^2}{D_{60} \times D_{10}} = 1 \text{ to } 3$
			GP	POORLY-GRADED GRAVELS AND GRAVEL-SAND MIXTURES <5% FINES	NOT MEETING ALL ABOVE REQUIREMENTS FOR GW
		DIRTY GRAVELS	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES >12% FINES	ATTERBERG LIMITS BELOW "A" LINE OR PI < 4
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES >12% FINES	ATTERBERG LIMITS ABOVE "A" LINE WITH PI > 7
	SANDS More than half coarse fraction smaller than No. 4 sieve size	CLEAN SANDS	SW	WELL-GRADED SANDS, GRAVELLY SANDS MIXTURES <5% FINES	$C_u = \frac{D_{60}}{D_{10}} > 6 \quad C_c = \frac{(D_{30})^2}{D_{60} \times D_{10}} = 1 \text{ to } 3$
			SP	POORLY-GRADED SANDS OR GRAVELLY SANDS <5% FINES	NOT MEETING ALL GRADATION REQUIREMENTS FOR SW
		DIRTY SANDS	SM	SILTY SANDS, SAND-SILT MIXTURES >12% FINES	ATTERBERG LIMITS BELOW "A" LINE OR PI < 4
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES >12% FINES	ATTERBERG LIMITS ABOVE "A" LINE WITH PI >7
FINE-GRAINED SOILS (MORE THAN HALF BY WEIGHT PASSING NO. 200 SIEVE SIZE)	SILTS Below "A" line on plasticity chart; negligible organic content		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY SANDS OF SLIGHT PLASTICITY	$W_L < 50$
			MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOILS	$W_L > 50$
	CLAYS Above 'A" line on plasticity chart; negligible organic content		CL	INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY, OR SILTY CLAYS, LEAN CLAYS	$W_L < 30$
			CI	INORGANIC CLAYS OF MEDIUM PLASTICITY, SILTY CLAYS	$W_L > 30 < 50$
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	$W_L > 50$
	ORGANIC SILTS & ORGANIC CLAYS Below "A" line on plasticity chart		OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	$W_L < 50$
			OH	ORGANIC CLAYS OF HIGH PLASTICITY	$W_L > 50$



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APPENDIX B

Laboratory Test Results

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Proposed Fertilizer Facility Expansion

Location: Darlington, MB

Project No.: 21401

Date Tested: May 22, 2024

Borehole No.: 24-2

Sample No.: 36

Depth (m): 4.5-4.9

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.100	100
1"	25.400	100
3/4"	19.100	100
1/2"	12.700	100
3/8"	9.500	100
# 4	4.750	99
# 10	2.000	96
# 20	0.850	91
# 40	0.425	86.7
#60	0.250	82.7
# 100	0.150	78.9
# 200	0.075	73.4

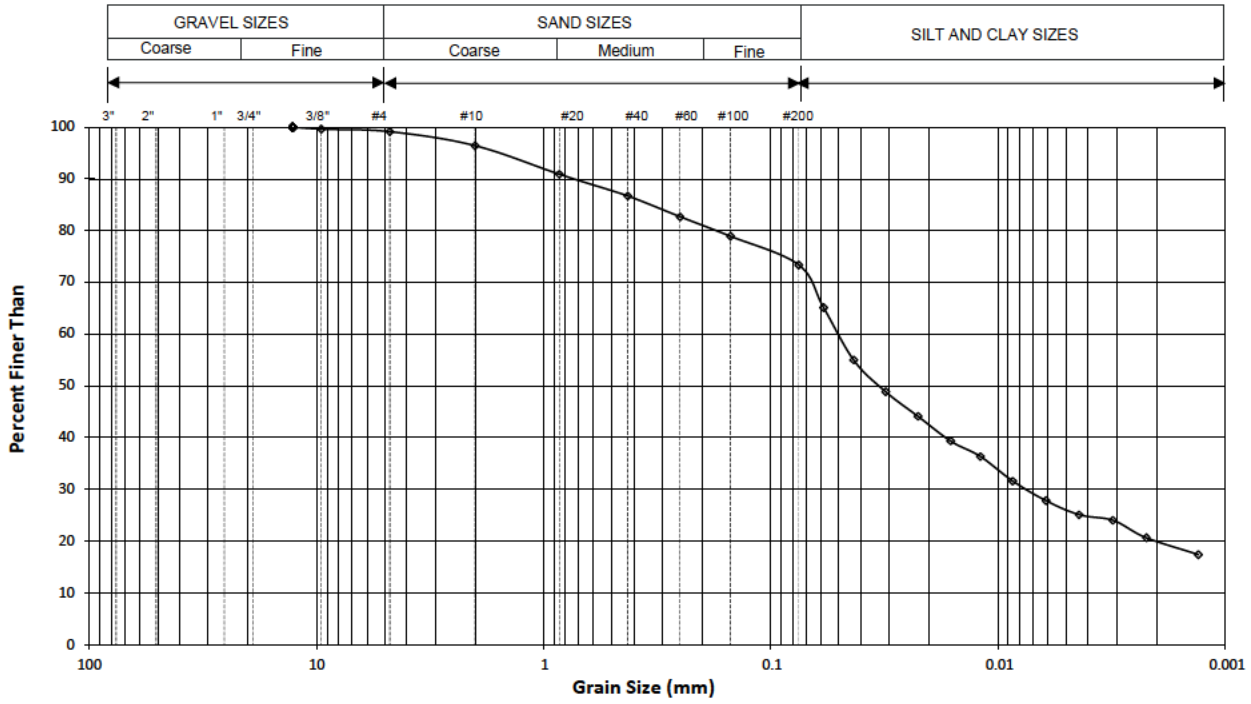
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0584	65.1
Sodium Hexametaphosphate	0.0430	55.0
	0.0311	48.9
	0.0224	44.1
	0.0161	39.3
	0.0119	36.3
	0.0086	31.6
	0.0061	27.8
	0.0044	25.1
	0.0031	24.0
	0.0022	20.6
	0.0013	17.4

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
1	26	53	20

Remarks:



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Drawing No.

Appendix B-1

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD
P. MACHIBRODA ENGINEERING LTD.

PER [redacted]

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Proposed Fertilizer Facility Expansion

Location: Darlington, MB

Project No.: 21401

Date Tested: May 22, 2024

Borehole No.: 24-2

Sample No.: 37

Depth (m): 6.0

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.100	100
1"	25.400	100
3/4"	19.100	100
1/2"	12.700	99
3/8"	9.500	98
# 4	4.750	97
# 10	2.000	96
# 20	0.850	93
# 40	0.425	90.0
#60	0.250	86.7
# 100	0.150	83.7
# 200	0.075	77.0

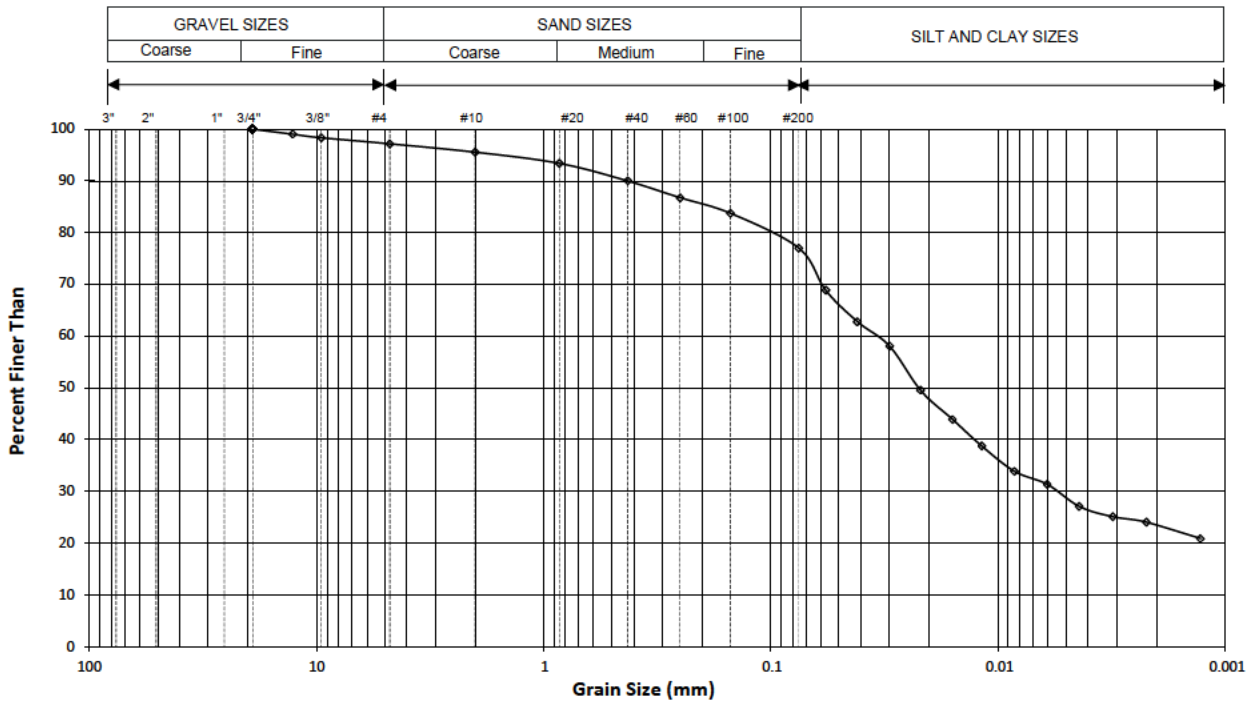
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0571	68.9
Sodium Hexametaphosphate	0.0414	62.8
	0.0299	58.1
	0.0219	49.6
	0.0158	43.9
	0.0117	38.8
	0.0084	33.9
	0.0060	31.3
	0.0044	27.1
	0.0031	25.1
	0.0022	24.0
	0.0013	20.9

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
3	20	54	23

Remarks:



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Drawing No.

Appendix B-2

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD
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PER [redacted]

P.MACHIBRODA ENGINEERING LTD.

AASHTO T 88: PARTICLE SIZE ANALYSIS OF SOILS

Project: Proposed Fertilizer Facility Expansion

Location: Darlington, MB

Project No.: 21401

Date Tested: May 22, 2024

Borehole No.: 24-2

Sample No.: 43

Depth (m): 15.0

Sieve Analysis:

Sieve	Diameter mm	% Finer
1.5"	38.100	100
1"	25.400	100
3/4"	19.100	100
1/2"	12.700	100
3/8"	9.500	100
# 4	4.750	99
# 10	2.000	98
# 20	0.850	89
# 40	0.425	72.3
#60	0.250	60.7
# 100	0.150	53.7
# 200	0.075	47.2

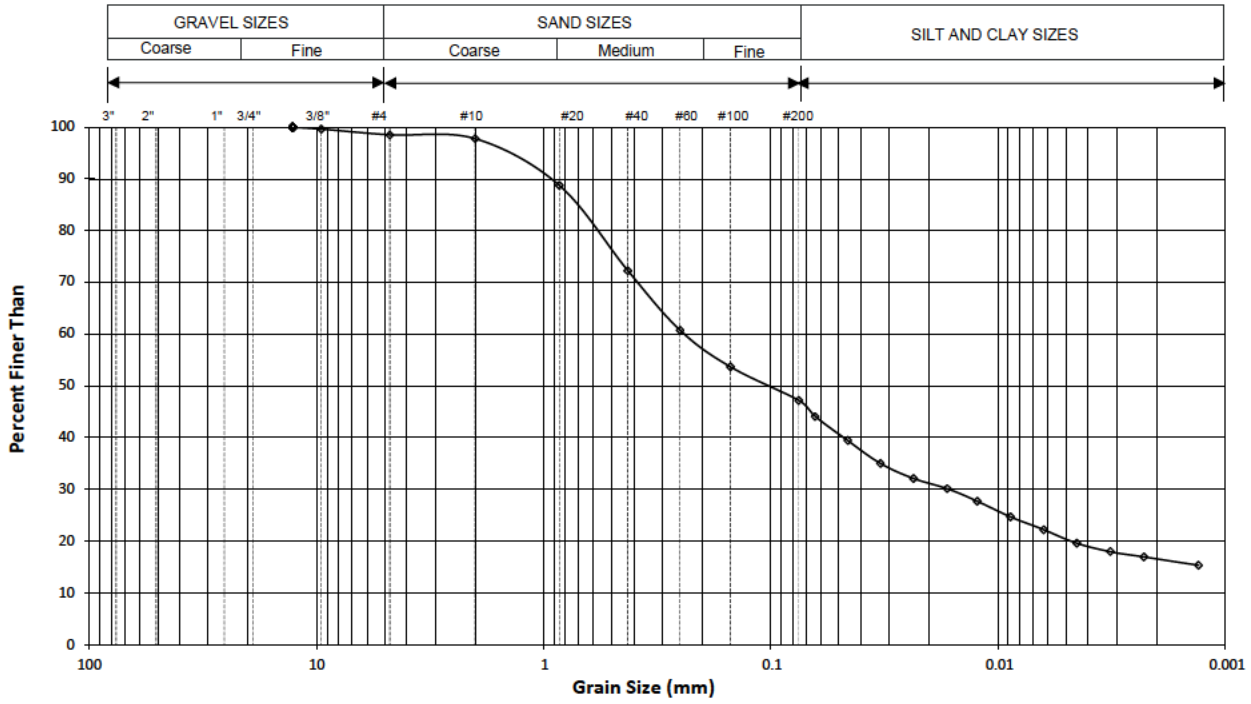
Hydrometer Analysis:

	Diameter mm	% Finer
Dispersing Agent:	0.0636	44.1
Sodium Hexametaphosphate	0.0457	39.4
	0.0328	35.0
	0.0234	32.1
	0.0167	30.1
	0.0123	27.7
	0.0088	24.6
	0.0063	22.2
	0.0045	19.6
	0.0032	17.9
	0.0023	16.9
	0.0013	15.3

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt Sizes	% Clay Sizes
1	52	31	16

Remarks:



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Drawing No.

Appendix B-3

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH AASHTO T 88 STANDARD
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PER [redacted]

P.MACHIBRODA ENGINEERING LTD.

ASTM C136: GRAIN SIZE ANALYSIS

Project: Proposed Fertilizer Facility Expansion

Location: Darlingford, MB

Project No.: 21401

Date Tested: May 10, 2024

Borehole No: 24-4

Sample No.: 57

Depth: 12.0

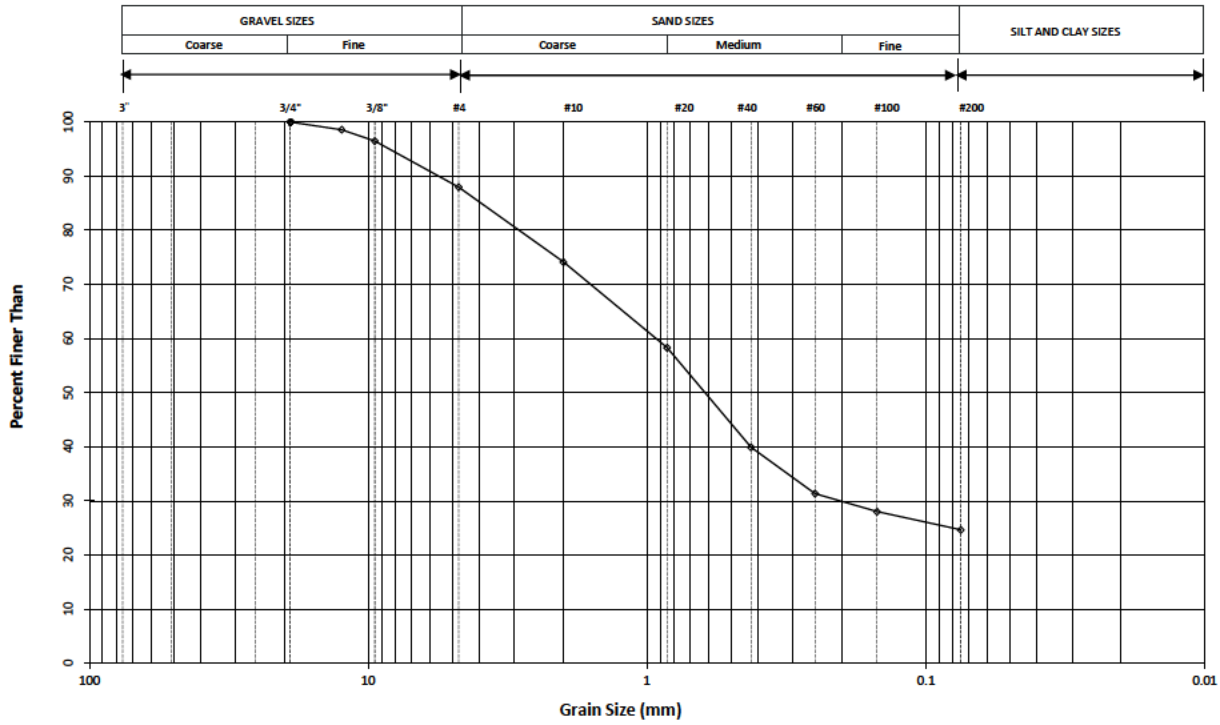
Sieve Analysis:

Sieve	Diameter mm	% Finer
	76.200	100
	63.500	100
	50.000	100
	37.500	100
	25.000	100
	19.000	100
	12.500	99
	9.500	96
	4.750	88
	2.000	74
	0.850	58
	0.425	40
	0.250	31
	0.150	28
	0.075	25

Material Description:

% Gravel Sizes	% Sand Sizes	% Silt and Clay Sizes
12	63	25

Remarks:



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DRAWING NO.

Appendix B-4

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH ASTM C136 AND C117 CSTANDARDS
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PER [redacted]

ASTM D2435: ONE-DIMENSIONAL CONSOLIDATION TEST REPORT

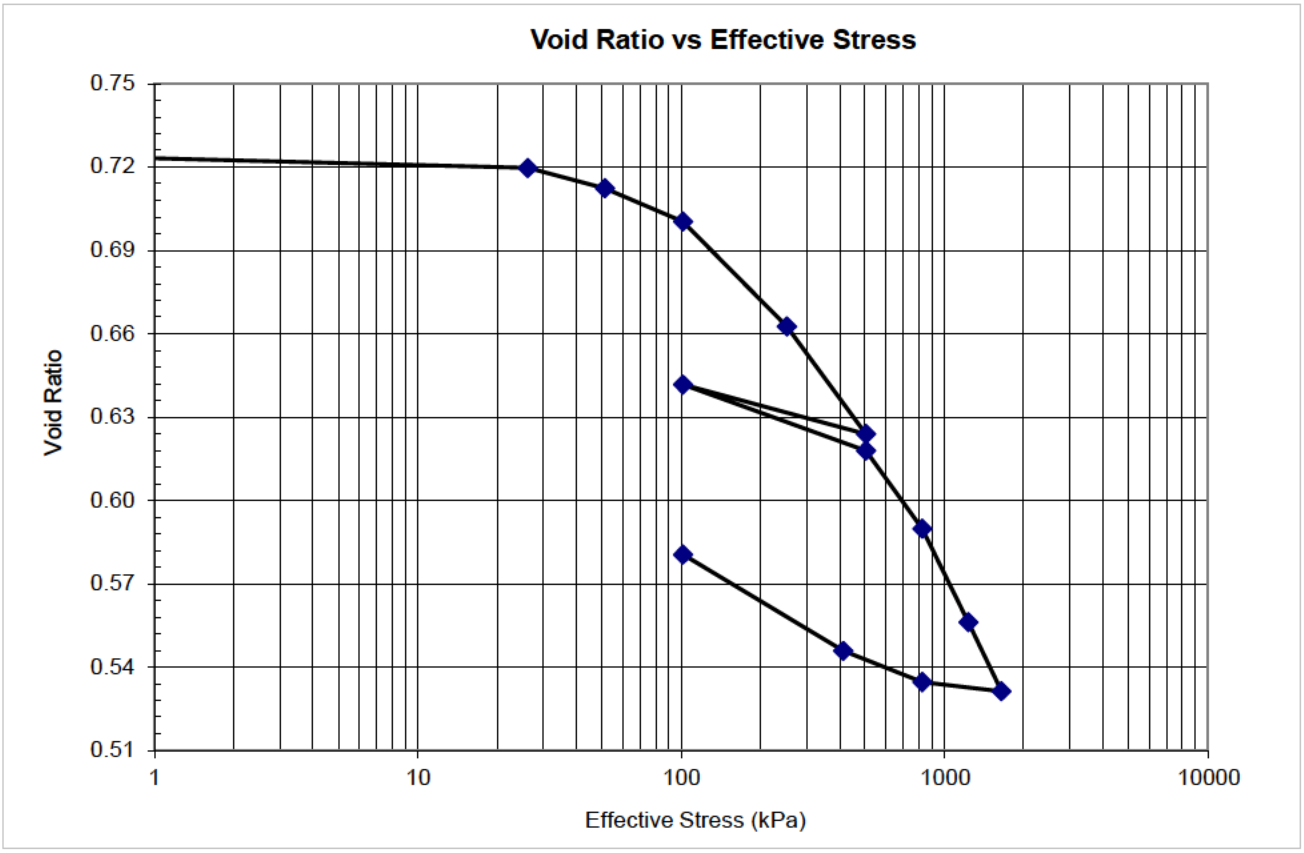
Project No:	21401	**Project Name:**	Proposed Fertilizer Facility Expansion
Date:	15-May-24	**Borehole No.**	24-2
Sample No:	36	**Depth:**	4.5 - 4.9 m
Condition of the Test:	Inundated		

Test Report:

Soil Type:	Glacial Till
Compression Index (C_c):	0.194
Recompression Index (C_r):	0.034
Swelling Index (C_s):	0.041
Preconsolidation Pressure (σ_p'):	400 kPa

Effective Stress (kPa):	26	51	102	253	504	102	504	825	1236
Void Ratio:	0.720	0.712	0.700	0.663	0.624	0.642	0.618	0.590	0.556

Effective Stress (kPa):	1648	825	413	102
Void Ratio:	0.531	0.535	0.546	0.581



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Drawing No.

Appendix B-5

WE CERTIFY TESTING PROCEDURES ARE IN ACCORDANCE WITH ASTM D2435 STANDARD
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PER [redacted]