Technical Document LA19036

# art 2 — Technical Requirements

NRCB Natural Resources Conservation Board

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

**NRCB USE ONLY**

☑ Approval ☐ Registration ☐ Authorization ☐ Amendment

Application number: LA 19036

Legal land description: NE 10-9-27 W4

## 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.

October 1, 2019
Date of signing

Signature

Corporate name (if applicable)

Erie + Willemina Muilwijk
Print name

## GENERAL INFORMATION REQUIREMENTS

**Proposed facilities.** List all proposed confined feeding operation facilities and their measurements, including if it is an addition to a an existing facility (attach additional pages if needed)

| Proposed manure collection areas & manure storage facilities | | Dimensions (m) |
|---|---|---|
| Covered Shelter | AO: Under Cover Pens | ~~82 m x 15 m~~ 82 m x 15 m |
| 3 corrals (2 existing + 1 new) | AO: Open Pens | ~~92 m x 37 m~~ 92 m x 37 m |
| Catch basin | AO: Size updated on Nov 17, 2020 to 36m x 21m x 1.8m deep at applicants request | ~~25 m x 17m x 1.5 m~~ 36m x 21m x 1.8m deep |
| AO: The under cover and open pens are proposed to have roller compacted concrete liners. The catch basin is proposed to have a synthetic liner. The under cover and open pens have already been constructed. | | |

**Existing facilities.** List **ALL** existing confined feeding operation facilities and their measurements (use additional pages if needed)

| Existing barns, manure collection areas & manure storage facility | | | Dimensions (m) | NRCB USE ONLY |
|---|---|---|---|---|
| Barn 1 | AO: East Hog Barn | | 50m x 12m | Confirmed |
| Barn 2 | AO: West Hog Barn | | 60 m x 12 m | Confirmed |
| Lagoon #1 | AO: East EMS | 40 x 25 x 1.75 m deep | 40 m x 25 m x 1.75m deep | Confirmed |
| Lagoon #2 | AO: West EMS | 20 x 20 x 2.5 m deep | 20m x 20 m x 2.5 m | Confirmed |
| The applicant requested on Nov 17, 2020 to add to their application to Decommission the concrete manure pit between the east hog barn and east EMS | | | | |

**NRCB USE ONLY**

The application does not identify that the calf hutches north of the open pens are to be considered as part of this CFO

**If a new facility is replacing an old facility, what will be done with the old facility and when?** ☐ **N/A**

**Proposed construction completion date:** November 30, 2022

**Additional information:**

AO: A drilling report was provided on November 5, 2020 showing test hole locations and test hole soil logs. An engineering report prepared by Wood Environment and Infrastructure Solutions (Wood) was provided on October 29, 2020 and updated on November 6, 2020.
Photos showing the construction of the roller compacted concrete (RCC) pads (circa November 15, 2019) were provided on November 6, 2020
The report and photographs has been appended to the end of the TD.

This information was provided by the applicant to support their application following requests for information, in May, 2020, to show how the proposed alternative liner (constructed using RCC) can meet AOPA groundwater protection requirements.

**Livestock Numbers:** (include all livestock)
Note: Livestock numbers in this table will be used when processing the application)

| Livestock type/ category | Existing number | Change in number (if applicable) | Total |
|---|---|---|---|
| Feeder Calves | 0 | + 3000 | 3000 |
| Hogs Farrow to wean | 250 | −250 | 0 |
| AO: The grandfathered hog barns are currently being used to house feeder calves and or equipment and supplies. There are no hogs on site. A grandfathered capacity determination was carried out as part of this decision and is included as an appendix in the decision summary. The determination identified that the deemed capacity as 64 sows farrow to finish , or 171 sows farrow to wean. | | | |
| | | | |
| | | | |
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| | | | |

AO: Email from applicant requesting to add/change items on their application

**From:** Arie and Willemiek Muilwijk
**To:** Andy Cumming
**Subject:** Permit Update
**Date:** Tuesday, November 17, 2020 1:49:28 PM

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Hello Andy,
Hope things are going well with you.

I would like to make some minor changes on the permit application.

1. Currently the catch basin size is listed at 31m long, 21m wide, and 1.8m deep. Could we change that to 36m long?
    a. This would help with manure management
2. Could we add in the permit application that I would like to decommission a concrete lagoon that currently sits in between Barn 1 and Lagoon 1? Piping has already been diverted around this lagoon and it is not my intent to use it for manure storage any longer.

Thanks
Arie

AO: Barn 1 = East Barn
Lagoon 1 = East EMS

AO: The concrete "lagoon" referred to is a deep concrete pit into which the manure from the East Barn flows , and from where the manure flows through a pipe into the East EMS.

# Part 2 — Technical Requirements

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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 Parks (AEP) for a confined feeding operation (CFO)

*Date and sign (or check) 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 AEP 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** AEP'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 AEP 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 AEP'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 de-populate the CFO and/or to cease further construction, or to remove "works" or "undertakings" (as defined in the *Water Act*).
6. **CHECK IF 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.

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 AEP under the *Water Act* for the development or activity proposed in this AOPA application.

Signed this ____ day of _____, 20____. _____

*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 AEP 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** AEP'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 AEP 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 AEP'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 de-populate the CFO and/or to cease further construction, or to remove "works" or "undertakings" (as defined in the *Water Act*).
6. **CHECK IF 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.

Signed this 14th day of August, 2019. _____

*Signature of Applicant or Agent*


AO: Calf Hutches - not included in application
AO: Open Pens
AO: Under Cover Pens
AO: Concrete manure pit to be decommissioned
AO: East EMS
AO: West EMS
AO: Dugout
AO: East Hog Barn
AO: West Hog Barn
Arie Muilwijk
272
785

# Part 2 — Technical Requirements

NRCB Natural Resources Conservation Board

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

| **GENERAL WATER INFORMATION – EXISTING** Barn #1 East Barn<br>**Use the existing manure storage facility that is closest to a common body of water or water well** | | | **NRCB USE ONLY**<br>**Comments** | **Meets regulations** |
|---|---|---|---|---|
| **Flood plain information**<br>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? | 14 (m) | ☑ Estimated<br>☐ From records | Not in known flood plain | ☒ YES ☐ NO<br>☐ YES with exemption |
| **Springs, wells, and surface water information**<br>a. How many springs are within 100 m of manure storage facilities or manure collection areas? | | 0 | None identified on site visit | ☒ YES ☐ NO<br>☐ YES with exemption |
| b. How many water wells are within 100 m of the manure storage facilities or manure collection areas? | | 1 ID 115735 | WW ID 115735 21 m to East Barn | ☐ YES ☒* NO<br>☐ YES with exemption |
| c. What is the shortest distance from an manure collection or storage facility to a surface water body? (ie, lake, creek, slough, seasonal, etc.) | | 1.34m irrigation canal | 1.34 km to irrigation canal | ☒ YES ☐ NO<br>☐ YES with exemption |
| **Groundwater information**<br>a. What is the depth to bedrock? | 29 (m) | ☐ Estimated<br>☐ Measured<br>☑ Drilling reports | 29 m (95 ft from ww 115735 drilling report) N/A | |
| c. What is the shallowest depth to the uppermost groundwater resource? | 24 (m) | ☑ Estimated<br>☐ Measured<br>☐ Drilling reports | 2.7 m see UGR report | Unknown<br>☐ YES ☐ NO<br>☐ YES with exemption |

**Additional information:** (attach borehole logs and records, as required)

AO: Water well ID 115735 is located in the middle of the farmyard. North of Hog Barn 1 (East Barn), West of the open feedlot pens and South of the proposed covered pens. Water well log is attached.

* - A variance will be required for proposed facilities which have already been constructed.

# Part 2 — Technical Requirements

NRCB Natural Resources Conservation Board

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

| **GENERAL WATER INFORMATION – PROPOSED**<br>**Use the proposed manure storage facility that is closest to a common body of water or water well** | | | **NRCB USE ONLY** | |
|---|---|---|---|---|
| | | | **Comments** | **Meets regulations** |
| **Proposed facility name** Arie & Willemiek Muilwijk<br>AO: Under cover and open pens Corrals + Covered Shelter | | | | |
| **Flood plain information**<br>What is the elevation of the floor of the lowest **proposed** manure storage or collection facility above the 1:25 year flood plain or the highest known flood level? | +1 (m) | ☑ Estimated<br>☐ From records | Not in known flood plain | ☒ YES ☐ NO<br>☐ YES with exemption |
| **Springs, wells, and surface water information**<br>a. How many springs are within 100 m of **proposed** manure storage facilities or manure collection areas? | | 0 | None observed during site visit | ☒ YES ☐ NO<br>☐ YES with exemption |
| b. How many water wells are within 100 m of **proposed** manure storage facilities or manure collection areas? | | 1 | WW ID 115735 | ☐ YES ☒ NO<br>☐ YES with exemption |
| c. What is the shortest distance from a **proposed** manure collection or storage facility to a surface water body? (ie, lake, creek, slough, seasonal, etc.) | | 1.2 km | 1.26 km from irrigation canal | ☒ YES ☐ NO<br>☐ YES with exemption |
| **Groundwater information**<br>a. What is the depth to bedrock? | 29 (m) | ☐ Estimated<br>☐ Measured<br>☑ Drilling reports | 29 m (95 ft) per ww 115735 drilling report N/A | |
| b. What is the depth to the water table? | ±4 (m) | ☑ Estimated<br>☐ Measured<br>☐ Drilling reports | 2.7 m in soils drilling report | ☐ YES ☐ NO *<br>☐ YES with exemption |
| c. What is the shallowest depth to the uppermost groundwater resource? | ±4 (m) | ☑ Estimated<br>☐ Measured<br>☐ Drilling reports | 2.7 m see UGR report | ☐ YES ☒ NO **<br>☐ YES with exemption |

**Additional information:** (attach borehole logs and records, as required)

* - May meet 1 m above water table requirement, but has not provided sufficient information to show that they can meet AOPA liner requirements or have a naturally occurring protective layer.

** - Because liner has not been shown to meet requirements

# Part 2 — Technical Requirements

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| **GENERAL WATER INFORMATION – PROPOSED**<br>**Use the proposed manure storage facility that is closest to a common body of water or water well** | | | **NRCB USE ONLY**<br>**Comments** | **Meets regulations** |
|---|---|---|---|---|
| **Proposed facility name** Catch Basin | | | | |
| **Flood plain information**<br>What is the elevation of the floor of the lowest **proposed** manure storage or collection facility above the 1:25 year flood plain or the highest known flood level? | +1 (m) | ☑ Estimated<br>☐ From records | Not in known flood plain | ☒ YES ☐ NO<br>☐ YES with exemption |
| **Springs, wells, and surface water information**<br>a. How many springs are within 100 m of **proposed** manure storage facilities or manure collection areas? | | 0 | None observed during site visit | ☒ YES ☐ NO<br>☐ YES with exemption |
| b. How many water wells are within 100 m of **proposed** manure storage facilities or manure collection areas? | | 1 | WW ID 115735 is located more than 100 m away. | ☒ YES ☐ NO<br>☐ YES with exemption |
| c. What is the shortest distance from a **proposed** manure collection or storage facility to a surface water body? (ie, lake, creek, slough, seasonal, etc.) | | 1.3 km | 1.3 km to irrigation canal | ☒ YES ☐ NO<br>☐ YES with exemption |
| **Groundwater information**<br>a. What is the depth to bedrock? | 29 (m) | ☐ Estimated<br>☐ Measured<br>☑ Drilling reports | A shallow quarry is located just east of the catch basin site, indicative of shallow bedrock N/A | |
| b. What is the depth to the water table? | +4 (m) | ☑ Estimated<br>☐ Measured<br>☐ Drilling reports | Less than 2.7 m from surface based on soil drilling report | ☐ YES ☒* NO<br>☐ YES with exemption |
| c. What is the shallowest depth to the uppermost groundwater resource? | +4 (m) | ☑ Estimated<br>☐ Measured<br>☐ Drilling reports | Approx 2.7 m - see UGR report | ☐ YES ☒* NO<br>☐ YES with exemption |

**Additional information:** (attach borehole logs and records, as required)

AO: The applicant requested to increase the size of the proposed catch basin on November 17, 2020 to 36 m x 25 m x 1.8 m deep.

* - The natural ground level of the catch basin is lower than the natural ground level of test hole AM4-19. It is therefore unlikely that the bottom of the catch basin can meet the 1 m water table separation requirement.

If approved following review a leakage detection monitoring system and condition relating to the shallow water table should be considered.

# Water Well Drilling Report

View in Metric | Export to Excel

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

GOWN ID

GIC Well ID 115735
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1982/12/14

## Well Identification and Location

Measurement in Imperial

| Owner Name | Address | Town | Province | Country | Postal Code |
|---|---|---|---|---|---|
| HAWTHORNE, WAYNE | P.O. BOX 1251 CLARESHOLM | | | | |

| Location | 1/4 or LSD | SEC | TWP | RGE | W of MER | Lot | Block | Plan | Additional Description |
|---|---|---|---|---|---|---|---|---|---|
| | 15 | 10 | 9 | 27 | 4 | | | | |

Measured from Boundary of
ft from
ft from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 49.725817 Longitude -113.578252
How Location Obtained
Map

Elevation ft
How Elevation Obtained
Not Obtained

## Drilling Information

**Method of Drilling**
Rotary

**Proposed Well Use**
Domestic & Stock

**Type of Work**
New Well

## Formation Log

Measurement in Imperial

| Depth from ground level (ft) | Water Bearing | Lithology Description |
|---|---|---|
| 40.00 | | Brown Till |
| 75.00 | | Blue Clay |
| 95.00 | | Hard Shale & Gravel |

## Yield Test Summary

Measurement in Imperial

Recommended Pump Rate 0.00 igpm

| Test Date | Water Removal Rate (igpm) | Static Water Level (ft) |
|---|---|---|
| 1982/09/20 | 16.00 | 62.00 |

## Well Completion

Measurement in Imperial

| Total Depth Drilled | Finished Well Depth | Start Date | End Date |
|---|---|---|---|
| 95.00 ft | | 1982/09/20 | 1982/09/20 |

**Borehole**

| Diameter (in) | From (ft) | To (ft) |
|---|---|---|
| 0.00 | 0.00 | 95.00 |

**Surface Casing (if applicable)**
Steel
Size OD : 7.00 in
Wall Thickness : 0.000 in
Bottom at : 6.00 ft

**Well Casing/Liner**
Steel
Size OD : 4.50 in
Wall Thickness : 0.188 in
Top at : 0.00 ft
Bottom at : 95.00 ft

**Perforations**

| From (ft) | To (ft) | Diameter or Slot Width(in) | Slot Length (in) | Hole or Slot Interval(in) |
|---|---|---|---|---|
| 80.00 | 95.00 | 0.188 | | 5.00 |

Perforated by Torch

**Annular Seal** Driven
Placed from 0.00 ft to 6.00 ft
Amount

Other Seals

| Type | At (ft) |
|---|---|
| | |

**Screen Type**
Size OD : 0.00 in

| From (ft) | To (ft) | Slot Size (in) |
|---|---|---|
| | | |

Attachment
Top Fittings Bottom Fittings

**Pack**
Type Grain Size
Amount

## Contractor Certification

Name of Journeyman responsible for drilling/construction of well
UNKNOWN NA DRILLER

Certification No
1

Company Name
HENNING DRILLING LTD.

Copy of Well report provided to owner Date approval holder signed

# Water Well Drilling Report

View in Metric | Export to Excel

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

GIC Well ID 115735
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1982/12/14

GOWN ID

## Well Identification and Location

Measurement in Imperial

| Owner Name | Address | Town | Province | Country | Postal Code |
|---|---|---|---|---|---|
| HAWTHORNE, WAYNE | P.O. BOX 1251 CLARESHOLM | | | | |

| Location | 1/4 or LSD | SEC | TWP | RGE | W of MER | Lot | Block | Plan | Additional Description |
|---|---|---|---|---|---|---|---|---|---|
| | 15 | 10 | 9 | 27 | 4 | | | | |

Measured from Boundary of
ft from
ft from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 49.725817 Longitude -113.578252
How Location Obtained: Map

Elevation ft
How Elevation Obtained: Not Obtained

## Additional Information

Measurement in Imperial

Distance From Top of Casing to Ground Level in
Is Artesian Flow
Rate igpm
Is Flow Control Installed
Describe

Recommended Pump Rate 0.00 igpm
Recommended Pump Intake Depth (From TOC) 80.00 ft
Pump Installed Yes Depth ft
Type SUB Make H.P. .5
Model (Output Rating)

Did you Encounter Saline Water (>4000 ppm TDS) Depth ft
Gas Depth ft
Well Disinfected Upon Completion
Geophysical Log Taken
Submitted to ESRD
Sample Collected for Potability
Submitted to ESRD Yes

Additional Comments on Well
DRILLER REPORTS WATER IS SOFT.

## Yield Test

Taken From Ground Level
Measurement in Imperial

| Test Date | Start Time | Static Water Level |
|---|---|---|
| 1982/09/20 | 12:00 AM | 62.00 ft |

Depth to water level

| Pumping (ft) | Elapsed Time Minutes:Sec | Recovery (ft) |
|---|---|---|
| | | |

**Method of Water Removal**
Type Bailer
Removal Rate 16.00 igpm
Depth Withdrawn From 62.00 ft

If water removal period was < 2 hours, explain why

## Water Diverted for Drilling

| Water Source | Amount Taken | Diversion Date & Time |
|---|---|---|
| | ig | |

## Contractor Certification

Name of Journeyman responsible for drilling/construction of well
UNKNOWN NA DRILLER

Certification No
1

Company Name
HENNING DRILLING LTD.

Copy of Well report provided to owner
Date approval holder signed

## WELL INFORMATION:

Well IDs: 115735

See UGR report at the end of this document for shallow water well information.

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

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

**Water Wells** AO. WW variance required to be applied for because facilities already constructed

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

**Surface Water** * - If approved, water quality monitoring should be considered

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

**ERST** for **proposed** facilities

| Facility | Groundwater score | Surface water score | File Number |
|---|---|---|---|
| Covered Pens | 82.8 Moderate | 15 Low | LA19036 |
| Open Pens | 80.4 Moderate | 20 Low | LA19036 |
| Catch Basin | 63.8 Low | 20 Low | LA19036 |
| | | | |
| Moderate risks will need to be addressed by the applicant. See next page. | | | |
| | | | |
| | | | |

**ERST** for **existing** facilities

| Facility | Groundwater score | Surface water score | File Number |
|---|---|---|---|
| East Hog Barn | 90 Moderate | 25 Low | LA19036 |
| West Hog Barn | 90 Moderate | 25 Low | LA19036 |
| East EMS | 95.7 High | 30 Low | LA19036 |
| West EMS | 95.7 High | 30 Low | LA19036 |
| | | | |
| High and Moderate risks will need to be addressed - see next page | | | |
| | | | |
| | | | |

**Groundwater or surface water related comments, see next page**

**Groundwater or surface water related comments**:

The soil drilling logs indicate shallow groundwater in the area of the pens and catch basin. Just east of the catch basin the land owner has dug a shallow pit from which they are extracting and crushing rock for use at their operation. This is indicative of shallow bedrock.

The east and west EMS's appear as holes dug in the ground. The east EMS had liquid manure in the bottom. The west EMS appeared to have only water in the bottom. The operator did not have any information related to their construction. The bottom of the EMS's are approximately at the same depth as the UGR and water table.

The condition of the concrete liners in the underfloor pits of the two existing barns are unknown. The barns were constructed some time before 2001, possibly as early as the early 1980's. I did not enter the barns as they had livestock and manure in them for biosecurity reasons and because the liners would not be readily visible.

The roller compacted concrete (RCC) proposed, and already constructed, as a liner for the under cover and open pens has not been shown to be able to meet AOPA groundwater protection requirements.

I enlisted the assistance of Scott Cunningham, an environmental specialist with the NRCB, to assist with the ERST scoring. Detailed information used for the ERST scoring is contained in the ERST reports at the end of this document for ease of reference. The ERST results are in the tables above and the scoring sheets are on file.

Moderate and high risks to groundwater will need to be addressed by the applicant irrespective of whether a permit is issued.

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

| Name | Legal Land Description | Distance (m) | Zoning (LUB) Category | MDS Cat (1-4) | Distance (m) | Meets Regulations |
|---|---|---|---|---|---|---|
| Nico & Corien DeWit | SE-15-9-27 W4 | 900 m | RG | 1 | 920 | Yes |
| Gerald & Jennifer Maljaars | SW-14-9-27-W4 | 900 m | RG | 1 | 925 | Yes |
| Dirk & Maria Mailwijk | SE-10-9-27-W4 | 500 m | RG | 1 | 502 | Yes |
| Trailer to west | NW-10-9-27-W4 | 900 m | RG | 1 | 900 | Yes |
| John Van Herk | SW-10-9-27-W4 | 1200 m | RG | 1 | 1171 | Yes |
| Hendrik & Elaine DeWit | NE-15-9-27 W4 | 900m | RG | 1 | 980 | Yes |
| | | | | | | |
| | | | | | | |

Methods used/margins of error to determine distance:

**Additional information:**

RG = Rural general

**NRCB USE ONLY**

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

Margin of error (if applicable): +/- 5 m

Requirements: Category 1: 367 m Category 2: 489 m Category 3: 612 m Category 4: 979 m

Technology factor: ☐ YES ☒ NO

Expansion factor: ☐ YES ☒ NO

Waivers required: ☐ YES ☒ NO # _____

Waivers attached: ☐ Waivers in file: ☐

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

Comments:

Name
Address
Legal Land
Location

**MDS Spreadsheet based on 2006 AOPA Regulations**

| Category of Livestock | Type of Livestock | Factor A | Technology Factor | MU | LSU Factor | Number of Animals | LSU |
|---|---|---|---|---|---|---|---|
| Beef | Cows/Finishers (900+ lbs) | 0.700 | 0.700 | 0.910 | 0.446 | | - |
| | Feeders (450 - 900 lbs) | 0.700 | 0.700 | 0.500 | 0.245 | | - |
| | Feeder Calves (<550 lbs) | 0.700 | 0.700 | 0.275 | 0.135 | 3,000 | 404.3 |
| | Other | | | | | | - |
| Dairy (*count lactating cows only) | *Free Stall – Lactating Cows with all associated dries, heifers, and calves | 0.800 | 1.100 | 2.000 | 1.760 | | - |
| | *Free Stall – Lactating cows with Dry Cows only | 0.800 | 1.100 | 1.640 | 1.443 | | - |
| | Free Stall – Lactating Cows only | 0.800 | 1.100 | 1.400 | 1.232 | | - |
| | Tie Stall – Lactating cows only | 0.800 | 1.000 | 1.400 | 1.120 | | - |
| | Loose Housing – Lactating cows only | 0.800 | 1.000 | 1.400 | 1.120 | | - |
| | Dry Cow (Solid manure) | 0.800 | 0.700 | 1.000 | 0.560 | | - |
| | Dry Cow (Liquid manure) | | | | | | |
| | Replacements – Bred Heifers (Breeding to Calving) | 0.800 | 0.700 | 0.875 | 0.490 | | - |
| | Replacements - Growing Heifers (350 lbs to breeding) | 0.800 | 0.700 | 0.525 | 0.294 | | - |
| | Calves (< 350 lbs) | 0.800 | 0.700 | 0.200 | 0.112 | | - |
| | Other | | | | | | - |
| Swine Liquid (*count sows only) | Farrow to finish * | 2.000 | 1.100 | 1.780 | 3.916 | | - |
| | Farrow to wean * | 2.000 | 1.100 | 0.670 | 1.474 | | - |
| | Farrow only * | 2.000 | 1.100 | 0.530 | 1.166 | | - |
| | Feeders/Boars | 2.000 | 1.100 | 0.200 | 0.440 | | - |
| | Growers/Roasters | 2.000 | 1.100 | 0.118 | 0.260 | | - |
| | Weaners | 2.000 | 1.100 | 0.055 | 0.121 | | - |
| | Other | | | | | | - |
| Swine Solid (*Count sows only) | Farrow to finish * | 2.000 | 0.800 | 1.780 | 2.848 | | - |
| | Farrow to wean * | 2.000 | 0.800 | 0.670 | 1.072 | | - |
| | Farrow only * | 2.000 | 0.800 | 0.530 | 0.848 | | - |
| | Feeders/Boars | 2.000 | 0.800 | 0.200 | 0.320 | | - |
| | Growers/Roasters | 2.000 | 0.800 | 0.118 | 0.189 | | - |
| | Weaners | 2.000 | 0.800 | 0.055 | 0.088 | | - |
| | Other | | | | | | - |
| Poultry | Chicken - Breeders - Solid | 1.000 | 0.700 | 0.010 | 0.007 | | - |
| | Chicken - Layers - Liquid (includes associated pullets) | 2.000 | 1.100 | 0.008 | 0.018 | | - |
| | Chicken - Layers - (Belt Cage) | 2.000 | 0.700 | 0.008 | 0.011 | | - |
| | Chicken - Layers - (Deep Pit) | 2.000 | 0.700 | 0.008 | 0.011 | | - |
| | Chicken - Pullets/Broilers | 1.000 | 0.700 | 0.002 | 0.001 | | - |
| | Turkey - Toms/Breeders | 1.000 | 0.700 | 0.020 | 0.014 | | - |
| | Turkey - Hens (light) | 1.000 | 0.700 | 0.013 | 0.009 | | - |
| | Turkey - Broilers | 1.000 | 0.700 | 0.010 | 0.007 | | - |
| | Ducks | 1.000 | 0.700 | 0.010 | 0.007 | | - |
| | Geese | 1.000 | 0.700 | 0.020 | 0.014 | | - |
| | Other | | | | | | - |
| Horses | PMU | 0.650 | 0.700 | 1.000 | 0.455 | | - |
| | Feeders > 750 lbs | 0.650 | 0.700 | 1.000 | 0.455 | | - |
| | Foals < 750 lbs | 0.650 | 0.700 | 0.300 | 0.137 | | - |
| | Mules | 0.600 | 0.700 | 1.000 | 0.420 | | - |
| | Donkeys | 0.600 | 0.700 | 0.670 | 0.281 | | - |
| | Other | | | | | | - |
| Sheep | Ewes/Rams | 0.600 | 0.700 | 0.200 | 0.084 | | - |
| | Ewes with lambs | 0.600 | 0.700 | 0.250 | 0.105 | | - |
| | Lambs | 0.600 | 0.700 | 0.050 | 0.021 | | - |
| | Feeders | 0.600 | 0.700 | 0.100 | 0.042 | | - |
| | Other | | | | | | - |
| Goats | Meat/Milk (per Ewe) | 0.700 | 0.700 | 0.170 | 0.083 | | - |
| | Nannies/Billies | 0.700 | 0.700 | 0.140 | 0.069 | | - |
| | Feeders | 0.700 | 0.700 | 0.077 | 0.038 | | - |
| | Other | | | | | | - |
| Bison | Bison | 0.600 | 0.700 | 1.000 | 0.420 | | - |
| | Other | | | | | | - |
| Cervid | Elk | 0.600 | 0.700 | 0.600 | 0.252 | | - |
| | Deer | 0.600 | 0.700 | 0.200 | 0.084 | | - |
| | Other | | | | | | - |
| Wild Boar | Feeders | 2.000 | 0.800 | 0.140 | 0.224 | | - |
| | Sow (farrowing) | 2.000 | 0.800 | 0.371 | 0.594 | | - |
| | Other | | | | | | - |
| | | | | | Total | | 404.3 |

**For New Operations**

Dispersion Factor: 1

| Category | Odour Objective | Distance | |
|---|---|---|---|
| | | Feet | Metres |
| 1 | 41.04 | 1,204 | 367 |
| 2 | 54.72 | 1,605 | 489 |
| 3 | 68.4 | 2,007 | 612 |
| 4 | 109.44 | 3,211 | 979 |

**For Expanding Operations**

Dispersion Factor: 1
Expansion Factor: 0.77

| Category | Odour Objective | Distance | |
|---|---|---|---|
| | | Feet | Metres |
| 1 | 41.04 | 927 | 283 |
| 2 | 54.72 | 1,236 | 377 |
| 3 | 68.40 | 1,545 | 471 |
| 4 | 109.44 | 2,472 | 754 |

# 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)

## LAND BASE FOR MANURE AND COMPOST APPLICATION (for approvals and registrations only)

| Name of landowner(s)* | Legal Land Description | Area ** (usable hectares) | Soil Zone | NRCB USE ONLY Area unsuitable: |
|---|---|---|---|---|
| Arie & Willemich Muilwijk | NE-10-9-27-W4 | 55 | Dark Brown | 136 ac DB dryland |
| Nico & Corien De Wit | SE-15-9-27-W4 | 63 | Irrigated Dark Brown | 155 irrig ac per agreement |
| | | | | |
| | | | | |
| | | | | |
| | TOTAL | | | |

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

** Available manure spreading area (do not include required setback areas from residences, common bodies of water, water wells, etc.) (to convert from acres to hectares divide acres by 2.47)

**Additional information:** (attach copies of all signed land use agreements)

See attached

**NRCB USE ONLY**

Land base required: 45ha (111 ac) irrigated or 93ha (230 ac) dark brown (dryland)

Land base listed: 63 ha (155 ac) irrigated & 55 ha (136 ac) dark brown (dryland)

Area not suitable:

Available area: Greater than required

Requirement Met: ☒ YES ☐ NO

Land spreading agreements required: ☒ YES ☐ NO If yes, Agreements in file: ☐ Agreements attached: ☒

Manure Management Plan: ☐ YES ☒ NO Plan attached: ☐ Plan in file: ☐

## Manure Spreading Agreement

Nico De Wit agree to allow Arie Mulwijk (applicant) to spread manure on the following fields during 2020 (calendar year).

| Land location | Acres | Suitable for spreading | Soil zone |
|---|---|---|---|
| SE-15-9-27-W4 | 155 | 155 | Irrigated Dark Brown |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

Signed: N-CP-de Wit

Date: _____

AO: If following a review hearing a permit is granted, a new manure spreading agreement will be required since this one is only valid for 2020.

| | |
|---|---|
| Name | 0 |
| Address | 0 |
| Legal Land | |
| Location | 0 |

**Landbase Requirements (hectares) based on 2006 AOPA requirements**

| Category of Livestock | Type of Livestock | Number of Animals | Dark Brown & Brown (ha) | Grey Wooded (ha) | Black (ha) | Irrigated (ha) |
|---|---|---|---|---|---|---|
| Beef | Cows/Finishers (900+ lbs) | 0 | 0 | 0 | 0 | 0 |
| | Feeders (450 - 900 lbs) | 0 | 0 | 0 | 0 | 0 |
| | Feeder Calves (<550 lbs) | 3000 | 93.000 | 78.000 | 57.000 | 45.000 |
| | Other | 0 | | | | |
| Dairy (*count lactating cows only) | *Free Stall – Lactating Cows with all associated dries, heifers, and calves | 0 | 0 | 0 | 0 | 0 |
| | *Free Stall – Lactating cows with Dry Cows only | 0 | - | - | - | - |
| | Free Stall – Lactating Cows only | 0 | - | - | - | - |
| | Tie Stall – Lactating cows only | 0 | - | - | 0 | 0 |
| | Loose Housing – Lactating cows only | 0 | - | - | - | - |
| | Dry Cow (Solid manure) | 0 | - | - | - | - |
| | Dry Cow (Liquid manure) | 0 | - | - | - | - |
| | Replacements – Bred Heifers (Breeding to Calving) | 0 | - | - | - | - |
| | Replacements - Growing Heifers (350 lbs to breeding) | 0 | - | - | - | - |
| | Calves (< 350 lbs) | 0 | - | - | - | - |
| | Other | 0 | | | | |
| Swine Liquid (*count sows only) | Farrow to finish * | 0 | - | 0 | - | - |
| | Farrow to wean * | 0 | - | - | - | - |
| | Farrow only * | 0 | - | - | - | - |
| | Feeders/Boars | 0 | - | 0 | 0 | 0 |
| | Growers/Roasters | 0 | - | - | - | - |
| | Weaners | 0 | - | - | - | - |
| | Other | 0 | | | | |
| Swine Solid (*Count sows only) | Farrow to finish * | 0 | - | - | - | - |
| | Farrow to wean * | 0 | - | - | - | - |
| | Farrow only * | 0 | - | - | - | - |
| | Feeders/Boars | 0 | - | - | - | - |
| | Growers/Roasters | 0 | - | - | - | - |
| | Weaners | 0 | - | - | - | - |
| | Other | 0 | | | | |
| Poultry | Chicken - Breeders - Solid | 0 | - | - | - | - |
| | Chicken - Layers - Liquid (includes associated pullets) | 0 | - | 0 | 0 | 0 |
| | Chicken - Layers - (Belt Cage) | 0 | - | - | - | - |
| | Chicken - Layers - (Deep Pit) | 0 | - | - | - | - |
| | Chicken - Pullets/Broilers | 0 | - | 0 | 0 | 0 |
| | Turkey - Toms/Breeders | 0 | 0 | 0 | 0 | 0 |
| | Turkey - Hens (light) | 0 | - | - | - | - |
| | Turkey - Broilers | 0 | - | - | - | - |
| | Ducks | 0 | 0 | 0 | 0 | 0 |
| | Geese | 0 | 0 | 0 | 0 | 0 |
| | Other | 0 | | | | |
| Horses | PMU | 0 | 0 | 0 | 0 | 0 |
| | Feeders > 750 lbs | 0 | - | 0 | - | - |
| | Foals < 750 lbs | 0 | - | - | - | - |
| | Mules | 0 | - | - | - | - |
| | Donkeys | 0 | - | - | - | - |
| | Other | 0 | | | | |
| Sheep | Ewes/Rams | 0 | - | 0 | 0 | 0 |
| | Ewes with lambs | 0 | - | - | - | - |
| | Lambs | 0 | - | - | - | - |
| | Feeders | 0 | - | - | - | - |
| | Other | 0 | | | | |
| Goats | Meat/Milk (per Ewe) | 0 | 0 | 0 | 0 | 0 |
| | Nannies/Billies | 0 | - | - | - | - |
| | Feeders | 0 | - | - | - | - |
| | Other | 0 | | | | |
| Bison | Bison | 0 | 0 | 0 | 0 | 0 |
| | Other | 0 | | | | |
| Cervid | Elk | 0 | 0 | 0 | 0 | 0 |
| | Deer | 0 | 0 | 0 | 0 | 0 |
| | Other | 0 | | | | |
| Wild Boar | Feeders | 0 | - | 0 | 0 | 0 |
| | Sow (farrowing) | 0 | - | - | - | - |
| | Other | 0 | | | | |
| | Total Hectares | | 93.0 | 78.0 | 57.0 | 45.0 |
| | Total Acres | | 229.8 | 192.7 | 140.8 | 111.2 |

**ALL SIGNATURES IN FILE**: ☒ Yes ☐ No

**DATES OF APPROVAL OFFICER SITE VISITS**:

| | |
|---|---|
| September 17 2019 (previous approval officer) | November 4 2020 |
| | |
| | |

**CORRESPONDENCE WITH MUNICIPALITIES AND REFERRAL AGENCIES:**

Date deeming letters sent Oct 9 2019

**Municipality:** MD of Willow Creek

☒ Letter sent ☒ Response received ☒ written/email ☐ verbal ☐ no comments received

**Alberta Health Services:**

☒ 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:** **Lethbridge Northern Irrigation District**

☒ Letter sent ☒ Response received ☒ written/email ☐ verbal ☐ no comments received

**Other:**

☐ Letter sent ☐ Response received ☐ written/email ☐ verbal ☐ no comments received

**PLANS**

Submitted and attached construction plans ☐ YES ☒ NO

Submitted aerial photos ☒ YES ☐ NO

Submitted photos ☐ YES ☒ NO

**GRANDFATHERING:**

On this application: ☒ Yes No

Comments: A determination of the grandfathered (deemed) capacity and facilities was carried out as part of the decision on this application. See appendix E in decision summary for details

On a previous application/decision: ☐ Yes ☒ No If yes, list application/decision number __

Comments:

Approval LA10054M included a "grandfathered capacity" for the CFO, however, LA10054N superseded LA10054M, correcting an error with the capacity and not listing any capacity for the CFO.

**DEEMING CAPACITY:** ☒ Yes ☐ No

Comments:

The operator indicated that the change from hogs to feeder calves occurred approximately 8 years ago. The east hog barn had feeder calves in it on the date of my site inspection. The west hog barn was primarily being used to store things for the operation. The operator did indicate that they had a few calves in a part of it on the day of my site inspection. (The proposed pens and shelter were also populated with feeder calves on the date of my site inspection)

# 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)

## SOLID MANURE, COMPOST & COMPOSTING MATERIALS: Barns, feedlots & storage facilities - Alternative liner

*(complete a copy of this section for **EACH** barn, feedlot and storage facility for solid manure, composting materials or compost with a alternative liner)*

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

1. Calf pens (corrals) Open pens

2. Covered Shelter Under cover pens

**Manure storage capacity**

| | Length (m) | Width (m) | Estimated storage capacity ($m^3$) | Depth below grade to the bottom of the liner (m) |
|---|---|---|---|---|
| 1. | 92 m | 37 m | NA | 0 |
| 2. | 82 m | 15 m | NA | 0 |

**NRCB USE ONLY**

Depth to water table: 2.7 - 3.0 m from drilling report Requirements met: ☐ YES ☒ NO

Depth to UGR: 2.7 - 3.0 m from drilling report Requirements met: ☐ YES ☒ NO

ERST completed: ☒ YES ☐ NO

Groundwater risk level: Moderate Surface Water risk level: Low

* - Applicant has not demonstrated that the liner being proposed can meet AOPA requirements

UGR: Uppermost Groundwater Resource as defined under AOPA's *Standards and Administration Regulation*.

**Surface water control systems**

☑ Under roof: Surface water will be controlled by the walls and roof of the building and by the finished landscaping.

☑ Outdoor: Describe the run-on and runoff control system proposed for feedlots and outdoor manure storage facilities:

Covered shelter will have a roof

**NRCB USE ONLY**

Requirements met: ☐ YES ☐ NO Details/comments:

See next page.

**SOLID MANURE, COMPOST & COMPOSTING MATERIALS: Barns, feedlots & storage facilities - Alternative liner (cont.)**

AO: This information does not show how AOPA requirements are met. Applicant provided a report from Wood Environmental and Infrastructure solutions (Wood) dated Oct. 29, 2020, updated on Nov 6, 2020to show how AOPA requirements are addressed

**Alternative liner details**

| | |
|---|---|
| a. Describe the proposed alternative liner<br>roller compacted Concrete liner | Provide details:<br>6" - 7" of roller compacted concrete to make a durable liner, professionally installed |
| b. Information and calculations used to show equivalency | Provide details: |

**Additional information:**

AO: The proposed alternative liner information in the application is not sufficient to show if AOPA groundwater protection requirements can be met. The RCC floor was placed in the Fall of 2019, prior to a permit being issued. The applicant was asked to provide information to show how what they proposed and constructed can meet AOPA requirements. Copies of soil drilling tests and a report prepared by Wood dated Oct. 29, 2020 and updated on Nov 6, 2020 was provided. This report provides information from tests which were carried out in June 2020 - approx. 7 months after the RCC had been installed. I note that the Engineer was not on site when the ground was prepared nor when the RCC was placed.
No information was provided from the contractor who installed the RCC.
The RCC floors in both the covered and open pens were covered with manure and bedding and not visible at the time of my site inspection in November 2020.

**NRCB USE ONLY**

Liner requirements met: ☐ YES ☒ NO  Condition required: ☐ YES ☐ NO

Comments:

Insufficient information has been provided to demonstrate that the proposed alternative liner can meet the AOPA groundwater protection requirements. Details are included in the decision summary for this application.

# 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)

## RUNOFF CONTROL CATCH BASINS: Synthetic liner

*(complete a copy of this section for **EACH** manure storage facility with a synthetic liner)*

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

Run-off catch basin

1. Catch Basin
2. _____
3. _____

**Determination of minimum required catch basin volume**

| Show your calculations for determining the minimum required catch basin volume | Provide details: See attached |
|---|---|

**Catch basin capacity**

| | Length (m) | Width (m) | Depth (m) | Slope run:rise | | | Estimated storage capacity (excl. freeboard) ($m^3$) | Depth below grade of the bottom of the synthetic liner (m) |
|---|---|---|---|---|---|---|---|---|
| | | | | Inside end walls | Inside side walls | Outside walls | | |
| 1. | ~~25~~ | ~~17~~ | ~~1.5~~ | 3 | 3 | | ~~212~~ | |
| 2. | 36 | 21 | 1.8 | AO: Revised dimensions as per applicant Nov 17, 20 | | | 540 | approx 1.8 m |
| 3. | | | | | | | | |
| | | | | | | **TOTAL CAPACITY** | 540 | |

**NRCB USE ONLY**

Catch basin calculator (calculation attached). Total volume @ freeboard level 540 $m^3$ Requirements met: ☒ YES ☐ NO

Depth to water table: less than 2.7 m* Requirements met: ☐ YES ☒ NO

Depth to UGR: less than 2.7 m* based on ERST support information Requirements met: ☐ YES ☒* NO

ERST completed: ☐ YES ☐ NO

Groundwater risk level: _____ Surface Water risk level: _____

* Top of catch basin is lower than surface level of test hole AM4-19 therefore water table will be shallower than 2.7 m

UGR: Uppermost Groundwater Resource as defined under AOPA's *Standards and Administration Regulation*.

## RUNOFF CONTROL CATCH BASINS: Synthetic liner (cont.)

**Synthetic liner details**

| a. Synthetic liner | Thickness and type of liner material : | Provide liner material details: |
|---|---|---|
| HDPE 40 | 40 mil | See attached |

**Additional information:**

**NRCB USE ONLY**

Liner requirements met: ☒ YES ☐ NO Condition required: ☒ YES ☐ NO

Comments:

Catch basin liner can meet AOPA GW protection requirements,

however, condition requiring completion report will be required

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

Comments: Test hole AM4-19 shows silty clay from surface to 1.0m, very fine sandy loam from 1.0 m to 4.4 m which is saturated below 2.7 m. Because the ground surface at the test hole is higher than the top of the proposed catch basin and the catch basin is proposed to be 1.8 m deep, it is likely that the catch basin will be constructed into or very close to the water table. Because of this, if a permit is issued, a leakage detection system will be required. The depth to water table must also be verified at the time of construction to ensure AOPA requirements are met if a permit is issued.

Construction plans approved by professional engineer: ☐ YES ☒ NO

Installed by approved contractor: ☒ YES ☐ NO

Preparation of liner bed (comments):

If a permit is issued, conditions will be required to ensure the construction of the catch basin and installation of the synthetic liner, and the installation of a leakage detection system, are carried out in accordance with engineering and liner manufacturer requirements.

## RUNOFF CONTROL CATCH BASIN: Synthetic liner (cont.)

**NRCB USE ONLY**

Catch basin calculator total volume @ freeboard level: 540 $m^3$ Runoff capacity requirements met: ☒ YES ☐ NO

Calculation of the volume attached: ☒ YES ☐ NO

Depth to water table: Less than 1 m based on soil test hole information. Requirements met: ☐ YES ☒ NO

Depth to Uppermost Groundwater Resource: Less than 1 m based on soil test hole results Requirements met: ☐ YES ☒ NO

ERST completed: ☒ See details in ERST page

Liner requirements met: ☒ YES ☐ NO Condition required: ☒ YES ☐ NO

Comments:

See comments below.

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

Proximity of the water table and UGR require a leakage detection system to be installed.

Construction plans approved by professional engineer: ☐ YES ☒ NO

Will liner be installed by manufacturer approved contractor and qualified third party?: ☒ YES ☐ NO

Condition required: ☒ YES ☐ NO

Preparation of liner bed (comments):

Preparation of liner bed needs to be in accordance with the liner manufacturer's requirements. Installation of synthetic liner needs to be supervised and in accordance with liner manufacturer's requirements. A leakage detection system will need to be installed.

# Catch Basin Calculator

| Construction Dimensions of Catch Basin | Metric | | English Units Capacity of Catch Basin | |
|---|---|---|---|---|
| **Size of Catch Basin** | | | | |
| Length*[4] | 36.0 | m | 118.11 | Feet |
| Width*[4] | 21.0 | m | 68.90 | Feet |
| Total Depth*[4] | 1.8 | m | 5.91 | Feet |
| Water Depth | 1.30 | m | 4.27 | Feet |
| End Slope*[4] | 3 | run:rise | 3 | run:rise |
| Side Slope*[4] | 3 | run:rise | 3 | run:rise |
| Length of Bottom | 25.2 | | | |
| Width of Bottom | 10.2 | | | |
| Total Capacity @ top of Bank | **877** | **$m^3$** | **30,962** | **$ft^3$** |
| | | | **192,857** | **Imp. Gal.** |

* Only cells in blue can be changed.

| Storage Volume of Catch Basin at Design Capacity (without freeboard) | | | Volume at Freeboard | |
|---|---|---|---|---|
| Length (Top of liquid level) | 33.0 | m | 108.27 | Feet |
| Width (Top of liquid level) | 18.0 | m | 59.06 | Feet |
| Depth | 1.8 | m | 5.91 | Feet |
| Water Depth | 1.30 | m | 4.27 | Feet |
| End Slope | 3 | run:rise | 3 | run:rise |
| Side Slope | 3 | run:rise | 3 | run:rise |
| Total Volume@ freeboard depth | **540** | **$m^3$** | **19,070** | **$ft^3$** |
| | | | **118,782** | **Imp. Gal.** |
| Surface Area of Liquid Manure | **594** | **$m^2$** | **6,394** | **$ft^2$** |

Name[1] LA19036 Muilwijk

Land Location[1] 1-1-4-W4

| Area[2] | Length (m) | Width (m) | Area ($m^2$) |
|---|---|---|---|
| 1 | 92 | 37 | 3,404 |
| 2 | | | 0 |
| 3 | | | 0 |
| 4 | | | 0 |
| 5 | | | 0 |
| | | Total Area | 3,404 |

Select Town[3]

Fort Macleod 90

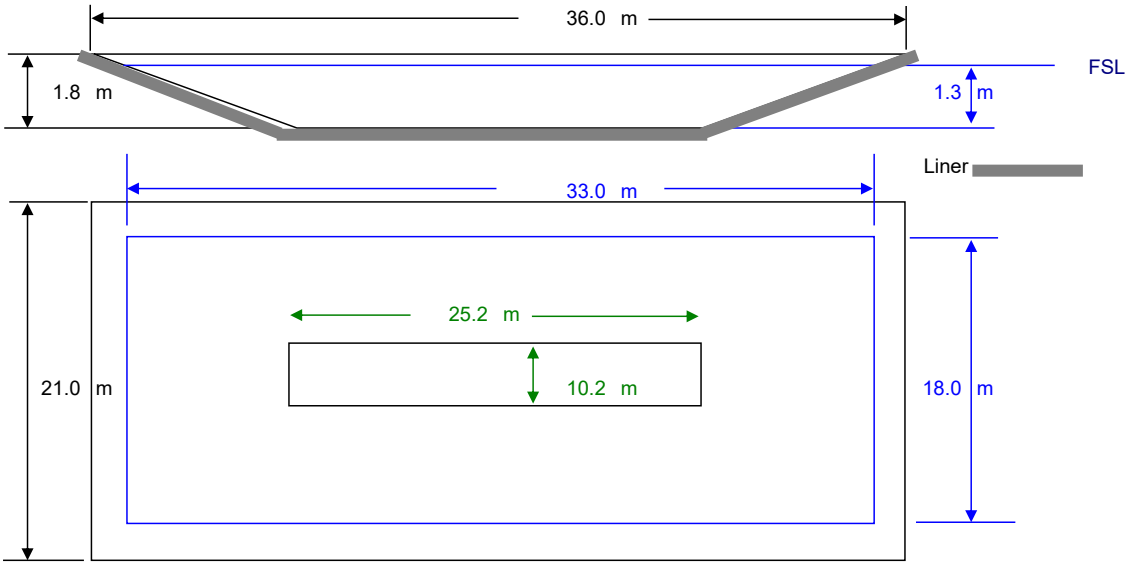
Design Rainfall 90 mm

**Catch Basin Minimum Design Storage Volume**

**306 $m^3$** **10,819 $ft^3$**

**67,390 Imp. Gal.**

** Actual storage volume should be same or slightly greater than design storage volume.




Lines in Black - Catch basin dimension

Lines in Blue - full level

NTS - Not Drawn To Scale

LAYFIELD

# Geomembrane [HDPE 40 Textured (SS) Black]

Our HDPE 40 geomembranes are designed in accordance with the Geomembrane Research Institute GM 13 standard. It is manufactured to meet the properties of GRI GM13 textured High Density Polyethylene and has been extensively used in a variety of containment applications. HDPE geomembranes have low permeability, good ultra violet resistance properties and excellent chemical resistance. HDPE 40 is a field assembled lining material that must be installed by trained installers. HDPE is used in a multitude of applications as a landfill liner, pond linings, and water containment projects.

| Property | ASTM | HDPE 40 Textured[1] Black Single Sided (SS) |
|---|---|---|
| Thickness nom. (min.avg) | D5994 | 40 mil (36 mil)<br>1.00 mm (0.915 mm) |
| Thickness | D5994<br>Lowest Individual for 8 out of 10 values<br>Lowest individual for any of the 10 values | <br>36 mil/0.93 mm<br>34 mil/0.88 mm |
| Asperity Height (min.ave) | D 7466 | 16 mil<br>0.4 mm |
| Sheet Density (minimum) | D792 | ≥0.940 g/cc |
| Dimensional Stability | D 1204 | ±2% |
| Tensile Properties (min. avg)<br>ASTM D 6693; Modified Type IV Die<br>Gage length break: 2" (50 mm)<br>Gage length yield: 1.3" (33 mm) | Tensile Strength @ Break<br><br><br>Tensile Strength @ Yield | 60 ppi<br>10 kN/m<br><br>84 ppi<br>15 kN/m |
| | Tensile Elongation @ Break<br>Tensile Elongation @ Yield | 100%<br>12% |
| Tear Resistance (min. avg) | D1004 | 28 lbs<br>125 N |
| Puncture Resistance (min. avg) | D4833 | 60 lbs<br>267 N |
| High Pressure Oxidative Induction Time (HPOIT) | D5885 | 400 mins |
| Stress Cracking | D5397 | 500 hrs |
| Carbon Black Content[1] | D1603 | 2.0-3.0 % |
| Carbon Black Dispersion[2] | D5596 | CAT 1 or 2 |
| Oven Aging<br>**85° C,** HPOIT retained after 90 days | D5721<br>D D5885 | 80% |
| UV Resistance- % HPOIT retained after 1600 hrs | D7238<br>D5885 | 50% |
| **Typical Roll Dimensions (Rolls dimensions may vary ± 1%)** | | |
| Roll Width | - | 22.5 feet<br>6.86 mtrs |
| Roll Length | - | 780 feet<br>237.8 mtrs |

[1] *This product is designed and manufactured to meet the GRI GM13 specification*

*Disclaimer: Layfield disclaims any and all express, implied, or statutory standards, warranties or guarantees, including without limitation any implied warranty as to merchantability or fitness for a particular purpose or arising from a course of dealing or usage of trade as to any equipment, materials, or information furnished herewith. This document should not be construed as engineering advice.*

LAYFIELD

# Geomembrane [HDPE 60 Textured (SS) Black]

Our HDPE 60 geomembranes are designed in accordance with the Geomembrane Research Institute GM 13 standard. It is manufactured to meet the properties of GRI GM13 and has been extensively used in a variety of containment applications. HDPE geomembranes have low permeability, good ultra violet resistance properties and excellent chemical resistance. HDPE 60 is a field assembled lining material that must be installed by trained installers. HDPE is used in a multitude of applications as a landfill liner, pond linings, and water containment projects.

| Property | ASTM | HDPE 60 Textured[1] Black Single Sided(SS) |
|---|---|---|
| Thickness nom. (min.avg) | D5199 | 60 mil (57 mil)<br>1.5 mm (1.45 mm) |
| Thickness | D5199<br>Lowest Individual for 8 out of 10 values<br>Lowest individual for any of the 10 values | <br>54 mil/1.4 mm<br>51 mil/1.3 mm |
| Asperity Height (min.ave) | D 7466 | 16 mil<br>0.4 mm |
| Sheet Density (minimum) | D792 | ≥0.940 g/cc |
| Dimensional Stability | D 1204 | ±2% |
| Tensile Properties (min. avg)<br>ASTM D 638; Modified Type IV Die<br>Gage length break: 2" (50 mm)<br>Gage length yield: 1.3" (33 mm) | Tensile Strength @ Break<br><br><br>Tensile Strength @ Yield | 90 ppi<br>16 kN/m<br>126 ppi<br>22 kN/m |
| | Tensile Elongation @ Break<br>Tensile Elongation @ Yield | 100%<br>12% |
| Tear Resistance (min. avg) | D1004 | 42 lbs<br>187 N |
| Puncture Resistance (min. avg) | D4833 | 90 lbs<br>400 N |
| High Pressure Oxidative Induction Time (HPOIT) | D5885 | 400 mins |
| Stress Cracking | D5397 | 500 hrs |
| Carbon Black Content[1] | D1603 | 2.0-3.0 % |
| Carbon Black Dispersion[2] | D5596 | CAT 1 or 2 |
| Oven Aging<br>**85° C,** HPOIT retained after 90 days | D5721<br>D D5885 | 80% |
| UV Resistance- % HPOIT retained after 1600 hrs | D7238<br>D5885 | 50% |
| **Typical Roll Dimensions (Rolls dimensions may vary ± 1%)** | | |
| Roll Width | - | 22.5 feet<br>6.86 mtrs |
| Roll Length | - | 560 feet<br>170.7 mtrs |

[1]*This product is designed and manufactured to meet the GRI GM13 specification*

*Disclaimer: Layfield disclaims any and all express, implied, or statutory standards, warranties or guarantees, including without limitation any implied warranty as to merchantability or fitness for a particular purpose or arising from a course of dealing or usage of trade as to any equipment, materials, or information furnished herewith. This document should not be construed as engineering advice.*

Alberta Transportation

**Southern Region**
Box 314, 909 3 Avenue North
Lethbridge, Alberta T1H 0H5
Telephone: 403-381-5426
Fax: 403-382-4057
www.alberta.ca/ministry-transportation.aspx

AT File Reference: RSDP027438
Our Reference: 2511-NE 10-9-27-W4M (785)
Permit No. 5548-19

September 26, 2019

Arie and Willemiek Muilwijk
awmuilwijk@hotmail.com
Box 1628
Fort Macleod, AB T0L 0Z0

Dear Mr. and Mrs. Muilwijk:

**RE: PROPOSED CALF SHELTER AND GRAIN SHED**

Attached is a permit issued under the Highways Development and Protection Regulation, being Alberta Regulation 326/2009 and amendments thereto, authorizing the above noted development. This permit is subject to the conditions listed on page 2.

In consideration of Permit No. 5548-19, the applicant shall indemnify and hold harmless Alberta Transportation, its employees and agents, from any and all claims, demands, actions, and costs whatsoever that may arise, directly or indirectly, from anything done or omitted to be done in the construction, maintenance, alteration, or operation of the works authorized.

Issuance of this permit by Alberta Transportation does not relieve the holder of the responsibility of complying with relevant municipal bylaws, and this permit once issued does not excuse violation of any regulation, bylaw, or act that may affect this project.

Upon completion of the project, we ask that you notify Darren Davis, Assistant Development/Planning Technologist, or Leah Olsen, Development/Planning Technologist, at Lethbridge, 403-381-5426, who will inspect the conditions of the permit. Your cooperation in this matter is appreciated.

Yours truly,

Darren Davis
Assistant Development/Planning Technologist

DD/jb

cc: Municipal District of Willow Creek No. 26 – chisholm@mdwillowcreek.com; brenda@mdwillowcreek.com
Volker Stevin – fortmacleod.admin@volkerstevin.ca
Rick Lemire – e-mailed
Darren Davis – e-mailed

Alberta

.../2

(To be completed by Alberta Transportation)

# ROADSIDE DEVELOPMENT APPLICATION APPROVAL FOR DEVELOPMENT NEAR A PRIMARY HIGHWAY

# PERMIT

Permission is hereby granted to **Arie and Willemiek Muilwijk** to carry out the development in accordance with the plan(s) and specifications attached hereto and subject to the conditions shown below.

If the development has not been carried out by the **26th** day of **September** **2020** this permit lapses and the applicant must reapply for a new permit if they wish to proceed.

SIGNED _____ PERMIT NO. **5548-19**

FILE NO. **2511-NE 10-9-27-W4M (785)**

TITLE Assistant Development/Planning Technologist DATE **September 26, 2019**

**PERMIT CONDITIONS**: (Note: This permit is subject to the provisions of Section 11 – 19 inclusive of the Highways Development and Protection Act, Chapter H-8.5 2004, amendments thereto, and Highways Development and Protection Regulation (Alberta Regulation 326/2009) and amendments thereto).

**A. ACCESS CONDITIONS: (Note: All highway accesses are to be considered temporary.** No compensation shall be payable to the applicant or his assigns or successors when the Department removes or relocates the temporary access or if highway access is removed and access provided via service road).

1. ~~(a) No direct highway access will be permitted. Access shall be via the local municipal road.~~
   (b) Use of the existing highway access may continue on a temporary basis.
   ~~(c) Permit authorizes construction of proposed access at the location shown and to the attached specifications. (Figure D-3.3b)~~
2. No additional highway access will be permitted.
3. The applicant shall construct and maintain any highway access to the Alberta Transportation's satisfaction.
4. Approval of companies having buried utilities shall be obtained prior to access construction or upgrading.

**B. SETBACK CONDITIONS (Note:** Minimum setbacks usually allow for anticipated highway widening and construction of a service road parallel and adjacent to the highway).

1. The proposed **calf shelter and grain shed** is to be set back **77 meters (28 feet)** from the highway property line as shown on attached approved site plan.
2. The department accepts no responsibility for the noise impact of highway traffic upon any development or occupants thereof.

**C. OTHER CONDITIONS:**

1. This permit is issued subject to the approval of the **Municipal District of Willow Creek No. 26.**
2. This permit approves only the development contained herein, and a further application is required for any changes or additions.
3. The department is under no obligation to reissue a permit if the development is not completed before expiry of this permit.
4. Darren Davis, Assistant Development/Planning Technologist, or Leah Olsen, Development/Planning Technologist, in Lethbridge, telephone 403-381-5426, shall be notified before construction commencement.
5. The applicant shall not place any signs contrary to Alberta Regulation 326/2009. A separate "SIGN APPLICATION" form shall be submitted for any proposed sign.

**D. ADDITIONAL CONDITIONS and/or ADVISEMENTS:**

See attached Schedule "A"

SCHEDULE "A"
Permit 5548-19

D: ADDITIONAL CONDITIONS and/or ADVISEMENTS:

1. This permit is approval for development of a calf shelter and grain shed only. Any additional development will be expressly subject to Condition C.2.

2. The applicant shall ensure that all on-site development, including ancillary development, is setback from the highway right-of-way boundary as shown on the attached approved site plan. Under no circumstance shall a different setback be implemented without the written permission of Alberta Transportation.

3. Further to condition A.1.(b), the department will not accept any responsibility for compensation requests/claims dealing with loss of business, inconvenient access, or any other disruption that may arise as result of the possible revision to the existing access arrangement. The possible revision to the existing access arrangement may be due to access management/operational, construction, or planning activities carried out by the department or its consultants.

4. Further to Condition B.2, noise impact and the need for attenuation should be thoroughly assessed. The applicant is advised that provisions for noise attenuation are the sole responsibility of the developer and should be incorporated as required into the development of the property.

5. Any peripheral lighting (yard lights/area lighting) that may be considered a distraction to the motoring public or deemed to create a traffic hazard will not be permitted.

Government of Alberta
Transportation

# ROADSIDE DEVELOPMENT APPLICATION FOR DEVELOPMENT NEAR A PROVINCIAL HIGHWAY

(print please)

Alberta Transportation Permit # 5548-19

RSDP027438

**Applicant's Name** Arie & Willemiek Mailwijk

**Mailing Address** Box 1628

**City/Town/Village** Fort Macleod **Province** Alberta **Postal Code** T0L 0Z0

**Phone #** 403-308-2449 **Fax #** _____ **e-mail** awmailwijk@hotmail.com

**Landowner's Name** (if different from above) _____

**Mailing Address** _____

**City/Town/Village** _____ **Province** _____ **Postal Code** _____

**Phone #** _____ **Fax #** _____ **e-mail** _____

**APPLICATION IS HEREBY MADE TO:** (Please provide a description of the proposed development including all proposed above and below ground installations. Attach a detailed report if necessary.)

Build covered calf shelter 260'x 48' with attached community shed. Liner will be underground. Open grop housing each individual pen being 16'x 48', 16 pens + grain shed.

***Also attach a plan showing in detail the location of all existing and proposed development and access.***

**Property Information**

| NE | 10 | 9 | 27 | 4W4 |
|---|---|---|---|---|
| (NE, NW, SE, SW) | ¼ Section | Township | Range | West of Meridian |

| | | | 156 |
|---|---|---|---|
| Lot | Block | Plan Number | Parcel size (acres or hectares) |

**Highway No.** 785 14 **kilometres** west (north, south, etc.) **of** Fort Macleod (City, Town or Village)

**Distance of the proposed development to the highway right-of-way boundary** 77 **metres**

| MD of Willow Creek | Agriculture | $1 750.00 |
|---|---|---|
| Name of Municipality | Existing / Proposed Land Use | Estimated cost of proposed development |

It is understood that all works will be constructed, altered, maintained or operated at the sole expense of the undersigned, and that any work must not begin before a permit has been issued by Alberta Transportation.

In consideration of any permit issued in respect to this application, the Applicant shall indemnify and hold harmless Alberta Transportation, its employees and agents from any and all claims, demands, actions and costs whatsoever that may arise, directly or indirectly from anything done or omitted to be done in the construction, maintenance, alteration or operation of the works authorized. The Applicant also consents to a person designated by Alberta Transportation to enter upon land for the purpose of inspection during the processing of this application.

The issuance of a permit by Alberta Transportation does not relieve the holder of the responsibility of complying with relevant municipal bylaws and this permit once issued does not excuse violation of any regulation, bylaw or act which may affect this project

I Arie Mailwijk (print full name) hereby certify that I am the registered owner _____ Signature

I _____ (print full name) hereby certify that ____ I am authorized to act on the owner's behalf _____ Signature

and that the information given on this form is full and complete and is, to the best of my knowledge, a true statement of facts relating to this application for roadside development.

**RECEIVED** (Date) September 25 / 2019

SEP 26 2019

Sep. 26/19

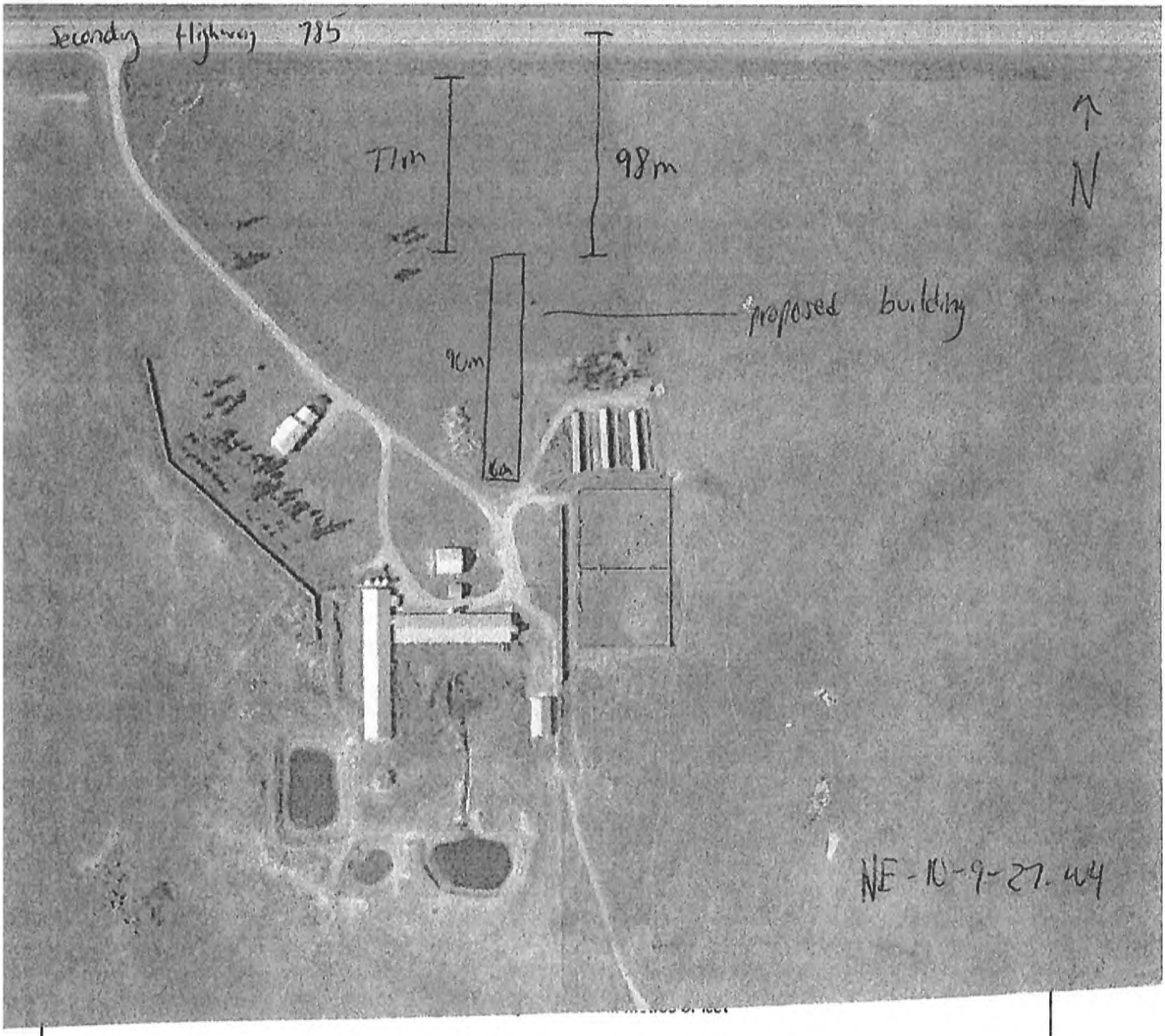
Southern Region
TRANSPORTATION

JB

Government of Alberta
Transportation

# ROADSIDE DEVELOPMENT APPLICATION FOR DEVELOPMENT NEAR A PROVINCIAL HIGHWAY

Alberta Transportation Permit # _____




## SITE PLAN

Alberta TRANSPORTATION APPROVED

Assistant Development/Planning Technologist

Signature of Registered Owner or Authorized Agent

Permit No. 5548-19

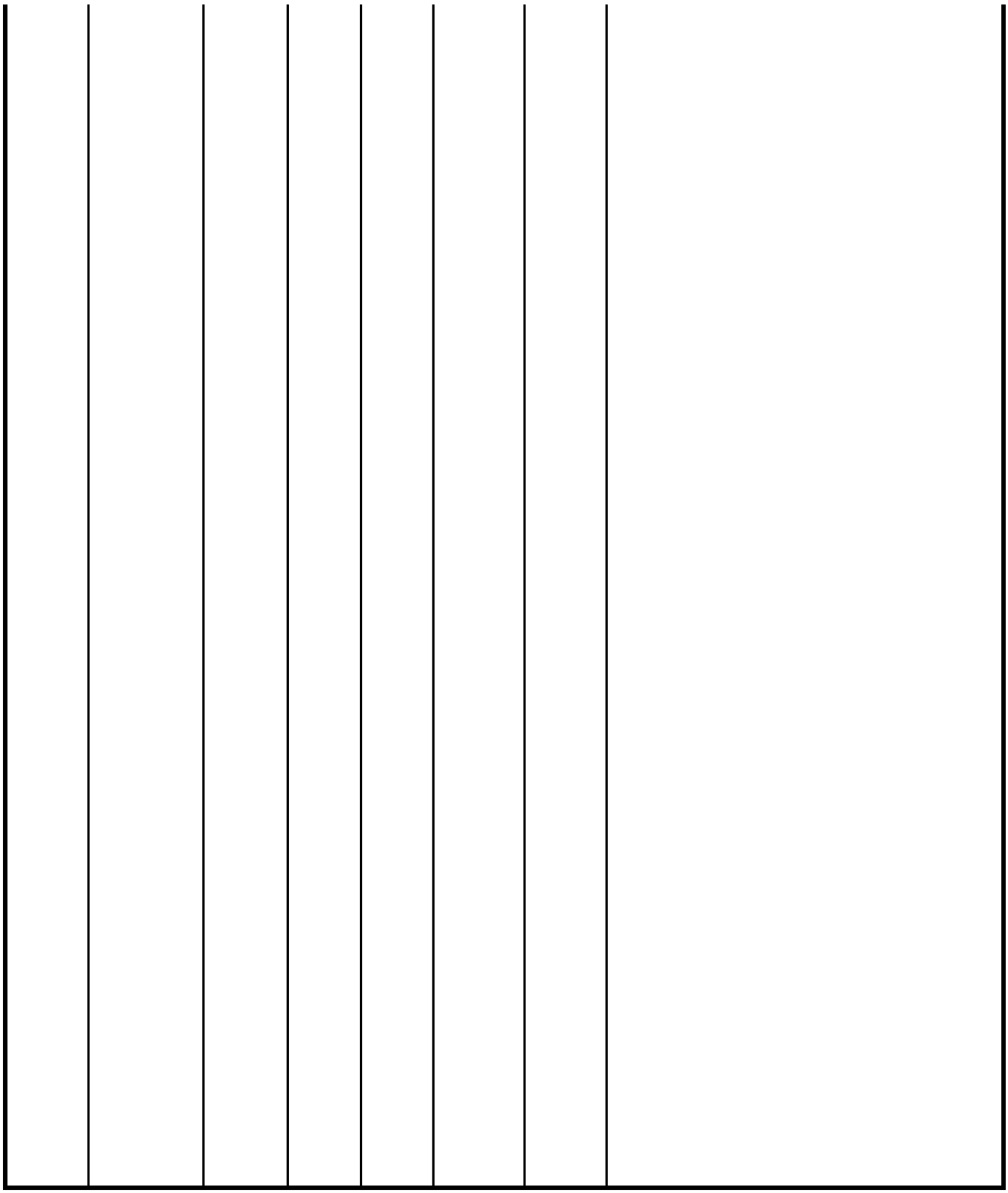
# CHILAKO DRILLING SERVICES LTD

Box 942 Coaldale, Alberta, T1M 1M8
(403) 345-3710

## SOIL PROFILE AND PARENT MATERIAL DESCRIPTION

Site Location: Arie Muilwijk  Date: 9-Aug-19

| Hole # | Location | Depth | Texture | Moisture | Geological | Sample | Remarks |
|---|---|---|---|---|---|---|---|
| AM1-19 | 0314346 | 0-2.1 | VFSL | SM | Lac | | Silty |
| | 5511364 | 2.1-3.5 | VFSCL | VM | Lac | | |
| | | 3.5-5.1 | VFSL | VM-Sat | Lac | | |
| | | 5.1-5.9 | SiCL | M | Lac | | V. firm, med-high plastic, yellow brown |
| | | 5.9-6.2 | FSCL | VM | Lac | | Slough @ 3.3m |
| AM2-19 | 0314354 | 0-2.9 | VFSL | SM | Lac | | Silty |
| | 5511400 | 2.9-3.6 | SiCL | VM | Lac | | Sandy |
| | | 3.6-5.6 | VFSL | Sat | Lac | | Soft, olive brown, silty, free water |
| | | 5.6-6.2 | SiCL | M | Lac | | V. firm, med-high plastic, olive brown |
| | | | | | | | slough @ 3.9m |
| AM3-19 | 0314364 | 0-1.8 | VFSL | M | Lac | | Loose, olive brown, silty |
| | 5511294 | 1.8-2.3 | VFSCL | VM | Lac | | Low plastic, olive brown, silty |
| | | 2.3-3.0 | VFSL | VM | Lac | | Silty |
| | | 3.0-4.1 | VFSL | Sat | Lac | | Silty, free water, VFSL sand lenses |
| | | 4.1-4.6 | SiCL | M | Lac | | Stiff, med plastic, olive brown |
| | | 4.6-5.0 | VFSCL | VM | Lac | | Soft, low plastic, olive brown |
| | | 5.0-6.2 | SiCL | VM | Lac | | Firm, low plastic, olive brown |
| AM4-19 | 0314411 | 0-1.0 | SiCL | M | Lac | | |
| | 5511281 | 1.0-2.7 | VFSL | M | Lac | | |
| | | 2.7-4.4 | VFSL | Sat | Lac | | Soft |
| | | 4.4-6.2 | C-SC | M | Till | | Stiff, low plastic, trace gravel |



Legend: L Loam
C Clay
S Sand

| | |
|---|---|
| Gr. | Gravel |
| Si | Silt |
| F | Fine (sand) |
| VF | Very Fine (sand) |

Eg. VFSCL = Very Fine Sandy Clay Loam


Untitled Map
Write a description for your map.
AO: This plan was provided as part of the Chilako Drilling Services soil report and shows the location of the test holes which were drilled. The date the photograph is unknown
Legend
Feature 1
AM2-19
AM1-19
AM3-19
AM4-19
Page 36 of 100
Google Earth
Image S. Alberta MD s and Counties
©2018 Google
N
80 m

**Photographs provided by Arie Muilwijk showing roller compacted concrete construction Uncovered / Open pens**

**Covered pens**

6 November 2020

Wood File: BX30653

3102 – 12 Avenue North
Lethbridge, Alberta T1H 5V1
www.woodplc.com

Arie & Willemiek Muilwijk
P.O. Box 1628
Fort Macleod, AB T0L 0Z0

Attention: Arie Muilwijk

**Re: Compliance Report – Roller Compacted Concrete for Calf Shelter, Calf/Feeder Pens NE-10-009-27-W4M, near Fort Macleod, Alberta**

As requested, Wood Environment & Infrastructure Solutions (Wood) has provided engineering support services in conjunction with the recently constructed calf shelter and feeder pens at the above-captioned site. It is understood that the NRBC permitting for this expansion was not quite finalized at the time of construction of the subject shelter and pens, and in the time since construction, several issues have been raised by the NRCB which have to this point encumbered the permitting of the facility. The purpose of this letter is to provide an engineering basis for the design of the shelter and pen base relative to the Agricultural Operation Practices Act, AB Reg. 267/2001 (hereinafter referred to as "AOPA"), to support NRCB permitting of the new facility.

In general, the subject floor of the shelter and base of three pens were constructed using Roller Compacted Concrete (RCC). The RCC mat was constructed with a minimum targeted thickness of 150 mm, and the nominal targeted compressive strength of the concrete was 25 MPa. The RCC was placed in November, 2019.

**Construction Review of the RCC Mat**

The calf shelter RCC mat encompasses an area of about 15 m wide by 80 m long, and is located directly east of the residence and north of the barns (*see Figure 1*). The new feedlot pens encompass an area of about 37 m wide by 97 m long, and are located just southeast of the calf shelter building (see Figure 1). At the time of Wood's field review, the catch basin had been formed, but the liner was not installed. The catch basin excavation measured roughly 20 m wide by 30 m long by 1.8 m deep, with side slopes of approximately 3 horizontal to 1 vertical (i.e., 3H:1V).

To assess the RCC mat, Wood reviewed records of construction, the concrete mix, and carried out testing and field review of the completed RCC mat. Construction of the RCC mat was carried out by Subterrain Excavating, who leveled and prepared the subgrade, and placed the RCC. The RCC was supplied by Prairie Stone Concrete, who had set up their plant at the White Lake Colony gravel pit, located along the Spring Point Road (Hwy 785), about 5 km from the site.

The site review by Wood was carried out on June 9, 2020, and included coring, non-destructive compressive strength testing, and a visual review of both mats to the extent possible. The following comments, observations, and test results by Wood relative to the recently placed RCC mat are provided as follows:

1. The sizes and locations of the calf shelter, pens, and catch basin are generally consistent with the details provided in the NRCB Permit Application (LA19036).
2. Photographs provided depicted the subgrade prior to placement of the RCC and showed that the subgrade had been levelled and compacted prior to RCC placement.
3. The RCC was placed by Subterrain Excavating using GPS based survey-controlled equipment to provide a uniform placement thickness of RCC and positive sloping of the pens. Based on coring of several locations in the RCC, the thickness of RCC ranged between 155 mm and 205 mm, with an average thickness of 173 mm for eight cores *(see Concrete Core Report, attached)*. The approximate core locations are illustrated on *Figure 1*, attached.
4. Photographs provided depicted the RCC being compacted around existing fence posts, waterers, and bunk aprons, using a walk-behind plate compactor, while a large vibrating ride-on compactor was used to compact the majority of the RCC.
5. Further photographs provided depicted a layer of straw over the RCC following placement to promote curing of the RCC and to provide crack control related to early-stage curing of the RCC.
6. Laboratory density testing was carried out on core samples recovered from the RCC mat, and indicated in-place densities ranging between 2,395 kg/m$^3$ and 2,420 kg/m$^3$, generally representing optimal compaction of the RCC mix, with densities ranging between 99 percent and 101 percent of the target mix density of 2,400 kg/m$^3$ *(see Concrete Core Report, attached)*.
7. During Wood's June 9, 2020 site visit, a Schmidt hammer was utilized to estimate the compressive strength of the RCC. The results of the rebound testing indicated compressive strengths of the RCC ranging between about 25 MPa and 40 MPa.
8. At the time of Wood's site review, the catch basin had also been roughly formed, and dimensions were found to be in general accordance with those provided in the application for permit. No accumulation of water or evidence of groundwater was observed in the catch basin excavation. Some accumulation of sand and silt was observed, which would require removal prior to placement of a liner. It is understood that an HDPE liner is proposed for this catch basin.

**Roller Compacted Concrete (RCC) as a Liner**

The use of RCC is gaining widespread popularity and acceptance among producers in the confined feeding industry in Southern Alberta. Since 2018, the local Lethbridge NRCB office has also permitted the construction of at least one feedlot expansion[1] with RCC as the pen base, with consideration of the RCC as a liner material meeting the requirements of the AOPA. Given the questions surrounding the use of RCC as a liner satisfying the requirements of AOPA, most of the local RCC pen base construction has encompassed the rehabilitation of older 'grandfathered' confined feeding operations or existing permitted facilities as an alternative to the ongoing requirement for imported clay to reconstruct pen bases following manure removal. Wood provided engineering support to one of the first projects

[1] NRCB permit: LA18053B

associated with the recent onslaught of RCC use as a pen base more than ten years ago. That first project, as well as the associated widespread use of RCC that has developed in the more recent few years, has consistently demonstrated that RCC is robust and performs very well for many years both in terms of animal health and performance of the pen bases during all cycles of pen cleaning activities and animal occupation.

While the NRCB has released a document entitled "Non-Engineered Concrete Liners for Manure Collection and Storage Areas" (dated June 2015), this provides guidance for the use of conventional reinforced plastic concrete, and is not directly applicable to the use of RCC as a liner material. At this time neither Alberta Agriculture nor the NRCB have released an official guidance document to support the use of RCC as a liner material for solid manure storage. Accordingly, this letter is prepared to satisfy the intent of AOPA Section 9(6), which indicates: *"The liner of a manure storage facility and of a manure collection area, if constructed of compacted soil or constructed of concrete, steel, or other synthetic or manufactured materials, must provide equal or greater protection than that provided by compacted soil (c)0.5m in depth with a hydraulic conductivity of not more than 5 x $10^{-7}$ centimetres per second for a solid manure storage or solid manure collection area.",* by providing engineering rational to support RCC as a liner which satisfies AOPA Section 9(6)c.

The use of concrete as a liner in past years, even in the case of completely unreinforced concrete, has demonstrated significant longevity, *and generally performs better than compacted soil, HDPE, or steel*. An important advantage of concrete, whether conventional concrete or RCC, is the level to which positive drainage can be maintained within the pen areas as compared to clay-lined pens. Particularly, RCC pens are generally characterized by much less ponding than for clay pens, and where water is efficiently shed off the mat rather than allowed to pond in the pen, the net result is that the volume of surface water available to permeate through the pen base is much less than for RCC pens. The more efficient shedding of water from the pen area also helps to mitigate the freeze/thaw effects on the soil subgrade or compacted clay liner, which is a major contributor to soft clay pen base conditions during spring months.

The readily available publication "*Design and Control of Concrete Mixtures*" by the Cement Association of Canada provides a good discourse on volume changes related to concrete. Cracking of concrete can be primarily attributed to slight volume changes in the concrete, particularly in conjunction with tension stresses that develop because of shrinkage. This volume change (or shrinkage) occurs for a variety of reasons. In early concrete stages, chemical shrinkage occurs in conjunction with the reduction in volume of solids and liquids in paste resulting from cement hydration. Autogenous shrinkage occurs at a macroscopic level where there is visible dimensional change of the cement paste resulting from hydration. Subsidence occurs in the form of vertical shrinkage of fresh concrete as bleed water rises to the surface. And plastic shrinkage occurs in the case that rapid evaporation of moisture from the surface of the concrete exceeds the bleeding rate. Following hardening of the concrete, volume changes occur as a result of moisture changes (with shrinkage occurring as a result of moisture loss and expansion during moisture gain), and as a result of temperature changes (with contraction occurring during cold weather, and expansion occurring during warmer weather.

The level of early age volume changes related to roller compacted concrete is generally considered to be *somewhat lower* than for conventional (plastic concrete) due to the typical lower water content and water-cement ratio of the concrete, the general absence of bleed water, and the effect of compacting the concrete matrix into place during placement. However, based on Wood's experience, the volume changes of the roller compacted concrete resulting from moisture changes or thermal expansion/contraction appear to be consistent with conventional concrete. Assuming a coefficient of thermal expansion of $8 \times 10^{-6}$ per degree Celsius for concrete using sand and gravel, the calculated linear change of a concrete pad associated with a temperature variation between -30 °C and +30°C would be about 5 mm per 10 m length of concrete. Assuming a similar reduction in volume during early age curing, and an additional 10 mm of further propagation of these cracks after a series of seasonal cycles, it would be reasonable to assume typical long-term potential crack propagation to 20 mm per 10 m length of RCC at the subject site. This is generally consistent with Wood's observations of older RCC mats, though it is noted that after one year no readily observable cracking was noted in the RCC mats at the subject Muilwijk operation.

Invariably, the cracks in the RCC mat become infilled with a combination of bedding material, manure, and soil. While Wood does not know of any studies specifically measuring permeability through infilled cracks of a manure storage pad, some excellent work has been done to measure permeability through the black interface and gleyed zone occurring in conjunction with moderately coarse and moderately fine textured soils in feedlot pen surfaces in Southern Alberta[2]. The intent (in part) of the referenced study was to investigate this black interface layer between the manure pack and underlying stained soils to assess suitability of this material relative to protection of groundwater. The results of the study indicated permeability of this interface layer ranging between about $4 \times 10^{-5}$ cm/sec and $9 \times 10^{-4}$ cm/sec (see Note[3]). While the permeability through this black interface zone or (in some cases a gleyed layer) would not directly satisfy the stated AOPA requirements for groundwater protection, the localized higher permeability through these narrow interface zones (i.e., infilled cracks) can be considered in conjunction with the broader relatively impermeable RCC (or concrete) matrix.

Permeability through RCC and typical hardened concrete is widely documented, and generally below $1 \times 10^{-9}$ cm/sec. Considering a 10 m by 10 m section of RCC mat containing one 20 mm wide crack in both directions (the cracked area having an assumed permeability of $1 \times 10^{-4}$ cm/sec), and a conservative estimate of 1 x 10-9 cm/sec for RCC, the average calculated permeability through the 150 mm thick RCC mat would be $9.0 \times 10^{-8}$ cm/sec. This represents the equivalent of approximately 0.8 m of compacted soil having a hydraulic conductivity of $5 \times 10^{-7}$ cm/sec, which is more than the minimum 0.5 m of compacted soil having a hydraulic conductivity of $5 \times 10^{-7}$ cm/sec indicated by Section 9(6)c for solid manure storage or solid manure collection. It is noted that both the hydraulic conductivity of the RCC and interface zone (cracks) indicated above would be considered conservative estimates of hydraulic conductivity.

---

[2] Jim J Miller, Tony Curtis, Francis J. Larney, Tim A. McAllister, and Barry M. Olson: *"Physical and Chemical Properties of Feedlot Pen Surfaces Located on Moderately Coarse- and Moderately Fine-Textured Soils in Southern Alberta"* Journal of Environmental Quality, Volume 37, July-August 2008.

[3] Note: Miller et al reports field-saturated hydraulic conductivity, $K_{fs}$, of 4.37 to $92.9 \times 10^{-7}$ m $s^{-1}$ for pen base soils at the three study sites.

**Closing Comment**

In general, the review of the RCC associated with the subject calf shelter and pens indicated that construction of the RCC mat was consistent with good construction practice. Further, the results of density and compressive strength testing of the finished mat indicate that the RCC is competent and suitable for its intended purpose.

Finally, as demonstrated in the discussion provided above it is Wood's opinion that the Roller Compacted Concrete (including with the consideration of potential cracking as outlined herein) satisfies the requirements for liner material indicated in Section 9(6)c of the AOPA.

This report has been prepared for the exclusive use of Arie & Willemiek Muilwijk for the specific application to the development described in this report, and may be used by the NRCB specifically to support the permit application by the Muilwijk's for the subject calf shelter and calf/feeder pens as described herein. Any use that a third party makes of this report, or any reliance or decisions based on this report are the sole responsibility of those parties. This report has been prepared in accordance with generally accepted soil and materials engineering practices. No other warranty, express or implied, is made.

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

Respectfully submitted,

**Wood Environment and Infrastructure Solutions,**
**A Division of Wood Canada Limited**

6 November 2020

PROFESSIONAL ENGINEER JOHN LOBBEZOO ALBERTA

John Lobbezoo, P.Eng.
Associate Engineer, Geotechnical
Lethbridge Geotechnical & Materials Testing Lead

*Reviewed by:*
Cody Metheral, P.Eng.
Linkage Ag Solutions

Adam Johnson, C.E.T.
Field & Laboratory Services Manager

PERMIT TO PRACTICE
Wood Environment & Infrastructure Solutions
Signature _____
Date 6 November 2020
PERMIT NUMBER: P-04546
The Association of Professional Engineers and Geoscientists of Alberta

Attachments: Figure 1 – Site Plan
Concrete Core Report


**Site Plan**
New Pen/Calf Shelter Construction
Arie & Willemiek Muilwijk
NE-10-009-27-W4M
Wood File: BX30653



Legend: *A RCC Core Location

# CONCRETE CORE REPORT

CCIL CERTIFIED CONCRETE TESTING LABORATORY
IN ACCORDANCE WITH STD A283

wood.

Wood Environment & Infrastructure Solutions
a Division of Wood Canada Limited
Lethbridge Laboratory

**To: Arie & Willemiek Muilwijk**
Box 1628
Fort Macleod, AB
T0L 0Z0

**Attention: Arie Muilwijk**

**Project No.: BX30653**

**Project: Material Testing Services**

SET NO: 1 NO. OF CORES: 8 DATE RECEIVED: 9-Jun-20 DATE CAST: Nov, 2019

| SPECIMEN NUMBER | DATE TESTED | RAW SPECIMEN LENGTH (mm) | SPECIMEN DENSITY (kg/m$^3$) | PERCENT OF TARGET DENSITY (%) | CORE LOCATION |
|---|---|---|---|---|---|
| A | 10-Jun-20 | 168 | 2413 | 100.5% | Calf Shelter (see drawing) |
| B | 10-Jun-20 | 183 | 2401 | 100.0% | Calf Shelter (see drawing) |
| C | 10-Jun-20 | 205 | 2420 | 100.8% | Calf Shelter (see drawing) |
| D | 10-Jun-20 | 170 | 2405 | 100.2% | Calf Shelter (see drawing) |
| E | 10-Jun-20 | 155 | 2395 | 99.8% | North Pen (see drawing) |
| F | 10-Jun-20 | 162 | 2399 | 100.0% | Centre Pen (see drawing) |
| G | 10-Jun-20 | 173 | 2404 | 100.2% | South Pen (see drawing) |
| H | 10-Jun-20 | 169 | 2415 | 100.6% | South Pen (see drawing) |
| | Average | 173.1 | 2406.5 | | |

SPECIFIED STRENGTH 25 Mpa @ - Days
TARGET DENSITY 2400 kg/m$^3$
AGGREGATE SIZE 20 mm

ADMIXTURES -

SUPPLIER Prairie Stone Concrete
MIX NO. -



***Notes:***

*1. Unless otherwise noted, all aspects of testing carried out by Wood personnel conform to CSA CAN A23.2.*
*2. Client Cast Cylinders: Various testing aspects related to client cast cylinders, if applicable, may not be in conformance to CSA CAN A23.2.*

**Wood Environment & Infrastructure Solutions a Division of Wood Canada Limited**

Per: _____
Adam Johnson, CET

## AO: Groundwater and Uppermost Groundwater Resource Report prepared as part of the ERST scoring for the CFO facilities

LA19036 Site Information Form
Supporting Information
Groundwater Resource and Uppermost Groundwater Resource (UGR) – NE 10-9-27 W4
December 3, 2020

**What groundwater resources exist at this site?**

The groundwater resource definition (Appendix A) (i) "means an aquifer below the site of a confined feeding operation or a manure storage facility that is being used as a water supply for the purposes of domestic use".

Part A of the groundwater resources definition (ii) discusses an aquifer with a sustained yield of 0.76 L/minute or more and a total dissolved solids (TDS) concentration of 4000 mg/L or less.

**Existing water well's groundwater resource**

Water well id 115735 is the only current water well within 400m of all facilities at this site. It was drilled in 1982 to a depth of 29.0m, with perforations from 24.4m to 29.0m (Appendix B). Formations logged were brown till (surface to 12.2m), underlain by blue clay (12.2m to 22.9m), and underlain by hard shale and gravel (22.9m to 29.0m). The static water level was identified as 18.9m. None of the formations are identified as water bearing in the formation log column. As the well was completed (and perforated into) the hard shale and gravel formation (and only that formation), the hard shale and gravel will be considered a water bearing aquifer. The formation is under sufficient confinement by the blue clay layer above that the water level rose to 18.9m, 4m above the top of the hard shale and gravel. The water level did not rise as high as the brown till, suggesting that the brown till and hard shale and gravel formations are hydrogeologically separate. Proposed well use is "Domestic & Stock". Because it is an aquifer for domestic use, the hard shale and gravel identified in well id 115735 is a groundwater resource.

**Are there other groundwater resources at site?**

The lithology for water well id 115735 does not indicate a shallower aquifer than the hard shale and gravel groundwater resource from 22.9m to 29.0m.

Water well id 115734 is a 1980 chemistry report from a well on site (Appendix B). The method of drilling was "Hand Dug", proposed well use was "Domestic", and the total depth of the well is identified as 4.6m. Lithology is not listed (as was very common for chemistry reports). This is clearly a different water well than id 115735, which was drilled in 1982. At some point in the past, well id 115734 was "being used as a water supply for the purposes of domestic use", so it would have been completed into an aquifer. However, well id 115734 is no longer in use, so the aquifer it was completed into is no longer in use at this site.

The (i) definition of groundwater resource is "an aquifer below the site of a confined feeding operation … *that is being used* as a water supply for the purposes of domestic use." (emphasis added) I note that this definition is specific that an aquifer must be below a confined feeding operation to be considered a groundwater resource, but the definition is not specific about the location of the domestic use of the aquifer. In other words, an aquifer that existed below a confined feeding operation (CFO) (but not used by the CFO) yet was used by a neighbouring residence for domestic use would be considered a groundwater resource and require a liner or layer between manure facilities and the groundwater resource below the CFO site.

**Within what distance should other domestic users of groundwater be looked for?**

The Environmental Risk Screening Tool, version 1.2, September 2011, page 10, (Appendix C) states:

> "The depth to the UGR should be determined using site-specific information when available (e.g. borehole logs or monitoring well completion information in geotechnical or hydrogeological reports).
> If the site-specific geological information shows that there may be a shallower aquifer located above the aquifer used on site, then the water well drillers logs from wells located within 1.6km (1 mile) of the facilities property boundary (quarter section) need to be reviewed.
> The uppermost aquifer within 1.6km (1 mile) currently in use must be correlated to the site specific information to call this identified uppermost aquifer on site the UGR."

**What information was found?**

A reconnaissance report from Alberta Environment's Groundwater Information Database for the NE 10-9-27 W4 plus 1.6km in all directions yielded 27 results. (Appendix D) The depth column was reviewed. All wells reports with a well depth equal to or less than 20 feet (including 0 feet) were reviewed with any associated chemistry results (Appendix E), and are summarized in Table 1.

Table 1. Summary of Well ids and Associated Chemistry results

| Well id | Land Location (of 9-27W4) | Depth (feet/ metres) | Well id report type | Total Dissolved Solids (mg/L) | Year Report Received | Other |
|---|---|---|---|---|---|---|
| 115717 | NE 3 | 5.0/1.5 | Chemistry | 446 | 1978 | |
| 115719 | NE 3 | 20.0/6.1 | Chemistry | 489 | 1980 | 1985 – owner reports well yield has decreased[2] |
| 155266 | NE 3 | 0.0[1] | Chemistry | 188 | 1990 | |
| 2093787 | SE 10 | 13.0/4.0 | Well Inventory (Drilled 1978/11/05) | No chemistry information | 1985 | Prior to 1984, yielded 10 gpm 1985, yielded 5 gpm 1985 – well service, 24" of gravel removed from well bottom[2] |
| 115734 | NE 10 | 15.0/4.6 | Chemistry | 461 | 1980 | |
| 244439 | SE 14 | 0.0[1] | Chemistry | 268 | 1987 | |
| 115750 | NW 14 | 13.0/4.0 | Test Hole, 2 inch plastic casing installed | No water levels or chemistry information | 1986 | Lithology: 0-2', Gravel 2'-7', Silty clay 7'-11', Medium grained sand 11'-13', Silty clay |

[1]A well depth of 0.0 is assumed to be unknown
[2]Emergency Groundwater Testing Program

Working up from the bottom of Table 1, well id 115750 will not be further assessed because it has no evidence of water presence.

Well id 244429 will not be further assessed because it could be a subsequent chemistry that was done on well id 115746 (1985 chemistry report on a well reported to be 200 feet deep).

Well id 115734 is the shallow well on site, discussed above.

All water well ids for SE 10-9-27W4 were searched, two were found. One is a well inventory (well id 2093787) drilled in 1978. The other well (id 115732) was drilled in 1985. Both wells are listed as having the same owner. The 1978 water well report indicates it's use was domestic and stock, a well depth of 13.0 feet, and a 10 gpm yield (prior to 1984), reduced to a 5 gpm yield (1985). This well was serviced in 1985 and 24" of gravel was removed from the well. The well depth for the 1978 well is similar to the water depth on NE 10. The flow rates of 10 and 5 gpm are greater than the 0.76 L/min minimum in the groundwater resource definition. There is no chemistry information attached to well id 2093787.

All water well ids for NE 3-9-27W4 were searched; four were found. Three are chemistries (well ids 115717, 115719 and 155266), and one is an Alberta Environment test hole that was not completed as a water well. There is no record of a water well being drilled at NE 3. The well depth reported for each of the three water wells is 20.0 feet (or less), similar to the water depth on NE 10. Each of the TDS results for NE 3 are <500 mg/L, below the 4000 mg/L in the groundwater resource definition.

**Rural domestic water use changes over time**

The Environmental Risk Screening Tool, version 1.2, September 2011, page 9, (Appendix C) discusses Alberta Environment well records from the early 1900s to the Second World War, and that wells that provided enough water pre-Second World War for domestic purposes may not provide sufficient water for residential use today. All five of these shallow well reports for NE10, SE10, and NE3 are from 1978 or later. This is the "modern" era of required yield of water for rural domestic purposes – the era of electricity, running water, dishwashers, washing machines, indoor toilets, showers, etc. Because of the decades between the Second World War and the earliest of these shallow well reports in 1978, none of these shallow wells can be discounted as having insufficient supply due to changes in domestic rural household water use over time.

**Other site information regarding groundwater**

Four boreholes were advanced on site on August 9, 2019 from surface to depths of 6.2m. Borehole logs and their location were provided (Appendix F), but without an accompanying report. All four boreholes indicate a saturated zone, with a top ranging from 2.7m to 3.6m below surface, and a bottom ranging from 4.1m to 5.6m below surface (Table 2).

Table 2. Borehole information for Arie Muilwijk (saturated zones)

| Hole # | Depth[1] | Texture | Moisture[2] | Remarks related to saturation |
|---|---|---|---|---|
| AM1-19 | 3.5-5.1 | VFSL[3] | VM-Sat | Slough @ 3.3m |
| AM2-19 | 3.6-5.6 | VFSL | Sat | Soft, olive brown, silty, free water; slough @ 3.9m |
| AM3-19 | 3.0-4.1 | VFSL | Sat | Silty, free water, VFSL sand lenses |
| AM4-19 | 2.7-4.4 | VFSL | Sat | |

[1]All depths assumed to be in metres.
[2]VM assumed to be Very Moist, Sat assumed to be Saturated
[3]VFSL is Very Fine Sandy Loam (as per legend provided)

All four boreholes indicate a saturated zone (a water table) shallower than the hard shale and gravel formation. The presence of this water table across all four boreholes and the similar depth as well id 115734 are supporting information that the aquifer used in water well id 115734 is laterally extensive, at minimum within the area of the boreholes on site.

**So, after reviewing all this information, are there other groundwater resources below the site?**

Yes. There is enough information that a shallow aquifer extends from NE10, south onto SE10 and further south onto NE3. It may still be in use on SE10 via a water well, and is most likely still in use on NE3 via a water well. All chemistry and yield data from the five shallow wells on these three quarter sections meet (ii) of the groundwater resource definition.

The aquifer that well id 115734 was completed into, further detailed in depth and extent by the four onsite boreholes, is a groundwater resource below the site.

**What is the Uppermost Groundwater Resource?**

The uppermost groundwater resource at NE10-9-27W4 is the shallow aquifer that well id 115734 was completed into. On site, the depth to the top of the UGR ranges from 2.7m to 3.6m below grade, based on saturated very fine sandy loam zones indicated in the four borehole logs.

The shallowest top of UGR depth will be entered on Site Information Forms for all facilities because that is a reasonably conservative assumption for screening level assessment:

Reference: borehole AM4-19
Predominant geology: very fine sandy loam [2.7m to 4.4m]
Depth to UGR from ground level: 2.7m
Subsoil Texture: Coarse

A subsoil texture of coarse was chosen for the UGR based on the ERST's Reference Materials (Appendix G). "Coarse" includes Clean Sand (fine), silty sand, and some silt, so I determined coarse was the most appropriate category for very fine sandy loam. In addition, well id 2093787 indicates a pre-1984 flow rate of 10gpm from this zone.

Scott Cunningham

Scott Cunningham, P.Eng, P.Ag. December 3, 2020

Appendix A – Groundwater Resource definition
Appendix B – Site Water Well Reports
Appendix C – Environmental Risk Screening Tool (pages 9 and 10)
Appendix D – Water Well Reconnaissance Report and Map
Appendix E – Water Well Reports within 1.6km of the Site
Appendix F – Site Borehole Logs and Locations
Appendix G – Environmental Risk Screening Tool (estimating subsoil texture)

# Appendix A

# Groundwater Resource definition

# Standards and Administration Regulation AR267/2001

(vi) a storm drainage system as defined in the *Environmental Protection and Enhancement Act*, and

(vii) a temporary stream on private land controlled by the owner or operator that has no outflow going beyond the private land directly to a drainage canal, reservoir, river, permanent stream or creek, lake or potable water source that is being used for human or livestock consumption;

(e) repealed AR 85/2004 s1;

(f) repealed AR 215/2006 s2;

(g) "freeboard" means the vertical distance between the full storage level of a structure and the upper edge of the structure;

(g.1) "groundwater resource" means an aquifer below the site of a confined feeding operation or a manure storage facility

(i) that is being used as a water supply for the purposes of domestic use, or

(ii) if no aquifer referred to in subclause (i) exists,

(A) an aquifer that has a sustained yield of 0.76 litres per minute or more and a total dissolved solids concentration of 4000 milligrams per litre or less as determined by well records, well drilling logs, hydrogeological maps, hydrogeological reports or other evidence satisfactory to an approval officer or the Board, and

(B) if there is more than one aquifer that meets the requirements of paragraph (A), the aquifer that an approval officer or the Board considers to be the best suited for development as a water supply for the purposes of domestic use;

(h) "liner" means, with respect to a manure storage facility or manure collection area, a layer constructed out of natural or manufactured materials that restricts the migration of the contents of the manure storage facility or manure collection area;

(i) "liquid manure" means manure that is in a predominantly liquid state or manure to which water has been added;

# Appendix B

# Site Water Well Reports

# NE10-9-27W4

# Water Well Drilling Report

View in Metric | Export to Excel

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

GOWN ID

GIC Well ID 115735
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1982/12/14

## Well Identification and Location

Measurement in Imperial

| Owner Name | Address | Town | Province | Country | Postal Code |
|---|---|---|---|---|---|
| HAWTHORNE, WAYNE | P.O. BOX 1251 CLARESHOLM | | | | |

| Location | 1/4 or LSD | SEC | TWP | RGE | W of MER | Lot | Block | Plan | Additional Description |
|---|---|---|---|---|---|---|---|---|---|
| | 15 | 10 | 9 | 27 | 4 | | | | |

Measured from Boundary of
ft from
ft from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 49.725817 Longitude -113.578252
How Location Obtained
Map

Elevation ft
How Elevation Obtained
Not Obtained

## Drilling Information

**Method of Drilling**
Rotary

**Proposed Well Use**
Domestic & Stock

**Type of Work**
New Well

## Formation Log

Measurement in Imperial

| Depth from ground level (ft) | Water Bearing | Lithology Description |
|---|---|---|
| 40.00 | | Brown Till |
| 75.00 | | Blue Clay |
| 95.00 | | Hard Shale & Gravel |

## Yield Test Summary

Measurement in Imperial

Recommended Pump Rate 0.00 igpm

| Test Date | Water Removal Rate (igpm) | Static Water Level (ft) |
|---|---|---|
| 1982/09/20 | 16.00 | 62.00 |

## Well Completion

Measurement in Imperial

| Total Depth Drilled | Finished Well Depth | Start Date | End Date |
|---|---|---|---|
| 95.00 ft | | 1982/09/20 | 1982/09/20 |

**Borehole**

| Diameter (in) | From (ft) | To (ft) |
|---|---|---|
| 0.00 | 0.00 | 95.00 |

**Surface Casing (if applicable)**
Steel
Size OD : 7.00 in
Wall Thickness : 0.000 in
Bottom at : 6.00 ft

**Well Casing/Liner**
Steel
Size OD : 4.50 in
Wall Thickness : 0.188 in
Top at : 0.00 ft
Bottom at : 95.00 ft

**Perforations**

| From (ft) | To (ft) | Diameter or Slot Width(in) | Slot Length (in) | Hole or Slot Interval(in) |
|---|---|---|---|---|
| 80.00 | 95.00 | 0.188 | | 5.00 |

Perforated by Torch

**Annular Seal** Driven
Placed from 0.00 ft to 6.00 ft
Amount

Other Seals

| Type | At (ft) |
|---|---|
| | |

**Screen Type**
Size OD : 0.00 in

| From (ft) | To (ft) | Slot Size (in) |
|---|---|---|
| | | |

Attachment
Top Fittings
Bottom Fittings

**Pack**
Type
Grain Size
Amount

## Contractor Certification

Name of Journeyman responsible for drilling/construction of well
UNKNOWN NA DRILLER

Certification No
1

Company Name
HENNING DRILLING LTD.

Copy of Well report provided to owner
Date approval holder signed

# Water Well Drilling Report

View in Metric | Export to Excel

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

GIC Well ID 115735
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1982/12/14

GOWN ID

## Well Identification and Location

Measurement in Imperial

| Owner Name | Address | Town | Province | Country | Postal Code |
|---|---|---|---|---|---|
| HAWTHORNE, WAYNE | P.O. BOX 1251 CLARESHOLM | | | | |

| Location | 1/4 or LSD | SEC | TWP | RGE | W of MER | Lot | Block | Plan | Additional Description |
|---|---|---|---|---|---|---|---|---|---|
| | 15 | 10 | 9 | 27 | 4 | | | | |

Measured from Boundary of
ft from
ft from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 49.725817 Longitude -113.578252
How Location Obtained: Map

Elevation ft
How Elevation Obtained: Not Obtained

## Additional Information

Measurement in Imperial

Distance From Top of Casing to Ground Level in
Is Artesian Flow
Rate igpm
Is Flow Control Installed
Describe

Recommended Pump Rate 0.00 igpm
Recommended Pump Intake Depth (From TOC) 80.00 ft
Pump Installed Yes Depth ft
Type SUB Make H.P. .5
Model (Output Rating)

Did you Encounter Saline Water (>4000 ppm TDS) Depth ft
Gas Depth ft
Well Disinfected Upon Completion
Geophysical Log Taken
Submitted to ESRD
Sample Collected for Potability
Submitted to ESRD Yes

Additional Comments on Well
DRILLER REPORTS WATER IS SOFT.

## Yield Test

Taken From Ground Level
Measurement in Imperial

| Test Date | Start Time | Static Water Level |
|---|---|---|
| 1982/09/20 | 12:00 AM | 62.00 ft |

Depth to water level

| Pumping (ft) | Elapsed Time Minutes:Sec | Recovery (ft) |
|---|---|---|
| | | |

**Method of Water Removal**
Type Bailer
Removal Rate 16.00 igpm
Depth Withdrawn From 62.00 ft

If water removal period was < 2 hours, explain why

## Water Diverted for Drilling

| Water Source | Amount Taken | Diversion Date & Time |
|---|---|---|
| | ig | |

## Contractor Certification

Name of Journeyman responsible for drilling/construction of well
UNKNOWN NA DRILLER

Certification No
1

Company Name
HENNING DRILLING LTD.

Copy of Well report provided to owner
Date approval holder signed

# Water Well Drilling Report

View in Metric | Export to Excel

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

GIC Well ID 115734
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1980/01/17

GOWN ID

## Well Identification and Location

Measurement in Imperial

| Owner Name | Address | Town | Province | Country | Postal Code |
|---|---|---|---|---|---|
| VAN WAARDHUIZEN, PETER | P.O. BOX 73 FT MACLEOD | | | | |

| Location | 1/4 or LSD | SEC | TWP | RGE | W of MER | Lot | Block | Plan | Additional Description |
|---|---|---|---|---|---|---|---|---|---|
| | NE | 10 | 9 | 27 | 4 | | | | |

Measured from Boundary of
ft from
ft from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 49.724009 Longitude -113.575461

How Location Obtained
Map

Elevation 3225.00 ft

How Elevation Obtained
Estimated

## Drilling Information

**Method of Drilling**
Hand Dug

**Proposed Well Use**
Domestic

**Type of Work**
Chemistry

## Formation Log

Measurement in Imperial

| Depth from ground level (ft) | Water Bearing | Lithology Description |
|---|---|---|
| | | |

## Yield Test Summary

Measurement in Imperial

Recommended Pump Rate igpm

| Test Date | Water Removal Rate (igpm) | Static Water Level (ft) |
|---|---|---|
| | | |

## Well Completion

Measurement in Imperial

| Total Depth Drilled | Finished Well Depth | Start Date | End Date |
|---|---|---|---|
| 15.00 ft | | | |

**Borehole**

| Diameter (in) | From (ft) | To (ft) |
|---|---|---|
| 0.00 | 0.00 | 15.00 |

**Surface Casing (if applicable)**

Size OD : 0.00 in
Wall Thickness : 0.000 in
Bottom at : 0.00 ft

**Well Casing/Liner**

Size OD : 0.00 in
Wall Thickness : 0.000 in
Top at : 0.00 ft
Bottom at : 0.00 ft

**Perforations**

| From (ft) | To (ft) | Diameter or Slot Width(in) | Slot Length (in) | Hole or Slot Interval(in) |
|---|---|---|---|---|
| | | | | |

Perforated by

**Annular Seal**

Placed from 0.00 ft to 0.00 ft
Amount

Other Seals

| Type | At (ft) |
|---|---|
| | |

**Screen Type**

Size OD : 0.00 in

| From (ft) | To (ft) | Slot Size (in) |
|---|---|---|
| | | |

Attachment
Top Fittings
Bottom Fittings

**Pack**

Type
Grain Size
Amount

## Contractor Certification

Name of Journeyman responsible for drilling/construction of well
UNKNOWN NA DRILLER

Certification No
1

Company Name
UNKNOWN DRILLER

Copy of Well report provided to owner

Date approval holder signed

# Water Well Drilling Report

View in Metric | Export to Excel

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

GIC Well ID 115734
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1980/01/17

GOWN ID

## Well Identification and Location

Measurement in Imperial

| Owner Name | Address | Town | Province | Country | Postal Code |
|---|---|---|---|---|---|
| VAN WAARDHUIZEN, PETER | P.O. BOX 73 FT MACLEOD | | | | |

| Location | 1/4 or LSD | SEC | TWP | RGE | W of MER | Lot | Block | Plan | Additional Description |
|---|---|---|---|---|---|---|---|---|---|
| | NE | 10 | 9 | 27 | 4 | | | | |

Measured from Boundary of
ft from
ft from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 49.724009 Longitude -113.575461
How Location Obtained: Map

Elevation 3225.00 ft
How Elevation Obtained: Estimated

## Additional Information

Measurement in Imperial

Distance From Top of Casing to Ground Level in
Is Artesian Flow
Rate igpm
Is Flow Control Installed
Describe

Recommended Pump Rate igpm
Recommended Pump Intake Depth (From TOC) ft
Pump Installed
Type
Depth ft
Make
H.P.
Model (Output Rating)

Did you Encounter Saline Water (>4000 ppm TDS)
Depth ft
Gas
Depth ft
Well Disinfected Upon Completion
Geophysical Log Taken
Submitted to ESRD

Sample Collected for Potability
Submitted to ESRD Yes

Additional Comments on Well

## Yield Test

Taken From Ground Level | Measurement in Imperial

| Test Date | Start Time | Static Water Level |
|---|---|---|
| | | ft |

**Method of Water Removal**

Type
Removal Rate igpm
Depth Withdrawn From ft

If water removal period was < 2 hours, explain why

## Water Diverted for Drilling

| Water Source | Amount Taken | Diversion Date & Time |
|---|---|---|
| | ig | |

## Contractor Certification

Name of Journeyman responsible for drilling/construction of well
UNKNOWN NA DRILLER

Certification No
1

Company Name
UNKNOWN DRILLER

Copy of Well report provided to owner

Date approval holder signed

# Appendix C

# Environmental Risk Screening Tool

# Companion document, pages 9 and 10

If the 'Type of Work' on a water well drillers log is indicated as chemistry, this may be a water sample that was taken from an existing well and not an indication of another well on the quarter section. However, if no other well logs exist for the quarter section, it could be an indication that there is an existing well that was never entered into Alberta Environment's system.

Alberta Environment's Information System includes well inventory and federal well survey logs reported approximately from the early 1900s to the Second World War. Generally, these well reports include much less information on depth, completion and water volumes than more recent well reports. Many of these wells are shallow, and were either hand dug or drilled using horse powered drilling. These wells generally provided suitable volumes of water for pre World War II residential use of washing and cooking but may not meet today's UGR volume requirements for residential water use. If a well inventory or federal well survey water well is still in use, then it should be entered on the site information form. If a well inventory or federal well survey water well is no longer in use at a site, it should be considered a decommissioned well (whether documented or not) and should not be included on the site information form.

Indicate the well identification number from the water well drilling log in Alberta Environment's Information System. If a well log was not filed with Alberta Environment, assign a name to the well on the log in the file and indicate same name on the table.

- Distance to well(s) – Note the distance to any water wells within 400 metres of a manure storage facility or catch basin.
- Well Sealing Method – Indicate how the water wells located within 400 m of the facility are constructed and sealed (e.g. driven seal). This information can be obtained from well completion information in water well drilling logs. If the water well drilling log does not contain any well sealing details, then indicate that well sealing method is unknown. Wells where the annulus is sealed with bentonite or cement are considered the standard or baseline.
- Depth to top of open interval – The depth to the top of the open interval (e.g. open hole, slotted casing or well screens) can be determined by using well completion information. The depth to the top of the open interval is the distance from ground surface to the top of the open hole, slotted casing or well screens.

  If the bottom of the seal in a water well is shallower than the top of the screened, slotted or open hole portion of the well, and if the geologic materials between the bottom of the seal and the top of the screened, slotted or open hole portion of the well contribute substantially to well yield, then the depth to the bottom of the seal should be considered the depth to the top of the open interval.
- Location of well(s) from the reference point – In ideal situations, water level elevation information from site-specific groundwater monitoring wells completed at approximately the same depth should be used to determine the direction of shallow groundwater flow. In situations where this information is not available, the land surface topography can be a good general indicator of shallow groundwater flow direction, since water table slope often mimics surface topography. Topographical information is readily available from topographical maps (MTS 1:50,000 preferred). If after looking at topography information from maps and from a site visit, you are still uncertain about whether or not a water well is upslope or down slope of a facility, choose the most conservative approach when scoring the facility, which is "unknown".

Note the position of the water well(s) with reference to the facilities being assessed as follows (choose the closest facility requiring scoring for the purposes of the site information form):

- Unknown – Choose 'Unknown' if it cannot be determined whether or not a water well is conclusively located upslope or downslope from the facility being assessed, or is located cross slope.
- Down slope – Well is conclusively located down slope from the facility being assessed.
- Upslope - Well is conclusively located upslope from the facility being assessed.
  - There may be situations where a producing water well may be at risk even if it is determined to be upslope of the facility. Pumping of the well results in a cone of depression that could extend beneath the facility and draw contaminated water toward the well. The size of a cone of depression is dependent on many factors including the pumping rate of the well and hydraulic properties of the aquifer. If not choosing 'Unknown', the use of special consideration points is recommended in cases where a pumping well is located upslope but relatively close to the facility.

**8. Uppermost Groundwater Resource (UGR)**

- Reference(s) for uppermost groundwater resource (UGR) – Indicate what sources of information were used to determine the UGR. For example, indicate the well I.D.s of the well logs used (could include information from decommissioned, chemistry and well inventory logs) or information on other boreholes in the area of the facility that were used.
- Depth to UGR – The UGR is defined by *AOPA*. The depth to the UGR should be determined using site-specific information when available (e.g. borehole logs or monitoring well completion information in geotechnical or hydrogeological reports).

  If the site-specific geological information shows that there may be a shallower aquifer located above the aquifer used on site, then the water well drillers logs from wells located within 1.6 km (1 mile) of the facilities property boundary (quarter section) need to be reviewed. Since the UGR definition within *AOPA* does not specify where the aquifer underlying the site must be used as a water supply, it was determined to mean within a reasonable distance from the location of the manure storage. The distance specified for the purposes of the ERST is 1.6 km (1 mile) of the facilities boundary (quarter section). The uppermost aquifer within 1.6 km (1 mile) currently in use must be correlated to the site specific information to call this identified uppermost aquifer on site the UGR.

  When site-specific information is not available, the depth to the UGR can be estimated using regional hydrogeology maps and/or information from water well drillers logs from wells located within 1.6 km (1 mile) of the facilities property boundary (quarter section).
- Predominant geology of the UGR – Using the most site-specific information available, indicate the predominant geology of the UGR (e.g. sandstone, coal). If the material is very heterogeneous (multiple layers of different geologic materials), then the geologic unit that has the highest hydraulic conductivity should be considered.
- Subsoil Texture of the UGR – Subsoil texture refers to the predominant grain size distribution. Using the "Estimating Subsoil Texture" table in Appendix 4, information about the geology of the UGR can be used to estimate the subsoil texture (i.e. fine,

# Appendix D

# Water Well Reconnaissance Report and Map

## NE10-9-27W4
## Plus a 1.6km radius

# Reconnaissance Report

View in Metric

Export to Excel

## Groundwater Wells

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

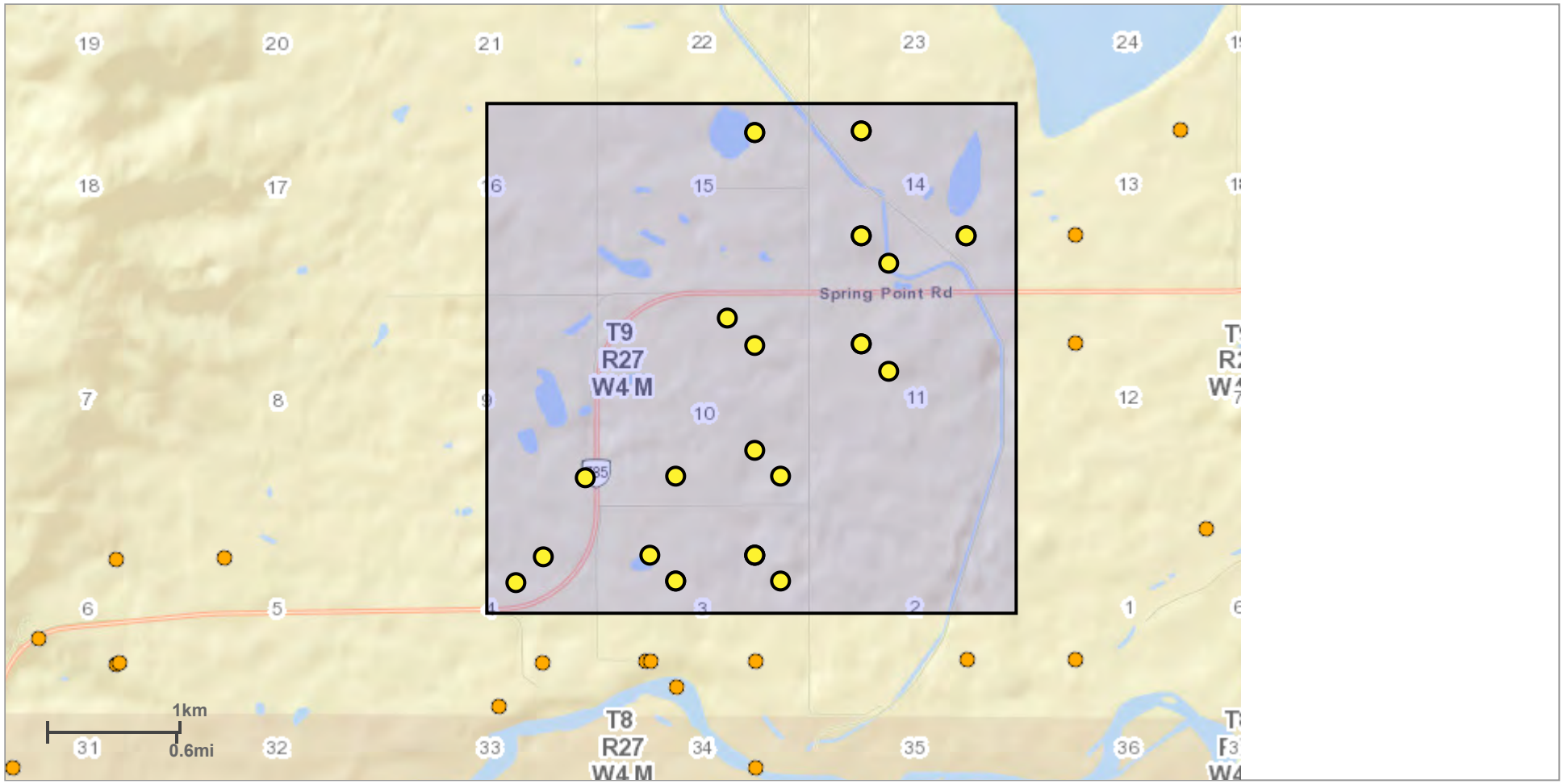
| GIC Well ID | LSD | SEC | TWP | RGE | M | DRILLING COMPANY | DATE COMPLETED | DEPTH (ft) | TYPE OF WORK | USE | CHM | LT | PT | WELL OWNER | STATIC LEVEL (ft) | TEST RATE (igpm) | SC_DIA (in) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 115714 | NW | 3 | 9 | 27 | 4 | ALBERTA ENVIRONMENT/EARTH SCIENCES DIVISION | 1978-07-16 | 105.00 | New Well | Unknown | | 6 | | ALTA ENV #1826E | | | 5.56 |
| 115715 | 11 | 3 | 9 | 27 | 4 | ALBERTA ENVIRONMENT/EARTH SCIENCES DIVISION | 1978-07-17 | 120.00 | Test Hole | Unknown | | 5 | | ALTA ENV #1827E | | | 0.00 |
| 115716 | 11 | 3 | 9 | 27 | 4 | HENNING DRILLING LTD. | 1984-04-18 | 101.00 | New Well | Domestic & Stock | | 4 | | SCHAMP, LOTHER | 85.00 | 9.00 | 7.00 |
| 115717 | NE | 3 | 9 | 27 | 4 | UNKNOWN DRILLER | | 5.00 | Chemistry | Domestic | 1 | | | VAN WAARDHUIZEN, PETER | | | 0.00 |
| 115718 | 9 | 3 | 9 | 27 | 4 | ALBERTA ENVIRONMENT/EARTH SCIENCES DIVISION | 1978-07-13 | 100.00 | Test Hole | Unknown | | 3 | | ALTA ENV #1824E | | | 0.00 |
| 115719 | NE | 3 | 9 | 27 | 4 | UNKNOWN DRILLER | | 20.00 | Chemistry | Domestic | 1 | | | SIEBERT, JOHN | | | |
| 115722 | 10 | 4 | 9 | 27 | 4 | ALBERTA ENVIRONMENT/EARTH SCIENCES DIVISION | 1978-07-13 | 115.00 | Test Hole | Unknown | | 6 | | ALTA ENV #1825E | | | 0.00 |
| 115723 | NE | 4 | 9 | 27 | 4 | H&H DRILLING | 1989-06-22 | 110.00 | New Well | Domestic | | 4 | | BRAUER, MONTY | 92.00 | 10.00 | 6.63 |
| 115732 | 1 | 10 | 9 | 27 | 4 | VANDRIESTEN WM | 1985-08-06 | 95.00 | New Well | Domestic | | 3 | | NEELS, GERALD | 72.00 | 18.00 | |
| 115733 | 3 | 10 | 9 | 27 | 4 | VANDRIESTEN WM | 1979-04-20 | 103.00 | New Well | Domestic | | 3 | | SCHMIDT, NEWTON | 80.00 | 10.00 | 0.00 |
| 115734 | NE | 10 | 9 | 27 | 4 | UNKNOWN DRILLER | | 15.00 | Chemistry | Domestic | 1 | | | VAN WAARDHUIZEN, PETER | | | 0.00 |
| 115735 | 15 | 10 | 9 | 27 | 4 | HENNING DRILLING LTD. | 1982-09-20 | 95.00 | New Well | Domestic & Stock | 1 | 3 | | HAWTHORNE, WAYNE | 62.00 | 16.00 | 7.00 |
| 115736 | NW | 11 | 9 | 27 | 4 | ALBERTA ENVIRONMENTAL PROTECTION/TECHNICAL SERVICES DIVISION | 1978-07-12 | 85.00 | Test Hole | Unknown | | 7 | | ALTA ENV #1821E | | | 0.00 |
| 115737 | NW | 11 | 9 | 27 | 4 | ALBERTA ENVIRONMENT/EARTH SCIENCES DIVISION | 1978-07-12 | 80.00 | Test Hole | Unknown | | | | ALTA ENV #1822E | | | 0.00 |
| 115738 | 11 | 11 | 9 | 27 | 4 | ALBERTA ENVIRONMENT/EARTH SCIENCES DIVISION | 1978-07-12 | 83.00 | Test Hole | Unknown | | | | ALTA ENV #1820E | | | 0.00 |
| 115746 | SE | 14 | 9 | 27 | 4 | UNKNOWN DRILLER | | 200.00 | Chemistry | Domestic & Stock | 1 | | | WALDIE, BRIAN | | | 0.00 |
| 115747 | SW | 14 | 9 | 27 | 4 | UNKNOWN DRILLER | | 150.00 | Chemistry | Domestic | 1 | | | WALDIE, BRIAN | | | 0.00 |
| 115748 | 3 | 14 | 9 | 27 | 4 | MAUGHAN, JOSEPH R. | 1967-01-01 | 115.00 | Well Inventory | Stock | 1 | | | | | | 0.00 |
| 115749 | NW | 14 | 9 | 27 | 4 | ALBERTA ENVIRONMENT/EARTH SCIENCES DIVISION | 1978-07-13 | 80.00 | Test Hole | Unknown | | 5 | | ALTA ENV #1823E | | | 0.00 |
| 115750 | NW | 14 | 9 | 27 | 4 | ALBERTA ENVIRONMENT/EARTH SCIENCES DIVISION | 1986-09-11 | 13.00 | Test Hole | Unknown | | 4 | | GROUNDWATER INVEST. #5067-T | | | 0.00 |

# Reconnaissance Report

View in Metric

Export to Excel

| GIC Well ID | LSD | SEC | TWP | RGE | M | DRILLING COMPANY | DATE COMPLETED | DEPTH (ft) | TYPE OF WORK | USE | CHM | LT | PT | WELL OWNER | STATIC LEVEL (ft) | TEST RATE (igpm) | SC_DIA (in) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 115751 | NE | 15 | 9 | 27 | 4 | CAMFIELD DRILLING SERVICES LTD. | 1988-04-09 | 90.00 | New Well | Stock | | 5 | | DERSCH RANCH | 80.00 | 50.00 | 6.63 |
| 155266 | NE | 3 | 9 | 27 | 4 | UNKNOWN DRILLER | | 0.00 | Chemistry | Domestic | 1 | | | ELLIOTT, TODD/CONNIE | | | 0.00 |
| 155267 | SW | 14 | 9 | 27 | 4 | UNKNOWN DRILLER | | 100.00 | Chemistry | Domestic | 4 | | | CLAYPOOL, LINDA | | | 0.00 |
| 244439 | SE | 14 | 9 | 27 | 4 | UNKNOWN DRILLER | | 0.00 | Chemistry | Domestic | 1 | | | HERWEYER, PETER | | | 0.00 |
| 250831 | 1 | 9 | 9 | 27 | 4 | STAVELY WATER WELLS | 1994-11-25 | 113.00 | New Well | Domestic | | 10 | 25 | 2B CATTLE CO LTD | 93.80 | 2.00 | 6.62 |
| 1250852 | NE | 15 | 9 | 27 | 4 | DOLLMAN'S WATER WELL DRILLING INC. | 2019-01-24 | 100.00 | New Well | Domestic | | 3 | 26 | DEWIT, HENDRIK | 54.46 | 75.00 | |
| 2093787 | SE | 10 | 9 | 27 | 4 | UNKNOWNDRILLINGCOMP11 | 1978-11-05 | 13.00 | Well Inventory | Domestic & Stock | | 1 | | NEELS, GERALD | | | |




## Alberta Water Well Information Database Map

**Projection**
Web Mercator (Auxillary Sphere)

**Datum**
WGS 84

**Date**
11/19/2020, 1:41:50 PM

**Legend**
- Groundwater Drilling Report
- Baseline Water Well Report

http://groundwater.alberta.ca/WaterWells/d/

# Appendix E

# Water Well Reports within 1.6km of the Site with a well depth equal to or less than 20 feet (including 0 feet) and associated chemistry results

# Water Well Drilling Report

View in Metric | Export to Excel

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

GOWN ID

GIC Well ID 115717
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1978/02/22

## Well Identification and Location

Measurement in Imperial

| Owner Name | Address | Town | Province | Country | Postal Code |
|---|---|---|---|---|---|
| VAN WAARDHUIZEN, PETER | | | | | |

| Location | 1/4 or LSD | SEC | TWP | RGE | W of MER | Lot | Block | Plan | Additional Description |
|---|---|---|---|---|---|---|---|---|---|
| | NE | 3 | 9 | 27 | 4 | | | | |

Measured from Boundary of
ft from
ft from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 49.709528 Longitude -113.575396
How Location Obtained
Not Verified

Elevation 3230.00 ft
How Elevation Obtained
Estimated

## Drilling Information

**Method of Drilling**
Hand Dug

**Proposed Well Use**
Domestic

**Type of Work**
Chemistry

## Formation Log

Measurement in Imperial

| Depth from ground level (ft) | Water Bearing | Lithology Description |
|---|---|---|
| | | |

## Yield Test Summary

Measurement in Imperial

Recommended Pump Rate igpm

| Test Date | Water Removal Rate (igpm) | Static Water Level (ft) |
|---|---|---|
| | | |

## Well Completion

Measurement in Imperial

| Total Depth Drilled | Finished Well Depth | Start Date | End Date |
|---|---|---|---|
| 5.00 ft | | | |

**Borehole**

| Diameter (in) | From (ft) | To (ft) |
|---|---|---|
| 0.00 | 0.00 | 5.00 |

**Surface Casing (if applicable)**

Size OD : 0.00 in
Wall Thickness : 0.000 in
Bottom at : 0.00 ft

**Well Casing/Liner**

Size OD : 0.00 in
Wall Thickness : 0.000 in
Top at : 0.00 ft
Bottom at : 0.00 ft

**Perforations**

| From (ft) | To (ft) | Diameter or Slot Width(in) | Slot Length (in) | Hole or Slot Interval(in) |
|---|---|---|---|---|
| | | | | |

Perforated by

**Annular Seal**

Placed from 0.00 ft to 0.00 ft
Amount

Other Seals

| Type | At (ft) |
|---|---|
| | |

**Screen Type**

Size OD : 0.00 in

| From (ft) | To (ft) | Slot Size (in) |
|---|---|---|
| | | |

Attachment
Top Fittings
Bottom Fittings

**Pack**

Type
Grain Size
Amount

## Contractor Certification

Name of Journeyman responsible for drilling/construction of well
UNKNOWN NA DRILLER

Certification No
1

Company Name
UNKNOWN DRILLER

Copy of Well report provided to owner

Date approval holder signed

# Water Well Drilling Report

View in Metric | Export to Excel

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

GIC Well ID 115717
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1978/02/22

GOWN ID

## Well Identification and Location

Measurement in Imperial

| Owner Name | Address | Town | Province | Country | Postal Code |
|---|---|---|---|---|---|
| VAN WAARDHUIZEN, PETER | | | | | |

| Location | 1/4 or LSD | SEC | TWP | RGE | W of MER | Lot | Block | Plan | Additional Description |
|---|---|---|---|---|---|---|---|---|---|
| | NE | 3 | 9 | 27 | 4 | | | | |

Measured from Boundary of
ft from
ft from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 49.709528 Longitude -113.575396
How Location Obtained: Not Verified

Elevation 3230.00 ft
How Elevation Obtained: Estimated

## Additional Information

Measurement in Imperial

Distance From Top of Casing to Ground Level in
Is Artesian Flow
Rate igpm
Is Flow Control Installed
Describe

Recommended Pump Rate igpm
Recommended Pump Intake Depth (From TOC) ft
Pump Installed
Type
Depth ft
Make
H.P.
Model (Output Rating)

Did you Encounter Saline Water (>4000 ppm TDS)
Depth ft
Gas
Depth ft
Well Disinfected Upon Completion
Geophysical Log Taken
Submitted to ESRD

Sample Collected for Potability
Submitted to ESRD Yes

Additional Comments on Well

## Yield Test

Taken From Ground Level | Measurement in Imperial

| Test Date | Start Time | Static Water Level |
|---|---|---|
| | | ft |

**Method of Water Removal**

Type
Removal Rate igpm
Depth Withdrawn From ft

If water removal period was < 2 hours, explain why

## Water Diverted for Drilling

| Water Source | Amount Taken | Diversion Date & Time |
|---|---|---|
| | ig | |

## Contractor Certification

Name of Journeyman responsible for drilling/construction of well
UNKNOWN NA DRILLER

Certification No
1

Company Name
UNKNOWN DRILLER

Copy of Well report provided to owner

Date approval holder signed

# CHEMICAL ANALYSIS REPORT

| | | | |
|---|---|---|---|
| **WELL NAME** | VAN WAARDHUIZEN, PETER | **GIC WELL ID** | 115717 |
| **LOCATION** | LSD NE SEC 3 TWP 9 RG 27 M 4 | **SAMPLE NO.** | 1664 |
| **WELL DEPTH** | 5.00 ft | **WATER LEVEL** | ft |
| **AQUIFER** | | **LABORATORY** | AE |
| **SAMPLING DATE** | 1978-02-20 | | |

| FIELD | MG/L | FIELD | MG/L |
|---|---|---|---|
| BICARBONATE | | CARBONATE | |
| CHLORIDE | | CONDUCTIVITY | |
| DISSOLVED OXYGEN | | EH | |
| IRON | | MANGANESE | |
| PH | | SULPHATE | |
| S2 | | TEMPERATURE(C) | 0 |
| TOTAL ALKALINITY | | TOTAL HARDNESS | |

| LABORATORY | | Analysis Date | 1978-02-27 |
|---|---|---|---|
| COD | | CONDUCTIVITY | 832 |
| DIC | | FLUORIDE | 0.7100 |
| ION BALANCE | 1.0500 | PH | 7.90 |
| SAR | | SIO2 | 8.3000 |
| TOTAL ALKALINITY | 452.0000 | TC | |
| TDS | 446 | TN | |
| DOC | | | |
| AMMONIUM-N | | BICARBONATE | 551.0526 |
| CALCIUM | 43.9998 | CARBONATE | |
| CHLORIDE | 6.0102 | MAGNESIUM | 72.0589 |
| NITRATE-N | | NITRITE-N | -0.0994 |
| PHOSPHATE | | POTASSIUM | 3.1720 |
| SODIUM | 39.9993 | SULPHATE | -10.0144 |
| NO2 + NO3 | -0.0994 | TOTAL HARDNESS | 404.0000 |

| | | | |
|---|---|---|---|
| ALUMINUM | | ARSENIC | |
| BARIUM | | BERYLLIUM | |
| CADMIUM | | CHROMIUM | |
| COBALT | | COPPER | |
| IRON | 0.2800 | LEAD | |
| MANGANESE | | MERCURY | |
| MOLYBDENUM | | NICKEL | |
| SELENIUM | | STRONTIUM | |
| VANADIUM | | ZINC | |
| HYDROCARBONS | | PESTICIDES | |
| PHENOLICS | | | |

**Remarks:**

Temperature reported in Degree Centigrade. Conductivity reported in microsiemens/cm, pH in pH units. Alkalinity and Hardness expressed as Calcium Carbonate. FE, VA, PB, AL, AG expressed as extractable. FE in field measurements and all remaining metals expressed as total.
'-' indicates concentrations less than.

| | | | | | |
|---|---|---|---|---|---|
| EH | - Oxidation-Reduction Potential | SAR | - Sodium Adsorption Ratio | DIC | - Dissolved Inorganic Carbon |
| COD | - Chemical Oxygen Demand | DOC | - Dissolved Organic Carbon | TN | - Total Particulate Nitrogen |
| TDS | - Total Dissolved Solids | TC | - Total Particulate Carbon | | |

# Water Well Drilling Report

View in Metric | Export to Excel

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

GOWN ID

GIC Well ID 115719
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1980/09/15

## Well Identification and Location

Measurement in Imperial

| Owner Name | Address | Town | Province | Country | Postal Code |
|---|---|---|---|---|---|
| SIEBERT, JOHN | P.O. BOX 1914 | FT. MACLEOD | ALBERTA | CANADA | T0L 0Z0 |

| Location | 1/4 or LSD | SEC | TWP | RGE | W of MER | Lot | Block | Plan | Additional Description |
|---|---|---|---|---|---|---|---|---|---|
| | NE | 3 | 9 | 27 | 4 | | | | |

Measured from Boundary of
ft from
ft from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 49.709528 Longitude -113.575396
How Location Obtained
Map

Elevation 3300.00 ft
How Elevation Obtained
Estimated

## Drilling Information

**Method of Drilling**
Hand Dug

**Proposed Well Use**
Domestic

**Type of Work**
Chemistry

## Formation Log

Measurement in Imperial

| Depth from ground level (ft) | Water Bearing | Lithology Description |
|---|---|---|
| | | |

## Yield Test Summary

Measurement in Imperial

Recommended Pump Rate igpm

| Test Date | Water Removal Rate (igpm) | Static Water Level (ft) |
|---|---|---|
| | | |

## Well Completion

Measurement in Imperial

| Total Depth Drilled | Finished Well Depth | Start Date | End Date |
|---|---|---|---|
| 20.00 ft | | | |

**Borehole**

| Diameter (in) | From (ft) | To (ft) |
|---|---|---|
| 0.00 | 0.00 | 20.00 |

**Surface Casing (if applicable)**
Size OD : in
Wall Thickness : in
Bottom at : ft

**Well Casing/Liner**
Size OD : in
Wall Thickness : in
Top at : 0.00 ft
Bottom at : ft

**Perforations**

| From (ft) | To (ft) | Diameter or Slot Width(in) | Slot Length (in) | Hole or Slot Interval(in) |
|---|---|---|---|---|
| | | | | |

Perforated by

**Annular Seal**
Placed from ft to ft
Amount

Other Seals

| Type | At (ft) |
|---|---|
| | |

**Screen Type**
Size OD : in

| From (ft) | To (ft) | Slot Size (in) |
|---|---|---|
| | | |

Attachment
Top Fittings Bottom Fittings

**Pack**
Type Grain Size
Amount

## Contractor Certification

Name of Journeyman responsible for drilling/construction of well
UNKNOWN NA DRILLER

Certification No
1

Company Name
UNKNOWN DRILLER

Copy of Well report provided to owner Date approval holder signed

# Water Well Drilling Report

View in Metric | Export to Excel

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

GIC Well ID 115719
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1980/09/15

GOWN ID

## Well Identification and Location

Measurement in Imperial

| Owner Name | Address | Town | Province | Country | Postal Code |
|---|---|---|---|---|---|
| SIEBERT, JOHN | P.O. BOX 1914 | FT. MACLEOD | ALBERTA | CANADA | T0L 0Z0 |

| Location | 1/4 or LSD | SEC | TWP | RGE | W of MER | Lot | Block | Plan | Additional Description |
|---|---|---|---|---|---|---|---|---|---|
| | NE | 3 | 9 | 27 | 4 | | | | |

Measured from Boundary of
ft from
ft from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 49.709528 Longitude -113.575396
How Location Obtained
Map

Elevation 3300.00 ft
How Elevation Obtained
Estimated

## Additional Information

Measurement in Imperial

Distance From Top of Casing to Ground Level in
Is Artesian Flow
Rate igpm
Is Flow Control Installed
Describe

Recommended Pump Rate igpm
Recommended Pump Intake Depth (From TOC) ft
Pump Installed
Type
Depth ft
Make
H.P.
Model (Output Rating)

Did you Encounter Saline Water (>4000 ppm TDS)
Depth ft
Gas
Depth ft
Well Disinfected Upon Completion
Geophysical Log Taken
Submitted to ESRD
Sample Collected for Potability
Submitted to ESRD Yes

Additional Comments on Well

THE FOLLOWING INFORMATION WAS TAKEN FROM DROUGHT EMERGENCY GROUNDWATER TESTING PROGRAM APPLICATION RECEIVED ON JANUARY 17, 1985. OWNER REPORTS YIELD OF WELL HAS DECREASED; ONLY PUMP WELL ONE TIME A DAY AND NOT FOR VERY LONG, 30 GALLON PRESSURE SYSTEM.

## Yield Test

Taken From Ground Level | Measurement in Imperial

| Test Date | Start Time | Static Water Level |
|---|---|---|
| | | ft |

**Method of Water Removal**

Type
Removal Rate igpm
Depth Withdrawn From ft

If water removal period was < 2 hours, explain why

## Water Diverted for Drilling

| Water Source | Amount Taken | Diversion Date & Time |
|---|---|---|
| | ig | |

## Contractor Certification

Name of Journeyman responsible for drilling/construction of well
UNKNOWN NA DRILLER

Certification No
1

Company Name
UNKNOWN DRILLER

Copy of Well report provided to owner

Date approval holder signed

# CHEMICAL ANALYSIS REPORT

| | | | |
|---|---|---|---|
| **WELL NAME** | SIEBERT, JOHN | **GIC WELL ID** | 115719 |
| **LOCATION** | LSD NE SEC 3 TWP 9 RG 27 M 4 | **SAMPLE NO.** | 9918 |
| **WELL DEPTH** | 20.00 ft | **WATER LEVEL** | ft |
| **AQUIFER** | | **LABORATORY** | AE |
| **SAMPLING DATE** | 1980-09-12 | | |

| **FIELD** | **MG/L** | **FIELD** | **MG/L** |
|---|---|---|---|
| BICARBONATE | | CARBONATE | |
| CHLORIDE | | CONDUCTIVITY | |
| DISSOLVED OXYGEN | | EH | |
| IRON | | MANGANESE | |
| PH | | SULPHATE | |
| S2 | | TEMPERATURE(C) | 0 |
| TOTAL ALKALINITY | | TOTAL HARDNESS | |

| **LABORATORY** | | Analysis Date | 1980-09-23 |
|---|---|---|---|
| COD | | CONDUCTIVITY | 869 |
| DIC | | FLUORIDE | 0.7800 |
| ION BALANCE | 1.0700 | PH | 8.40 |
| SAR | | SIO2 | 11.1000 |
| TOTAL ALKALINITY | 505.0000 | TC | |
| TDS | 489 | TN | |
| DOC | | | |
| AMMONIUM-N | | BICARBONATE | 597.0601 |
| CALCIUM | 58.9998 | CARBONATE | 9.0000 |
| CHLORIDE | 3.0033 | MAGNESIUM | 85.0701 |
| NITRATE-N | | NITRITE-N | -0.0504 |
| PHOSPHATE | | POTASSIUM | 1.7400 |
| SODIUM | 26.9997 | SULPHATE | 11.0149 |
| NO2 + NO3 | -0.0504 | TOTAL HARDNESS | 496.0000 |

| | | | |
|---|---|---|---|
| ALUMINUM | | ARSENIC | |
| BARIUM | | BERYLLIUM | |
| CADMIUM | | CHROMIUM | |
| COBALT | | COPPER | |
| IRON | 0.0600 | LEAD | |
| MANGANESE | | MERCURY | |
| MOLYBDENUM | | NICKEL | |
| SELENIUM | | STRONTIUM | |
| VANADIUM | | ZINC | |

| | |
|---|---|
| HYDROCARBONS | PESTICIDES |
| PHENOLICS | |

**Remarks:**

Temperature reported in Degree Centigrade. Conductivity reported in microsiemens/cm, pH in pH units. Alkalinity and Hardness expressed as Calcium Carbonate. FE, VA, PB, AL, AG expressed as extractable. FE in field measurements and all remaining metals expressed as total.
'-' indicates concentrations less than.

| | | | | | |
|---|---|---|---|---|---|
| EH | - Oxidation-Reduction Potential | SAR | - Sodium Adsorption Ratio | DIC | - Dissolved Inorganic Carbon |
| COD | - Chemical Oxygen Demand | DOC | - Dissolved Organic Carbon | TN | - Total Particulate Nitrogen |
| TDS | - Total Dissolved Solids | TC | - Total Particulate Carbon | | |

# Water Well Drilling Report

View in Metric | Export to Excel

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

GOWN ID

GIC Well ID 155266
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1990/10/19

## Well Identification and Location

Measurement in Imperial

| Owner Name | Address | Town | Province | Country | Postal Code |
|---|---|---|---|---|---|
| ELLIOTT, TODD/CONNIE | #124 21 BERKELY PL, LETHBRIDGE | | | | T1K 5N1 |

| Location | 1/4 or LSD | SEC | TWP | RGE | W of MER | Lot | Block | Plan | Additional Description |
|---|---|---|---|---|---|---|---|---|---|
| | NE | 3 | 9 | 27 | 4 | | | | |

Measured from Boundary of
ft from
ft from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 49.709528 Longitude -113.575396

How Location Obtained
Not Verified

Elevation ft
How Elevation Obtained
Not Obtained

## Drilling Information

**Method of Drilling**
Not Applicable

**Proposed Well Use**
Domestic

**Type of Work**
Chemistry

## Formation Log

Measurement in Imperial

| Depth from ground level (ft) | Water Bearing | Lithology Description |
|---|---|---|
| | | |

## Yield Test Summary

Measurement in Imperial

Recommended Pump Rate igpm

| Test Date | Water Removal Rate (igpm) | Static Water Level (ft) |
|---|---|---|
| | | |

## Well Completion

Measurement in Imperial

| Total Depth Drilled | Finished Well Depth | Start Date | End Date |
|---|---|---|---|
| 0.00 ft | | | |

**Borehole**

| Diameter (in) | From (ft) | To (ft) |
|---|---|---|
| 0.00 | 0.00 | 0.00 |

**Surface Casing (if applicable)**

Size OD : 0.00 in
Wall Thickness : 0.000 in
Bottom at : 0.00 ft

**Well Casing/Liner**

Size OD : 0.00 in
Wall Thickness : 0.000 in
Top at : 0.00 ft
Bottom at : 0.00 ft

**Perforations**

| From (ft) | To (ft) | Diameter or Slot Width(in) | Slot Length (in) | Hole or Slot Interval(in) |
|---|---|---|---|---|
| | | | | |

Perforated by

**Annular Seal**

Placed from 0.00 ft to 0.00 ft
Amount

Other Seals

| Type | At (ft) |
|---|---|
| | |

**Screen Type**

Size OD : 0.00 in

| From (ft) | To (ft) | Slot Size (in) |
|---|---|---|
| | | |

Attachment
Top Fittings
Bottom Fittings

**Pack**

Type
Grain Size
Amount 0.00

## Contractor Certification

Name of Journeyman responsible for drilling/construction of well
UNKNOWN NA DRILLER

Certification No
1

Company Name
UNKNOWN DRILLER

Copy of Well report provided to owner

Date approval holder signed

# Water Well Drilling Report

View in Metric | Export to Excel

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

GIC Well ID 155266
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1990/10/19

GOWN ID

## Well Identification and Location

Measurement in Imperial

| Owner Name | Address | Town | Province | Country | Postal Code |
|---|---|---|---|---|---|
| ELLIOTT, TODD/CONNIE | #124 21 BERKELY PL, LETHBRIDGE | | | | T1K 5N1 |

| Location | 1/4 or LSD | SEC | TWP | RGE | W of MER | Lot | Block | Plan | Additional Description |
|---|---|---|---|---|---|---|---|---|---|
| | NE | 3 | 9 | 27 | 4 | | | | |

Measured from Boundary of
ft from
ft from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 49.709528 Longitude -113.575396
How Location Obtained: Not Verified

Elevation ft
How Elevation Obtained: Not Obtained

## Additional Information

Measurement in Imperial

Distance From Top of Casing to Ground Level in
Is Artesian Flow
Rate igpm
Is Flow Control Installed
Describe

Recommended Pump Rate igpm
Recommended Pump Intake Depth (From TOC) ft
Pump Installed
Type
Depth ft
Make
H.P.
Model (Output Rating)

Did you Encounter Saline Water (>4000 ppm TDS)
Depth ft
Gas
Depth ft
Well Disinfected Upon Completion
Geophysical Log Taken
Submitted to ESRD

Sample Collected for Potability
Submitted to ESRD Yes

Additional Comments on Well

## Yield Test

Taken From Ground Level | Measurement in Imperial

| Test Date | Start Time | Static Water Level |
|---|---|---|
| | | ft |

**Method of Water Removal**

Type
Removal Rate igpm
Depth Withdrawn From ft

If water removal period was < 2 hours, explain why

## Water Diverted for Drilling

| Water Source | Amount Taken | Diversion Date & Time |
|---|---|---|
| | ig | |

## Contractor Certification

Name of Journeyman responsible for drilling/construction of well
UNKNOWN NA DRILLER

Certification No
1

Company Name
UNKNOWN DRILLER

Copy of Well report provided to owner

Date approval holder signed

# CHEMICAL ANALYSIS REPORT

| | | | |
|---|---|---|---|
| **WELL NAME** | ELLIOTT, TODD/CONNIE | **GIC WELL ID** | 155266 |
| **LOCATION** | LSD NE SEC 3 TWP 9 RG 27 M 4 | **SAMPLE NO.** | 9009354 |
| **WELL DEPTH** | 0.00 ft | **WATER LEVEL** | ft |
| **AQUIFER** | WELL | **LABORATORY** | AE |
| **SAMPLING DATE** | 1990-10-09 | | |

| FIELD | MG/L | FIELD | MG/L |
|---|---|---|---|
| BICARBONATE | | CARBONATE | |
| CHLORIDE | | CONDUCTIVITY | |
| DISSOLVED OXYGEN | | EH | |
| IRON | | MANGANESE | |
| PH | | SULPHATE | |
| S2 | | TEMPERATURE(C) | 0 |
| TOTAL ALKALINITY | | TOTAL HARDNESS | |

| LABORATORY | | Analysis Date | 1990-10-17 |
|---|---|---|---|
| COD | | CONDUCTIVITY | 342 |
| DIC | | FLUORIDE | 0.1800 |
| ION BALANCE | 1.0600 | PH | 8.13 |
| SAR | | SIO2 | 5.9000 |
| TOTAL ALKALINITY | 154.0000 | TC | |
| TDS | 188 | TN | |
| DOC | | | |
| AMMONIUM-N | | BICARBONATE | 188.0000 |
| CALCIUM | 46.0000 | CARBONATE | |
| CHLORIDE | 1.1000 | MAGNESIUM | 15.0000 |
| NITRATE-N | | NITRITE-N | -0.0010 |
| PHOSPHATE | | POTASSIUM | 0.8000 |
| SODIUM | 7.0000 | SULPHATE | 25.0000 |
| NO2 + NO3 | 0.1200 | TOTAL HARDNESS | 177.0000 |

| | | | |
|---|---|---|---|
| ALUMINUM | | ARSENIC | |
| BARIUM | | BERYLLIUM | |
| CADMIUM | | CHROMIUM | |
| COBALT | | COPPER | |
| IRON | -0.0100 | LEAD | |
| MANGANESE | | MERCURY | |
| MOLYBDENUM | | NICKEL | |
| SELENIUM | | STRONTIUM | |
| VANADIUM | | ZINC | |

| | |
|---|---|
| HYDROCARBONS | PESTICIDES |
| PHENOLICS | |

**Remarks:**

CATIONS - 3.85 ANIONS - 3.65

Temperature reported in Degree Centigrade. Conductivity reported in microsiemens/cm, pH in pH units. Alkalinity and Hardness expressed as Calcium Carbonate. FE, VA, PB, AL, AG expressed as extractable. FE in field measurements and all remaining metals expressed as total. '-' indicates concentrations less than.

| | | | | | |
|---|---|---|---|---|---|
| EH | - Oxidation-Reduction Potential | SAR | - Sodium Adsorption Ratio | DIC | - Dissolved Inorganic Carbon |
| COD | - Chemical Oxygen Demand | DOC | - Dissolved Organic Carbon | TN | - Total Particulate Nitrogen |
| TDS | - Total Dissolved Solids | TC | - Total Particulate Carbon | | |

**Note: this data may not be fully checked. The Province disclaims all responsibility for its accuracy**

# Water Well Drilling Report

View in Metric | Export to Excel

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

GOWN ID

GIC Well ID 2093787
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1985/09/10

## Well Identification and Location

Measurement in Imperial

| Owner Name | Address | Town | Province | Country | Postal Code |
|---|---|---|---|---|---|
| NEELS, GERALD | P.O. BOX 881 | FORT MACLEOD | ALBERTA | CANADA | T0L 0Z0 |

| Location | 1/4 or LSD | SEC | TWP | RGE | W of MER | Lot | Block | Plan | Additional Description |
|---|---|---|---|---|---|---|---|---|---|
| | SE | 10 | 9 | 27 | 4 | | | | |

Measured from Boundary of
ft from
ft from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 49.716746 Longitude -113.575400
How Location Obtained
Not Verified

Elevation ft
How Elevation Obtained
Not Obtained

## Drilling Information

**Method of Drilling**
Unknown

**Proposed Well Use**
Domestic & Stock

**Type of Work**
Well Inventory

## Formation Log

Measurement in Imperial

| Depth from ground level (ft) | Water Bearing | Lithology Description |
|---|---|---|
| 13.00 | | Unknown |

## Yield Test Summary

Measurement in Imperial

Recommended Pump Rate igpm

| Test Date | Water Removal Rate (igpm) | Static Water Level (ft) |
|---|---|---|
| | | |

## Well Completion

Measurement in Imperial

| Total Depth Drilled | Finished Well Depth | Start Date | End Date |
|---|---|---|---|
| 13.00 ft | | 1978/11/05 | 1978/11/05 |

**Borehole**

| Diameter (in) | From (ft) | To (ft) |
|---|---|---|
| | | |

**Surface Casing (if applicable)**

Size OD : in
Wall Thickness : in
Bottom at : ft

**Well Casing/Liner**

Size OD : in
Wall Thickness : in
Top at : ft
Bottom at : ft

**Perforations**

| From (ft) | To (ft) | Diameter or Slot Width(in) | Slot Length (in) | Hole or Slot Interval(in) |
|---|---|---|---|---|
| | | | | |

Perforated by

**Annular Seal**

Placed from ft to ft
Amount

Other Seals

| Type | At (ft) |
|---|---|
| | |

**Screen Type**

Size OD : in

| From (ft) | To (ft) | Slot Size (in) |
|---|---|---|
| | | |

Attachment
Top Fittings Bottom Fittings

**Pack**

Type Grain Size
Amount

## Contractor Certification

Name of Journeyman responsible for drilling/construction of well
UNKNOWN DRILLER11

Certification No
11

Company Name
UNKNOWNDRILLINGCOMP11

Copy of Well report provided to owner Date approval holder signed

# Water Well Drilling Report

View in Metric | Export to Excel

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

GIC Well ID 2093787
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1985/09/10

GOWN ID

## Well Identification and Location

Measurement in Imperial

| Owner Name | Address | Town | Province | Country | Postal Code |
|---|---|---|---|---|---|
| NEELS, GERALD | P.O. BOX 881 | FORT MACLEOD | ALBERTA | CANADA | T0L 0Z0 |

| Location | 1/4 or LSD | SEC | TWP | RGE | W of MER | Lot | Block | Plan | Additional Description |
|---|---|---|---|---|---|---|---|---|---|
| | SE | 10 | 9 | 27 | 4 | | | | |

Measured from Boundary of
ft from
ft from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 49.716746 Longitude -113.575400
How Location Obtained: Not Verified

Elevation ft
How Elevation Obtained: Not Obtained

## Additional Information

Measurement in Imperial

Distance From Top of Casing to Ground Level in
Is Artesian Flow
Rate igpm
Is Flow Control Installed
Describe

Recommended Pump Rate igpm
Recommended Pump Intake Depth (From TOC) ft
Pump Installed
Type
Depth ft
Make
H.P.
Model (Output Rating)

Did you Encounter Saline Water (>4000 ppm TDS)
Depth ft
Gas
Depth ft
Well Disinfected Upon Completion
Geophysical Log Taken
Submitted to ESRD

Sample Collected for Potability
Submitted to ESRD

Additional Comments on Well

INFORMATION FOR THIS WELL WAS OBTAINED FROM AN EMERGENCY GROUNDWATER TESTING & FARM WELL COMPLETION PROGRAM - INDIVIDUAL APPLICATION (1985/09/10), PRIOR TO 1984 THIS WELL PRODUCED 10 GPM, 1985 - YIELD = 5 GPM, 1985- WELL WAS SERVICED - OWNER'S DUG 24' OF GRAVEL OUT OF THE BOTTOM WITH A PAIL,

## Yield Test

Taken From Ground Level | Measurement in Imperial

| Test Date | Start Time | Static Water Level |
|---|---|---|
| | | ft |

**Method of Water Removal**

Type
Removal Rate igpm
Depth Withdrawn From ft

If water removal period was < 2 hours, explain why

## Water Diverted for Drilling

| Water Source | Amount Taken | Diversion Date & Time |
|---|---|---|
| | ig | |

## Contractor Certification

Name of Journeyman responsible for drilling/construction of well
UNKNOWN DRILLER11

Certification No
11

Company Name
UNKNOWNDRILLINGCOMP11

Copy of Well report provided to owner

Date approval holder signed

# Water Well Drilling Report

View in Metric | Export to Excel

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

GIC Well ID 115734
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1980/01/17

GOWN ID

## Well Identification and Location

Measurement in Imperial

| Owner Name | Address | Town | Province | Country | Postal Code |
|---|---|---|---|---|---|
| VAN WAARDHUIZEN, PETER | P.O. BOX 73 FT MACLEOD | | | | |

| Location | 1/4 or LSD | SEC | TWP | RGE | W of MER | Lot | Block | Plan | Additional Description |
|---|---|---|---|---|---|---|---|---|---|
| | NE | 10 | 9 | 27 | 4 | | | | |

Measured from Boundary of
ft from
ft from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 49.724009 Longitude -113.575461

How Location Obtained
Map

Elevation 3225.00 ft

How Elevation Obtained
Estimated

## Drilling Information

**Method of Drilling**
Hand Dug

**Proposed Well Use**
Domestic

**Type of Work**
Chemistry

## Formation Log

Measurement in Imperial

| Depth from ground level (ft) | Water Bearing | Lithology Description |
|---|---|---|
| | | |

## Yield Test Summary

Measurement in Imperial

Recommended Pump Rate igpm

| Test Date | Water Removal Rate (igpm) | Static Water Level (ft) |
|---|---|---|
| | | |

## Well Completion

Measurement in Imperial

| Total Depth Drilled | Finished Well Depth | Start Date | End Date |
|---|---|---|---|
| 15.00 ft | | | |

**Borehole**

| Diameter (in) | From (ft) | To (ft) |
|---|---|---|
| 0.00 | 0.00 | 15.00 |

**Surface Casing (if applicable)**

Size OD : 0.00 in
Wall Thickness : 0.000 in
Bottom at : 0.00 ft

**Well Casing/Liner**

Size OD : 0.00 in
Wall Thickness : 0.000 in
Top at : 0.00 ft
Bottom at : 0.00 ft

**Perforations**

| From (ft) | To (ft) | Diameter or Slot Width(in) | Slot Length (in) | Hole or Slot Interval(in) |
|---|---|---|---|---|
| | | | | |

Perforated by

**Annular Seal**

Placed from 0.00 ft to 0.00 ft
Amount

Other Seals

| Type | At (ft) |
|---|---|
| | |

**Screen Type**

Size OD : 0.00 in

| From (ft) | To (ft) | Slot Size (in) |
|---|---|---|
| | | |

Attachment
Top Fittings
Bottom Fittings

**Pack**

Type
Grain Size
Amount

## Contractor Certification

Name of Journeyman responsible for drilling/construction of well
UNKNOWN NA DRILLER

Certification No
1

Company Name
UNKNOWN DRILLER

Copy of Well report provided to owner

Date approval holder signed

# Water Well Drilling Report

View in Metric | Export to Excel

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GIC Well ID 115734
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1980/01/17

GOWN ID

## Well Identification and Location

Measurement in Imperial

| Owner Name | Address | Town | Province | Country | Postal Code |
|---|---|---|---|---|---|
| VAN WAARDHUIZEN, PETER | P.O. BOX 73 FT MACLEOD | | | | |

| Location | 1/4 or LSD | SEC | TWP | RGE | W of MER | Lot | Block | Plan | Additional Description |
|---|---|---|---|---|---|---|---|---|---|
| | NE | 10 | 9 | 27 | 4 | | | | |

Measured from Boundary of
ft from
ft from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 49.724009 Longitude -113.575461
How Location Obtained: Map

Elevation 3225.00 ft
How Elevation Obtained: Estimated

## Additional Information

Measurement in Imperial

Distance From Top of Casing to Ground Level in
Is Artesian Flow
Rate igpm
Is Flow Control Installed
Describe

Recommended Pump Rate igpm
Recommended Pump Intake Depth (From TOC) ft
Pump Installed
Type
Depth ft
Make
H.P.
Model (Output Rating)

Did you Encounter Saline Water (>4000 ppm TDS)
Depth ft
Gas
Depth ft
Well Disinfected Upon Completion
Geophysical Log Taken
Submitted to ESRD

Sample Collected for Potability
Submitted to ESRD Yes

Additional Comments on Well

## Yield Test

Taken From Ground Level | Measurement in Imperial

| Test Date | Start Time | Static Water Level |
|---|---|---|
| | | ft |

**Method of Water Removal**

Type
Removal Rate igpm
Depth Withdrawn From ft

If water removal period was < 2 hours, explain why

## Water Diverted for Drilling

| Water Source | Amount Taken | Diversion Date & Time |
|---|---|---|
| | ig | |

## Contractor Certification

Name of Journeyman responsible for drilling/construction of well
UNKNOWN NA DRILLER

Certification No
1

Company Name
UNKNOWN DRILLER

Copy of Well report provided to owner

Date approval holder signed

# CHEMICAL ANALYSIS REPORT

| | | | |
|---|---|---|---|
| **WELL NAME** | VAN WAARDHUIZEN, PETER | **GIC WELL ID** | 115734 |
| **LOCATION** | LSD NE SEC 10 TWP 9 RG 27 M 4 | **SAMPLE NO.** | 446 |
| **WELL DEPTH** | 15.00 ft | **WATER LEVEL** | ft |
| **AQUIFER** | | **LABORATORY** | AE |
| **SAMPLING DATE** | 1980-01-11 | | |

| FIELD | MG/L | FIELD | MG/L |
|---|---|---|---|
| BICARBONATE | | CARBONATE | |
| CHLORIDE | | CONDUCTIVITY | |
| DISSOLVED OXYGEN | | EH | |
| IRON | | MANGANESE | |
| PH | | SULPHATE | |
| S2 | | TEMPERATURE(C) | 0 |
| TOTAL ALKALINITY | | TOTAL HARDNESS | |

| LABORATORY | | Analysis Date | 1980-01-22 |
|---|---|---|---|
| COD | | CONDUCTIVITY | 772 |
| DIC | | FLUORIDE | 0.3200 |
| ION BALANCE | 1.0300 | PH | 8.30 |
| SAR | | SIO2 | 9.6000 |
| TOTAL ALKALINITY | 425.0000 | TC | |
| TDS | 461 | TN | |
| DOC | | | |
| AMMONIUM-N | | BICARBONATE | 518.0497 |
| CALCIUM | 61.9998 | CARBONATE | |
| CHLORIDE | 3.0033 | MAGNESIUM | 57.0474 |
| NITRATE-N | | NITRITE-N | -0.0504 |
| PHOSPHATE | | POTASSIUM | 3.5800 |
| SODIUM | 40.9998 | SULPHATE | 24.0356 |
| NO2 + NO3 | 3.4370 | TOTAL HARDNESS | 388.0000 |

| | | | |
|---|---|---|---|
| ALUMINUM | | ARSENIC | |
| BARIUM | | BERYLLIUM | |
| CADMIUM | | CHROMIUM | |
| COBALT | | COPPER | |
| IRON | 0.0200 | LEAD | |
| MANGANESE | | MERCURY | |
| MOLYBDENUM | | NICKEL | |
| SELENIUM | | STRONTIUM | |
| VANADIUM | | ZINC | |

| | |
|---|---|
| HYDROCARBONS | PESTICIDES |
| PHENOLICS | |

**Remarks:**

Temperature reported in Degree Centigrade. Conductivity reported in microsiemens/cm, pH in pH units. Alkalinity and Hardness expressed as Calcium Carbonate. FE, VA, PB, AL, AG expressed as extractable. FE in field measurements and all remaining metals expressed as total.
'-' indicates concentrations less than.

| | | | | | |
|---|---|---|---|---|---|
| EH | - Oxidation-Reduction Potential | SAR | - Sodium Adsorption Ratio | DIC | - Dissolved Inorganic Carbon |
| COD | - Chemical Oxygen Demand | DOC | - Dissolved Organic Carbon | TN | - Total Particulate Nitrogen |
| TDS | - Total Dissolved Solids | TC | - Total Particulate Carbon | | |

# Water Well Drilling Report

View in Metric | Export to Excel

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

GOWN ID

GIC Well ID 244439
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1987/05/25

## Well Identification and Location

Measurement in Imperial

| Owner Name | Address | Town | Province | Country | Postal Code |
|---|---|---|---|---|---|
| HERWEYER, PETER | P.O. BOX 687 FORT MACLEOD | | | | T0L 0Z0 |

| Location | 1/4 or LSD | SEC | TWP | RGE | W of MER | Lot | Block | Plan | Additional Description |
|---|---|---|---|---|---|---|---|---|---|
| | SE | 14 | 9 | 27 | 4 | | | | |

Measured from Boundary of
ft from
ft from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 49.731485 Longitude -113.552860
How Location Obtained
Map

Elevation ft
How Elevation Obtained
Not Obtained

## Drilling Information

**Method of Drilling**
Unknown

**Proposed Well Use**
Domestic

**Type of Work**
Chemistry

## Formation Log

Measurement in Imperial

| Depth from ground level (ft) | Water Bearing | Lithology Description |
|---|---|---|
| | | |

## Yield Test Summary

Measurement in Imperial

Recommended Pump Rate igpm

| Test Date | Water Removal Rate (igpm) | Static Water Level (ft) |
|---|---|---|
| | | |

## Well Completion

Measurement in Imperial

| Total Depth Drilled | Finished Well Depth | Start Date | End Date |
|---|---|---|---|
| 0.00 ft | | | |

**Borehole**

| Diameter (in) | From (ft) | To (ft) |
|---|---|---|
| 0.00 | 0.00 | 0.00 |

**Surface Casing (if applicable)**

Size OD : 0.00 in
Wall Thickness : 0.000 in
Bottom at : 0.00 ft

**Well Casing/Liner**

Size OD : 0.00 in
Wall Thickness : 0.000 in
Top at : 0.00 ft
Bottom at : 0.00 ft

**Perforations**

| From (ft) | To (ft) | Diameter or Slot Width(in) | Slot Length (in) | Hole or Slot Interval(in) |
|---|---|---|---|---|
| | | | | |

Perforated by

**Annular Seal**

Placed from 0.00 ft to 0.00 ft
Amount

Other Seals

| Type | At (ft) |
|---|---|
| | |

**Screen Type**

Size OD : 0.00 in

| From (ft) | To (ft) | Slot Size (in) |
|---|---|---|
| | | |

Attachment
Top Fittings
Bottom Fittings

**Pack**

Type
Grain Size
Amount

## Contractor Certification

Name of Journeyman responsible for drilling/construction of well
UNKNOWN NA DRILLER

Certification No
1

Company Name
UNKNOWN DRILLER

Copy of Well report provided to owner

Date approval holder signed

# Water Well Drilling Report

View in Metric | Export to Excel

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GIC Well ID 244439
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1987/05/25

GOWN ID

## Well Identification and Location

Measurement in Imperial

| Owner Name | Address | Town | Province | Country | Postal Code |
|---|---|---|---|---|---|
| HERWEYER, PETER | P.O. BOX 687 FORT MACLEOD | | | | T0L 0Z0 |

| Location | 1/4 or LSD | SEC | TWP | RGE | W of MER | Lot | Block | Plan | Additional Description |
|---|---|---|---|---|---|---|---|---|---|
| | SE | 14 | 9 | 27 | 4 | | | | |

Measured from Boundary of
ft from
ft from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 49.731485 Longitude -113.552860
How Location Obtained: Map

Elevation ft
How Elevation Obtained: Not Obtained

## Additional Information

Measurement in Imperial

Distance From Top of Casing to Ground Level in
Is Artesian Flow
Rate igpm
Is Flow Control Installed
Describe

Recommended Pump Rate igpm
Recommended Pump Intake Depth (From TOC) ft
Pump Installed
Type
Depth ft
Make
H.P.
Model (Output Rating)

Did you Encounter Saline Water (>4000 ppm TDS)
Depth ft
Gas
Depth ft
Well Disinfected Upon Completion
Geophysical Log Taken
Submitted to ESRD
Sample Collected for Potability
Submitted to ESRD Yes

Additional Comments on Well
ORIGINALLY NO LSD

## Yield Test

Taken From Ground Level | Measurement in Imperial

| Test Date | Start Time | Static Water Level |
|---|---|---|
| | | ft |

**Method of Water Removal**

Type
Removal Rate igpm
Depth Withdrawn From ft

If water removal period was < 2 hours, explain why

## Water Diverted for Drilling

| Water Source | Amount Taken | Diversion Date & Time |
|---|---|---|
| | ig | |

## Contractor Certification

Name of Journeyman responsible for drilling/construction of well
UNKNOWN NA DRILLER

Certification No
1

Company Name
UNKNOWN DRILLER

Copy of Well report provided to owner

Date approval holder signed

# CHEMICAL ANALYSIS REPORT

| | | | |
|---|---|---|---|
| **WELL NAME** | HERWEYER, PETER | **GIC WELL ID** | 244439 |
| **LOCATION** | LSD SE SEC 14 TWP 9 RG 27 M 4 | **SAMPLE NO.** | 121 |
| **WELL DEPTH** | 0.00 ft | **WATER LEVEL** | ft |
| **AQUIFER** | WELL | **LABORATORY** | AE |
| **SAMPLING DATE** | 1987-04-16 | | |

| FIELD | MG/L | FIELD | MG/L |
|---|---|---|---|
| BICARBONATE | | CARBONATE | |
| CHLORIDE | | CONDUCTIVITY | |
| DISSOLVED OXYGEN | | EH | |
| IRON | | MANGANESE | |
| PH | | SULPHATE | |
| S2 | | TEMPERATURE(C) | 0 |
| TOTAL ALKALINITY | | TOTAL HARDNESS | |

| LABORATORY | | Analysis Date | 1987-05-11 |
|---|---|---|---|
| COD | | CONDUCTIVITY | 440 |
| DIC | | FLUORIDE | 0.3300 |
| ION BALANCE | | PH | 7.01 |
| SAR | 1.0000 | SIO2 | |
| TOTAL ALKALINITY | 213.0000 | TC | |
| TDS | 268 | TN | |
| DOC | | | |
| AMMONIUM-N | 0.1400 | BICARBONATE | 260.0000 |
| CALCIUM | 46.0000 | CARBONATE | |
| CHLORIDE | 0.9000 | MAGNESIUM | 16.0000 |
| NITRATE-N | | NITRITE-N | |
| PHOSPHATE | | POTASSIUM | 2.0000 |
| SODIUM | 32.0000 | SULPHATE | 43.0000 |
| NO2 + NO3 | -0.0700 | TOTAL HARDNESS | 182.0000 |

| | | | |
|---|---|---|---|
| ALUMINUM | | ARSENIC | |
| BARIUM | | BERYLLIUM | |
| CADMIUM | | CHROMIUM | |
| COBALT | | COPPER | |
| IRON | 1.2200 | LEAD | |
| MANGANESE | | MERCURY | |
| MOLYBDENUM | | NICKEL | |
| SELENIUM | | STRONTIUM | |
| VANADIUM | | ZINC | |

| | |
|---|---|
| HYDROCARBONS | PESTICIDES |
| PHENOLICS | |

**Remarks:**

Temperature reported in Degree Centigrade. Conductivity reported in microsiemens/cm, pH in pH units. Alkalinity and Hardness expressed as Calcium Carbonate. FE, VA, PB, AL, AG expressed as extractable. FE in field measurements and all remaining metals expressed as total.
'-' indicates concentrations less than.

| | | | | | |
|---|---|---|---|---|---|
| EH | - Oxidation-Reduction Potential | SAR | - Sodium Adsorption Ratio | DIC | - Dissolved Inorganic Carbon |
| COD | - Chemical Oxygen Demand | DOC | - Dissolved Organic Carbon | TN | - Total Particulate Nitrogen |
| TDS | - Total Dissolved Solids | TC | - Total Particulate Carbon | | |

# Water Well Drilling Report

View in Metric | Export to Excel

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

GIC Well ID 115750
GoA Well Tag No.
Drilling Company Well ID
Date Report Received

GOWN ID

## Well Identification and Location

Measurement in Imperial

| Owner Name | Address | Town | Province | Country | Postal Code |
|---|---|---|---|---|---|
| GROUNDWATER INVEST. #5067-T | | | | | |

| Location | 1/4 or LSD | SEC | TWP | RGE | W of MER | Lot | Block | Plan | Additional Description |
|---|---|---|---|---|---|---|---|---|---|
| | NW | 14 | 9 | 27 | 4 | | | | |

Measured from Boundary of
ft from
ft from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 49.738716 Longitude -113.564025
How Location Obtained: Not Verified

Elevation ft
How Elevation Obtained: Not Obtained

## Drilling Information

**Method of Drilling**
Auger

**Proposed Well Use**
Unknown

**Type of Work**
Test Hole

## Formation Log

Measurement in Imperial

| Depth from ground level (ft) | Water Bearing | Lithology Description |
|---|---|---|
| 2.00 | | Gravel |
| 7.00 | | Silty Clay |
| 11.00 | | Medium Grained Sand |
| 13.00 | | Silty Clay |

## Yield Test Summary

Measurement in Imperial

Recommended Pump Rate igpm

| Test Date | Water Removal Rate (igpm) | Static Water Level (ft) |
|---|---|---|
| | | |

## Well Completion

Measurement in Imperial

| Total Depth Drilled | Finished Well Depth | Start Date | End Date |
|---|---|---|---|
| 13.00 ft | | 1986/09/11 | 1986/09/11 |

**Borehole**

| Diameter (in) | From (ft) | To (ft) |
|---|---|---|
| 0.00 | 0.00 | 13.00 |

**Surface Casing (if applicable)**
Size OD : 0.00 in
Wall Thickness : 0.000 in
Bottom at : 0.00 ft

**Well Casing/Liner**
Plastic
Size OD : 2.00 in
Wall Thickness : 1.063 in
Top at : 0.00 ft
Bottom at : 13.00 ft

**Perforations**

| From (ft) | To (ft) | Diameter or Slot Width(in) | Slot Length (in) | Hole or Slot Interval(in) |
|---|---|---|---|---|
| | | | | |

Perforated by Unknown

**Annular Seal**
Placed from 0.00 ft to 0.00 ft
Amount

Other Seals

| Type | At (ft) |
|---|---|
| | |

**Screen Type**
Size OD : 0.00 in

| From (ft) | To (ft) | Slot Size (in) |
|---|---|---|
| | | |

Attachment
Top Fittings
Bottom Fittings

**Pack**
Type
Grain Size
Amount

## Contractor Certification

Name of Journeyman responsible for drilling/construction of well
UNKNOWN NA DRILLER

Certification No
1

Company Name
ALBERTA ENVIRONMENT/EARTH SCIENCES DIVISION

Copy of Well report provided to owner

Date approval holder signed

# Water Well Drilling Report

View in Metric | Export to Excel

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

GIC Well ID 115750
GoA Well Tag No.
Drilling Company Well ID
Date Report Received

GOWN ID

## Well Identification and Location

Measurement in Imperial

| Owner Name | Address | Town | Province | Country | Postal Code |
|---|---|---|---|---|---|
| GROUNDWATER INVEST. #5067-T | | | | | |

| Location | 1/4 or LSD | SEC | TWP | RGE | W of MER | Lot | Block | Plan | Additional Description |
|---|---|---|---|---|---|---|---|---|---|
| | NW | 14 | 9 | 27 | 4 | | | | |

Measured from Boundary of
ft from
ft from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 49.738716 Longitude -113.564025
How Location Obtained: Not Verified

Elevation ft
How Elevation Obtained: Not Obtained

## Additional Information

Measurement in Imperial

Distance From Top of Casing to Ground Level in
Is Artesian Flow
Rate igpm
Is Flow Control Installed
Describe

Recommended Pump Rate igpm
Recommended Pump Intake Depth (From TOC) ft
Pump Installed
Depth ft
Type
Make
H.P.
Model (Output Rating)

Did you Encounter Saline Water (>4000 ppm TDS)
Depth ft
Well Disinfected Upon Completion
Gas
Depth ft
Geophysical Log Taken
Submitted to ESRD

Sample Collected for Potability
Submitted to ESRD

Additional Comments on Well

## Yield Test

Taken From Ground Level | Measurement in Imperial

| Test Date | Start Time | Static Water Level |
|---|---|---|
| | | ft |

**Method of Water Removal**

Type
Removal Rate igpm
Depth Withdrawn From ft

If water removal period was < 2 hours, explain why

## Water Diverted for Drilling

| Water Source | Amount Taken | Diversion Date & Time |
|---|---|---|
| | ig | |

## Contractor Certification

Name of Journeyman responsible for drilling/construction of well
UNKNOWN NA DRILLER

Certification No
1

Company Name
ALBERTA ENVIRONMENT/EARTH SCIENCES DIVISION

Copy of Well report provided to owner
Date approval holder signed

# Appendix F

# Site Borehole Logs and Locations

# advanced August 9, 2019

# CHILAKO DRILLING SERVICES LTD

Box 942 Coaldale, Alberta, T1M 1M8
(403) 345-3710

## SOIL PROFILE AND PARENT MATERIAL DESCRIPTION

Site Location: Arie Muilwijk  Date: 09-Aug-19

| Hole # | Location | Depth | Texture | Moisture | Geological | Sample | Remarks |
|---|---|---|---|---|---|---|---|
| AM1-19 | 0314346 | 0-2.1 | VFSL | SM | Lac | | Silty |
| | 5511364 | 2.1-3.5 | VFSCL | VM | Lac | | |
| | | 3.5-5.1 | VFSL | VM-Sat | Lac | | |
| | | 5.1-5.9 | SiCL | M | Lac | | V. firm, med-high plastic, yellow brown |
| | | 5.9-6.2 | FSCL | VM | Lac | | Slough @ 3.3m |
| AM2-19 | 0314354 | 0-2.9 | VFSL | SM | Lac | | Silty |
| | 5511400 | 2.9-3.6 | SiCL | VM | Lac | | Sandy |
| | | 3.6-5.6 | VFSL | Sat | Lac | | Soft, olive brown, silty, free water |
| | | 5.6-6.2 | SiCL | M | Lac | | V. firm, med-high plastic, olive brown |
| | | | | | | | slough @ 3.9m |
| AM3-19 | 0314364 | 0-1.8 | VFSL | M | Lac | | Loose, olive brown, silty |
| | 5511294 | 1.8-2.3 | VFSCL | VM | Lac | | Low plastic, olive brown, silty |
| | | 2.3-3.0 | VFSL | VM | Lac | | Silty |
| | | 3.0-4.1 | VFSL | Sat | Lac | | Silty, free water, VFSL sand lenses |
| | | 4.1-4.6 | SiCL | M | Lac | | Stiff, med plastic, olive brown |
| | | 4.6-5.0 | VFSCL | VM | Lac | | Soft, low plastic, olive brown |
| | | 5.0-6.2 | SiCL | VM | Lac | | Firm, low plastic, olive brown |
| AM4-19 | 0314411 | 0-1.0 | SiCL | M | Lac | | |
| | 5511281 | 1.0-2.7 | VFSL | M | Lac | | |
| | | 2.7-4.4 | VFSL | Sat | Lac | | Soft |
| | | 4.4-6.2 | C-SC | M | Till | | Stiff, low plastic, trace gravel |

Legend:

| | |
|---|---|
| L | Loam |
| C | Clay |
| S | Sand |
| Gr. | Gravel |
| Si | Silt |
| F | Fine (sand) |
| VF | Very Fine (sand) |

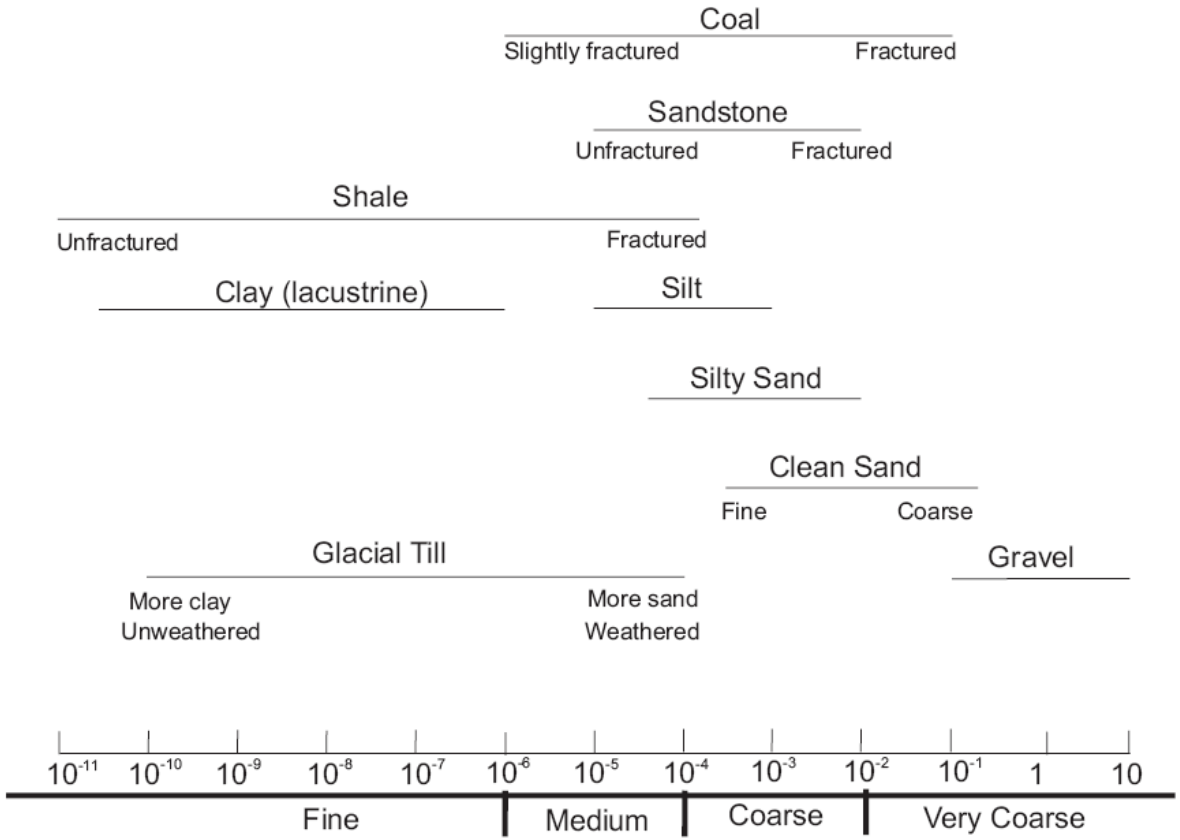
Eg. VFSCL = Very Fine Sandy Clay Loam


Untitled Map
Write a description for your map.
Legend
Feature 1
AM2-19
AM1-19
AM3-19
AM4-19
Google Earth
Image S. Alberta MD s and Counties
©2018 Google
N
80 m

# Appendix G

# Environmental Risk Screening Tool

# Estimating Subsoil Texture




## Estimating Subsoil Texture

(Hydraulic Conductivity(cm/s) scale included as a guide)

(Developed for use with the NRCB's Risk Screening Tool for sites in Alberta and not intended to replace published information)

## AO: Protective Layer Report prepared as part of the ERST Scoring

LA19036 Site Information Form
Supporting Information
Protective Layer (PL) – NE 10-9-27 W4

The Environmental Risk Screening Tool, version 1.2, September 2011, page 11, (Appendix A) states:

> Predominant Geology of the PL – Using the most site specific information; indicate the geology of the protective layer. If the material is very heterogeneous (i.e. multiple layers of different geologic materials), then the dominant geologic unit that has the lowest hydraulic conductivity should be considered.

The most site specific information is the four borehole logs (Appendix B). SiCL (silty clay loam) from 0.9 to 1.0m thick was found above the uppermost groundwater resource (UGR) in AM2-19 and AM4-19 and would have the lowest hydraulic conductivity of soils located above the UGR.

However, VFSL (very fine sandy loam) is found in all four boreholes above the UGR. Therefore, I find it to be the dominant geologic unit on site above the UGR, so is the best choice for the Protective Layer.

Reference: borehole AM4-19
Predominant geology: very fine sandy loam [1.0 m to 2.7m]
PL measured From: 1.0m
PL measured To: 2.7m
Subsoil Texture: Coarse

The subsoils texture is chosen as coarse because this is the same lithology as the UGR, and coarse was the texture choice for the UGR.

Scott Cunningham

Scott Cunningham, P.Eng, P.Ag. December 3, 2020

Appendix A – Environmental Risk Screening Tool (page 11)
Appendix B – Site Borehole Logs and Locations

# Appendix A

# Environmental Risk Screening Tool

# Companion document, page 11

medium, coarse or very coarse). For example, a gravel UGR would be assigned a "very coarse" subsoil texture using the table. For reference, a hydraulic conductivity scale is also included in the table to allow for estimating of hydraulic conductivity. If a shale UGR has been identified, the shale should be considered as fractured.

**9. Protective Layer (PL)**

- Reference(s) for protective layer (PL) – Indicate what sources of information were used to determine the PL. For example, indicate the well I.D.s of the well logs used (could include information from decommissioned, chemistry and well inventory logs) or information on other boreholes in the area of the facility that were used.
- Thickness of PL – Protective layers are geologic units that generally have a low hydraulic conductivity (e.g. unfractured glacial till) overlying a UGR. These layers can be identified by examining water well drillers logs or site specific geotechnical information. At a facility where a liner has been constructed, use the native subsoil under the facility when determining the protective layer thickness – not the liner thickness. If multiple layers are considered, only the layers of similar geology should be lumped together as the ERST is simplified to consider only the dominant protective layer. The groundwater section of the ERST is only addressing the risk to the UGR below the site and not contemplating lateral movement of potential manure constituents.
- Predominant geology of the PL – Using the most specific site information; indicate the geology of the protective layer. If the material is very heterogeneous (i.e. multiple layers of different geologic materials), then the dominant geologic unit that has the lowest hydraulic conductivity should be considered.
- Estimated subsoil texture of the PL – Subsoil texture refers to the predominant grain size distribution. Using the "Estimating Subsoil Texture" table in Appendix 4, information about the geology of the PL can be used to estimate the subsoil texture (i.e. fine, medium, coarse or very coarse). For example, a clay PL would be assigned a "fine" subsoil texture using the table. For reference, a hydraulic conductivity scale is also included in the table to allow for estimating of hydraulic conductivity. If the material is a glacial till with high clay content, choose a subsoil texture that is finer in the range. If the glacial till is sandier, then choose a subsoil texture that is coarser in the range. If the glacial till is weathered, it likely contains fractures, therefore choose a subsoil texture that is coarser in the range. If a layer of clay or glacial till contains amounts of silt, sand or gravel that are likely to be dominant for transport of groundwater, then the appropriate range for that material should be used. At a facility where a liner has been constructed, use the native subsoil under the facility when determining the subsoil texture of the protective layer.
- PL measured From (e.g. surface, at specific depth) and To – the chosen protective layer is not always a geologic unit found at the surface. Indicate what depth the unit starts 'From' and ends 'To'. There may be multiple layers that are used – indicate these separately in additional notes. If multiple layers are considered as one unit, enter the top of the unit as 'From' and the bottom of the unit as 'To'.

**10. Infiltration Potential and Surface Water Runoff**

- Average annual precipitation – Estimate the annual total precipitation using the "Annual Total Precipitation of Alberta, 1971 to 2000" (Alberta Agriculture) map in Appendix 4.

# Appendix B

# Site Borehole Logs and Locations

# advanced August 9, 2019

# CHILAKO DRILLING SERVICES LTD

Box 942 Coaldale, Alberta, T1M 1M8
(403) 345-3710

## SOIL PROFILE AND PARENT MATERIAL DESCRIPTION

Site Location: Arie Muilwijk  Date: 09-Aug-19

| Hole # | Location | Depth | Texture | Moisture | Geological | Sample | Remarks |
|---|---|---|---|---|---|---|---|
| AM1-19 | 0314346 | 0-2.1 | VFSL | SM | Lac | | Silty |
| | 5511364 | 2.1-3.5 | VFSCL | VM | Lac | | |
| | | 3.5-5.1 | VFSL | VM-Sat | Lac | | |
| | | 5.1-5.9 | SiCL | M | Lac | | V. firm, med-high plastic, yellow brown |
| | | 5.9-6.2 | FSCL | VM | Lac | | Slough @ 3.3m |
| AM2-19 | 0314354 | 0-2.9 | VFSL | SM | Lac | | Silty |
| | 5511400 | 2.9-3.6 | SiCL | VM | Lac | | Sandy |
| | | 3.6-5.6 | VFSL | Sat | Lac | | Soft, olive brown, silty, free water |
| | | 5.6-6.2 | SiCL | M | Lac | | V. firm, med-high plastic, olive brown |
| | | | | | | | slough @ 3.9m |
| AM3-19 | 0314364 | 0-1.8 | VFSL | M | Lac | | Loose, olive brown, silty |
| | 5511294 | 1.8-2.3 | VFSCL | VM | Lac | | Low plastic, olive brown, silty |
| | | 2.3-3.0 | VFSL | VM | Lac | | Silty |
| | | 3.0-4.1 | VFSL | Sat | Lac | | Silty, free water, VFSL sand lenses |
| | | 4.1-4.6 | SiCL | M | Lac | | Stiff, med plastic, olive brown |
| | | 4.6-5.0 | VFSCL | VM | Lac | | Soft, low plastic, olive brown |
| | | 5.0-6.2 | SiCL | VM | Lac | | Firm, low plastic, olive brown |
| AM4-19 | 0314411 | 0-1.0 | SiCL | M | Lac | | |
| | 5511281 | 1.0-2.7 | VFSL | M | Lac | | |
| | | 2.7-4.4 | VFSL | Sat | Lac | | Soft |
| | | 4.4-6.2 | C-SC | M | Till | | Stiff, low plastic, trace gravel |

Legend:

| | |
|---|---|
| L | Loam |
| C | Clay |
| S | Sand |
| Gr. | Gravel |
| Si | Silt |
| F | Fine (sand) |
| VF | Very Fine (sand) |

Eg. VFSCL = Very Fine Sandy Clay Loam


Untitled Map
Write a description for your map.
Legend
Feature 1
AM2-19
AM1-19
AM3-19
AM4-19
Google Earth
Image S. Alberta MD s and Counties
©2018 Google
N
80 m

**AO: Calculations made to try to replicate the hydraulic conductivity calculations made in the Wood Environment and Infrastructure Solutions report.**

Andy Cumming
NRCB Approval Officer
Lethbridge, AB
andy.cumming@nrcb.ca

RE: Arie Muilwijk
NE 10-9-27 W4

November 26, 2020

Hi Andy,

Thank you for accepting my offer on November 23, 2020 to provide you with a written analysis of the average calculated permeability on page 4 of the Compliance Report – Roller Compacted Concrete for Calf Shelter, Calf/Feeder Pens (dated November 6, 2020), from Wood Environment and Infrastructure Solutions ("Wood").

Wood information
Wood stated …."the average calculated permeability through the 150mm thick RCC mat would be $9.0 \times 10^{-8}$ cm/sec."

Wood provided:
- Overall area of RCC mat of 10m by 10m
- A 20mm wide crack in both directions in the overall area
- RCC permeability is $1 \times 10^{-9}$ cm/sec
- Crack permeability is $1 \times 10^{-4}$ cm/sec

Wood did not provide the methodology used or the calculations that arrived at their stated average calculated permeability.

Analysis
An applicable methodology that uses area and permeability is Darcy's Law:

$$Q = kiA \qquad \text{(Equation 1)}[1]$$

where
Q is the flow rate
k is the hydraulic conductivity/permeability
i is the hydraulic gradient
A is the area

As the information provided by Wood are inputs into Equation 1, I will use Darcy's Law methodology and provide my calculations in an attempt to duplicate the Wood result for average calculated permeability of $9.0 \times 10^{-8}$ cm/sec. In this report, I will refer to this value as the overall permeability ($k_O$).

[1] Groundwater, Freeze and Cherry, Page 16.

I assumed that the flow rate through the overall area ($Q_O$) will be equal to the sum of the flow rate through the area of the cracks ($Q_C$) and the flow rate through the uncracked area ($Q_U$). In equation form, this assumption reads:

$$Q_O = Q_C + Q_U \qquad \text{(Equation 2)}$$

Expanding equation 2 by substituting equation 1 for each Q provides:

$$k_O i_O A_O = k_C i_C A_C + k_U i_U A_U \qquad \text{(Equation 3)}$$

Darcy's Law is valid for analysis of liners for solid manure. However, making a reasonable numeric assumption of a hydraulic gradient (i) for solid manure is difficult because it requires information (or assumptions) about hydraulic head. Instead, I make the assumption that the hydraulic gradient (i) will be the same for the flow rate in the overall area, the cracked area, and the uncracked area:

$$i_O = i_C = i_U \qquad \text{(Equation 4)}$$

Substituting equation 4 into equation 3 (all hydraulic gradients would then be $i_O$), then dividing both sides of equation 3 by $i_O$ yields:

$$k_O A_O = k_C A_C + k_U A_U \qquad \text{(Equation 5)}$$

Table 1 lists the data provided by Wood, and the assigned variables and resulting calculations (if any). All of the variables in Equation 5 have a numeric value listed in Table 1, except the variable I am trying to determine ($k_O$).

Table 1. Assigned variables and calculations

| Wood data | Variable and Abbreviation | Calculation (if any) |
|---|---|---|
| Overall area of RCC mat of 10m by 10m | Area overall ($A_O$) | 10m x 10m= 100m$^2$ |
| Two cracks 20mm wide in overall area | Area of cracks ($A_C$) | 20mm=0.02m x 2 x 10m = 0.4m$^2$ |
| | Uncracked area ($A_U$) | $A_U = A_O - A_C$ = 100-0.4= 99.6m$^2$ |
| RCC permeability is 1x10$^{-9}$ cm/sec | Permeability of uncracked RCC ($k_U$) | |
| Crack permeability is 1x10$^{-4}$ cm/sec | Permeability of cracks ($k_C$) | |

Dividing both sides of equation 5 by $A_O$ yields

$$k_O = [k_C A_C + k_U A_U] / A_O \qquad \text{(Equation 6)}$$

Substituting numeric values from Table 1 into Equation 6 and solving

$$k_O = [(1x10^{-4} \text{ cm/sec} \times 0.4m^2) + (1x10^{-9} \text{ cm/sec} \times 99.6m^2)] / 100m^2$$

$$k_O = [4x10^{-5} \text{ m}^2 \text{ cm/sec} + 9.96x10^{-8} \text{ m}^2 \text{ cm/sec}] / 100m^2$$

$$k_O = [4.00996x10^{-5} \text{ m}^2 \text{ cm/sec}] / 100m^2$$

$$k_O = 4.00996x10^{-7} \text{ cm/sec}$$

My analysis indicates that the overall permeability ($k_O$) for RCC using Darcy's Law is $4x10^{-7}$ cm/sec ($40x10^{-8}$ cm/sec).

Using the methodology and assumptions listed above, I was not able to duplicate the Wood result for average calculated permeability/overall permeability of $9.0x10^{-8}$ cm/sec.

In closing, please contact me if you have any questions.

Scott Cunningham

Scott Cunningham, P.Eng., P.Ag.
NRCB Environmental Specialist
scott.cunningham@nrcb.ca