ENGINEERING LIMITED

MARCH 26 2025

5310 RUSSMAN ROAD

SERVICING SUITABILITY ASSESSMENT

5310 RUSSMAN ROAD, PRINCE GEORGE, BC
DL 10223, LAND DISTRICT 05, EXCEPT PLAN 16496
PID: 013-713-485
PROPERTY AREA: 47.8 HA (118 ACRES)

CLIENT: ROD MCLEOD

L&M PROJECT NO.: 1657-02

L&M ENGINEERING LIMITED

1210 Fourth Avenue, Prince George, BC V2L 3J4

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Permit to Practice No. 1002375

TABLE OF CONTENTS

1.0 INTRODUCTION

L&M Engineering Limited has been engaged by Rod McLeod to complete a servicing suitability assessment for the Subject Property located at 5310 Russman Road, Prince George, British Columbia. This servicing assessment has been prepared to address the suitability of the property to accommodate sanitary sewer and potable water servicing with the implementation of onsite sewerage systems and groundwater wells.

1.1. PROPERTY DESCRIPTION

Civic Address:	5310 Russman Road
Legal Description:	DL 10223 land district 05 except plan 16496
Roll Number:	26-226-90-40330.000
PID:	013-713-485
Lot Size:	47.7 Ha (118 acres)

2.0 BACKGROUND REPORTS AND DATA

We have reviewed the following reports and information in relation to the proposed subdivision development:

- PG Map
- City of Prince George Subdivision and Development Servicing Bylaw 8618, 2014
- City of Prince George Zoning Bylaw No. 7850, 2007
- LIDAR Survey Mapping
- BC Sewerage System Regulation (BC SSR)
- BC Water Resources Atlas
- Sewerage System Standard Practice Manual Version 3 – September 2014
- Northern Health Subdivision Guidelines

3.0 EXISTING SITE CONDITIONS

3.1. TOPOGRAPHY

The land slope of the Subject Property varies significantly from 0-10% on the western portion of the property, with slopes greater than 45% on the eastern portion of the property and in select areas containing ravines.

3.2. EXISTING SERVICING

There is no existing community sewer or water infrastructure available to service the Subject Property. Future development will require an onsite sewage system and private water supply to meet domestic sanitary sewer and potable water servicing requirements.

3.3. EXISTING SURFACE WATER CONVEYANCE

The Subject Property does not have existing stormwater conveyance infrastructure available for connection to service future development.

Stormwater and overland drainage flow from west to east across the Subject Property and lands beyond the east property boundary. Surface flows that are present would eventually arrive at Foothills Boulevard. Topographical mapping of the Subject Property indicates four (4) distinct ravines that may act as natural drainage collection and conveyance features.

4.0 ONSITE SEWAGE SERVICING

L&M Engineering Limited completed an onsite sewage suitability assessment for the Subject Property following the recommendations and guidance of the Northern Health Subdivision Guidelines and the Sewage System Standard Practice Manual V.3 (SPM.V3) .

4.1. SOIL ASSESSMENT

L&M Engineering witnessed the excavation of 21 test pits on the Subject Property to assess the suitability for onsite sewage treatment and disposal. The soil characteristics varied across the subject property, with three distinct conditions identified.

- Coarse Sand and Gravel
  - Depths ranging from 0.1m to 2.0m below grade
  - Saturated hydraulic conductivity ranging from >800 to <2000 mm/day
- Silty Sand/Sandy Silt
  - Depths ranging from 0.2m to >2.0m
  - Saturated hydraulic conductivity ranging from >200 to <1000 mm/day
- Silt/Clayey Silt
  - Depths ranging from 0.2m to > 2.0m
  - Saturated hydraulic conductivity ranging from <100 to <200 mm/day

4.2. LAND SLOPE

The land slope of the Subject Property varies significantly from 0-10% on the western portion of the property, with slopes greater than 35% on the eastern portion of the property and in select areas throughout the property. There is sufficient area with suitable slopes (< 25%) for onsite sewage disposal on the Subject Property.

4.3. DAILY DESIGN FLOWS

The design basis for onsite septic suitability to support subdivision is 1,600 L/d, which is the estimated flow for a 4-bedroom dwelling as indicated in the Northern Health Subdivision Guidelines and the Sewage System Standard Practice Manual V.3 (SPM.V3).

4.4. MINIMUM LOT AREA

The Guidelines for Subdivision prepared by the Northern Health Authority indicate that the minimum recommended lot size for properties to be serviced by individual groundwater wells and onsite sewerage systems is 1 Ha (2.5 acres). This should be considered a limiting factor for any future subdivision or land development for onsite servicing of potable water and sanitary sewer.

4.5. SEWAGE SYSTEM SUITABILITY

The recommended methods of onsite sewage treatment and disposal to support future residential development include:

- Type 1 treatment to a pressurized subsurface disposal field
- Type 1 treatment to a pressurized raised bed disposal field

Type 1 treatment to a pressurized subsurface disposal field is a method of onsite sewage treatment and disposal that requires conventional septic tank treatment with effluent discharge to be pumped to the disposal field on a set timing sequence.

A Type 1 raised bed disposal system incorporates the addition of imported specified sand media to raise the disposal system and improve effluent quality at the point of discharge to the natural soil profile. This method of onsite sewage treatment and disposal can be applied to sites with low permeable soils and minimal vertical separation to a water table or restrictive layer such as a saturated soil horizon, hardpan, bedrock, or massive clay.

5.0 WATER SERVICING

A desktop assessment for groundwater source feasibility was conducted for the Subject Property using the BC Groundwater Water Resources Atlas.

5.1. AQUIFER ASSESSMENT

The Subject Property overlays Aquifer 93, which is classified as a bedrock aquifer with moderate vulnerability, low productivity, and a moderate well density at 4.0 wells/km^2.

Aquifer 93 has an estimated average yield of 0.3 L/s (4.8 USgpm), with well records reporting yields ranging between less than 0.1 L/s (1.6 USgpm) and 2.3 L/s (36.4 USgpm). The aquifer is estimated to have an estimated recharge of up to approximately 61 L/s and an estimated total groundwater withdrawal of 37 L/s, according to the BC Water Resource Atlas. This would suggest that the aquifer has the recharge capacity to provide further domestic use up to 24 L/s (380 USgpm).

5.2. GROUNDWATER WELL ASSESSMENT

To further assess the Subject Property's suitability for groundwater source development, well log reports were collected for five wells within each aquifer area surrounding the Subject Property. Copies of the Well Log Reports are enclosed under Appendix B. The well-log information is summarized in Table 1 below:

Table 1- WELL LOG SUMMARY

AQUIFER	WELL TAG	DEPTH (FT)	DIAMETER (mm)	YIELD (USgpm)
93	WTN 92496**	270	150	6
93	WTN 6344**	91	125	4
93	WTN 111542**	490	150	1.2
93	WTN 111645**	570	150	1
93	WTN 126725**	410	150	5
93	WTN 106708*	185	150	9.6
93	WTN 95588*	180	150	15
93	WTN 126724*	230	150	15
93	WTN 57940*	305	150	8

* Wells are located within 1000 m directly upgradient of the Subject Property

** Wells are located south of the Subject Property, upgradient and downgradient

As can be seen in Table 1, within close upgradient proximity to the Subject Property, Aquifer 93 has reported groundwater well yields ranging between 8 USgpm and 15 USgpm. Low-production wells are evident upgradient (west) of the southern boundary of the Subject Property, suggesting that water availability is variable across Aquifer 93.

The City of Prince George Subdivision and Development Servicing Bylaw 8618, 2014 prescribes a minimum flow rate of 2,500 L/d (0.46 USgpm) per dwelling unit in a single-family dwelling. The historical well information collected provides strong evidence that the Subject Property can be serviced by groundwater wells drilled on individual lots without additional water storage infrastructure.

5.3. GROUNDWATER QUALITY ASSESSMENT

At this time, no groundwater quality results are available. As the aquifer is considered a deep bedrock aquifer, it is possible that treatment for hardness, iron, and manganese would be recommended, with manganese having a maximum allowable concentration (MAC) of 0.12 mg/L. These water quality parameters can be easily treated using readily available water treatment processes such as water softeners and oxidizing media filters. Treatment for these parameters is common within Prince George and Fraser Fort George regions for both residential and commercial applications.

6.0 SUMMARY

The servicing suitability assessment conducted for the Subject Property indicates that the implementation of onsite sewerage systems and groundwater wells to meet domestic servicing needs for a typical 4-bedroom dwelling is feasible. It is recommended that future land development or subdivisions consider a minimum developable lot area of 1 Ha (2.5 acres) to accommodate onsite servicing in accordance with the Guidelines for Subdivision issued by the Northern Health Authority.

7.0 DISCLOSURE

The contents of this report are presented for the exclusive use of Rod McLeod and the City of Prince George. Any use, reliance on, or decisions made based on the contents of the report by third parties are the responsibility of such third parties. L&M Engineering Limited accepts no liability or responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on this study.

The information and data contained within this document represent L&M Engineering Limited's professional judgment in accordance with the knowledge and information available to L&M Engineering Limited at the time of the report's preparation. No other warranty, expressed or implied, is made.

If you have any questions regarding the contents of this report, please feel free to contact the undersigned directly.

L&M ENGINEERING LIMITED

Prepared by:

Jamie Schenkeveld, P.Eng.
Principal

Copies to: Rod McLeod

Enclosures: As Noted

Appendix A

Onsite Sewage System Evaluation Data

ONSITE SEWERAGE SYSTEM

SITE EVALUATION SUMMARY

Job No. 1657-01

RUSSMAN ROAD, CRANBROOK HILL, PRINCE GEORGE

Client: Rod McLeod

Lot Number	13			Lot Number	13		
Test Pit No.	7	Description		Test Pit No.	8	Description	
0 - 0.2m		Organics	Some medium roots (D<20mm)	0 - 0.2m		Organics	Some medium roots (D<20mm)
0.2 - 2.1m		Sandy Silt	Moderate Blocky	0.2 - 2.7m		Silt	Firm Sub-angular Blocky
@ 0.6m	PT 1	Kfs(mm/day)	384				
Lot Number	**12**			**Lot Number**	**12**		
Test Pit No.	9	Description		Test Pit No.	10	Description	
0 - 0.2m		Organics	Some medium roots (D<20mm)	0 - 0.2m		Organics	Some medium roots (D<20mm)
0.2 - 1.9m		Sandy Silt	Moderate Blocky	0.2 - 1.2m		Sandy Silt	Moderate Blocky
@ 0.6m	PT 2	Kfs(mm/day)	423	1.2 - 2.6m		Silt	Firm Sub-angular Blocky
1.9 - 2.5m		Silt	Very Firm Strong Blocky				
Lot Number	**11**			**Lot Number**	**10**		
Test Pit No.	11	Description		Test Pit No.	12	Description	
0 - 0.2m		Organics	Some medium roots (D<20mm)	0 - 0.2m		Organics	Some medium roots (D<20mm)
0.2 - 1.9m		Sandy Silt	Weak Blocky	0.2 - 1.9m		Silt	Weak Sub-angular Blocky, Moist
@ 0.6m	PT 3	Kfs(mm/day)	486	@ 0.6m	PT 4	Kfs(mm/day)	378
1.9 - 2.7m		Silty Sand	Moderate Blocky, C.F <5%	@1.0m			Many Mottles
				1.9 - 2.7m		Clayey Silt	Weak, Blocky, Layered, Moist
Lot Number	**9**			**Lot Number**	**8**		
Test Pit No.	13	Description		Test Pit No.	14	Description	
0 - 0.2m		Organics	Some medium roots (D<20mm)	0 - 0.2m		Organics	Some medium roots (D<20mm)
0.2 - 1.0m		Sandy Silt	Weak Layered, C.F < 5%	0.2 - 0.6m		Sandy Silt	Blocky Moderate, Some Gravel < 20%
@ 0.6m	PT 5	Kfs(mm/day)	141	@ 0.6m	PT 6	Kfs(mm/day)	209
1.0 - 2.4m		Silt	Moderate Blocky, Trace Gravel	0.6 - 1.1m		Sandy Gravel	Strong Angular Blocky, Trace Cobbles
			C.F < 15%				C.F < 30%
				1.1 - 1.9m		Sandy Gravel	Strong Angular Blocky, Trace Cobbles

ONSITE SEWERAGE SYSTEM

SITE EVALUATION SUMMARY

Job No. 1657-01

RUSSMAN ROAD, CRANBROOK HILL, PRINCE GEORGE

Client: Rod McLeod

Lot Number	7			Lot Number	6		
Test Pit No.	15	Description		Test Pit No.	16	Description	
0 - 0.2m		Organics	Some medium roots (D<20mm)	0 - 0.2m		Organics	Some medium roots (D<20mm)
0.2 - 1.2m		Silt	Moderate Blocky, Some Sand	0.2 - 2.0m		Sandy Silt	Moderate Blocky, Some Clay
			Trace Cobbles C.F <10%				Some Gravel, C.F <10%
@ 0.6m	PT 7	Kfs(mm/day)	96	@ 0.6m	PT 8	Kfs(mm/day)	85
1.2 - 2.0m		Sandy Gravel	Incohesive Granular, Some Cobbles				
			C.F <20%				
Lot Number	**5**			**Lot Number**	**4**		
Test Pit No.	17	Description		Test Pit No.	18	Description	
0 - 0.2m		Organics	Some medium roots (D<20mm)	0 - 0.2m		Organics	Some medium roots (D<20mm)
0.2 - 2.0m		Sandy Silt	Moderate Blocky, Some Gravel	0.2 - 1.0m		Sandy Silt	Granular, Some Gravel, C.F <20%
			C.F <20%	@ 0.6m	PT 10	Kfs(mm/day)	959
@ 0.6m	PT 9	Kfs(mm/day)	1975	1.0 - 1.2m		Gravely Sand	Layered, Trace Cobbles, C.F <20%
				1.2 - 2.0m		Gravely Sand	Layered, Trace Cobbles, C.F <30%
Lot Number	**3**			**Lot Number**	**2**		
Test Pit No.	19	Description		Test Pit No.	20	Description	
0 - 0.2m		Organics	Some medium roots (D<20mm)	0 - 0.2m		Organics	Some medium roots (D<20mm)
0.2 - 1.0m		Silt/Sand	Moderate Blocky, Some Gravel C.F <35%	0.2 - 1.0m		Silt/Sand	Moderate Blocky, Some Gravel C.F <10%
@ 0.6m	PT 11	Kfs(mm/day)	751	@ 0.6m	PT 12	Kfs(mm/day)	564
1.0 - 1.5m		Silty Gravel	Moderate Blocky, C.F <40%	1.0 - 2.0m		Sandy Silt	Moderate Blocky Layered, Some Rocks
1.5m >		Bed Rock					C.F < 25%
Lot Number	**1**			**Lot Number**			
Test Pit No.	21	Description		Test Pit No.		Description	
0 - 0.2m		Organics	Some medium roots (D<20mm)				
0.2 - 0.6m		Silt/Sand	Moderate Blocky, Little Clay				
@ 0.6m	PT 13	Kfs(mm/day)	124				
0.6 - 0.9m		Sandy Silt	Moderate Blocky, Little Gravel C.F <30%				

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PERMEAMETER TEST

Inputs
Outputs

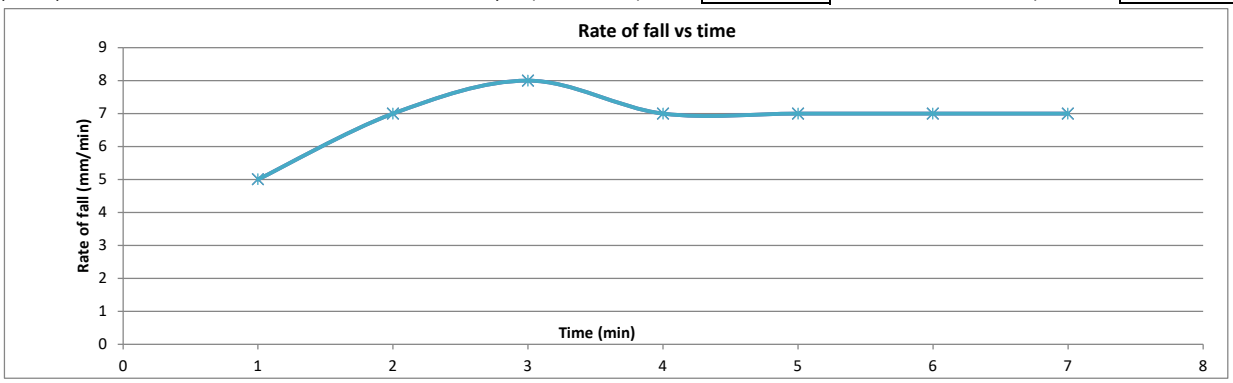
Date: 17-Oct-19
File No.: 1657-01
Client: Rod McLeod
Location: Cranbrook Hill PG
Weather: Sunny

Auger Hole #: 1 TP7, Lot 13
AH Depth: 600 (mm) 11"
AH Diameter: 75 (mm)
Input Soil type (4,3,2) Clay liner=1: 3

Total Elapsed Min	Interim Time (Min)	Water Level Reading (mm)	Drop in Level (mm)	Rates of fall (mm/min)	Remarks of Observations
0		185			
1	1	180	5	5	
2	1	173	7	7	
3	1	165	8	8	
4	1	158	7	7	
5	1	151	7	7	
6	1	144	7	7	
7	1	137	7	7	

Note (5min to 30min typical duration to stabilize)

	Stable rate (mm/min)		Soil factor		Kfs (mm/day)
Calculated Soil field saturated hydraulic conductivity Kfs (mm/day) =	6.8	X	56.4	=	384
Input depth from bottom of test hole to shallow restrictive layer (50-400 mm)	150 mm		Alt Shallow layer Kfs =		572



4" Permeameter

Soil Factors to use in the calculation of the Kfs with the L&M Engineering Limited 4" permeameter

AH Diameter (cm)	7	7.5	8	9	10	11	12	13
Coarce & gravely Sand (4)	73.0	69.8	67.0	61.9	57.6	53.9	50.7	47.8
Structured Loams + Clay (med & fine sand) (3)	58.9	56.4	54.1	50.1	46.7	43.7	41.1	38.8
Unstructured Clay (2)	36.3	34.9	33.6	31.4	29.5	27.8	26.3	25.0

AH Diameter (cm)	14	15	16	18	20	22	24	26
Coarce & gravely Sand (4)	45.2	43.0	40.9	37.3	34.3	31.7	29.5	27.5
Structured Loams + Clay (med & fine sand) (3)	36.8	35.0	33.3	30.5	28.1	26.0	24.2	22.7
Unstructured Clay (2)	23.9	22.8	21.9	20.2	18.8	17.6	16.5	15.6

Results based on a constant water depth of 20 cm
Results based on a permeameter reservoir inside diameter of 10.23 cm

ENGINEERING LIMITED

PERMEAMETER TEST

Inputs
Outputs

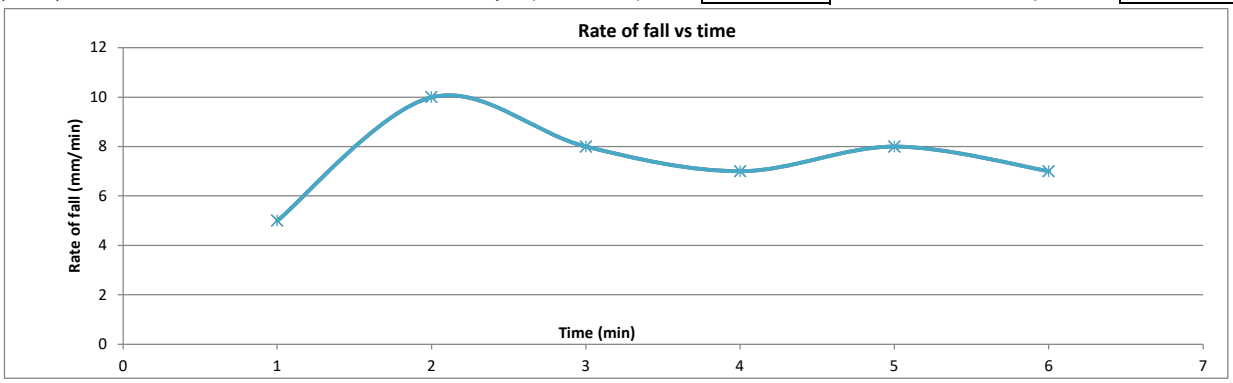
Date: 17-Oct-19
File No.: 1657-01
Client: Rod McLeod
Location: Cranbrook Hill PG
Weather: Sunny

Auger Hole #: 2 TP9, Lot 12
AH Depth: 600 (mm) 11"
AH Diameter: 75 (mm)
Input Soil type (4,3,2) Clay liner=1: 3

Total Elapsed Min	Interim Time (Min)	Water Level Reading (mm)	Drop in Level (mm)	Rates of fall (mm/min)	Remarks of Observations
0		325			
1	1	320	5	5	
2	1	310	10	10	
3	1	302	8	8	
4	1	295	7	7	
5	1	287	8	8	
6	1	280	7	7	

Note (5min to 30min typical duration to stabilize)

	Stable rate (mm/min)		Soil factor		Kfs (mm/day)
Calculated Soil field saturated hydraulic conductivity Kfs (mm/day) =	7.5	X	56.4	=	423
Input depth from bottom of test hole to shallow restrictive layer (50-400 mm)	150 mm		Alt Shallow layer Kfs =		631



4" Permeameter

Soil Factors to use in the calculation of the Kfs with the L&M Engineering Limited 4" permeameter

AH Diameter (cm)	7	7.5	8	9	10	11	12	13
Coarce & gravely Sand (4)	73.0	69.8	67.0	61.9	57.6	53.9	50.7	47.8
Structured Loams + Clay (med & fine sand) (3)	58.9	56.4	54.1	50.1	46.7	43.7	41.1	38.8
Unstructured Clay (2)	36.3	34.9	33.6	31.4	29.5	27.8	26.3	25.0

AH Diameter (cm)	14	15	16	18	20	22	24	26
Coarce & gravely Sand (4)	45.2	43.0	40.9	37.3	34.3	31.7	29.5	27.5
Structured Loams + Clay (med & fine sand) (3)	36.8	35.0	33.3	30.5	28.1	26.0	24.2	22.7
Unstructured Clay (2)	23.9	22.8	21.9	20.2	18.8	17.6	16.5	15.6

Results based on a constant water depth of 20 cm
Results based on a permeameter reservoir inside diameter of 10.23 cm

PERMEAMETER TEST

ENGINEERING LIMITED

Inputs
Outputs

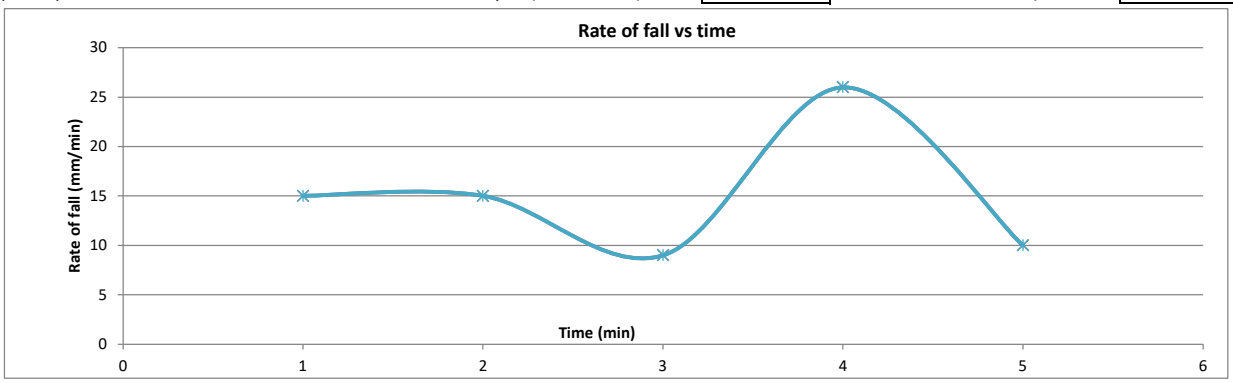
Date: 17-Oct-19
File No.: 1657-01
Client: Rod McLeod
Location: Cranbrook Hill PG
Weather: Sunny

Auger Hole #: 3 TP11, Lot 11
AH Depth: 600 (mm) 11"
AH Diameter: 75 (mm)
Input Soil type (4,3,2) Clay liner=1: 3

Total Elapsed Min	Interim Time (Min)	Water Level Reading (mm)	Drop in Level (mm)	Rates of fall (mm/min)	Remarks of Observations
0		485			
1	1	470	15	15	
2	1	455	15	15	
3	1	446	9	9	
4	1	420	26	26	
5	1	410	10	10	

Note (5min to 30min typical duration to stabilize)

	Stable rate (mm/min)		Soil factor		Kfs (mm/day)
Calculated Soil field saturated hydraulic conductivity Kfs (mm/day) =	15	X	56.4	=	846
Input depth from bottom of test hole to shallow restrictive layer (50-400 mm)	150 mm		Alt Shallow layer Kfs =		1261



4" Permeameter

Soil Factors to use in the calculation of the Kfs with the L&M Engineering Limited 4" permeameter

AH Diameter (cm)	7	7.5	8	9	10	11	12	13
Coarce & gravely Sand (4)	73.0	69.8	67.0	61.9	57.6	53.9	50.7	47.8
Structured Loams + Clay (med & fine sand) (3)	58.9	56.4	54.1	50.1	46.7	43.7	41.1	38.8
Unstructured Clay (2)	36.3	34.9	33.6	31.4	29.5	27.8	26.3	25.0

AH Diameter (cm)	14	15	16	18	20	22	24	26
Coarce & gravely Sand (4)	45.2	43.0	40.9	37.3	34.3	31.7	29.5	27.5
Structured Loams + Clay (med & fine sand) (3)	36.8	35.0	33.3	30.5	28.1	26.0	24.2	22.7
Unstructured Clay (2)	23.9	22.8	21.9	20.2	18.8	17.6	16.5	15.6

Results based on a constant water depth of 20 cm
Results based on a permeameter reservoir inside diameter of 10.23 cm

ENGINEERING LIMITED

PERMEAMETER TEST

Inputs
Outputs

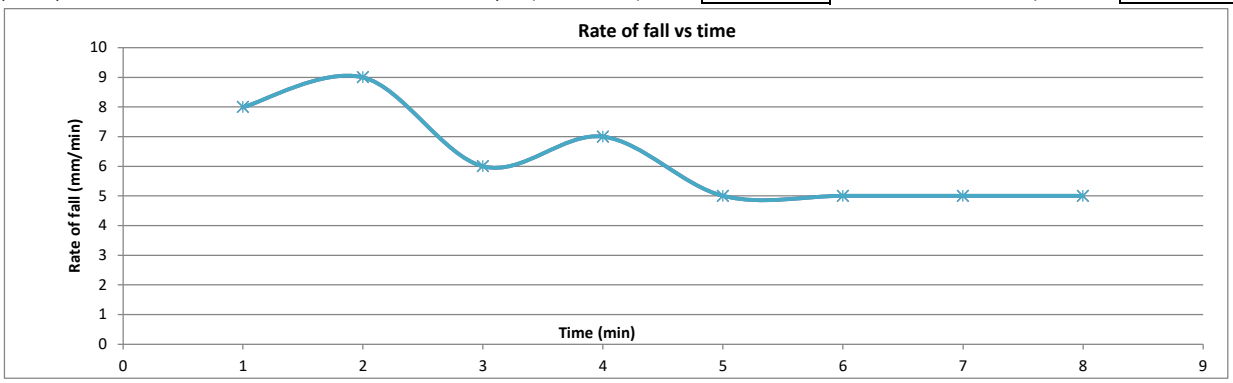
Date: 17-Oct-19
File No.: 1657-01
Client: Rod McLeod
Location: Cranbrook Hill PG
Weather: Sunny

Auger Hole #: 4 TP12, Lot 10
AH Depth: 600 (mm) 11"
AH Diameter: 75 (mm)
Input Soil type (4,3,2) Clay liner=1: 3

Total Elapsed Min	Interim Time (Min)	Water Level Reading (mm)	Drop in Level (mm)	Rates of fall (mm/min)	Remarks of Observations
0		495			
1	1	487	8	8	
2	1	478	9	9	
3	1	472	6	6	
4	1	465	7	7	
5	1	460	5	5	
6	1	455	5	5	
7	1	450	5	5	
8	1	445	5	5	

Note (5min to 30min typical duration to stabilize)

	Stable rate (mm/min)		Soil factor		Kfs (mm/day)
Calculated Soil field saturated hydraulic conductivity Kfs (mm/day) =	6.7	X	56.4	=	378
Input depth from bottom of test hole to shallow restrictive layer (50-400 mm)	150 mm		Alt Shallow layer Kfs =		563



4" Permeameter

Soil Factors to use in the calculation of the Kfs with the L&M Engineering Limited 4" permeameter

AH Diameter (cm)	7	7.5	8	9	10	11	12	13
Coarce & gravely Sand (4)	73.0	69.8	67.0	61.9	57.6	53.9	50.7	47.8
Structured Loams + Clay (med & fine sand) (3)	58.9	56.4	54.1	50.1	46.7	43.7	41.1	38.8
Unstructured Clay (2)	36.3	34.9	33.6	31.4	29.5	27.8	26.3	25.0

AH Diameter (cm)	14	15	16	18	20	22	24	26
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Results based on a constant water depth of 20 cm
Results based on a permeameter reservoir inside diameter of 10.23 cm

ENGINEERING LIMITED

PERMEAMETER TEST

Inputs
Outputs

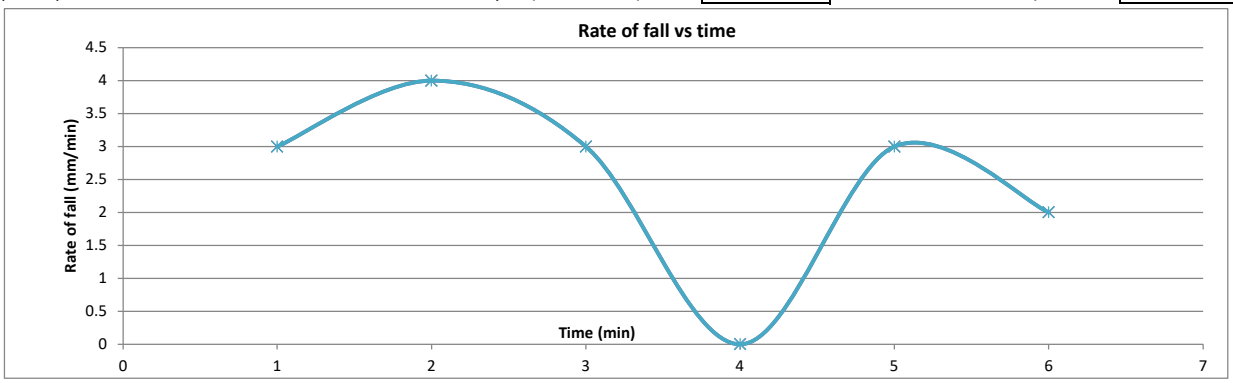
Date: 17-Oct-19
File No.: 1657-01
Client: Rod McLeod
Location: Cranbrook Hill PG
Weather: Sunny

Auger Hole #: 5 TP13, Lot 9
AH Depth: 600 (mm) 11"
AH Diameter: 75 (mm)
Input Soil type (4,3,2) Clay liner=1: 3

Total Elapsed Min	Interim Time (Min)	Water Level Reading (mm)	Drop in Level (mm)	Rates of fall (mm/min)	Remarks of Observations
0		378			
1	1	375	3	3	
2	1	371	4	4	
3	1	368	3	3	
4	1	368	0	0	
5	1	365	3	3	
6	1	363	2	2	

Note (5min to 30min typical duration to stabilize)

	Stable rate (mm/min)		Soil factor		Kfs (mm/day)
Calculated Soil field saturated hydraulic conductivity Kfs (mm/day) =	2.5	X	56.4	=	141
Input depth from bottom of test hole to shallow restrictive layer (50-400 mm)	150 mm		Alt Shallow layer Kfs =		210



4" Permeameter

Soil Factors to use in the calculation of the Kfs with the L&M Engineering Limited 4" permeameter

AH Diameter (cm)	7	7.5	8	9	10	11	12	13
Coarce & gravely Sand (4)	73.0	69.8	67.0	61.9	57.6	53.9	50.7	47.8
Structured Loams + Clay (med & fine sand) (3)	58.9	56.4	54.1	50.1	46.7	43.7	41.1	38.8
Unstructured Clay (2)	36.3	34.9	33.6	31.4	29.5	27.8	26.3	25.0

AH Diameter (cm)	14	15	16	18	20	22	24	26
Coarce & gravely Sand (4)	45.2	43.0	40.9	37.3	34.3	31.7	29.5	27.5
Structured Loams + Clay (med & fine sand) (3)	36.8	35.0	33.3	30.5	28.1	26.0	24.2	22.7
Unstructured Clay (2)	23.9	22.8	21.9	20.2	18.8	17.6	16.5	15.6

Results based on a constant water depth of 20 cm
Results based on a permeameter reservoir inside diameter of 10.23 cm

ENGINEERING LIMITED

PERMEAMETER TEST

Inputs
Outputs

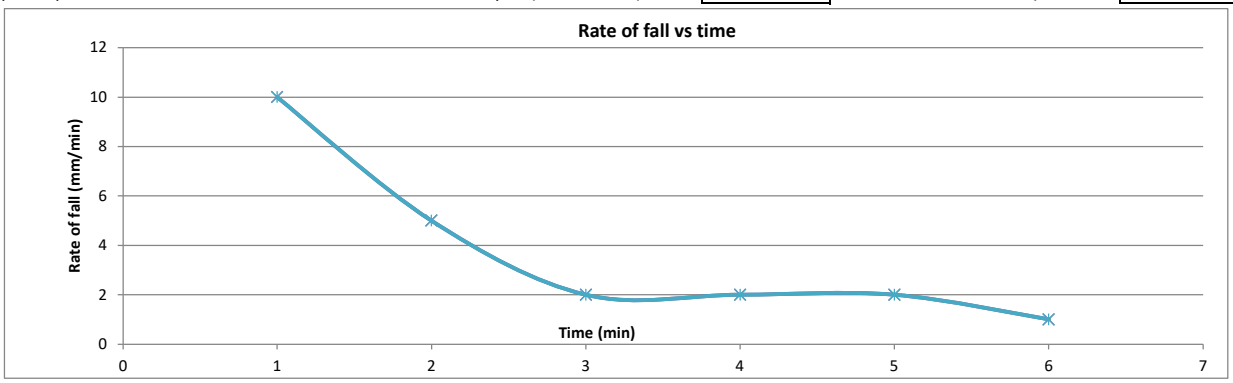
Date: 17-Oct-19
File No.: 1657-01
Client: Rod McLeod
Location: Cranbrook Hill PG
Weather: Sunny

Auger Hole #: 6 TP14, Lot 8
AH Depth: 600 (mm) 11"
AH Diameter: 75 (mm)
Input Soil type (4,3,2) Clay liner=1 3

Total Elapsed Min	Interim Time (Min)	Water Level Reading (mm)	Drop in Level (mm)	Rates of fall (mm/min)	Remarks of Observations
0		275			
1	1	265	10	10	
2	1	260	5	5	
3	1	258	2	2	
4	1	256	2	2	
5	1	254	2	2	
6	1	253	1	1	

Note (5min to 30min typical duration to stabilize)

	Stable rate (mm/min)		Soil factor		Kfs (mm/day)
Calculated Soil field saturated hydraulic conductivity Kfs (mm/day) =	3.7	X	56.4	=	209
Input depth from bottom of test hole to shallow restrictive layer (50-400 mm)	150 mm		Alt Shallow layer Kfs =		311



4" Permeameter

Soil Factors to use in the calculation of the Kfs with the L&M Engineering Limited 4" permeameter

AH Diameter (cm)	7	7.5	8	9	10	11	12	13
Coarce & gravely Sand (4)	73.0	69.8	67.0	61.9	57.6	53.9	50.7	47.8
Structured Loams + Clay (med & fine sand) (3)	58.9	56.4	54.1	50.1	46.7	43.7	41.1	38.8
Unstructured Clay (2)	36.3	34.9	33.6	31.4	29.5	27.8	26.3	25.0

AH Diameter (cm)	14	15	16	18	20	22	24	26
Coarce & gravely Sand (4)	45.2	43.0	40.9	37.3	34.3	31.7	29.5	27.5
Structured Loams + Clay (med & fine sand) (3)	36.8	35.0	33.3	30.5	28.1	26.0	24.2	22.7
Unstructured Clay (2)	23.9	22.8	21.9	20.2	18.8	17.6	16.5	15.6

Results based on a constant water depth of 20 cm
Results based on a permeameter reservoir inside diameter of 10.23 cm

PERMEAMETER TEST

L&M ENGINEERING LIMITED

Inputs
Outputs

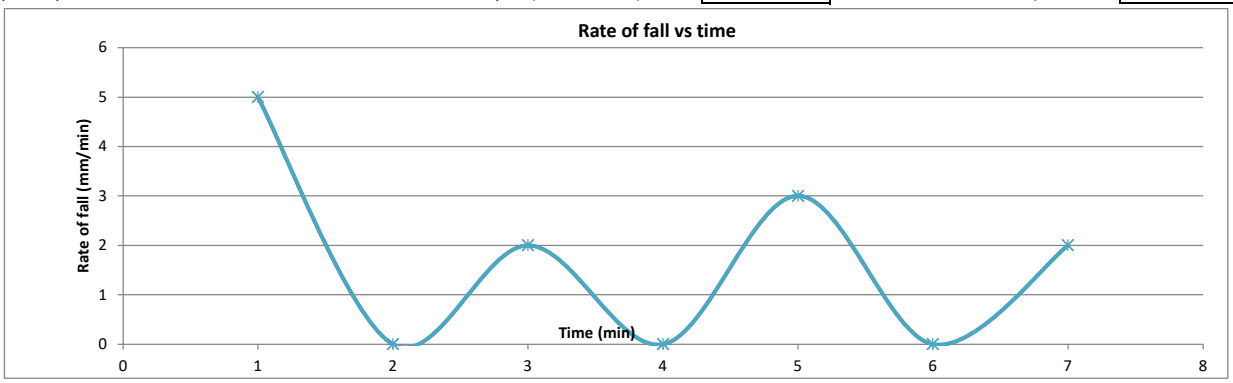
Date: 17-Oct-19
File No.: 1657-01
Client: Rod McLeod
Location: Cranbrook Hill PG
Weather: Sunny

Auger Hole #: 7 TP15, Lot 7
AH Depth: 600 (mm) 11"
AH Diameter: **75** (mm)
Input Soil type (4,3,2) Clay liner=1 **3**

Total Elapsed Min	Interim Time (Min)	Water Level Reading (mm)	Drop in Level (mm)	Rates of fall (mm/min)	Remarks of Observations
0		165			
1	1	160	5	5	
2	1	160	0	0	
3	1	158	2	2	
4	1	158	0	0	
5	1	155	3	3	
6	1	155	0	0	
7	1	153	2	2	

Note (5min to 30min typical duration to stabilize)

	Stable rate (mm/min)		Soil factor		Kfs (mm/day)
Calculated Soil field saturated hydraulic conductivity Kfs (mm/day) =	**1.7**	**X**	**56.4**	**=**	**96**
Input depth from bottom of test hole to shallow restrictive layer (50-400 mm)	**150** mm		Alt Shallow layer Kfs =		143



4" Permeameter

Soil Factors to use in the calculation of the Kfs with the L&M Engineering Limited 4" permeameter

AH Diameter (cm)	7	7.5	8	9	10	11	12	13
Coarce & gravely Sand (4)	73.0	69.8	67.0	61.9	57.6	53.9	50.7	47.8
Structured Loams + Clay (med & fine sand) (3)	58.9	56.4	54.1	50.1	46.7	43.7	41.1	38.8
Unstructured Clay (2)	36.3	34.9	33.6	31.4	29.5	27.8	26.3	25.0

AH Diameter (cm)	14	15	16	18	20	22	24	26
Coarce & gravely Sand (4)	45.2	43.0	40.9	37.3	34.3	31.7	29.5	27.5
Structured Loams + Clay (med & fine sand) (3)	36.8	35.0	33.3	30.5	28.1	26.0	24.2	22.7
Unstructured Clay (2)	23.9	22.8	21.9	20.2	18.8	17.6	16.5	15.6

Results based on a constant water depth of 20 cm
Results based on a permeameter reservoir inside diameter of 10.23 cm

PERMEAMETER TEST

L&M ENGINEERING LIMITED

Inputs
Outputs

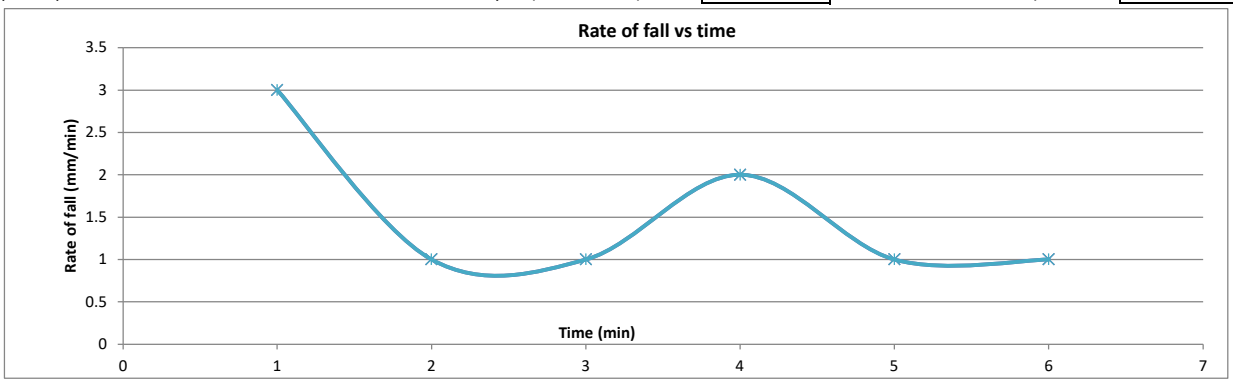
Date: 17-Oct-19
File No.: 1657-01
Client: Rod McLeod
Location: Cranbrook Hill PG
Weather: Sunny

Auger Hole #: 8 TP16, Lot 6
AH Depth: 600 (mm) 11"
AH Diameter: **75** (mm)
Input Soil type (4,3,2) Clay liner=1 **3**

Total Elapsed Min	Interim Time (Min)	Water Level Reading (mm)	Drop in Level (mm)	Rates of fall (mm/min)	Remarks of Observations
0		88			
1	1	85	3	3	
2	1	84	1	1	
3	1	83	1	1	
4	1	81	2	2	
5	1	80	1	1	
6	1	79	1	1	

Note (5min to 30min typical duration to stabilize)

	Stable rate (mm/min)		Soil factor		Kfs (mm/day)
Calculated Soil field saturated hydraulic conductivity Kfs (mm/day) =	**1.5**	**X**	**56.4**	**=**	**85**
Input depth from bottom of test hole to shallow restrictive layer (50-400 mm)	**150** mm		Alt Shallow layer Kfs =		126



4" Permeameter

Soil Factors to use in the calculation of the Kfs with the L&M Engineering Limited 4" permeameter

AH Diameter (cm)	7	7.5	8	9	10	11	12	13
Coarce & gravely Sand (4)	73.0	69.8	67.0	61.9	57.6	53.9	50.7	47.8
Structured Loams + Clay (med & fine sand) (3)	58.9	56.4	54.1	50.1	46.7	43.7	41.1	38.8
Unstructured Clay (2)	36.3	34.9	33.6	31.4	29.5	27.8	26.3	25.0

AH Diameter (cm)	14	15	16	18	20	22	24	26
Coarce & gravely Sand (4)	45.2	43.0	40.9	37.3	34.3	31.7	29.5	27.5
Structured Loams + Clay (med & fine sand) (3)	36.8	35.0	33.3	30.5	28.1	26.0	24.2	22.7
Unstructured Clay (2)	23.9	22.8	21.9	20.2	18.8	17.6	16.5	15.6

Results based on a constant water depth of 20 cm
Results based on a permeameter reservoir inside diameter of 10.23 cm

ENGINEERING LIMITED

PERMEAMETER TEST

Inputs
Outputs

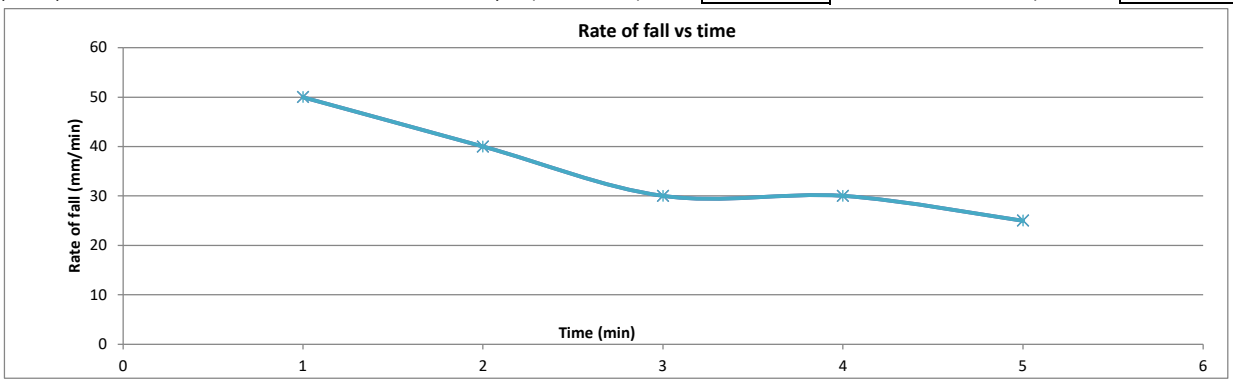
Date: 17-Oct-19
File No.: 1657-01
Client: Rod McLeod
Location: Cranbrook Hill PG
Weather: Sunny

Auger Hole #: 9 TP17, Lot 5
AH Depth: 600 (mm) 11"
AH Diameter: 75 (mm)
Input Soil type (4,3,2) Clay liner=1: 3

Total Elapsed Min	Interim Time (Min)	Water Level Reading (mm)	Drop in Level (mm)	Rates of fall (mm/min)	Remarks of Observations
0		415			
1	1	365	50	50	
2	1	325	40	40	
3	1	295	30	30	
4	1	265	30	30	
5	1	240	25	25	

Note (5min to 30min typical duration to stabilize)

	Stable rate (mm/min)		Soil factor		Kfs (mm/day)
Calculated Soil field saturated hydraulic conductivity Kfs (mm/day) =	35	X	56.4	=	1975
Input depth from bottom of test hole to shallow restrictive layer (50-400 mm)	150 mm		Alt Shallow layer Kfs =		2943



4" Permeameter

Soil Factors to use in the calculation of the Kfs with the L&M Engineering Limited 4" permeameter

AH Diameter (cm)	7	7.5	8	9	10	11	12	13
Coarce & gravely Sand (4)	73.0	69.8	67.0	61.9	57.6	53.9	50.7	47.8
Structured Loams + Clay (med & fine sand) (3)	58.9	56.4	54.1	50.1	46.7	43.7	41.1	38.8
Unstructured Clay (2)	36.3	34.9	33.6	31.4	29.5	27.8	26.3	25.0

AH Diameter (cm)	14	15	16	18	20	22	24	26
Coarce & gravely Sand (4)	45.2	43.0	40.9	37.3	34.3	31.7	29.5	27.5
Structured Loams + Clay (med & fine sand) (3)	36.8	35.0	33.3	30.5	28.1	26.0	24.2	22.7
Unstructured Clay (2)	23.9	22.8	21.9	20.2	18.8	17.6	16.5	15.6

Results based on a constant water depth of 20 cm
Results based on a permeameter reservoir inside diameter of 10.23 cm

ENGINEERING LIMITED

PERMEAMETER TEST

Inputs
Outputs

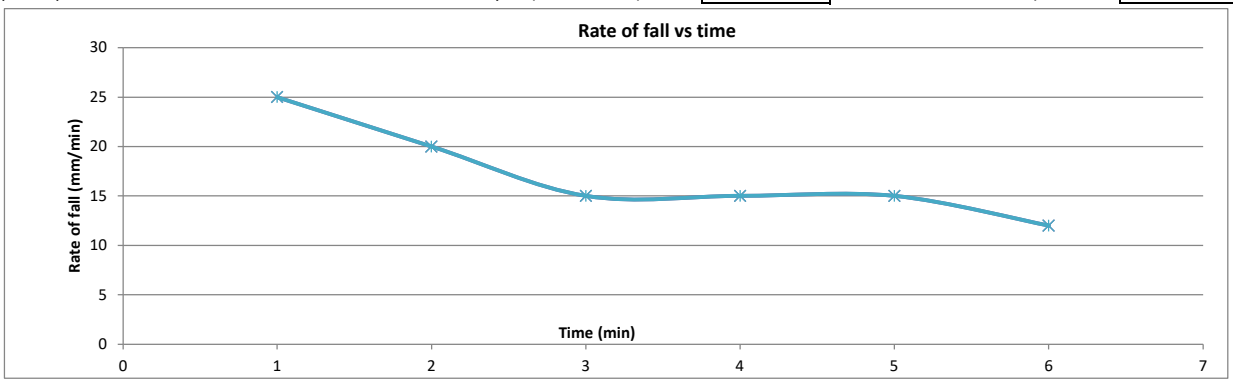
Date: 17-Oct-19
File No.: 1657-01
Client: Rod McLeod
Location: Cranbrook Hill PG
Weather: Sunny

Auger Hole #: 10 TP18, Lot 4
AH Depth: 600 (mm) 11"
AH Diameter: 75 (mm)
Input Soil type (4,3,2) Clay liner=1: 3

Total Elapsed Min	Interim Time (Min)	Water Level Reading (mm)	Drop in Level (mm)	Rates of fall (mm/min)	Remarks of Observations
0		400			
1	1	375	25	25	
2	1	355	20	20	
3	1	340	15	15	
4	1	325	15	15	
5	1	310	15	15	
6	1	298	12	12	

Note (5min to 30min typical duration to stabilize)

	Stable rate (mm/min)		Soil factor		Kfs (mm/day)
Calculated Soil field saturated hydraulic conductivity Kfs (mm/day) =	17	X	56.4	=	959
Input depth from bottom of test hole to shallow restrictive layer (50-400 mm)	150 mm		Alt Shallow layer Kfs =		1430



4" Permeameter

Soil Factors to use in the calculation of the Kfs with the L&M Engineering Limited 4" permeameter

AH Diameter (cm)	7	7.5	8	9	10	11	12	13
Coarce & gravely Sand (4)	73.0	69.8	67.0	61.9	57.6	53.9	50.7	47.8
Structured Loams + Clay (med & fine sand) (3)	58.9	56.4	54.1	50.1	46.7	43.7	41.1	38.8
Unstructured Clay (2)	36.3	34.9	33.6	31.4	29.5	27.8	26.3	25.0

AH Diameter (cm)	14	15	16	18	20	22	24	26
Coarce & gravely Sand (4)	45.2	43.0	40.9	37.3	34.3	31.7	29.5	27.5
Structured Loams + Clay (med & fine sand) (3)	36.8	35.0	33.3	30.5	28.1	26.0	24.2	22.7
Unstructured Clay (2)	23.9	22.8	21.9	20.2	18.8	17.6	16.5	15.6

Results based on a constant water depth of 20 cm
Results based on a permeameter reservoir inside diameter of 10.23 cm

ENGINEERING LIMITED

PERMEAMETER TEST

Inputs
Outputs

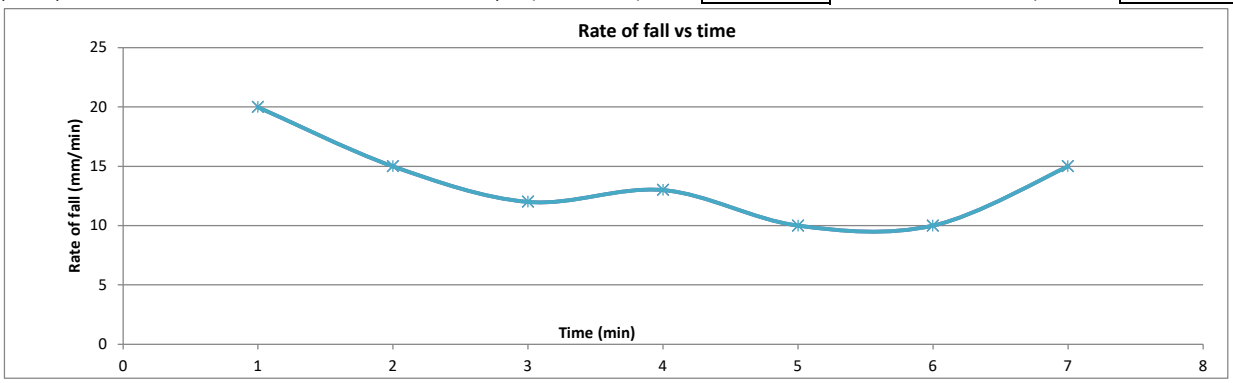
Date: 17-Oct-19
File No.: 1657-01
Client: Rod McLeod
Location: Cranbrook Hill PG
Weather: Sunny

Auger Hole #: 11 TP19, Lot 3
AH Depth: 600 (mm) 11"
AH Diameter: 75 (mm)
Input Soil type (4,3,2) Clay liner=1 3

Total Elapsed Min	Interim Time (Min)	Water Level Reading (mm)	Drop in Level (mm)	Rates of fall (mm/min)	Remarks of Observations
0		505			
1	1	485	20	20	
2	1	470	15	15	
3	1	458	12	12	
4	1	445	13	13	
5	1	435	10	10	
6	1	425	10	10	
7	1	410	15	15	

Note (5min to 30min typical duration to stabilize)

	Stable rate (mm/min)		Soil factor		Kfs (mm/day)
Calculated Soil field saturated hydraulic conductivity Kfs (mm/day) =	13.3	X	56.4	=	751
Input depth from bottom of test hole to shallow restrictive layer (50-400 mm)	150 mm		Alt Shallow layer Kfs =		1118



4" Permeameter

Soil Factors to use in the calculation of the Kfs with the L&M Engineering Limited 4" permeameter

AH Diameter (cm)	7	7.5	8	9	10	11	12	13
Coarce & gravely Sand (4)	73.0	69.8	67.0	61.9	57.6	53.9	50.7	47.8
Structured Loams + Clay (med & fine sand) (3)	58.9	56.4	54.1	50.1	46.7	43.7	41.1	38.8
Unstructured Clay (2)	36.3	34.9	33.6	31.4	29.5	27.8	26.3	25.0

AH Diameter (cm)	14	15	16	18	20	22	24	26
Coarce & gravely Sand (4)	45.2	43.0	40.9	37.3	34.3	31.7	29.5	27.5
Structured Loams + Clay (med & fine sand) (3)	36.8	35.0	33.3	30.5	28.1	26.0	24.2	22.7
Unstructured Clay (2)	23.9	22.8	21.9	20.2	18.8	17.6	16.5	15.6

Results based on a constant water depth of 20 cm
Results based on a permeameter reservoir inside diameter of 10.23 cm

ENGINEERING LIMITED

PERMEAMETER TEST

Inputs
Outputs

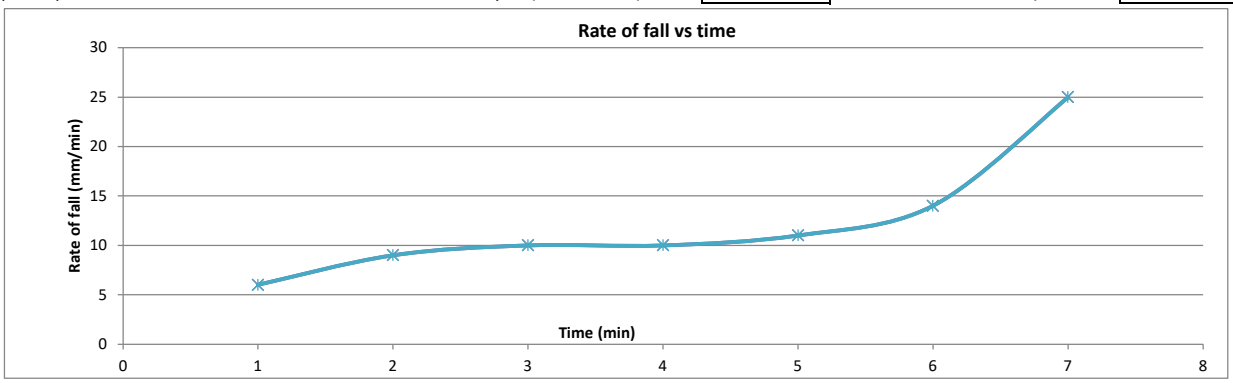
Date: 18-Oct-19
File No.: 1657-01
Client: Rod McLeod
Location: Cranbrook Hill PG
Weather: Sunny

Auger Hole #: 12 TP20, Lot 2
AH Depth: 600 (mm) 11"
AH Diameter: 75 (mm)
Input Soil type (4,3,2) Clay liner=1: 3

Total Elapsed Min	Interim Time (Min)	Water Level Reading (mm)	Drop in Level (mm)	Rates of fall (mm/min)	Remarks of Observations
0		355			
1	1	349	6	6	
2	1	340	9	9	
3	1	330	10	10	
4	1	320	10	10	
5	1	309	11	11	
6	1	295	14	14	
7	1	270	25	25	

Note (5min to 30min typical duration to stabilize)

	Stable rate (mm/min)		Soil factor		Kfs (mm/day)
Calculated Soil field saturated hydraulic conductivity Kfs (mm/day) =	10	X	56.4	=	564
Input depth from bottom of test hole to shallow restrictive layer (50-400 mm)	150 mm		Alt Shallow layer Kfs =		841



4" Permeameter

Soil Factors to use in the calculation of the Kfs with the L&M Engineering Limited 4" permeameter

AH Diameter (cm)	7	7.5	8	9	10	11	12	13
Coarce & gravely Sand (4)	73.0	69.8	67.0	61.9	57.6	53.9	50.7	47.8
Structured Loams + Clay (med & fine sand) (3)	58.9	56.4	54.1	50.1	46.7	43.7	41.1	38.8
Unstructured Clay (2)	36.3	34.9	33.6	31.4	29.5	27.8	26.3	25.0

AH Diameter (cm)	14	15	16	18	20	22	24	26
Coarce & gravely Sand (4)	45.2	43.0	40.9	37.3	34.3	31.7	29.5	27.5
Structured Loams + Clay (med & fine sand) (3)	36.8	35.0	33.3	30.5	28.1	26.0	24.2	22.7
Unstructured Clay (2)	23.9	22.8	21.9	20.2	18.8	17.6	16.5	15.6

Results based on a constant water depth of 20 cm
Results based on a permeameter reservoir inside diameter of 10.23 cm

ENGINEERING LIMITED

PERMEAMETER TEST

Inputs
Outputs

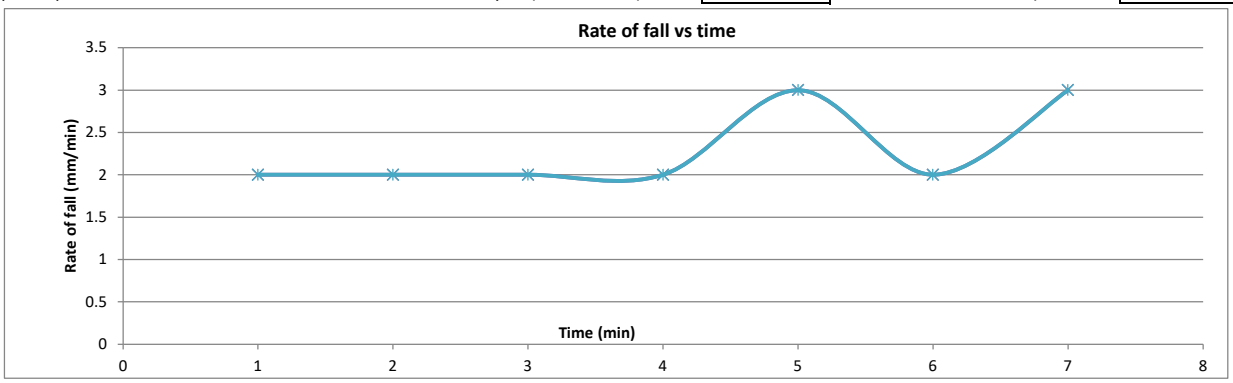
Date: 18-Oct-19
File No.: 1657-01
Client: Rod McLeod
Location: Cranbrook Hill PG
Weather: Sunny

Auger Hole #: 13 TP21, Lot 1
AH Depth: 600 (mm) 11"
AH Diameter: 75 (mm)
Input Soil type (4,3,2) Clay liner=1: 3

Total Elapsed Min	Interim Time (Min)	Water Level Reading (mm)	Drop in Level (mm)	Rates of fall (mm/min)	Remarks of Observations
0		420			
1	1	418	2	2	
2	1	416	2	2	
3	1	414	2	2	
4	1	412	2	2	
5	1	409	3	3	
6	1	407	2	2	
7	1	404	3	3	

Note (5min to 30min typical duration to stabilize)

	Stable rate (mm/min)		Soil factor		Kfs (mm/day)
Calculated Soil field saturated hydraulic conductivity Kfs (mm/day) =	2.2	X	56.4	=	124
Input depth from bottom of test hole to shallow restrictive layer (50-400 mm)	150 mm		Alt Shallow layer Kfs =		185



4" Permeameter

Soil Factors to use in the calculation of the Kfs with the L&M Engineering Limited 4" permeameter

AH Diameter (cm)	7	7.5	8	9	10	11	12	13
Coarce & gravely Sand (4)	73.0	69.8	67.0	61.9	57.6	53.9	50.7	47.8
Structured Loams + Clay (med & fine sand) (3)	58.9	56.4	54.1	50.1	46.7	43.7	41.1	38.8
Unstructured Clay (2)	36.3	34.9	33.6	31.4	29.5	27.8	26.3	25.0

AH Diameter (cm)	14	15	16	18	20	22	24	26
Coarce & gravely Sand (4)	45.2	43.0	40.9	37.3	34.3	31.7	29.5	27.5
Structured Loams + Clay (med & fine sand) (3)	36.8	35.0	33.3	30.5	28.1	26.0	24.2	22.7
Unstructured Clay (2)	23.9	22.8	21.9	20.2	18.8	17.6	16.5	15.6

Results based on a constant water depth of 20 cm
Results based on a permeameter reservoir inside diameter of 10.23 cm

L&M ENGINEERING LIMITED

Test Pit No.: 1
Location: PR. Road, Near Lot 1
Client: Rod McCleod
File No.: 1657-01
Completed By: Seongmin Jang
Date: 16-Oct-19

Soil Profile Description

DEPTH CM/IN	TEXTURE	C.F.	STRUCTURE			CONSISTENCE	COLOR	MOTTLES			ROOTS	
			TYPE	GRADE	SIZE			QUANTITY	SIZE	CONTRAST	QUANTITY	SIZE
0 - 0.3m	Organics					Friable	Dark Brown	None			Some	10-20mm
0.3 - 0.6m	Rocky		Blocky	Moderate	<10cm	Firm	Bright Grey	None			None	
Below 0.6m	Bed Rock											

Redoximorphic features (motting/gleying): None Visible
Ground water table (seasonal): N/A
Restrictive horizon: 0.6m
Rooting depth: 0.3m
Natural Soil Vertical: >2.0m
Natural Soil Vertical Separation Distance: >2.0m

L&M ENGINEERING LIMITED

Test Pit No.: 2
Location: PR. Road, Near Lot 4
Client: Rod McCleod
File No.: 1657-01
Completed By: Seongmin Jang
Date: 16-Oct-19

Soil Profile Description

DEPTH CM/IN	TEXTURE	C.F.	STRUCTURE			CONSISTENCE	COLOR	MOTTLES			ROOTS	
			TYPE	GRADE	SIZE			QUANTITY	SIZE	CONTRAST	QUANTITY	SIZE
0 - 0.3m	Organics					Loose	Dark Brown	None			Some	10-20mm
0.3 - 2.0m	Sandy Gravel Some silt	< 40%	Granular		< 20 cm		Brown to Grey	None			None	

Redoximorphic features (motting/gleying): None Visible
Ground water table (seasonal): N/A
Restrictive horizon: N/A
Rooting depth: 0.3m
Natural Soil Vertical: >2.0m
Natural Soil Vertical Separation Distance: >2.0m

L&M ENGINEERING LIMITED

Test Pit No.: 3
Location: PR. Road, Near Lot 6
Client: Rod McCleod
File No.: 1657-01
Completed By: Seongmin Jang
Date: 16-Oct-19

Soil Profile Description

DEPTH CM/IN	TEXTURE	C.F.	STRUCTURE			CONSISTENCE	COLOR	MOTTLES			ROOTS	
			TYPE	GRADE	SIZE			QUANTITY	SIZE	CONTRAST	QUANTITY	SIZE
0 - 0.2m	Organics					Loose	Dark Brown	None			Some	10-20mm
0.2 - 0.6m	Sandy Gravel Some fines	< 20%	Granular			Firm	Brown	None			None	
0.6 - 1.2m	Silty and Gravelly Clay	< 10%	Blocky	Moderate	< 10cm	Firm	Grey	None			None	
1.2 - 1.8m	Sandy Gravel Some Clay, Cobbles	< 30%	Sub-angular	Moderate	< 20cm	Firm	Grey	None			None	

Redoximorphic features (motting/gleying): None Visible
Ground water table (seasonal): N/A
Restrictive horizon: N/A
Rooting depth: 0.2m
Natural Soil Vertical: >2.0m
Natural Soil Vertical Separation Distance: >2.0m

L&M ENGINEERING LIMITED

Test Pit No.: 4
Location: PR. Road, Near Lot 9
Client: Rod McCleod
File No.: 1657-01
Completed By: Seongmin Jang
Date: 16-Oct-19

Soil Profile Description

DEPTH CM/IN	TEXTURE	C.F.	STRUCTURE			CONSISTENCE	COLOR	MOTTLES			ROOTS	
			TYPE	GRADE	SIZE			QUANTITY	SIZE	CONTRAST	QUANTITY	SIZE
0 - 0.3m	Organics					Friable	Dark Brown	None			Some	10-20mm
0.3 - 0.8m	Gravelly Sand Some Silt, Cobbles and Boulders	< 20%	Granular			Friable	Brown	None			None	
0.8 - 1.8m	Silty Sand Some Cobbles	< 10%	Sub-angular	Moderate	< 20cm	Firm	Grey to Brown	None			None	

Redoximorphic features (motting/gleying): None Visible
Ground water table (seasonal): N/A
Restrictive horizon: N/A
Rooting depth: 0.3m
Natural Soil Vertical: >2.0m
Natural Soil Vertical Separation Distance: >2.0m

L&M ENGINEERING LIMITED

Test Pit No.: 5
Location: PR. Road, Near Lot 11
Client: Rod McCleod
File No.: 1657-01
Completed By: Seongmin Jang
Date: 16-Oct-19

Soil Profile Description

DEPTH CM/IN	TEXTURE	C.F.	STRUCTURE			CONSISTENCE	COLOR	MOTTLES			ROOTS	
			TYPE	GRADE	SIZE			QUANTITY	SIZE	CONTRAST	QUANTITY	SIZE
0 - 0.3m	Organics					Loose	Dark Brown	None			Some	10-20mm
0.3 - 1.0m	Sandy Gravel Some fines	< 10%	Blocky	Moderate	< 10cm	Friable	Brown	None			None	
1.0 - 1.7m	Sandy Gravel Some fines, Cobbles and Boulders	< 20%	Blocky	Moderate	Boulders < 50cm	Firm	Brown	None			None	

Redoximorphic features (motting/gleying): None Visible
Ground water table (seasonal): N/A
Restrictive horizon: N/A
Rooting depth: 0.3m
Natural Soil Vertical: >2.0m
Natural Soil Vertical Separation Distance: >2.0m

L&M ENGINEERING LIMITED

Test Pit No.: 6
Location: PR. Road, Near Lot 13
Client: Rod McCleod
File No.: 1657-01
Completed By: Seongmin Jang
Date: 16-Oct-19

Soil Profile Description

DEPTH CM/IN	TEXTURE	C.F.	STRUCTURE			CONSISTENCE	COLOR	MOTTLES			ROOTS	
			TYPE	GRADE	SIZE			QUANTITY	SIZE	CONTRAST	QUANTITY	SIZE
0 - 0.3m	Organics					Loose	Dark Brown	None			Some	10-20mm
0.3 - 1.1m	Sandy Gravel Some Silt and Cobbles	< 10%	Blocky	Firm	< 10cm	Loose	Brown	None			None	
1.1 - 2.0m	Sandy Silt Some gravel	< 10%	Layered	Firm	< 10cm	Loose	Brown	None			None	

Redoximorphic features (motting/gleying): None Visible
Ground water table (seasonal): N/A
Restrictive horizon: N/A
Rooting depth: 0.2m
Natural Soil Vertical: >2.0m
Natural Soil Vertical Separation Distance: >2.0m

L&M ENGINEERING LIMITED

Test Pit No.: 7
Location: Lot 13
Client: Rod McCleod
File No.: 1657-01
Completed By: Seongmin Jang
Date: 16-Oct-19

Soil Profile Description

DEPTH CM/IN	TEXTURE	C.F.	STRUCTURE			CONSISTENCE	COLOR	MOTTLES			ROOTS	
			TYPE	GRADE	SIZE			QUANTITY	SIZE	CONTRAST	QUANTITY	SIZE
0-0.2m	Organics					Friable	Dark Brown	None			Some	10-20mm
0.2-2.1m	Sandy Silt		Blocky	Moderate	<10cm	Firm	Bright Grey	None			None	

Redoximorphic features (motting/gleying): None Visible
Ground water table (seasonal): N/A
Restrictive horizon: N/A
Rooting depth: 0.2m
Natural Soil Vertical: >2.0m
Natural Soil Vertical Separation Distance: >2.0m

L&M ENGINEERING LIMITED

Test Pit No.: 8
Location: Lot 13
Client: Rod McCleod
File No.: 1657-01
Completed By: Seongmin Jang
Date: 16-Oct-19

Soil Profile Description

DEPTH CM/IN	TEXTURE	C.F.	STRUCTURE			CONSISTENCE	COLOR	MOTTLES			ROOTS	
			TYPE	GRADE	SIZE			QUANTITY	SIZE	CONTRAST	QUANTITY	SIZE
0-0.2m	Organics					Friable	Dark Brown	None			Some	10-20mm
0.2-2.7m	Silt		Angular Blocky	Strong	<30cm	Very Firm	Bright Grey	None			None	

Redoximorphic features (motting/gleying): None Visible
Ground water table (seasonal): N/A
Restrictive horizon: N/A
Rooting depth: 0.2m
Natural Soil Vertical: >2.0m
Natural Soil Vertical Separation Distance: >2.0m

L&M ENGINEERING LIMITED

Test Pit No.: 9
Location: Lot 12
Client: Rod McCleod
File No.: 1657-01
Completed By: Seongmin Jang
Date: 16-Oct-19

Soil Profile Description

DEPTH CM/IN	TEXTURE	C.F.	STRUCTURE			CONSISTENCE	COLOR	MOTTLES			ROOTS	
			TYPE	GRADE	SIZE			QUANTITY	SIZE	CONTRAST	QUANTITY	SIZE
0-0.2m	Organics					Friable	Dark Brown	None			Some	10-20mm
0.2-1.9m	Sandy Silt		Blocky	Moderate	<5cm	Firm	Grey	None			None	
1.9-2.5m	Silt		Blocky	Strong	<10cm	Very Firm	Bright Grey	None			None	

Redoximorphic features (motting/gleying): None Visible
Ground water table (seasonal): N/A
Restrictive horizon: N/A
Rooting depth: 0.2m
Natural Soil Vertical: >2.0m
Natural Soil Vertical Separation Distance: >2.0m

L&M ENGINEERING LIMITED

Test Pit No.: 10
Location: Lot 12
Client: Rod McCleod
File No.: 1657-01
Completed By: Seongmin Jang
Date: 16-Oct-19

Soil Profile Description

DEPTH CM/IN	TEXTURE	C.F.	STRUCTURE			CONSISTENCE	COLOR	MOTTLES			ROOTS	
			TYPE	GRADE	SIZE			QUANTITY	SIZE	CONTRAST	QUANTITY	SIZE
0-0.2m	Organics					Friable	Dark Brown	None			Some	10-20mm
0.2-1.2m	Sandy Silt		Blocky	Strong	<10cm	Firm	Bright Brown	None			Some	5-10mm
1.2-2.6m	Silt		Angular Blocky	Strong	<30cm	Very Firm	Bright Brown	None			None	

Redoximorphic features (motting/gleying): None Visible
Ground water table (seasonal): N/A
Restrictive horizon: N/A
Rooting depth: 0.2m
Natural Soil Vertical: >2.0m
Natural Soil Vertical Separation Distance: >2.0m

L&M ENGINEERING LIMITED

Test Pit No.: 11
Location: Lot 11
Client: Rod McCleod
File No.: 1657-01
Completed By: Seongmin Jang
Date: 17-Oct-19

Soil Profile Description

DEPTH CM/IN	TEXTURE	C.F.	STRUCTURE			CONSISTENCE	COLOR	MOTTLES			ROOTS	
			TYPE	GRADE	SIZE			QUANTITY	SIZE	CONTRAST	QUANTITY	SIZE
0-0.2m	Organics					Friable	Dark Brown	None			Some	10-20mm
0.2-1.9m	Sandy Silt		Blocky	Weak		Friable	Bright Brown	None			Some	5-10mm
1.9-2.7m	Silty Sand	<5%	Blocky	Moderate		Firm	Bright Brown	None			None	

Redoximorphic features (motting/gleying): None Visible
Ground water table (seasonal): N/A
Restrictive horizon: N/A
Rooting depth: 0.2m
Natural Soil Vertical: >2.0m
Natural Soil Vertical Separation Distance: >2.0m

L&M ENGINEERING LIMITED

Test Pit No.: 12
Location: Lot 10
Client: Rod McCleod
File No.: 1657-01
Completed By: Seongmin Jang
Date: 17-Oct-19

Soil Profile Description

DEPTH CM/IN	TEXTURE	C.F.	STRUCTURE			CONSISTENCE	COLOR	MOTTLES			ROOTS	
			TYPE	GRADE	SIZE			QUANTITY	SIZE	CONTRAST	QUANTITY	SIZE
0-0.2m	Organics	None				Friable	Dark Brown	None			Some	10-20mm
0.2-1.9m	Silt	None	Angular Blocky	Moderate	<15cm	Soft	Grey	None			None	
1.9-2.7m	Clayey Silt	None	Blocky / Layered	Moderate	<15cm	Moist / Soft	Grey	None			None	

Redoximorphic features (motting/gleying): None Visible
Ground water table (seasonal): N/A
Restrictive horizon: N/A
Rooting depth: 0.2m
Natural Soil Vertical: >2.0m
Natural Soil Vertical Separation Distance: >2.0m

L&M ENGINEERING LIMITED

Test Pit No.: 13
Location: Lot 9
Client: Rod McCleod
File No.: 1657-01
Completed By: Seongmin Jang
Date: 17-Oct-19

Soil Profile Description

DEPTH CM/IN	TEXTURE	C.F.	STRUCTURE			CONSISTENCE	COLOR	MOTTLES			ROOTS	
			TYPE	GRADE	SIZE			QUANTITY	SIZE	CONTRAST	QUANTITY	SIZE
0-0.2m	Organics	None				Friable	Dark Brown	None			Some	10-20mm
0.2-1.0m	Sandy Silt	<5%	Layered	Weak		Firm	Bright Brown	None			Some	5-10mm
1.0-2.4m	Silt Trace gravel	<15%	Blocky	Moderate	<10cm	Firm	Bright Brown	None			None	

Redoximorphic features (motting/gleying): None Visible
Ground water table (seasonal): N/A
Restrictive horizon: N/A
Rooting depth: 0.2m
Natural Soil Vertical: >2.0m
Natural Soil Vertical Separation Distance: >2.0m

ENGINEERING LIMITED

Test Pit No.: 14
Location: Lot 8
Client: Rod McCleod
File No.: 1657-01
Completed By: Seongmin Jang
Date: 17-Oct-19

Soil Profile Description

DEPTH CM/IN	TEXTURE	C.F.	STRUCTURE			CONSISTENCE	COLOR	MOTTLES			ROOTS	
			TYPE	GRADE	SIZE			QUANTITY	SIZE	CONTRAST	QUANTITY	SIZE
0-0.2m	Organics							None			Some	5-20mm
0.2-0.6m	Sandy Silt Some Gravel	<20%	Blocky	Moderate	<10cm	Friable	Bright Brown	None			None	
0.6-1.1m	Gravel Some sand Some Cobbles	<30%	Angular Blocky	Strong	<10cm	Firm	Greyey Brown	None			None	
1.1-1.9m	Gravely Sand Some Silt Some Cobbles	<40%	Angular Blocky	Strong	<10cm	Firm	Grey	None			None	

Redoximorphic features (motting/gleying): None Visible
Ground water table (seasonal): N/A
Restrictive horizon: N/A
Rooting depth: 0.2m
Natural Soil Vertical: >2.0m
Natural Soil Vertical Separation Distance: >2.0m

L&M ENGINEERING LIMITED

Test Pit No.: 15
Location: Lot 7
Client: Rod McCleod
File No.: 1657-01
Completed By: Seongmin Jang
Date: 17-Oct-19

Soil Profile Description

DEPTH CM/IN	TEXTURE	C.F.	STRUCTURE			CONSISTENCE	COLOR	MOTTLES			ROOTS	
			TYPE	GRADE	SIZE			QUANTITY	SIZE	CONTRAST	QUANTITY	SIZE
0-0.2m	Organics							None			Some	5-20mm
0.2-1.2m	Sandy Silt Some Cobble	<10%	Blocky	Moderate	<10cm	Firm	Bright Brown	None			None	
1.2-2.0m	Sandy Gravel Some Cobble	<20%	Granular Incohesive			Firm	Grey	None			None	

Redoximorphic features (motting/gleying): None Visible
Ground water table (seasonal): N/A
Restrictive horizon: N/A
Rooting depth: 0.2m
Natural Soil Vertical: >2.0m
Natural Soil Vertical Separation Distance: >2.0m

L&M ENGINEERING LIMITED

Test Pit No.: 16
Location: Lot 6
Client: Rod McCleod
File No.: 1657-01
Completed By: Seongmin Jang
Date: 17-Oct-19

Soil Profile Description

DEPTH CM/IN	TEXTURE	C.F.	STRUCTURE			CONSISTENCE	COLOR	MOTTLES			ROOTS	
			TYPE	GRADE	SIZE			QUANTITY	SIZE	CONTRAST	QUANTITY	SIZE
0-0.2m	Organics							None			Some	5-20mm
0.2-2.0m	Sandy Silt Some Clay Some Gravel	<10%	Blocky	Moderate	<5cm	Firm	Bright Brown	None			None	

Redoximorphic features (motting/gleying): None Visible
Ground water table (seasonal): N/A
Restrictive horizon: N/A
Rooting depth: 0.2m
Natural Soil Vertical: >2.0m
Natural Soil Vertical Separation Distance: >2.0m

L&M ENGINEERING LIMITED

Test Pit No.: 17
Location: Lot 5
Client: Rod McCleod
File No.: 1657-01
Completed By: Seongmin Jang
Date: 17-Oct-19

Soil Profile Description

DEPTH CM/IN	TEXTURE	C.F.	STRUCTURE			CONSISTENCE	COLOR	MOTTLES			ROOTS	
			TYPE	GRADE	SIZE			QUANTITY	SIZE	CONTRAST	QUANTITY	SIZE
0-0.2m	Organics							None			Some	5-20mm
0.2-2.0m	Sandy Silt Some Gravel	<20%	Blocky	Moderate	<5cm	Strong	Brown	None			None	

Redoximorphic features (motting/gleying): None Visible
Ground water table (seasonal): N/A
Restrictive horizon: N/A
Rooting depth: 0.2m
Natural Soil Vertical: >2.0m
Natural Soil Vertical Separation Distance: >2.0m

ENGINEERING LIMITED

Test Pit No.: 18
Location: Lot 4
Client: Rod McCleod
File No.: 1657-01
Completed By: Seongmin Jang
Date: 17-Oct-19

Soil Profile Description

DEPTH CM/IN	TEXTURE	C.F.	STRUCTURE			CONSISTENCE	COLOR	MOTTLES			ROOTS	
			TYPE	GRADE	SIZE			QUANTITY	SIZE	CONTRAST	QUANTITY	SIZE
0-0.2m	Organics	<5%				Friable	Dark Brown	None			Some	10-20mm
0.2-1.0m	Silty Sand / Gravel	<20%	Granular			Loose	Grey	None			None	
1.0-1.2m	Gravel / Med-Sand Trace Cobbles	<20%	Layered	Moderate		Friable	Grey	None			None	
1.2-2.0m	Gravel / Med-Sand Trace Cobbles	<30%	Layered	Moderate		Friable	Grey	None			None	

Redoximorphic features (motting/gleying): None Visible
Ground water table (seasonal): None
Restrictive horizon: None
Rooting depth: 0.15m
Natural Soil Vertical: 1.0m
Natural Soil Vertical Separation Distance: 1.0m

L&M ENGINEERING LIMITED

Test Pit No.: 19
Location: Lot 3
Client: Rod McCleod
File No.: 1657-01
Completed By: Owen Wass-Little
Date: 18-Oct-19

Soil Profile Description

DEPTH CM/IN	TEXTURE	C.F.	STRUCTURE			CONSISTENCE	COLOR	MOTTLES			ROOTS	
			TYPE	GRADE	SIZE			QUANTITY	SIZE	CONTRAST	QUANTITY	SIZE
0-0.2m	Organics	<5%	Granular	Mild		Friable	Dark Brown	None	n/a	n/a	Some	10-20mm
0.2-1.0m	Silt w/Gravely Sand	<35%	Blocky	Moderate	Coarse (20-40mm)	Firm	Bright Grey	None	n/a	n/a	None	n/a
1.0-1.5m	Silty Gravel w/ Packed Silt	<45%	Blocky	Moderate	Coarse (40-80mm)	Firm	Bright Grey	None	n/a	n/a	None	n/a
>1.5m	Bedrock											

Redoximorphic features (motting/gleying): None Visible
Ground water table (seasonal): N/a
Restrictive horizon: >1.5m
Rooting depth: 0.15m
Natural Soil Vertical: 1.5m
Natural Soil Vertical Separation Distance: 1.5m

ENGINEERING LIMITED

Test Pit No.: 20
Location: 2
Client: Rod McCleod
File No.: 1657-01
Completed By: Owen Wass-Little
Date: 18-Oct-19

Soil Profile Description

DEPTH CM/IN	TEXTURE	C.F.	STRUCTURE			CONSISTENCE	COLOR	MOTTLES			ROOTS	
			TYPE	GRADE	SIZE			QUANTITY	SIZE	CONTRAST	QUANTITY	SIZE
0-0.2m	Organics	<5%	Granular	Mild		Friable	Dark Brown	None	n/a	n/a	Some	10-20mm
0.2-1.0m	Silt w/Gravely Sand	<10%	Blocky	Moderate	Coarse (20-40mm)	Firm	Brown	None	n/a	n/a	None	n/a
1.0-2.0m	Silty Sand w/ layered sedimentary rock	<25%	Blocky	Moderate	Coarse (40-80mm)	Firm	Brown	None	n/a	n/a	None	n/a

Redoximorphic features (motting/gleying): None Visible
Ground water table (seasonal): N/a
Restrictive horizon: n/a
Rooting depth: 0.15m
Natural Soil Vertical: 2.0m
Natural Soil Vertical Separation Distance: 2.0m

ENGINEERING LIMITED

Test Pit No.: 21
Location: 1
Client: Rod McCleod
File No.: 1657-01
Completed By: Owen Wass-Little
Date: 18-Oct-19

Soil Profile Description

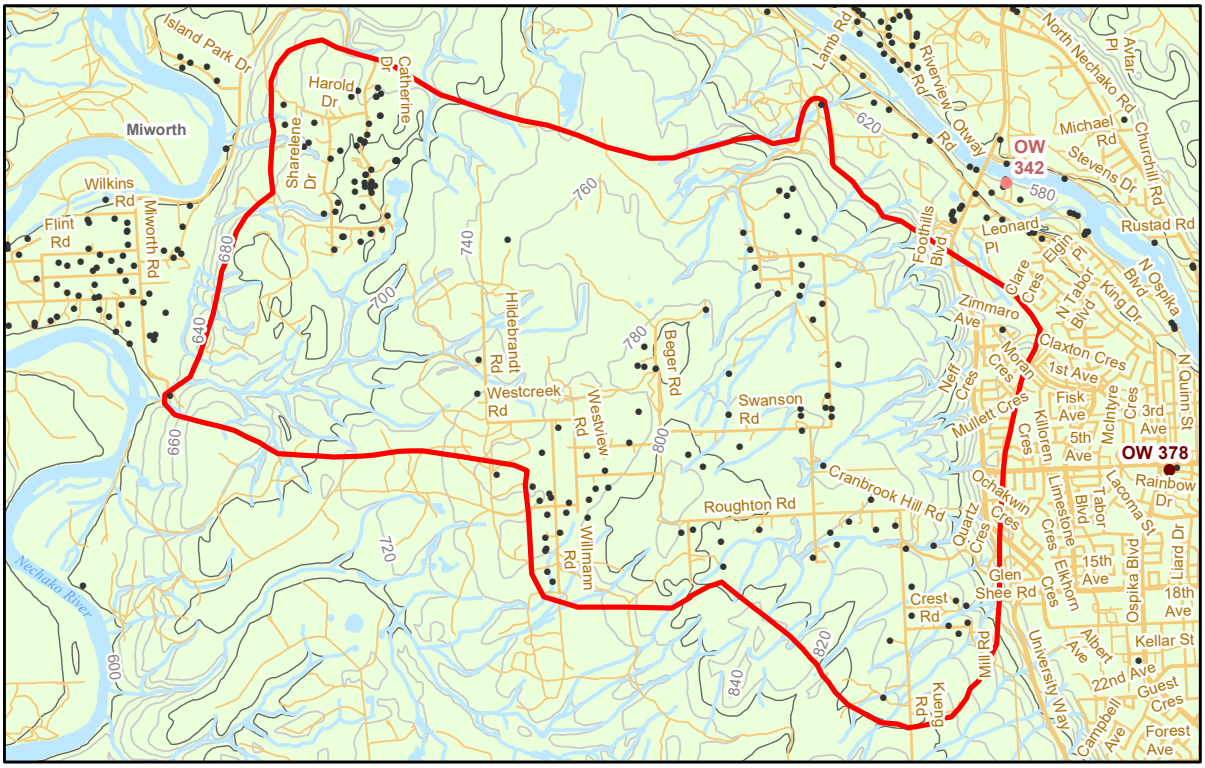
DEPTH CM/IN	TEXTURE	C.F.	STRUCTURE			CONSISTENCE	COLOR	MOTTLES			ROOTS	
			TYPE	GRADE	SIZE			QUANTITY	SIZE	CONTRAST	QUANTITY	SIZE
0-0.2m	Organics	<5%	Granular	Mild		Friable	Dark Brown	None	n/a	n/a	Some	10-20mm
0.2-0.6m	Silt & Sand w/ little Clay	<10%	Blocky	Moderate	Coarse (20-40mm)	Firm	Brown	None	n/a	n/a	None	n/a
0.6-0.9m	Silty Sand w/ little gravel	<30%	Blocky	Moderate	Coarse (40-80mm)	Firm	Brown	None	n/a	n/a	None	n/a

Redoximorphic features (motting/gleying): None Visible
Ground water table (seasonal): N/a
Restrictive horizon: n/a
Rooting depth: 0.15m
Natural Soil Vertical: 0.9m
Natural Soil Vertical Separation Distance: 0.9m

Appendix B

Groundwater Well & Aquifer Records

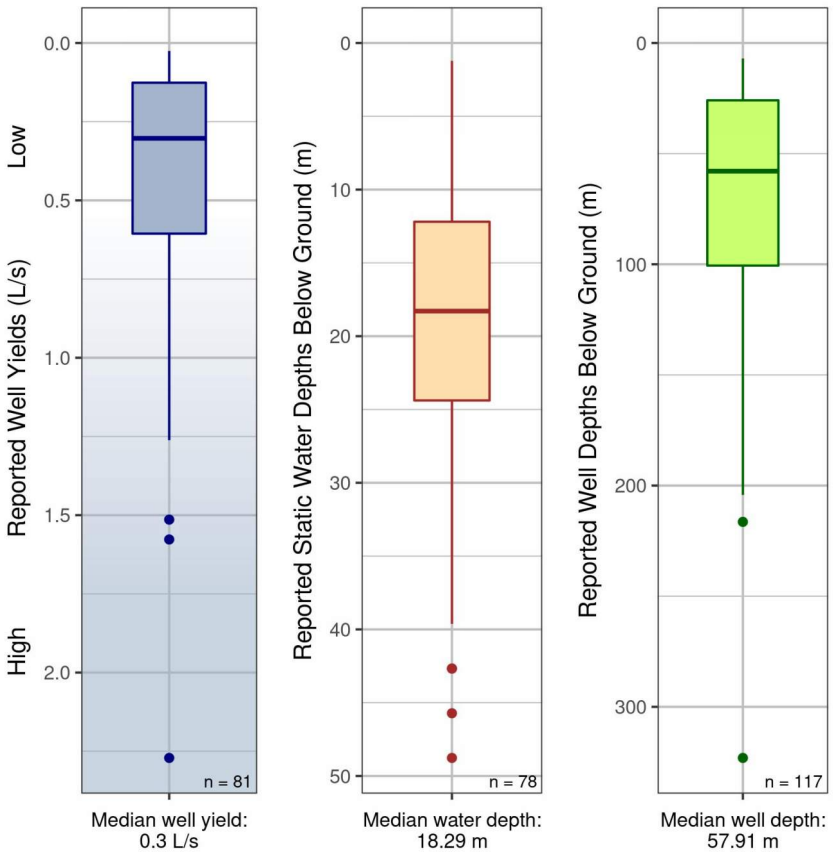
Aquifer #93



Aquifer Description (Mapping Report - 2017): Fractured crystalline (igneous intrusive or metamorphic, meta-sedimentary, meta-volcanic, volcanic) rock aquifer (subtype = 6b).

Aquifer Details	
Region	Omineca
Water District	Prince George
Aquifer Area	29.7 km^2
No. Wells Correlated	117
Vulnerability to Contamination	Moderate
Productivity	Low
Aquifer Classification	IIIB
Hydraulic Conductivity *	Unknown
Transmissivity *	Unknown
Storativity *	Unknown
No. Water Licences Issued to Wells	1
Observation Wells (**Active**, Inactive)	None

* min - max
For Hydraulic Connection see guidance document



Detailed methods for all figures are described in the companion document (Aquifer Factsheet - Companion Document.pdf).
Factsheet generated: 2022-07-27. Aquifers online: https://apps.nrs.gov.bc.ca/gwells/aquifers.

AQUIFER CLASSIFICATION WORKSHEET

DATE: March 14, 2017 (Fresh Water Solutions Ltd.)

AQUIFER REFERENCE NUMBER: 0093

DESCRIPTIVE LOCATION OF AQUIFER: West of Prince George, Cranbrook Hill

NTS MAP SHEET: NTS Map: 093G / 15

BCGS MAP SHEET: Trim Map: 093G.096

CLASSIFICATION: IIB **RANKING: 10**

Aquifer Size: 29.6 km^2

Aquifer Boundaries:

This fractured bedrock aquifer has been delineated on the basis of well development, topography and surface geology (Leaming and Armstrong, 1969; Tipper, 1961; 1971) and hydrogeology (McCallum, 1969). The aquifer underlies Cranbrook Hill and is located south of the southern shore of the Nechako River west of Prince George. The boundaries of this aquifer are to be considered uncertain, in light of the limited lithological information available.

Aquifer Sub-type: 5a

Aquifer Priority Rating for Observation Wells: 52.4

Geologic Formation (overlying materials):

Glacio-lacustrine deposits comprising silt, clay and fine to medium sand.

Geologic Formation (aquifer):

Argillite; greywacke; andesite and related tuffs and breccias; minor presence of conglomerates and limestones.

Confined/Partially Confined/Unconfined: Unconfined with confined portions

Vulnerability: Moderate (B)

Wells are completed in an aquifer that is partially unconfined. The confining layer mainly consists of clay and till and has an average thickness of 13 m. Groundwater levels are moderate, with an average level of 20 m bgs and ranging from 1 to 49 m bgs. Well record lithology suggests that the aquifer has a low permeability.

Productivity: Low - Average 0.3 L/s

Reported well yields range between less than 0.1 L/s and 2.3 L/s. The median well yield is 0.2 L/s and the arithmetic mean is 0.3 L/s. Well yields reported are estimated by the driller based on short-term bail or air- tests only and results obtained are often unreliable. The majority of wells have been completed simply as *open hole* into the fractured bedrock and have not been completed with designed

well screens for maximum hydraulic efficiency. Well yields could therefore be greater than well records suggest.

Depth to Water: Moderate - Average 20 m, Range 1 - 49 m bgs

The deeper groundwater level records may be due to pumping interference of wells clusters.

Direction of Groundwater Flow:

Unknown – Insufficient data available to determine with certainty but, ignoring geologic complexities, likely from areas of higher elevation to areas of lower elevation (i.e. North toward Nechako River).

Recharge:

The main source of recharge is precipitation recharge and lateral groundwater flow from adjacent aquifer units.

Well Density: Moderate – 4.0 wells/km^2

Well density of up to 30 wells per km^2 in the NW portion of the aquifer, where most wells are clustered.

Type of Water Use: Drinking Water

The reported type of use for most of the wells located in the aquifer is Private Domestic, with unknown use reported for some wells.

Reliance on Source/Development:

Well water is the only known source of supply for domestic use. Level of Development is Moderate, given an estimated precipitation recharge of up to approximately 61 L/s (assuming 10% infiltration rate and an annual average precipitation of 630 mm/yr, based on Environment Canada records collected at the local meteorological station), with a likely additional contribution as lateral groundwater flow, and the total groundwater withdrawal (based on the total reported well yield) of approximately 37 L/s.

Conflicts between Users:

None documented.

Quantity Concerns:

None documented.

Quality Concerns:

None reported.

Comments:

None reported.

Water Budget:

No water budget calculations documented.

Groundwater model(s):

No groundwater models available for the aquifer.

Observation Wells:

No observation wells are reported to be located in the aquifer.

References:

Bernardinucci J. and K Ronneseth, 2002. Guide to Using the BC Aquifer Classification Maps for the Protection and Management of Groundwater. BC Ministry of Water, Land and Air Protection, Water Air and Climate Change Branch, Water Protection Section.

Leaming, S.P. and Armstrong, J.E. 1969. Surficial Geology, Prince George. G.S.C. Map 3 - 1969

McCallum, J.A. 1969. Groundwater and Geology of the Prince George Area, Central British Columbia. NTS 93/15 #17. A.R.D.A. Research Project No. 10014. Water Investigations Branch, Dept. of Lands, Forests and Water Resources. 45p.

Tipper, H.W. 1961. Geology, Prince George. GSC Map 49—1960.

Tipper, H.W. 1971. Surficial Geology, Prince George. GSC Map 1288A.

Wei, M., D. M. Allen, A. P. Kohut, S. Grasby, K. Ronneseth, and B. Turner. 2009. Understanding the Types of Aquifers in the Canadian Cordillera Hydrogeologic Region to Better Manage and Protect Groundwater. *Streamline Watershed Management Bulletin*, FORREX Forum for Research and Extension in Natural Resources.

Ranking

Ranking Component:	*Ranking Value:*
Productivity:	1
Vulnerability:	2
Size:	3
Demand*:	2
Type Of Use:	2
Quality:	0
Quantity:	0
Total:	**10**

** Demand was estimated based on the total yield of the wells located in the aquifer, and by assuming that the reported well capacity is the amount of water used. This is a conservative assumption, since reported well capacity is often higher than actual use.*

Statistical Summary of Well Data for Aquifer

Total number of wells available for statistical analysis: 117

	Depth to Bedrock (m bgs)	Well Depth (m bgs)	Depth to Water (m bgs)	Reported Est. Well Yield (L/s)	Est. Thickness of Confining Materials (m)
Number of Wells	54	109	78	80	68
Minimum	2	7	1	0.03	1
Maximum	174	323	49	2.3	37
Median	28	61	18	0.3	11
Average	52	75	20	0.5	13
Geometric Mean	32	58	17	0.3	10

093609624 WIN 95582

Province of British Columbia **Environment** **Water Management Division**

WATER WELL RECORD

Date 05 09 28

MAP 10 51 09 69 E 54 57 58 N 6 Y M WELL No. ELEV Location Accuracy

Date 19__ Well Type

Name & Address Pat Nicholas 6237 Cranbrook Hill Rd, Prince George B.C, V2M-7C7

Description & Address

Give Location

1 ☑ New Well 2 ☐ Reconditioned
WORK 3 ☐ Deepened 4 ☐ Abandoned

METHOD 1 ☐ Cable tool 2 ☐ Bored 3 ☐ Jetted 4 ☑ Rotary a ☐ mud b ☑ air c ☐ reverse ☐ Other

USE 1 ☑ Domestic 2 ☐ Municipal 3 ☐ Irrigation 4 ☐ Comm. & Ind. ☐ Other

DRILLING ADDITIVES None

MEASUREMENTS from 1 ☐ ground level 2 ☑ top of casing
casing height above ground level ft.

TO ft	6. WELL LOG DESCRIPTION	SWL ft
6	brown clay	
71	grey hard pan	
78	brown clay	
81	brown hard pan	
103	grey hard pan	
134	orange hard pan	
173	brown hard pan	
180	sand & gravel	

CONSULTANT

Address

LOCATION SKETCH

N

Cranbrook Hill Road

9. CASING: Materials 1 ☑ Steel 2 ☐ Galvanized 3 ☐ Wood 4 ☐ Plastic 5 ☐ Concrete ☐ Other

							units
Hole Diameter	6"						ins
Diameter							ins
from							ft
to							ft
Thickness							ins
Weight							lb/ft

Pitless unit ft 1 ☐ above 2 ☐ below ground level
1 ☐ Welded 2 ☐ Cemented 3 ☐ Threaded | 1 ☐ New 2 ☐ Used
Perforations:

Shoe(s): 1-6"
Open hole, from to ft Diameter ins
Grout:

10. SCREEN: 1 ☐ Nominal (Telescope) 2 ☐ Pipe Size
Type 1 ☐ Continuous Slot 2 ☐ Perforated 3 ☐ Louvre ☐ Other
Material 1 ☐ Stainless Steel 2 ☐ Plastic ☐ Other
Set from to ft below ground level

RISER, SCREEN & BLANKS							units
Length							ft
Diam. I D							ins
Slot Size							ins
from							ft
to							ft

Fittings, top bottom
Gravel Pack

11. DEVELOPED BY: 1 ☐ Surging 2 ☐ Jetting 3 ☑ Air 4 ☐ Bailing 5 ☐ Pumping ☐ Other

12. TEST 1 ☐ Pump 2 ☐ Bail 3 ☐ Air Date
Rate USgpm Temp °C SWL before test ft
Water Level ft after test of hrs

☐ DRAWDOWN in ft				☐ RECOVERY in ft			
mins	WL	mins	WL	mins	WL	mins	WL

13. RECOMMENDED PUMP TYPE | RECOMMENDED PUMP SETTING ft | RECOMMENDED PUMPING RATE USgpm

14. WATER TYPE: 1 ☐ fresh 2 ☐ salty 3 ☐ clear 4 ☐ cloudy
colour smell ; gas 1 ☐ yes 2 ☐ no

15. WATER ANALYSIS: 1 Hardness mg/L 2 Iron mg/L 3 Chloride mg/L 4 pH Field Date Lab Date

SITE I.D No.

16. FINAL WELL COMPLETION DATA
Well Depth 1680 ft Well Yield 15 US gpm
Static Water Level 615 ft Artesian Flow US gpm Pressure Head ft
Back filled
Well Head Completion

17. DRILLER PLEASE PRINT SURNAME BERNARD FIRST NAME REMI
Signature

18. CONTRACTOR, Address
BERNARD DRILLING
7160 Beaver Road
Prince George, B.C.
V2N 6E6

Member, BCWWDA ☐ yes ☐ no ;

The Province of British Columbia ... responsibility for the accuracy or omission of this record.

ISH MBIA
nvironment

☑ Well Construction Report
☐ Well Closure Report
☐ Well Alteration Report

Waterfall Drilling

Stamp company name/address/ phone/fax/e-mail here, if desired.

Ministry Well ID Plate Number: 20587
Ministry Well Tag Number: 106708
☐ Confirmation/alternative specs. attached
☐ Original well construction report attached

ering indicates minimum mandatory information. See reverse for notes & definitions of abbreviations.

ame: ROBERT MALCOLM
ddress: 5944 CRANBROOK HILL Town PRINCE GEORGE Prov. B.C Postal Code
ation: Address: Street no. 5944 Street name CRANBROOK HILL Town PRINCE GEORGE
description: Lot ____ Plan ____ D.L. ____ Block ____ Sec. ____ Twp. ____ Rg. ____ Land District ____
and Description of well location (attach sketch, if nec.): ____

Zone: 2 (2) and UTM Northing: ____ m UTM Easting: ____ m or Latitude (see note 3): N 53° 55. 20 18.30" Longitude: W 122° 50. 52 31.90"

f drilling: ☑ air rotary ☐ cable tool ☐ mud rotary ☐ auger ☐ driving ☐ jetting ☐ excavating ☐ other (specify): ____
on of well: ☑ vertical ☐ horizontal Ground elevation: 2592 ft (asl) Method (see note 4): G.P.S
well (see note 5): WATER Supply Sub-class of well: DOMESTIC
ly wells: indicate intended water use: ☐ private domestic ☐ water supply system ☐ irrigation ☐ commercial or industrial ☐ other (specify): ____

gic description (see notes 7-14) or closure description (see notes 15 and 16)

To ft (bgl)	Relative Hardness	Colour	Material Description (Use recommended terms on reverse. List in order of decreasing amount, if applicable)	Water-bearing Estimated Flow (USgpm)	Observations (e.g., fractured, weathered, well sorted, silty wash), closure details
7		BROWN	CLAY		
39		BROWN	CLAY WITH ROCK		
47		BROWN	CLAY		
110		GREY	CLAY		
125		BROWN	BEDROCK		
162		GREEN	BEDROCK	3gpm	
185		GREEN + WHITE	BEDROCK	8gpm	

details

To ft (bgl)	Dia in	Casing Material / Open Hole	Wall Thickness in	Drive Shoe
20	6"	STEEL		✓

al: Type: BENTONITE Depth: 15 ft
nstallation: ☑ Poured ☐ Pumped Thickness: ____ in
pe: ____ Depth: ____ ft
VC ☐ Other (specify): ____
____ in Thickness: ____ in
ft (bgl) To: ____ ft (bgl) Perforated: From: ____ ft (bgl) To: ____ ft (bgl)

Screen details

From ft (bgl)	To ft (bgl)	Dia in	Type (see note 18)	Slot Size

Intake: ☐ Screen ☐ Open bottom ☐ Uncased hole
Screen type: ☐ Telescope ☐ Pipe size
Screen material: ☐ Stainless steel ☐ Plastic ☐ Other (specify): ____
Screen opening: ☐ Continuous slot ☐ Slotted ☐ Perforated pipe
Screen bottom: ☐ Bail ☐ Plug ☐ Plate ☐ Other (specify): ____
Filter pack: From: ____ ft To: ____ ft Thickness: ____ in
Type and size of material: ____

ped by:

g ☐ Surging ☐ Jetting ☐ Pumping ☐ Bailing
pecify): ____ Total duration: ____ hrs

ld estimated by:

g ☑ Air lifting ☐ Bailing ☐ Other (specify): ____
____ USgpm Duration: ____ hrs
e test: ____ ft (btoc) Pumping water level: ____ ft (btoc)

s water quality characteristics:

☐ Salty ☐ Clear ☐ Cloudy ☐ Sediment ☐ Gas
ur: ____ Water sample collected: ☐

Final well completion data:

Total depth drilled: ____ ft Finished well depth: 185 ft (bgl)
Final stick up: ____ in Depth to bedrock: 110 ft (bgl)
SWL: 55 ft (btoc) Estimated well yield: 8 USgpm
Artesian flow: ____ USgpm, or Artesian pressure: ____ ft
Type of well cap: ____ Well disinfected: ☑ Yes ☐ No
Where well ID plate is attached: ____

Well closure information:

Reason for closure: ____
Method of closure: ☐ Poured ☐ Pumped
Sealant material: ____ Backfill material: ____
Details of closure (see note 17): ____

ller (print clearly):

st, last) (see note 19): LORNE BERNARD
on no. (see note 20): 06010901
t (if applicable; name and company): ____

ION: Well construction, well alteration or well closure, as the case may be, ne in accordance with the requirements in the *Water Act* and the Ground ction Regulation.

Date of work (YYYY/MM/DD):
Started: 2010/08/13 Completed: 2010/08/13
Comments: ____

e of Driller Responsible Lorne Bernard

TE: The information recorded in this well report describes the works and hydrogeologic conditions at the time of construction, closure, as the case may be. Well yield, well performance and water quality are not guaranteed as they are influenced by a ctors, including natural variability, human activities and condition of the works, which may change over time.

white: Customer copy
canary: Driller copy
pink: Ministry copy

Sheet ____ of ____

Groundwater Wells and Aquifers

Well Summary

Well Tag Number: 92496
Well Identification Plate Number: 20512
Owner Name: JOHN BLUEMINK
Licensed Status: Unlicensed

Well Status: New
Well Class: Water Supply
Well Subclass:
Intended Water Use: Private Domestic

Observation Well Number:
Observation Well Status:
Environmental Monitoring System (EMS) ID:
Aquifer Number: 93
Alternative specs submitted: No

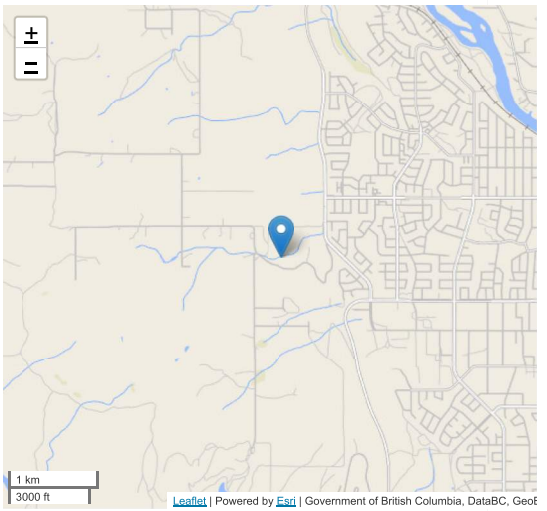
Location Information

Street Address: 5028 CRANBROOK HILL ROAD
Town/City: PRINCE GEORGE

Legal Description:

Lot	A
Plan	13039
District Lot	10224
Block	
Section	
Township	
Range	
Land District	05
Property Identification Description (PID)	12327522

Description of Well Location: NOT PROVIDED



Geographic Coordinates - North American Datum of 1983 (NAD 83)
Latitude: 53.914663
Longitude: -122.826912
UTM Easting: 511369
UTM Northing: 5974041
Zone: 10
Location Accuracy Code:

Well Activity

Activity Type	Work Start Date	Work End Date	Drilling Company
There are no records to show			

Well Completion Data

Total Depth Drilled:
Finished Well Depth: 270.00 feet
Final Casing Stick Up:
Depth to Bedrock: 54.00 feet
Ground elevation: 2542.00

Static Water Level (BTOC): 60.00 feet
Estimated Well Yield: 5.000 USGPM
Artesian Flow:
Artesian Pressure:
Method of determining elevation: GPS

Well Cap:
Well Disinfected: No
Drilling Method: Air Rotary
Orientation of Well: vertical

Lithology

From (ft bgl)	To (ft bgl)	Raw Data	Description	Moisture	Colour	Hardness	Observations	Water Bearing Flow Estimate (USGPM)
0.00	7.00				brown			
7.00	38.00				brown			
38.00	54.00				grey			
54.00	90.00				yellow			
90.00	145.00				green			1.0000
145.00	230.00				black			1.5000

From (ft bgl)	To (ft bgl)	Raw Data	Description	Moisture	Colour	Hardness	Observations	Water Bearing Flow Estimate (USGPM)
230.00	270.00				green			5.0000

Casing Details

From (ft)	To (ft)	Casing Type	Casing Material	Diameter	Wall Thickness	Drive Shoe
0.00	54.00		Steel	6.000		Yes

Surface Seal and Backfill Details

Surface Seal Material: Bentonite clay
Surface Seal Installation Method: Poured
Surface Seal Thickness:
Surface Seal Depth:
Backfill Material Above Surface Seal:
Backfill Depth:

Liner Details

Liner Material: PVC
Liner Diameter:
Liner from:
Liner Thickness:
Liner to:

Liner perforations

From	To
There are no records to show	

Screen Details

Intake Method:
Type:
Material:
Opening:
Bottom:

Installed Screens

From	To	Internal Diameter	Assembly Type	Slot Size
There are no records to show				

Well Development

Developed by:
Development Total Duration:

Well Yield

No well yield data available.

Well Decommission Information

Reason for Decommission:
Sealant Material:
Decommission Details:
Method of Decommission:
Backfill Material:

Comments

No comments submitted

Alternative Specs Submitted: No

Documents

- WTN 92496_Well Construction.pdf

Disclaimer

Groundwater Wells and Aquifers

Well Summary

Well Tag Number: 6344
Well Identification Plate Number:
Owner Name: LES TAYLOR
Licensed Status: Unlicensed

Well Status: New
Well Class: Unknown
Well Subclass:
Intended Water Use: Unknown Well Use

Observation Well Number:
Observation Well Status:
Environmental Monitoring System (EMS) ID:
Aquifer Number: 93
Alternative specs submitted: No

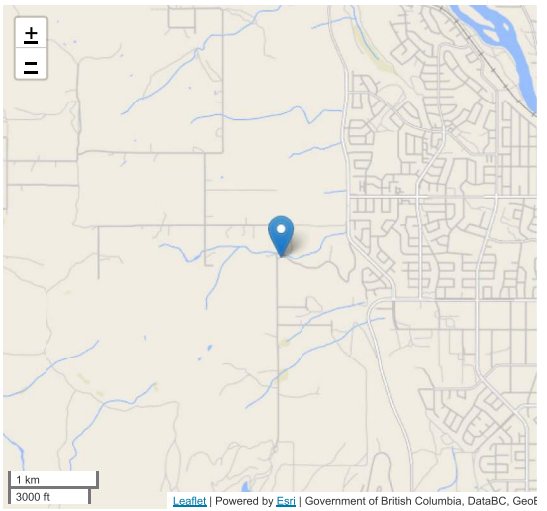
Location Information

Street Address:
Town/City:

Legal Description:

Lot	10
Plan	11808
District Lot	10224
Block	
Section	
Township	
Range	
Land District	05
Property Identification Description (PID)	

Description of Well Location:



Geographic Coordinates - North American Datum of 1983 (NAD 83)
Latitude: 53.914516 **Longitude:** -122.830871
UTM Easting: 511109 **UTM Northing:** 5974024
Zone: 10 **Location Accuracy Code:**

Well Activity

Activity Type	Work Start Date	Work End Date	Drilling Company
There are no records to show			

Well Completion Data

Total Depth Drilled:
Finished Well Depth: 91.00 feet
Final Casing Stick Up:
Depth to Bedrock: 50.00 feet
Ground elevation: 0.00

Static Water Level (BTOC): 4.00 feet
Estimated Well Yield: 200.000 USGPM
Artesian Flow:
Artesian Pressure:
Method of determining elevation:

Well Cap:
Well Disinfected: No
Drilling Method: Other
Orientation of Well: vertical

Lithology

From (ft bgl)	To (ft bgl)	Raw Data	Description	Moisture	Colour	Hardness	Observations	Water Bearing Flow Estimate (USGPM)
0.00	15.00	brown till						
15.00	35.00	sandy gravel						
35.00	50.00	sandy gravel with little water						
50.00	91.00	bl. schist rock						

Casing Details

From (ft)	To (ft)	Casing Type	Casing Material	Diameter	Wall Thickness	Drive Shoe
There are no records to show						

Surface Seal and Backfill Details

Surface Seal Material:
Surface Seal Installation Method:
Surface Seal Thickness:
Surface Seal Depth:
Backfill Material Above Surface Seal:
Backfill Depth:

Liner Details

Liner Material:
Liner Diameter:
Liner from:
Liner Thickness:
Liner to:

Liner perforations

From	To
There are no records to show	

Screen Details

Intake Method:
Type:
Material:
Opening:
Bottom:

Installed Screens

From	To	Internal Diameter	Assembly Type	Slot Size
There are no records to show				

Well Development

Developed by:
Development Total Duration:

Well Yield

No well yield data available.

Well Decommission Information

Reason for Decommission:
Sealant Material:
Decommission Details:
Method of Decommission:
Backfill Material:

Comments

METHOD OF DRILLING = DRILLED

Alternative Specs Submitted: No

Documents

- WTN 6344_Well Record.pdf

Disclaimer

Groundwater Wells and Aquifers

Well Summary

Well Tag Number: 111542
Well Identification Plate Number: 36918
Owner Name: BOB TOPLIS
Licensed Status: Unlicensed

Well Status: New
Well Class: Water Supply
Well Subclass:
Intended Water Use:

Observation Well Number:
Observation Well Status:
Environmental Monitoring System (EMS) ID:
Aquifer Number: 93
Alternative specs submitted: No

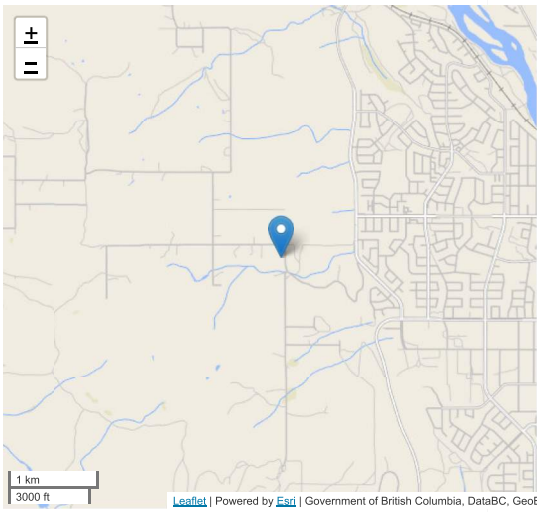
Location Information

Street Address: 5233 CRANBROOK HILL ROAD
Town/City: PRINCE GEORGE

Legal Description:

Lot	
Plan	
District Lot	
Block	
Section	
Township	
Range	
Land District	
Property Identification Description (PID)	

Description of Well Location: NOT PROVIDED



Geographic Coordinates - North American Datum of 1983 (NAD 83)
Latitude: 53.916467
Longitude: -122.832267
UTM Easting: 511017
UTM Northing: 5974241
Zone: 10
Location Accuracy Code:

Well Activity

Activity Type	Work Start Date	Work End Date	Drilling Company
There are no records to show			

Well Completion Data

Total Depth Drilled:
Finished Well Depth: 490.00 feet
Final Casing Stick Up:
Depth to Bedrock: 32.00 feet
Ground elevation: 2559.00

Static Water Level (BTOC): 140.00 feet
Estimated Well Yield: 1.000 USGPM
Artesian Flow:
Artesian Pressure:
Method of determining elevation: GPS

Well Cap: NOT PROVIDED
Well Disinfected: Yes
Drilling Method: Air Rotary
Orientation of Well: vertical

Lithology

From (ft bgl)	To (ft bgl)	Raw Data	Description	Moisture	Colour	Hardness	Observations	Water Bearing Flow Estimate (USGPM)
0.00	32.00	CLAY AND ROCKS			grey			
32.00	155.00	BEDROCK			green			
155.00	290.00	BEDROCK			grey			1.0000
290.00	385.00	BEDROCK			green			
385.00	430.00	BEDROCK WITH QUARTZ			green			
430.00	490.00	BEDROCK			grey			

Casing Details

From (ft)	To (ft)	Casing Type	Casing Material	Diameter	Wall Thickness	Drive Shoe
0.00	33.00		Steel	6.000		Yes

Surface Seal and Backfill Details

Surface Seal Material: Bentonite clay
Surface Seal Installation Method: Poured
Surface Seal Thickness:
Surface Seal Depth:
Backfill Material Above Surface Seal:
Backfill Depth:

Liner Details

Liner Material:
Liner Diameter:
Liner from:
Liner Thickness:
Liner to:

Liner perforations

From	To
There are no records to show	

Screen Details

Intake Method:
Type:
Material:
Opening:
Bottom:

Installed Screens

From	To	Internal Diameter	Assembly Type	Slot Size
There are no records to show				

Well Development

Developed by:
Development Total Duration:

Well Yield

No well yield data available.

Well Decommission Information

Reason for Decommission:
Sealant Material:
Decommission Details:
Method of Decommission:
Backfill Material:

Comments

No comments submitted

Alternative Specs Submitted: No

Documents

No additional documentation available for this well.

Disclaimer

The information provided should not be used as a basis for making financial or any other commitments. The Government of British Columbia accepts no liability for the accuracy, availability, suitability, reliability, usability, completeness or timeliness of the data or graphical depictions rendered from the data.

Groundwater Wells and Aquifers

Well Summary

Well Tag Number: 111645
Well Identification Plate Number: 36922
Owner Name: HOLLY WORKMAN
Licensed Status: Unlicensed

Well Status: New
Well Class: Water Supply
Well Subclass:
Intended Water Use:

Observation Well Number:
Observation Well Status:
Environmental Monitoring System (EMS) ID:
Aquifer Number: 93
Alternative specs submitted: No

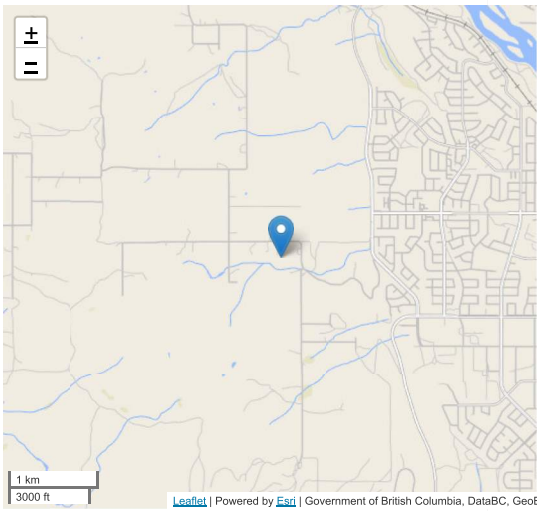
Location Information

Street Address: 5451 CRANBROOK HILL ROAD
Town/City: PRINCE GEORGE

Legal Description:

Lot	
Plan	
District Lot	
Block	
Section	
Township	
Range	
Land District	
Property Identification Description (PID)	

Description of Well Location: NOT PROVIDED



Geographic Coordinates - North American Datum of 1983 (NAD 83)
Latitude: 53.9162
Longitude: -122.83505
UTM Easting: 510834
UTM Northing: 5974211
Zone: 10
Location Accuracy Code:

Well Activity

Activity Type	Work Start Date	Work End Date	Drilling Company
There are no records to show			

Well Completion Data

Total Depth Drilled:
Finished Well Depth: 570.00 feet
Final Casing Stick Up: 18.000 inches
Depth to Bedrock: 52.00 feet
Ground elevation: 2570.00

Static Water Level (BTOC): 110.00 feet
Estimated Well Yield:
Artesian Flow:
Artesian Pressure:
Method of determining elevation: GPS

Well Cap: NOT PROVIDED
Well Disinfected: Yes
Drilling Method: Air Rotary
Orientation of Well: vertical

Lithology

From (ft bgl)	To (ft bgl)	Raw Data	Description	Moisture	Colour	Hardness	Observations	Water Bearing Flow Estimate (USGPM)
0.00	21.00	CLAY			brown			
21.00	52.00	CLAY AND ROCKS			brown			
52.00	185.00	BEDROCK			green			
185.00	345.00	BEDROCK WITH QUARTZ			green			1.0000
345.00	415.00	BEDROCK			grey			
415.00	470.00	BEDROCK			green			

From (ft bgl)	To (ft bgl)	Raw Data	Description	Moisture	Colour	Hardness	Observations	Water Bearing Flow Estimate (USGPM)
470.00	515.00	BEDROCK WITH QUARTZ			black			
515.00	570.00	BEDROCK WITH QUARTZ			green			

Casing Details

From (ft)	To (ft)	Casing Type	Casing Material	Diameter	Wall Thickness	Drive Shoe
0.00	55.00		Steel	6.000		Yes

Surface Seal and Backfill Details

Surface Seal Material: Bentonite clay
Surface Seal Installation Method: Poured
Surface Seal Thickness: 1.50
Surface Seal Depth:
Backfill Material Above Surface Seal:
Backfill Depth:

Liner Details

Liner Material:
Liner Diameter:
Liner from:
Liner Thickness:
Liner to:

Liner perforations

From	To
There are no records to show	

Screen Details

Intake Method:
Type:
Material:
Opening:
Bottom:

Installed Screens

From	To	Internal Diameter	Assembly Type	Slot Size
There are no records to show				

Well Development

Developed by:
Development Total Duration:

Well Yield

No well yield data available.

Well Decommission Information

Reason for Decommission:
Sealant Material:
Decommission Details:
Method of Decommission:
Backfill Material:

Comments

SFC SEAL THICKNESS AND STICK-UP PROVIDED BY DRILLER VIA EMAIL

Alternative Specs Submitted: No

Documents

No additional documentation available for this well.

Disclaimer