Technical Document LA24038

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	LA24038	NW 10-11-21 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.

September 5 2024
Date of signing

[redacted]
Signature

Vanden Dool Farms Ltd
Corporate name (if applicable)

Peter Vanden Dool
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)
increase existing catch basin	40 x 40 x 3.6 m (final dimensions)

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

Existing facilities	Dimensions (m) (length, width, and depth)	NRCB USE ONLY
LA17027 (and LA18029)		see next page

NRCB USE ONLY

All facilities and dimensions confirmed

Last updated September 11, 2023

Existing Facilities

		dimensions in (m)
1	Old dairy barn	76 x 20.8
2	Calf barn 1	10 x 23
3	old maternity barn	21.8 x10.8
4	old EMS	19.3 x 33 x 3.6
5	old dry cow barn	14.2 x 24
6	New dairy barn	31.9 x 182.8 + 21.6 x 114.6
7	new EMS	100 x 45 x 3.6 (actual size 115 x 66 x 6.5 deep)
8	old catch basin	37 x 32 x 3.6 (to be expanded)
9	feed pens	20 x 46 + 141.6 x 30 + 17 x 44.5 + 86 x 24 + 23 x 30.5
10	solid manure storage pad	6.1 x 7.3
11	New calf barn	31.7 x 19.5 + 7.3 x 3
12	New catch basin	75 x 50 x 6


Untitled Map
Write a description for your map.
Legend
catch laggon
2
1
11
3
5
10
6
12
4
7
8
catch basin that is proposed to be enlarged
Google Earth
Image © 2024 Airbus
100 m
N

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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 December 2025

Additional information

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**
no changes			
This CFO is permitted for 520 dairy cows (plus associated dries and replacements)			

Last updated September 11, 2023

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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 _____
   C121111060NW

Signed this 5 day of September, 2024 [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 (old) **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 located in know flood plain
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 or EPA database
	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 or EPA database
	What is the shortest distance from the manure collection or storage facility to a surface water body? (e.g., lake, creek, slough, seasonal)	30 m to canal				☒ YES ☐ NO ☐ YES with exemption	distance catch basin to canal is 149 m, 46 m from southwest pens
Groundwater information	What is the depth to the water table?	<10 m				☒ YES ☐ NO ☐ YES with exemption	below 9 m (see drilling report
	What is the depth to the groundwater resource/aquifer you draw water from?	none				☒ 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 see Decision Summary LA24038

Facility	Groundwater score	Surface water score	File number

ERST for **existing** facilities All facilities scored low for groundwater and surface water

Facility	Groundwater score	Surface water score	File number

ERST related comments:

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NRCB USE ONLY

WATER WELL AND SURFACE WATER INFORMATION

No water wells in area

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

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

			NRCB USE ONLY				
Neighbour name(s)	**Legal land description**	**Distance (m)**	**Zoning (LUB) category**	**MDS category (1-4)**	**Distance (m)**	**Waiver attached (if required)**	**Meets regulations**
Lyle Adams	SE 9-11-21 W4	560	RG	1	567 m		yes
Brendon Grisnich	NE 10-11-21 W4	1144	RG	1	1144 m		yes
Unknown	NW 3-11-21 W4	908	RG	1	908 m		yes

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

				NRCB USE ONLY	
Name of land owner(s)*	**Legal land description**	**Usable area** (ha)**	**Soil zone *****	**Usable area (ha)**	**Agreement attached (if required)**
				No increase in manure production proposed	
			Total		

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

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

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

Additional information (attach any additional information as required)

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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: 494 m Category 2: 659 m Category 3: 824 m Category 4: 1319 m

Technology factor: ☐ YES ☒ NO

Expansion factor: ☐ YES ☒ NO

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

The expansion of the catch basin does not change the established distance to surrounding residences.

LAND BASE FOR MANURE AND COMPOST APPLICATION

Land base required: _____

Land base listed: _____ Not applicable

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 Authorization LA08010

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NRCB USE ONLY

ALL SIGNATURES IN FILE ☒ YES ☐ NO

DATES OF APPROVAL OFFICER SITE VISITS

September 5, 2024	

CORRESPONDENCE WITH MUNICIPALITIES AND REFERRAL AGENCIES

Date deeming letters sent: September 9, 2024

Municipality: Lethbridge County

☒ 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: LNID ☐ N/A

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

Other: ATCO Pipelines and Fortis Alberta ☐ N/A

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

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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. east catch basin expansion
2. _____
3. _____

Determination of runoff area

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

see calculator attached

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.	40	40	3.6	AO: 3.6 m				2468 m^3
2.								
3.								
							TOTAL CAPACITY	

Naturally occurring protective layer details

Thickness of naturally occurring protective layer	10.7 (m)	Provide details (as required)	
Soil texture	_____ % sand	_____ % silt	_____ % clay
Hydraulic conductivity - naturally occurring protective layer	Depth and type of soil tested: 10.7 clay	Hydraulic conductivity (cm/s): 4.16×10^{-8} cm/s	Describe test standard used: falling head test

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: Naturally occurring protective layer (cont.)

NRCB USE ONLY

Catch basin calculator. Total volume @ freeboard level: 2469 m^3 Runoff capacity requirements met: ☒ YES ☐ NO

Calculation of the volume attached: ☒ YES ☐ NO

Depth to water table: below drilling zone (10 m) Requirements met: ☒ YES ☐ NO

Depth to uppermost groundwater resource: _____ Requirements met: ☒ YES ☐ NO

No UGR identified. Worst case below 10 m below grade

ERST completed: ☒ See ERST page for details

Protective layer specification comments (e.g. sand lenses; layering uniform or irregular; number and location of boreholes):

Uniform layering of clay overlaying clay till of medium plasticity. No send lensing

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

Catch Basin Storage Volume Calculator

Construction Dimensions of Catch Basin

* Only cells in blue can be changed.

Overall Dimensions of Catch Basin			Catch Basin Dimensions
Total Length*4	40.0	m	131 ft
Total Width*4	40.0	m	131 ft
Total Depth*4	3.6	m	12 ft
Design Capacity Depth	*3.10*	m	10 ft
End Slope*4	3	run:rise	3 run:rise
Side Slope*4	3	run:rise	3 run:rise
Length of Bottom	18.4	m	60 ft
Width of Bottom	18.4	m	60 ft
Capacity @ top of Bank	*3,209*	m^3	*Capacity (@tob)* *113,341* ft^3 *705,985 Imp. Gal*

Design Capacity of Catch Basin (freeboard level)			Design Capacity (freeboard level)
Length (design capacity depth)	37.0	m	121 ft
Width (design capacity depth)	37.0	m	121 ft
Total Depth	*3.6*	m	*12* ft
Design Capacity Depth	3.10	m	10 ft
End Slope	3	run:rise	3 run:rise
Side Slope	3	run:rise	3 run:rise
Design Capacity (freeboard level)	**2,468**	m^3	87,156 ft^3
			542,878 Imp. Gal.
level)	*1,369*	m^2	*14,736* ft^2

CFO Name 1: (Enter CFO Name Here)
Land Location 1: 1-1-4-W5

Paved Runoff Catchment Area(s)

Area 2	Length (m)	Width (m)	Area (m^2)
1			0.0
2			0.0
3			0.0
4			0.0
5			0.0
		Total Area (m^2)	0

Unpaved Runoff Catchment Area(s)

Area 2	Length (m)	Width (m)	Area (m^2)
6			1,071.0
7			7,975.0
8			0.0
9			0.0
10			0.0
		Total Area (m^2)	9,046

Rainfall (Select Town 3)

Picture Butte 85

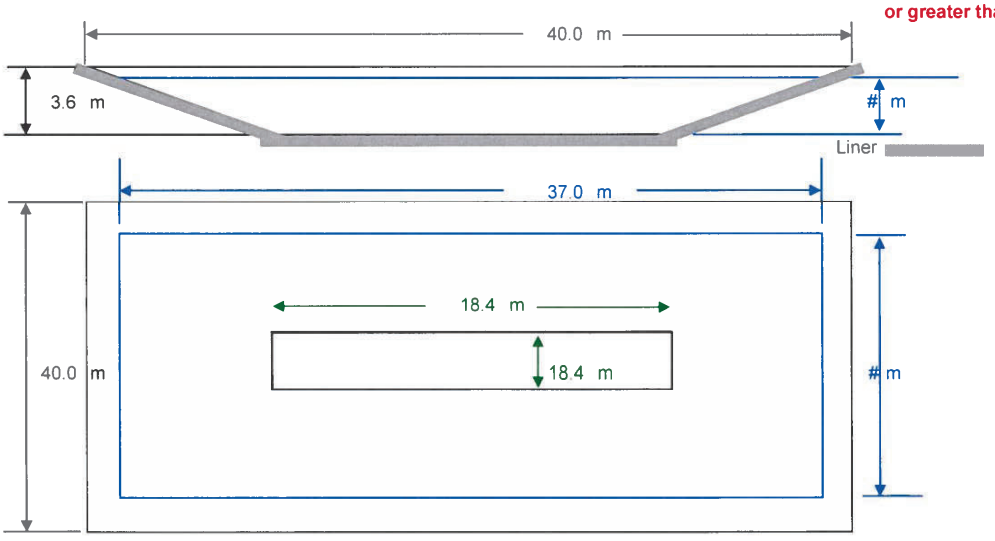
AOPA Design Rainfall 85 mm

Minimum Catchbasin Storage Volume Required

~~XXX~~ m^3 ** 16292.28 ft^3

101481.89 Imp. Gal.

** Design capacity of catch basin should be equal to or greater than, minimum storage volume required.



Lines in Black - Overall catch basin dimensions
Lines in Blue - Design capacity depth dimensions (excludes freeboard)

NTS - Not To Scale

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NRCB USE ONLY **RUNOFF CONTROL CATCH BASIN CAPACITY SUMMARY (if applicable)**	
Facility 1	
Name / description: catch basin east	Capacity: 9809 m^3
Facility 2	
Name / description: catch basin south	Capacity: 2468 m^3
Facility 3	
Name / description	Capacity
Facility 4	
Name / description	Capacity
TOTAL CAPACITY	12,277m^3
RUNOFF VOLUME FROM CONTRIBUTING AREAS	approx. 1200 m^3 including contributing areas
MEETS AOPA RUNOFF CONTROL VOLUME REQUIREMENTS	☒ YES ☐ NO

July 24, 2017

Amec Foster Wheeler File: BX30484

Vanden Dool Farms Ltd.
P.O. Box 610
Picture Butte, AB T0K 1V0

Attention: Mr. Peter Vanden Dool

Re: Geotechnical Review and Evaluation
Proposed Catch Basin
NW-10-11-21-W4, near Picture Butte, Alberta

As requested, Amec Foster Wheeler Environment & Infrastructure has carried out a geotechnical review and evaluation of the above captioned site relative to the required protection of the groundwater resource, as required by the Agricultural Operation Practices Act, AB Reg. 267/2001 (hereinafter referred to as "AOPA"). This letter encompasses the soil conditions associated with the proposed catch basin, to be located north of an existing lagoon, as illustrated on Figure 1.

In order to demonstrate the suitability of the natural clay soils for consideration as a naturally occurring protective layer, a series of threee boreholes were advanced at the site on June 14, 2017. The boreholes were advanced at the approximate locations illustrated on Figure 1.

The boreholes were advanced by a truck-mounted drill rig, and extended to depths of 7.6 m below existing grades. Chilako Drilling Services returned to the site on July 14, 2017 in order to redrill and install a new test well in borehole BH17-02. At this time, borehole BH17-02 was extended to 10.7 m depth. These boreholes were logged by an Amec Foster Wheeler EIT (see attachments).

In general, the soils encountered in the boreholes were predominantly clay till, with lacustrine medium plastic clay observed to about 3 m depth. No groundwater resource (as defined by the AOPA) was identified within the 10.7 m drilling depth.

In order to demonstrate the permeability of the subsurface soils, a 50 mm diameter PVC monitoring well was constructed in borehole BH17-02. The test well was screened from 6.9 m to 10.1 m depth. Well saturation of the 50 mm diameter monitoring well was carried out by filling the monitoring well to the top of the well for several consecutive days. After several days, the 24 hour water drop in the standpipe at BH17-02 was measured to be about 1.47 m.

In order to calculate the permeability of the screened portion of the clay stratum at the test well location, a modified falling head test (as outlined in the USBR *Engineering Geology Field Manual Volume 2* [2001]) was used. The input variables and output data are outlined on the *In Situ Permeability Test* report, attached. As outlined on the report, the results of the *in situ* permeability testing indicate a hydraulic conductivity, k_s, of **4.6×10^{-8} cm/s**.

Using the measured permeability of the clay stratum, the 3.1 m portion of clay which has been screened at borehole BH17-02 has been estimated to represent an equivalent of about 67 m of naturally occurring materials having a hydraulic conductivity of 1×10^{-6} cm/s. This represents

Amec Foster Wheeler
Environment & Infrastructure
469 – 40 Street South
Lethbridge, AB, CANADA T1J 4M1
Tel +1 (403) 327-7474
Fax +1 (403) 327-7682
www.amecfw.com

amec foster wheeler

natural material protection in excess of the minimum requirements outlined by the AOPA for catch basins (minimum 5 m, Section 9.5-b).

Conclusion

Based on the results of the current investigation and permeability testing, and our understanding of the site and proposed development at the site, it is Amec Foster Wheeler's opinion that the naturally occurring materials at the site satisfy the requirements for a naturally occurring 'protective layer' for the proposed catch basin, as outlined in the AOPA.

While a naturally occurring protective layer was ascertained for the site, it is noted that localized silty sand lenses were encountered at about 1.3 m depth in one of the boreholes. Following excavation of the lagoon, the base and sideslopes should be reviewed, and any sandy layers observed should be subexcavated to a minimum depth of 1.0 m and replaced with well compacted low permeable clay soils. The extent of excavation will require field determination at the time of construction. Amec Foster Wheeler can assist further in this regard.

We trust this satisfies your present requirements. If you have questions or require further information or clarification, please don't hesitate to contact the undersigned.

Respectfully submitted,

Amec Foster Wheeler Environment & Infrastructure
A division of Amec Foster Wheeler Americas Ltd.

PROFESSIONAL ENGINEER ALBERTA
JOHN LOBBEZOO

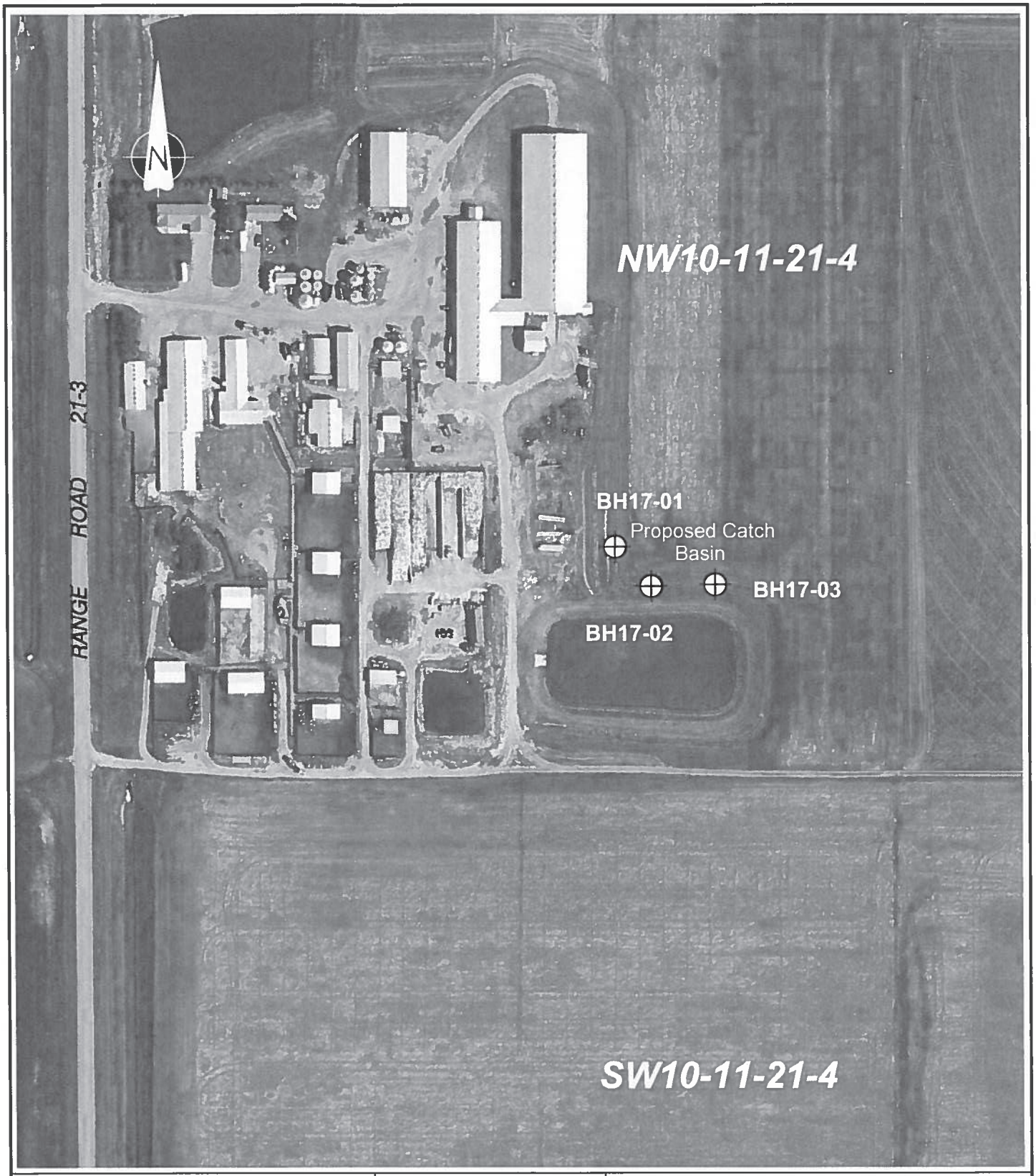
July 25, 2017

John Lobbezoo, P.Eng.
Senior Geotechnical Engineer
Lethbridge/Medicine Hat Branch Manager

APEGA Permit: P04546

Attachments:

Figure 1 – Borehole Location Plan
In Situ Permeability Test Calculations
Borehole Logs
Explanation of Symbols and Terms used on Logs



Amec Foster Wheeler Environment & Infrastructure 469 - 40th Street South Lethbridge, Alberta CANADA T1J 4M1 Tel. (403) 327-7474 Fax (403) 327-7682	amec foster wheeler	Vanden Dool Farms Ltd.		
TITLE: BOREHOLE LOCATION PLAN		DWN BY: BJ	DATUM: NA	DATE: JUNE 2017
PROJECT: Vanden Dool NRCB Permeability Testing NW10-11-21-W4M near Picture Butte, Alberta		CHK'D BY: BM SCALE: NTS	PROJECT NO: BX30484	FIGURE 1

BH17-02

In Situ Permeability Test

Modified Falling Head Permeability Equation

$$K_s = \frac{r^2}{2\ell\Delta t}\left[\frac{\sinh^{-1}\frac{\ell}{r_e}}{2}\ln\left[\frac{2H_1-\ell}{2H_2-\ell}\right]-\ln\left[\frac{2H_1H_2-\ell H_2}{2H_1H_2-\ell H_1}\right]\right]$$

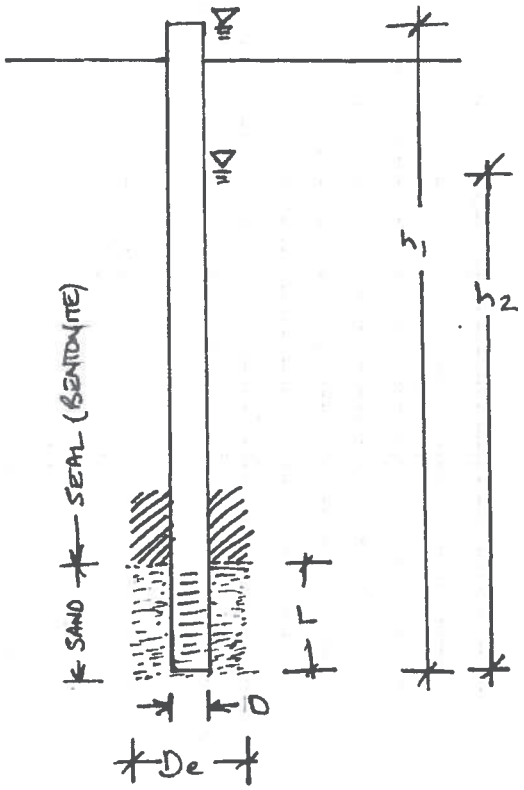
taken from USBR Engineering Geology Field Manual Volume 2 (2001)

BH 17-02 - Vanden Dool Farms Ltd.

Amec Foster Wheeler File: BX30484

INPUT VARIABLES	Terms	Value	Definition
	D	0.0520	diameter of standpipe (m)
	De	0.1500	diameter of borehole (m)
	L	3.10	length of sand section (m)
	h1	10.60	initial height of water above base of hole (m)
	h2	9.13	final height of water above base of hole (m)
	t	24.0	time of test (h)

Ks = 4.6E-08 cm/sec



PROJECT: Vanden Dool NRCB Permeability Testing	DRILLER: Biantco Environmental Services Inc.	BOREHOLE NO: **BH17-01**
CLIENT: Vanden Dool Farms Ltd.	DRILL/METHOD: Truck Mounted Drill/SSA	PROJECT NO: BX30484
LOCATION: Near west edge of proposed catch basin; Refer to Figure 1		ELEVATION: --

SAMPLE TYPE: Shelby Tube; No Recovery; SPT Test (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Slough; Grout; Drill Cuttings; Sand

Depth (m)	STANDARD PEN (N) 20 40 60 80 / PLASTIC M.C. LIQUID 20 40 60 80	SOIL SYMBOL	SOIL DESCRIPTION	SPT (N)	SAMPLE TYPE	SAMPLE NO	SLOTTED PIEZOMETER	OTHER TESTS COMMENTS	Depth (m)
0			**TOPSOIL** (300 mm thick)						0
			CLAY -medium plastic, silty, sandy, mottled brown, moist			S1		PP=1 5 kg cm2	
1						S2		PP=1 5 kg cm2	1
			CLAY TILL -medium plastic, silty, sandy, trace gravel, mottled brown, moist			S3		PP=2 0 kg cm2	
2						S4		PP=1.0 kg/cm2	2
			...softer at 2.9m depth ...coal and oxide inclusions below 3.0m depth			S5		PP=2.0 kg/cm2	
3						S6		PP=2.0 kg/cm2	3
			...intermittent sand stringers from 5.1m to 5.5m depth, loose			S7			
4						S8		PP=1.0 kg/cm2	4
			...softer from 6.1m to 7.4m depth			S9			
5						S10		PP=1.5 kg/cm2	5
			End of Borehole at 7.6 m depth						
6			Notes: 1. Borehole log to be read in conjunction with Amec Foster Wheeler report BX30484. For definitions of terms and symbols used on logs refer to sheets following logs. 2. Borehole open upon completion, surface water entry during drilling. 3. 25mm PVC standpipe installed upon completion of drilling, hand-slotted from 1.5m to 7.6m depth. Annular space backfilled with drill cuttings, bentonite cap at surface.						6
7									7
8									8
9									9
10									10
11									11
12									12
13									13
14									14
15									

BX30484.GPJ 17/07/25 08:38 AM (BOREHOLE LOG)

Amec Foster Wheeler
Environment & Infrastructure

LOGGED BY: BM
REVIEWED BY: JL

COMPLETION DEPTH: 7.60 m
COMPLETION DATE: 14/6/17

PROJECT: Vanden Dool NRCB Permeability Testing	DRILLER: Biantco Environmental Services Inc./Chilako	BOREHOLE NO: **BH17-02**
CLIENT: Vanden Dool Farms Ltd.	DRILL/METHOD: Truck Mounted Drill/SSA	PROJECT NO: BX30484
LOCATION: Near center of proposed catch basin; Refer to Figure 1		ELEVATION: --

SAMPLE TYPE: Shelby Tube; No Recovery; SPT Test (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Slough; Grout; Drill Cuttings; Sand

Depth (m)	STANDARD PEN (N) 20 40 60 80 / PLASTIC M.C. LIQUID 20 40 60 80	SOIL SYMBOL	SOIL DESCRIPTION	SPT (N)	SAMPLE TYPE	SAMPLE NO	WELL INSTALLATION	OTHER TESTS COMMENTS	Depth (m)
0			**TOPSOIL** (300 mm thick)						0
			CLAY -medium plastic, silty, sandy, dark brown, moist						
1			...brown below 0.7m depth			S1			1
			...sand/silt lens (200mm thick) at 1.3m depth			S2			
2			...softer below 1.5m depth			S3		PP=0.5 kg/cm2	2
3			**CLAY TILL** -medium plastic, silty, sandy, trace gravel, coal and oxide incluisions, brown, moist			S4		PP=0.5 kg/cm2	3
4						S5		PP=0.5 kg/cm2	4
5						S6		PP=0.5 kg/cm2	5
6						S7			6
						S8			
7			...sand stringer at 6.7m depth			S9		PP=1.5 kg/cm2	7
						S10		PP=1.5 kg/cm2	
8									8
9			...becoming grey (basal till) below 9.2m depth						9
10									10
11			**End of Borehole at 10.7 m depth**						11
12			Notes:						12
13			1. Borehole log to be read in conjunction with Amec Foster Wheeler report BX30484. For definitions of terms and symbols used on logs refer to sheets following logs.						13
14			2. Near surface seepage & sloughing (1.3m)						14
15			3. 50mm monitoring well installed by Chilako Drilling on July 14, 2017; Machine screen from 7.0m to 10.0m depth; Sand bedding from 6.95m to 10.05m depth. Bentonite plug from 2m to 6.95m.						

BX30484.GPJ 17/07/25 08:38 AM (BOREHOLE LOG)

Amec Foster Wheeler
Environment & Infrastructure

LOGGED BY: BM	COMPLETION DEPTH: 7.60 m
REVIEWED BY: JL	COMPLETION DATE: 14/6/17

PROJECT: Vanden Dool NRCB Permeability Testing	DRILLER: Biantco Environmental Services Inc.	BOREHOLE NO: **BH17-03**
CLIENT: Vanden Dool Farms Ltd.	DRILL/METHOD: Truck Mounted Drill/SSA	PROJECT NO: BX30484
LOCATION: Near east edge of proposed catch basin; Refer to Figure 1		ELEVATION: --

SAMPLE TYPE: Shelby Tube; No Recovery; SPT Test (N); Grab Sample; Split-Pen; Core

BACKFILL TYPE: Bentonite; Pea Gravel; Slough; Grout; Drill Cuttings; Sand

STANDARD PEN (N) 20 40 60 80

PLASTIC M.C. LIQUID 20 40 60 80

Depth (m)	SOIL DESCRIPTION	SPT (N)	SAMPLE TYPE	SAMPLE NO	OTHER TESTS COMMENTS
0	**TOPSOIL** (300 mm thick)				
	CLAY -medium plastic, trace organics to 0.7m depth, silty, sandy, dark brown, moist			S1	PP=0.5 - 2.0 kg/cm2
1	...brown below 0.7m depth			S2	PP=0.5 - 2.0 kg/cm2
2				S3	PP=2.0 kg/cm2
3	**CLAY TILL** -medium plastic, silty, sandy, trace gravel, coal and oxide inclusions, brown, moist			S4	PP=2.0 kg/cm2
4				S5	PP=0.5 kg/cm2
5				S6	PP=1.0 kg/cm2
6				S7	PP=1.5 kg/cm2
7				S8	PP=1.0 kg/cm2
8	**End of Borehole at 7.6 m depth**			S9	PP=1.5 kg/cm2
				S10	PP=1.5 kg/cm2
9					
10					
11					
12					
13					
14					
15					

Notes:
1. Borehole log to be read in conjunction with Amec Foster Wheeler report BX30484. For definitions of terms and symbols used on logs refer to sheets following logs.
2. Borehole open upon completion, surface water entry during drilling.
3. Borehole backfilled with drill cuttings.

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Amec Foster Wheeler
Environment & Infrastructure

LOGGED BY: BM	COMPLETION DEPTH: 7.60 m
REVIEWED BY: JL	COMPLETION DATE: 14/6/17

MODIFIED UNIFIED CLASSIFICATION SYSTEM FOR SOILS

MAJOR DIVISION			GROUP SYMBOL	GRAPH SYMBOL	COLOUR CODE	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA
COARSE GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN 75µm)	GRAVELS MORE THAN HALF THE COARSE FRACTION LARGER THAN 4.75mm	CLEAN GRAVELS (LITTLE OR NO FINES)	GW		RED	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	$C_U = \frac{D_{60}}{D_{10}} > 4$; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1$ to 3
			GP		RED	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS
		DIRTY GRAVELS (WITH SOME FINES)	GM		YELLOW	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12 %: ATTERBERG LIMITS BELOW "A" LINE OR P.I. LESS THAN 4
			GC		YELLOW	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES	CONTENT OF FINES EXCEEDS 12 %: ATTERBERG LIMITS ABOVE "A" LINE P.I. MORE THAN 7
	SANDS MORE THAN HALF THE COARSE FRACTION SMALLER THAN 4.75mm	CLEAN SANDS (LITTLE OR NO FINES)	SW		RED	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	$C_U = \frac{D_{60}}{D_{10}} > 6$; $C_C = \frac{(D_{60})^2}{D_{10} \times D_{60}} = 1$ to 3
			SP		RED	POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS
		DIRTY SANDS (WITH SOME FINES)	SM		YELLOW	SILTY SANDS, SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12 %: ATTERBERG LIMITS BELOW "A" LINE OR P.I. LESS THAN 4
			SC		YELLOW	CLAYEY SANDS, SAND-CLAY MIXTURES	CONTENT OF FINES EXCEEDS 12 %: ATTERBERG LIMITS ABOVE "A" LINE P.I. MORE THAN 7
FINE-GRAINED SOILS (MORE THAN HALF BY WEIGHT SMALLER THAN 75µm)	SILTS BELOW "A" LINE NEGLIGIBLE ORGANIC CONTENT	W_L < 50%	ML		GREEN	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY SANDS OF SLIGHT PLASTICITY	CLASSIFICATION IS BASED UPON PLASTICITY CHART (SEE BELOW)
		W_L < 50%	MH		BLUE	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDS OR SILTY SOILS	
	CLAYS ABOVE "A" LINE NEGLIGIBLE ORGANIC CONTENT	W_L < 30%	CL		GREEN	INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY OR SILTY CLAYS, LEAN CLAYS	
		30% < W_L < 50%	CI		GREEN-BLUE	INORGANIC CLAYS OF MEDIUM PLASTICITY, SILTY CLAYS	
		W_L > 50%	CH		BLUE	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	
	ORGANIC SILTS & CLAYS BELOW "A" LINE	W_L < 50%	OL		GREEN	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	WHENEVER THE NATURE OF THE FINES CONTENT HAS NOT BEEN DETERMINED, IT IS DESIGNATED BY THE LETTER "F", E.G. SF IS A MIXTURE OF SAND WITH SILT OR CLAY
		W_L > 50%	OH		BLUE	ORGANIC CLAYS OF HIGH PLASTICITY	
HIGHLY ORGANIC SOILS			Pt		ORANGE	PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG COLOUR OR ODOUR, AND OFTEN FIBEROUS TEXTURE

SPECIAL SYMBOLS

LIMESTONE		OILSAND	
SANDSTONE		SHALE	
SILTSTONE		FILL (UNDIFFERENTIATED)	

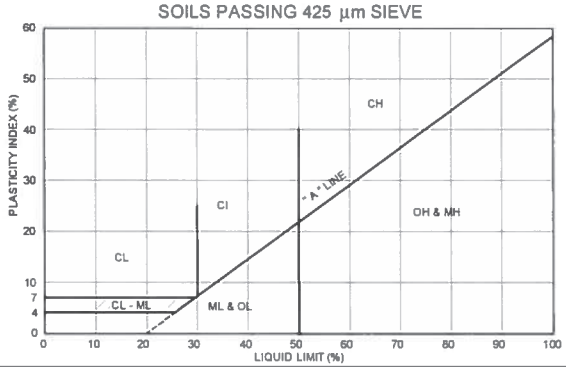
SOIL COMPONENTS

FRACTION	U.S. STANDARD SIEVE SIZE		DEFINING RANGES OF PERCENTAGE BY WEIGHT OF MINOR COMPONENTS	
GRAVEL	PASSING	RETAINED	PERCENT	DESCRIPTOR
COARSE	76mm	19mm	35-50	AND
FINE	19mm	4.75mm		
SAND			20-35	Y/EY
COARSE	4.75mm	2.00mm		
MEDIUM	2.00mm	425µm	10-20	SOME
FINE	425µm	75µm		
FINES (SILT OR CLAY BASED ON PLASTICITY)	75µm		1-10	TRACE

OVERSIZED MATERIAL

ROUNDED OR SUBROUNDED	NOT ROUNDED:
COBBLES 76mm TO 200mm	ROCK FRAGMENTS > 76mm
BOULDERS > 200mm	ROCKS > 0.76 CUBIC METRE IN VOLUME

PLASTICITY CHART FOR SOILS PASSING 425 µm SIEVE



NOTES:

1. ALL SIEVE SIZES MENTIONED ON THIS CHART ARE U.S. STANDARD A.S.T.M. E.11
2. COARSE GRAIN SOILS WITH 5 TO 12% FINES GIVEN COMBINED GROUP SYMBOLS, E.G. GW-GC IS A WELL GRADED GRAVEL SAND MIXTURE WITH CLAY BINDER BETWEEN 5 AND 12% FINES.

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EXPLANATION OF TERMS AND SYMBOLS

The terms and symbols used on the borehole logs to summarize the results of field investigation and subsequent laboratory testing are described in these pages.

It should be noted that materials, boundaries and conditions have been established only at the borehole locations at the time of investigation and are not necessarily representative of subsurface conditions elsewhere across the site.

TEST DATA

Data obtained during the field investigation and from laboratory testing are shown at the appropriate depth interval.

Abbreviations, graphic symbols, and relevant test method designations are as follows:

*C	Consolidation test	*ST	Swelling test
D_R	Relative density	TV	Torvane shear strength
*k	Permeability coefficient	VS	Vane shear strength
*MA	Mechanical grain size analysis and hydrometer test	w	Natural Moisture Content (ASTM D2216)
		w_l	Liquid limit (ASTM D 423)
N	Standard Penetration Test (CSA A119.1-60)	w_p	Plastic Limit (ASTM D 424)
N_d	Dynamic cone penetration test	E_f	Unit strain at failure
NP	Non plastic soil	γ	Unit weight of soil or rock
pp	Pocket penetrometer strength (kg/cm²)	γ_d	Dry unit weight of soil or rock
*q	Triaxial compression test	ρ	Density of soil or rock
q_u	Unconfined compressive strength	ρ_d	Dry Density of soil or rock
*SB	Shearbox test	C_u	Undrained shear strength
SO_4	Concentration of water-soluble sulphate	→	Seepage
		▼	Observed water level

* The results of these tests are usually reported separately

Soils are classified and described according to their engineering properties and behaviour.

The soil of each stratum is described using the Unified Soil Classification System[1] modified slightly so that an inorganic clay of "medium plasticity" is recognized.

The modifying adjectives used to define the actual or estimated percentage range by weight of minor components are consistent with the Canadian Foundation Engineering Manual[2].

Relative Density and Consistency:

Cohesionless Soils		Cohesive Soils		
Relative Density	SPT (N) Value	Consistency	Undrained Shear Strength c_u (kPa)	Approximate SPT (N) Value
Very Loose	0-4	Very Soft	0-12	0-2
Loose	4-10	Soft	12-25	2-4
Compact	10-30	Firm	25-50	4-8
Dense	30-50	Stiff	50-100	8-15
Very Dense	>50	Very Stiff	100-200	15-30
		Hard	>200	>30

Standard Penetration Resistance ("N" value)
The number of blows by a 63.6kg hammer dropped 760 mm to drive a 50 mm diameter open sampler attached to "A" drill rods for a distance of 300 mm.

1 "Unified Soil Classification System", Technical Memorandum 36-357 prepared by Waterways Experiment Station, Vicksburg, Mississippi, Corps of Engineers, U.S. Army. Vol. 1 March 1953.

2 "Canadian Foundation Engineering Manual", 4th Edition, Canadian Geotechnical Society, 2006.