TETRA TECH

TECHNICAL MEMO

ISSUED FOR USE

To:	Michelle Klaben, YG Project Manager	**Date:**	March 31, 2023
c:		**Memo No.:**	003
From:	Stephan Klump, TT Project Manager Julianna Hogenson, TT, Field Scientist	**File:**	704-ENW.GENV03329-01
Subject:	Monitoring Well Installation, McConnell Lake, Yukon		

1.0 INTRODUCTION

Tetra Tech Canada Inc. (Tetra Tech) was retained by the Government of Yukon (YG) to complete a hydrological assessment to determine the reason for overland flooding in recent years and to develop potential high-level mitigation options. Several residences in the Hamlet of Mount Lorne are severely affected by annually re-occurring flooding during freshet in the area of McConnell Lake near Annie Lake Road, Yukon.

This technical memorandum includes the installation of monitoring wells at three locations to the east of McConnell Lake to assess the shallow subsurface conditions in the area that may be related to the re-occurring flooding.

A hydrological assessment of the McConnell Lake area is reported under separate cover.

2.0 INSTALLATION OF MONITORING WELLS

Prior to mobilizing a drill rig to install monitoring wells in the area to the east of McConnell Lake, Arcrite Northern Ltd. (Arcrite) was retained to clear all proposed drilling locations of the presence of any underground utilities. Clearance was obtained from Arcrite on October 21, 2022. In addition, clearance was also obtained from Northwestel Inc. and Atco Electric Yukon.

Tetra Tech oversaw the installation of three (3) groundwater monitoring wells within the project area to assess the subsurface conditions and monitor groundwater elevations using dataloggers. The monitoring wells were designed to provide information needed to support the hydrological assessment of the McConnell area. In addition, the borehole logs provide pertinent information on the shallow subsurface conditions which may also be required to support the selection of future mitigation options.

The monitoring wells were drilled using a small track-mounted auger drill operated by Midnight Sun Drilling Inc of Whitehorse, Yukon on October 25-27, 2022. The monitoring wells were completed as shallow 50 mm (2-inch) diameter monitoring wells with polyvinyl chloride (PVC) standpipes. At all three locations, shallow saturated sand was encountered to a depth of about 2 to 3 m, overlying a silt and clay layer, typically more than 15 m thick. The continuous, thick silt and clay unit prevents shallow water from infiltrating deeper into the ground and hence, contributes to the flooding issues noted at the site.

Figure A details the location of the wells. Table A includes details on the boreholes and monitoring wells installed. Well logs are included in Appendix B.

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The monitoring wells were developed on November 16, 2022 prior to collecting water samples on November 17, 2022. The water samples were provided to the Water Resources Branch, Government of Yukon for analysis outside of the scope of this project.

Field parameters were obtained using a YSI Professional Plus field meter. Field parameters recorded at each sample site included:

- Water temperature (°C)
- Dissolved oxygen (mg/L)
- Electrical Conductivity (µS/cm)
- pH (pH units)
- Oxidation-reduction potential (ORP; mV)

The YSI meter was calibrated each field day and checked before each site visit to ensure field measurements were accurate.

Field notes, including the measured field parameters, are appended to this memo in Appendix C.

Table A: Drilling and Monitoring Well Details

Well ID	UTM Coordinates NAD83, Zone 8		Stick-up	Depth to Bottom	Screen Length	Depth to Water
	Easting	Northing	m ag	m bg	m	m bg
MW22-01s	505853	6700079	0.89	2.30	1.52	1.31
MW22-01d	505850	6700083	0.77	14.89	3.03	9.75
MW22-02	506139	6701688	0.91	1.80	1.20	0.77
MW22-03	507634	6703039	0.92	2.60	1.90	2.27
BH22-03d	507634	6703039	-	15.24	-	-

Notes:
m ag – metres above ground surface
m bg – metres below ground surface

Pressure transducers with dataloggers (Solinst Levelogger Series 5 LTC) were installed in each monitoring well to continuously monitor groundwater elevations (see Table 1).

Figure A: Monitoring wells installed in the flood-prone areas to the east of McConnell Lake.

3.0 RESULTS AND CONCLUSIONS

At all three drilling locations, Tetra Tech found a shallow aquifer with a bottom depth of about two to three metres below ground surface, followed by at least about 15 m of glaciolacustrine silt and clay with a low hydraulic conductivity.

The shallow aquifer has a very limited thickness and therefore, limited opportunity to receive excess surface water. This promotes the flooding of the area during spring freshet when a significant volume of surface water occurs. The absence of an outflow from McConnell Lake and no direct access to a creek or river further favours flood occurrence throughout the area of concern.

Based on the conditions encountered, the possibility of using infiltration wells or galleries to divert the flood water into the subsurface is unlikely to be a viable option. Based on the surrounding topography it is very probable that

groundwater underneath the glaciolacustrine silt and clay layer is confined and unable to receive a significant additional water volume of diverted flood water.

4.0 LIMITATIONS OF REPORT

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5.0 CLOSURE

We trust this report meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,
Tetra Tech Canada Inc.

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TABLES

Table 1: Monitoring Wells and Dataloggers

Well ID	UTM Coordinates NAD83, Zone 8		Stick-up	Depth to Bottom	Depth to Water (December 8, 2022)	Time of Depth to Water Measurement	Logger Serial Number
	Easting	Northing	m	m below TOC [1]	m below TOC [1]		
MW22-01s	505853	6700079	0.89	3.00	2.20	9:45 AM	1091391
MW22-01d	505850	6700083	0.77	14.86	10.52	9:30 AM	2162866 (Barologger)
MW22-02	506139	6701688	0.91	2.71	1.68	10:20 AM	1091395
MW22-03	507634	6703039	0.92	3.44	2.27	10:52 AM	1091474

NOTES:

[1] TOC - top of casing. Measured from the marking at the top of the PVC pipe

APPENDIX A

LIMITATIONS ON THE USE OF THIS DOCUMENT

LIMITATIONS ON USE OF THIS DOCUMENT

GEOENVIRONMENTAL

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1.4 DISCLOSURE OF INFORMATION BY CLIENT

The Client acknowledges that it has fully cooperated with TETRA TECH with respect to the provision of all available information on the past, present, and proposed conditions on the site, including historical information respecting the use of the site. The Client further acknowledges that in order for TETRA TECH to properly provide the services contracted for in the Contract, TETRA TECH has relied upon the Client with respect to both the full disclosure and accuracy of any such information.

1.5 INFORMATION PROVIDED TO TETRA TECH BY OTHERS

During the performance of the work and the preparation of this Professional Document, TETRA TECH may have relied on information provided by third parties other than the Client.

While TETRA TECH endeavours to verify the accuracy of such information, TETRA TECH accepts no responsibility for the accuracy or the reliability of such information even where inaccurate or unreliable information impacts any recommendations, design or other deliverables and causes the Client or an Authorized Party loss or damage.

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This Professional Document is based solely on the conditions presented and the data available to TETRA TECH at the time the data were collected in the field or gathered from available databases.

The Client, and any Authorized Party, acknowledges that the Professional Document is based on limited data and that the conclusions, opinions, and recommendations contained in the Professional Document are the result of the application of professional judgment to such limited data.

The Professional Document is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the site conditions present, or variation in assumed conditions which might form the basis of design or recommendations as outlined in this report, at or on the development proposed as of the date of the Professional Document requires a supplementary exploration, investigation, and assessment.

TETRA TECH is neither qualified to, nor is it making, any recommendations with respect to the purchase, sale, investment or development of the property, the decisions on which are the sole responsibility of the Client.

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In certain instances, the discovery of hazardous substances or conditions and materials may require that regulatory agencies and other persons be informed and the client agrees that notification to such bodies or persons as required may be done by TETRA TECH in its reasonably exercised discretion.

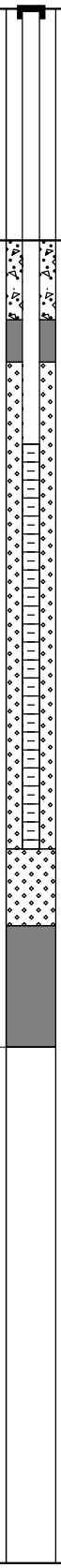
APPENDIX B

BOREHOLE LOGS

Borehole No: **22MW01s**

Project: Hydrological Assessment	Project No: ENW.GENV03329-01
Location: Annie Lake Road	
McConnell Lake, Yukon	UTM: 505853 E; 6700079 N; Z 8

Depth (m)	Method	Soil Description	Notes and Comments
0			
	Solid and hollow stem auger	SAND - trace gravel, medium to coarse grained sand, trace fine grained sand, fine grained gravel to 20 mm diameter, damp, medium brown, no discernible odour	Pipe stickup = 0.89 metres
		- moist	
1		- wet to very wet	
Dec8/22 ▼			
2		SILT - clayey, moist to wet, stiff to very stiff, medium brown, trace oxide staining	
3		END OF BOREHOLE (3.05 metres) water - 1.31 metres on December 8, 2022 Monitoring well installed to 2.30 metres	
4			
5			



Depth (ft): 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16

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Contractor: Midnight Sun Drilling	Completion Depth: 3.05 m
Equipment Type: Track mounted	Start Date: 2022 October 25
Logged By: JH	Completion Date: 2022 October 25
Reviewed By:	Page 1 of 1

Borehole No: **22MW01d**

Project: Hydrological Assessment	Project No: ENW.GENV03329-01
Location: Annie Lake Road	
McConnell Lake, Yukon	UTM: 505850 E; 6700083 N; Z 8

Depth (m)	Method	Soil Description	Notes and Comments	Depth (ft)
0	Solid and hollow stem auger	SAND - trace gravel, trace silt, medium to coarse grained sand, gravel to 15 mm diameter, moist, loose, medium brown	Pipe stickup = 0.77 metres	0
		- damp to moist		1
1		- wet to very wet		2
				3
				4
				5
				6
2		SILT - clayey, trace sand, damp to moist, dense, medium plastic, medium brown, trace oxides		7
				8
				9
3		- damp		10
				11
				12
		- 100 mm thick sand layer - trace gravel, medium grained sand, gravel to 10 mm diameter, damp to moist		13
4				14
				15
		- moist, stiff to very stiff, medium plastic, grey, trace black streaks		16
5				

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Contractor: Midnight Sun Drilling	Completion Depth: 15.24 m
Equipment Type: Track mounted	Start Date: 2022 October 25
Logged By: JH	Completion Date: 2022 October 25
Reviewed By:	Page 1 of 4

Borehole No: **22MW01d**

Project: Hydrological Assessment	Project No: ENW.GENV03329-01
Location: Annie Lake Road	
McConnell Lake, Yukon	UTM: 505850 E; 6700083 N; Z 8

Depth (m)	Method	Soil Description	Notes and Comments	22MW01d	Depth (ft)
5		- moist to wet			17
					18
		- moist, stiff			19
6					20
					21
					22
		- moist to wet, very soft			
7	Solid and hollow stem auger				23
					24
					25
		- 100 mm thick sand lens - moist, grey to medium brown			
8		- moist			26
		- moist to wet			27
					28
					29
9		- 5 mm thick sand lens - medium grained sand, brown			
		- alternating 100 mm thick clay and sand lenses for 400 mm			30
					31
Dec8/22					Dec8/22 32
10					

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Contractor: Midnight Sun Drilling	Completion Depth: 15.24 m
Equipment Type: Track mounted	Start Date: 2022 October 25
Logged By: JH	Completion Date: 2022 October 25
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Borehole No: **22MW01d**

Project: Hydrological Assessment	Project No: ENW.GENV03329-01
Location: Annie Lake Road	
McConnell Lake, Yukon	UTM: 505850 E; 6700083 N; Z 8

Depth (m)	Method	Soil Description	Notes and Comments	22MW01d	Depth (ft)
10	Solid and hollow stem auger	- moist to wet			33
					34
					35
11		- moist, stiff, trace black streaks, trace oxides			36
					37
					38
					39
12		- moist to wet			40
					41
					42
		- moist			
13		- moist to wet			43
					44
					45
					46
14					47
					48
15					49

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Contractor: Midnight Sun Drilling	Completion Depth: 15.24 m
Equipment Type: Track mounted	Start Date: 2022 October 25
Logged By: JH	Completion Date: 2022 October 25
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Borehole No: **22MW01d**

Project: Hydrological Assessment	Project No: ENW.GENV03329-01
Location: Annie Lake Road	
McConnell Lake, Yukon	UTM: 505850 E; 6700083 N; Z 8

Depth (m)	Method	Soil Description	Notes and Comments	22MW01d	Depth (ft)
15					50
		END OF BOREHOLE (15.24 metres) slough - 14.89 metres at 0 hrs. water - 9.75 metres on December 8, 2022 Monitoring well installed to 14.89 metres			51
16					52
					53
					54
					55
17					56
					57
					58
18					59
					60
					61
19					62
					63
					64
					65
20					

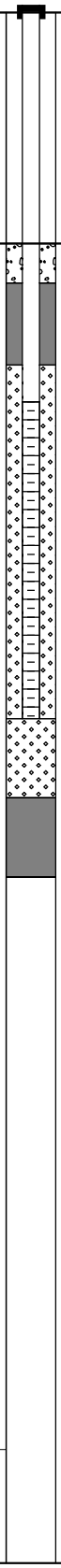
TETRA TECH

Contractor: Midnight Sun Drilling	Completion Depth: 15.24 m
Equipment Type: Track mounted	Start Date: 2022 October 25
Logged By: JH	Completion Date: 2022 October 25
Reviewed By:	Page 4 of 4

Borehole No: **22MW02**

Project: Hydrological Assessment	Project No: ENW.GENV03329-01
Location: Annie Lake Road	
McConnell Lake, Yukon	UTM: 506139 E; 6701688 N; Z 8

Depth (m)	Method	Soil Description	Notes and Comments
0			
	Solid stem auger	SAND - trace gravel, medium to coarse grained sand, gravel to 15 mm diameter, moist to wet, brown - no visible gravel, fine to medium grained sand, well graded, wet, light brown to orange - orange oxidation staining	Pipe stickup = 0.91 metres
1		- very wet Dec8/22 ▼	
2		SILT - some clay, trace sand, fine grained sand, moist, low plastic, brown, no to trace oxides - moist to wet	
3		SAND - some silt, fine to medium grained sand, well graded, wet, brown	
		SILT - clayey, trace sand, moist, stiff, medium plastic, grey, black streaks wet - moist to wet	
4			
		END OF BOREHOLE (4.57 metres) water - 0.77 metres on December 8, 2022 Monitoring well installed to 1.80 metres Note: Backfilled hole and moved 1.00 metre to installed monitoring well	
5			



Depth (ft): 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16

TETRA TECH	Contractor: Midnight Sun Drilling	Completion Depth: 4.57 m
	Equipment Type: Track mounted	Start Date: 2022 October 26
	Logged By: JH	Completion Date: 2022 October 26
	Reviewed By:	Page 1 of 1

Borehole No: **22MW03**

Project: Hydrological Assessment	Project No: ENW.GENV03329-01
Location: Annie Lake Road	
McConnell Lake, Yukon	UTM: 507634 E; 6703039 N; Z 8

Depth (m)	Method	Soil Description	Notes and Comments	Depth (ft)
0	Solid stem auger	SAND AND SILT - trace clay, trace gravel, trace black organics, medium grained sand, gravel to 15 mm dimeter, moist to wet, loose, non plastic, brown	Pipe stickup = 0.92 metres	0
		SAND - medium to coarse grained, wet, brown, trace oxide staining - very wet		1
1				2
				3
				4
Dec8/22		- mostly coarse grained sand		Dec8/22
		SILT - clayey, trace sand, fine grained sand, moist, stiff, medium plastic, brown - medium to coarse grained sand, wet		5
2				6
		SAND - medium to coarse grained, wet, brown, trace oxide staining		7
				8
		SILT - clayey, trace sand, fine grained sand, moist, stiff, medium plastic, brown		9
3				10
				11
		- some clay for 50 mm		12
4				13
		- 80 mm thick moist medium grained sand lens		14
				15
		END OF BOREHOLE (4.57 metres) water - 1.35 metres on December 8, 2022 Monitoring well installed to 2.60 metres		16
5				

Contractor: Midnight Sun Drilling	Completion Depth: 4.57 m
Equipment Type: Track mounted	Start Date: 2022 October 27
Logged By: JH	Completion Date: 2022 October 27
Reviewed By:	Page 1 of 1

Borehole No: **22BH03d**

Project: Hydrological Assessment	Project No: ENW.GENV03329-01
Location: Annie Lake Road	
McConnell Lake, Yukon	UTM: 507634 E; 6703039 N; Z 8

Depth (m)	Method	Soil Description	Notes and Comments	Backfill	Depth (ft)
0					0
	Solid stem auger	SAND AND SILT - clay, organics, fine grained sand, moist, orange and black, oxides staining, (300 mm thick)			
		SAND - some silt, trace gravel, fine to medium grained sand, gravel to 15 mm diameter, moist			
		- moist to wet, orangish brown			
1		- no visible gravel, medium to coarse grained sand, trace oxides - wet			1
					2
					3
					4
					5
2					6
					7
					8
		SILT - clayey, trace sand, fine grained sand, moist, stiff, medium plastic, brown			
		SAND - some silt, trace gravel, fine to medium grained sand, gravel to 15 mm diameter, moist			9
3					10
		- moist to wet, firm			11
		- moist, stiff			12
		SILT - clayey, trace sand, fine grained sand, moist, stiff, medium plastic, brown			
4					13
		- grey, trace black streaks			14
		- moist to wet, firm			15
					16
5					

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Contractor: Midnight Sun Drilling	Completion Depth: 15.24 m
Equipment Type: Track mounted	Start Date: 2022 October 27
Logged By: JH	Completion Date: 2022 October 27
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Borehole No: **22BH03d**

Project: Hydrological Assessment	Project No: ENW.GENV03329-01
Location: Annie Lake Road	
McConnell Lake, Yukon	UTM: 507634 E; 6703039 N; Z 8

Depth (m)	Method	Soil Description	Notes and Comments	Backfill	Depth (ft)
5					17
					18
					19
6		- moist, stiff			20
					21
		- moist to wet, firm			22
7					23
	Solid stem auger	- moist, stiff			24
					25
					26
8		- moist to wet, firm			27
					28
		- moist, stiff			29
9					30
					31
					32
10					

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Contractor: Midnight Sun Drilling	Completion Depth: 15.24 m
Equipment Type: Track mounted	Start Date: 2022 October 27
Logged By: JH	Completion Date: 2022 October 27
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Borehole No: **22BH03d**

Project: Hydrological Assessment	Project No: ENW.GENV03329-01
Location: Annie Lake Road	
McConnell Lake, Yukon	UTM: 507634 E; 6703039 N; Z 8

Depth (m)	Method	Soil Description	Notes and Comments	Backfill	Depth (ft)
10	Solid stem auger	- moist to wet, firm - moist, stiff - moist to wet, firm - moist, stiff - moist to wet, firm - moist, stiff			33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49
11					
12					
13					
14					
15					

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Contractor: Midnight Sun Drilling	Completion Depth: 15.24 m
Equipment Type: Track mounted	Start Date: 2022 October 27
Logged By: JH	Completion Date: 2022 October 27
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Borehole No: **22BH03d**

Project: Hydrological Assessment	Project No: ENW.GENV03329-01
Location: Annie Lake Road	
McConnell Lake, Yukon	UTM: 507634 E; 6703039 N; Z 8

Depth (m)	Method	Soil Description	Notes and Comments	Backfill	Depth (ft)
15					50
		END OF BOREHOLE (15.24 metres) slough - 1.22 metres at 0 hrs. Note: Backfilled at completion			51
					52
16					53
					54
					55
17					56
					57
					58
18					59
					60
					61
19					62
					63
					64
					65
20					

Contractor: Midnight Sun Drilling	Completion Depth: 15.24 m
Equipment Type: Track mounted	Start Date: 2022 October 27
Logged By: JH	Completion Date: 2022 October 27
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APPENDIX C

FIELD NOTES

Groundwater Purge and Sample Form

WELL ID.: 22MW015 | PROJECT NO.: 704-ENVGENV03329.01
SITE: Annie Lake Rd | FIELD PERSONNEL: JH, EH
WEATHER: Cloudy | DATE & TIME SAMPLED: ~~Nov~~ Nov 17/22
TEMPERATURE: -12°C | GPS LOCATION: N: 6700079 E: 505853 Zone: 08V (Map datum NAD83)

Is well ID visible? ☒ Yes ☐ No | Is seal intact? ☒ Yes ☐ No | Is lid/j-plug in place/working? ☒ Yes ☐ No
Is well locked? ☐ Yes ☒ No | General well condition - list any damage, pooled water around well etc.:
Well Casing Inner Diameter (mm) 51

Depth to Water Below Top of Casing (A):	2.105 (metres)	Depth to Product Below Top of Casing:	(metres)
Depth to Bottom of Well Below Top of Casing (B):	3.015 (metres)	Product Thickness:	(metres)
Depth to Ground Below Top of Casing (stand-up):	0.89 (metres)	☐ LNAPL ☐ DNAPL Colour/Odour:	
Screen Interval (if known)	(m bTOC)	Confirmed by: ☐ Bailer ☒ Interface Probe	

FIELD EQUIPMENT
Field Meters Calibrated: YSI | Calibration Reference: pH, ORP, SPC

Pump:	☐ none	☐ Waterra	☐ Submersible	☒ Peristaltic	☐ Bladder
Bailer:	☒ none		☐ Stainless Steel	☐ Teflon	☐ PVC
Filter:	☐ none		☒ In-line	☐ Syringe	☐ Other (i.e. vacuum)
Equipment left in well:	☐ none		☐ Bailer	☒ Waterra	☐ Other

WELL PURGING
Purge Volumes

Casing In. Diam. (mm)	38	51	78	100	150
Vol (L/m of casing)* (C)	1.1	2.0	4.5	7.9	17.7

*double for filter pack

One well volume ((B – A) * C): litres
Purge volume to aim for: litres
or until parameters stabilize: ✓
Pump inlet depth (m bTOC): ~2.7m (m bTOC)

TIME	PURGE RATE (L/min)	VOLUME REMOVED (L)	TEMP (°C)	pH (UNITS)	COND. (uS/cm)	Redox (mV)	DIS.O_2 (mg/L) or %	Water Level (m bTOC)	REMARKS (colour, odour, sheen, brittle film, silt content, etc.)
Stabilisation Criteria			+/- 0.5	+/-0.1	+/- 5%		0.2mg/L or +/- 10%	+/- 0.1m if low flow	Visual observations (colour, turbidity, odour etc should be stable)
10:48		0.40	2.6	8.58	7270	-67.0	4.73	2.115	- med. turbidity - Brown
10:47		0.90	1.8	7.33	1958	-14.1	2.01	2.118	to orange No odor
10:52		1.4	2.0	7.07	1800	7.8	1.42	2.121	
10:57		1.9	1.8	6.85	1762	28.3	1.60	2.124	
11:02		2.4	1.9	6.80	1746	39.7	1.67	2.127	
11:07		2.9	2.0	6.78	1742	42.1	1.51	2130	
11:12		3.4	2.6	6.77	1740	44.2	1.58	2.133	- Slight less turbid Brown to orange

SAMPLING Water Odour: ☒ No ☐ Yes (describe) | Sheen ☒ No ☐ Yes (describe)
Turbidity: _____ NTU or relative scale (circle as appropriate): Clear (1) (2) 3 4 5 6 7 8 9 10 Very Silty

QA/QC Sample/s - ☐ Yes ☒ No | **QA/QC Type and ID –**

Other (comments, notes, observations, recovery if well dried up, headspace measurements):

Groundwater Purge and Sample Form

WELL ID.: 22MW01d
SITE: Annelake
WEATHER: Cloudy
TEMPERATURE: -12°C
PROJECT NO.: 209-ENVGEN03208-01
FIELD PERSONNEL: JN, EH
DATE & TIME SAMPLED: Nov 17/22
GPS LOCATION: N: 6700083 E: 505870 Zone: 09V (Map datum NAD83)

Is well ID visible? ☒ Yes ☐ No Is seal intact? ☒ Yes ☐ No Is lid/j-plug in place/working? ☒ Yes ☐ No
Is well locked? ☐ Yes ☒ No General well condition - list any damage, pooled water around well etc.:
Well Casing Inner Diameter (mm) 51

Depth to Water Below Top of Casing (A):	10.650	(metres)	Depth to Product Below Top of Casing: (metres)
Depth to Bottom of Well Below Top of Casing (B):	15.176	(metres)	Product Thickness: (metres)
Depth to Ground Below Top of Casing (stand-up):	0.77	(metres)	☐ LNAPL ☐ DNAPL Colour/Odour:
Screen Interval (if known)		(m bTOC)	Confirmed by: ☐ Bailer ☒ Interface Probe

FIELD EQUIPMENT

Field Meters Calibrated: YSI Calibration Reference: pH, ORP, SPC

Pump:	☒ none	☒ hand Waterra	☐ Submersible	☐ Peristaltic	☐ Bladder
Bailer:	☐ none		☐ Stainless Steel	☐ Teflon	☐ PVC
Filter:	☐ none		☒ In-line	☐ Syringe	☐ Other (i.e. vacuum)
Equipment left in well:	☐ none		☐ Bailer	☒ Waterra	☐ Other

WELL PURGING

Purge Volumes

Casing In. Diam. (mm)	38	51	78	100	150
Vol (L/m of casing)* (C)	1.1	2.0	4.5	7.9	17.7

*double for filter pack

One well volume ((B – A) * C): 9.048 litres
Purge volume to aim for: 27.144 litres
or until parameters stabilize:
Pump inlet depth (m bTOC): (m bTOC)

TIME	PURGE RATE (L/min)	VOLUME REMOVED (L)	TEMP (°C)	pH (UNITS)	COND. (uS/cm)	Redox (mV)	DIS.O2 (mg/L) or %	Water Level (m bTOC)	REMARKS (colour, odour, sheen, brittle film, silt content, etc.)
Stabilisation Criteria			+/- 0.5	+/-0.1	+/- 5%		0.2mg/L or +/- 10%	+/- 0.1m if low flow	Visual observations (colour, turbidity, odour etc should be stable)
14:35			1.4	7.42	2.07	105.4	7.56		- very turbid, high sus. sed. - brown-grey colour, no odour

SAMPLING Water Odour: ☒ No ☐ Yes (describe) Sheen ☒ No ☐ Yes (describe)
Turbidity: NTU or relative scale (circle as appropriate): Clear 1 2 3 4 5 6 7 8 9 10 Very Silty

QA/QC Sample/s - ☐ Yes ☒ No QA/QC Type and ID –

Other (comments, notes, observations, recovery if well dried up, headspace measurements):

10:20 - Purged ~ 9-10L of very turbid, high sus. sed., brown-grey water - No odor - Ran dry
- Very slow Recharge, will return end of day.
14:30 depth to water: 11.614 m bTOC

Groundwater Purge and Sample Form

WELL ID.: 22MW02 | PROJECT NO.: 704-ENV. GENVD 8329-0
SITE: Annie Lake Rd | FIELD PERSONNEL: JH, EH
WEATHER: overcast | DATE & TIME SAMPLED: Nov 17/22
TEMPERATURE: ~12 °C | GPS LOCATION: N: 6701688 E: 506139 Zone: 08V Map datum NAD83

Is well ID visible? ☒ Yes ☐ No | Is seal intact? ☒ Yes ☐ No | Is lid/j-plug in place/working? ☒ Yes ☐ No
Is well locked? ☐ Yes ☒ No | General well condition - list any damage, pooled water around well etc.:
Well Casing Inner Diameter (mm) 51

Depth to Water Below Top of Casing (A):	1.605 (metres)	Depth to Product Below Top of Casing:	(metres)
Depth to Bottom of Well Below Top of Casing (B):	3.166 (metres)	Product Thickness:	(metres)
Depth to Ground Below Top of Casing (stand-up):	0.905 (metres)	☐ LNAPL ☐ DNAPL	Colour/Odour:
Screen Interval (if known)	(m bTOC)	Confirmed by: ☐ Bailer ☒ Interface Probe	

FIELD EQUIPMENT
Field Meters Calibrated: YST | Calibration Reference: pH, SPC, ORP

Pump:	☐ none	☐ Waterra	☐ Submersible	☒ Peristaltic	☐ Bladder
Bailer:	☒ none		☐ Stainless Steel	☐ Teflon	☐ PVC
Filter:	☐ none		☒ In-line	☐ Syringe	☐ Other (i.e. vacuum)
Equipment left in well:	☐ none		☐ Bailer	☒ Waterra	☐ Other

WELL PURGING
Purge Volumes

Casing In. Diam. (mm)	38	51	78	100	150
Vol (L/m of casing)* (C)	1.1	2.0	4.5	7.9	17.7

*double for filter pack

One well volume ((B – A) * C): litres
Purge volume to aim for: litres
or until parameters stabilize: ✓
Pump inlet depth (m bTOC): ~2.5 (m bTOC)

TIME	PURGE RATE (L/min)	VOLUME REMOVED (L)	TEMP (°C)	pH (UNITS)	COND. (uS/cm)	Redox (mV)	DIS.O2 (mg/L) or %	Water Level (m bTOC)	REMARKS (colour, odour, sheen, brittle film, silt content, etc.)
Stabilisation Criteria			+/- 0.5	+/-0.1	+/- 5%		0.2mg/L or +/- 10%	+/- 0.1m if low flow	Visual observations (colour, turbidity, odour etc should be stable)
12:15		0.3 L	0.9	7.26	1807	-36.7	3.86	1.634	- med turbidity, Brownto
12:20		0.7L	0.7	6.84	1729	-30.5	2.40	1.635	orange, NO odor,
12:25		1.1	0.6	6.72	1747	-20.6	2.03	1.635	some sus. sed.
12:30		1.5	0.5	6.59	1745	-7.0	1.91	1.636	
12:35		1.9	0.5	6.53	1745	-0.08	2.40	1.636	
12:40		2.4	0.4	6.52	1739	-4.1	3.41	1.637	
12:45		2.9	0.5	6.50	1732	6.1	3.52	1.638	- less turbid, sl. silt some orange/Brown

SAMPLING Water Odour: ☒ No ☐ Yes (describe) | Sheen ☒ No ☐ Yes (describe)
Turbidity: NTU or relative scale (circle as appropriate): Clear 1 2 3 4 5 6 7 8 9 10 Very Silty

QA/QC Sample/s - ☐ Yes ☒ No | **QA/QC Type and ID –**

Other (comments, notes, observations, recovery if well dried up, headspace measurements):

Groundwater Purge and Sample Form

WELL ID.: 22MW03 | PROJECT NO.: 704-ENV.GENV03529-01
SITE: Annie Lake Rd | FIELD PERSONNEL: JH
WEATHER: Overcast | DATE & TIME SAMPLED: Nov 17/22
TEMPERATURE: -12°C | GPS LOCATION: N: 6703039 E: 507634 Zone: 08V (Map datum NAD83)

Is well ID visible? ☒ Yes ☐ No | Is seal intact? ☒ Yes ☐ No | Is lid/j-plug in place/working? ☒ Yes ☐ No
Is well locked? ☐ Yes ☒ No | General well condition - list any damage, pooled water around well etc.:
Well Casing Inner Diameter (mm) 51

Depth to Water Below Top of Casing (A):	1.923	(metres)	Depth to Product Below Top of Casing: (metres)
Depth to Bottom of Well Below Top of Casing (B):	3.402	(metres)	Product Thickness: (metres)
Depth to Ground Below Top of Casing (stand-up):	0.915	(metres)	☐ LNAPL ☐ DNAPL Colour/Odour:
Screen Interval (if known)		(m bTOC)	Confirmed by: ☐ Bailer ☒ Interface Probe

FIELD EQUIPMENT
Field Meters Calibrated: YSI | Calibration Reference: pH, ORP, SPC

Pump:	☐ none	☐ Waterra	☐ Submersible	☒ Peristaltic	☐ Bladder
Bailer:	☒ none		☐ Stainless Steel	☐ Teflon	☐ PVC
Filter:	☐ none		☒ In-line	☐ Syringe	☐ Other (i.e. vacuum)
Equipment left in well:	☐ none		☐ Bailer	☒ Waterra	☐ Other

WELL PURGING
Purge Volumes

Casing In. Diam. (mm)	38	51	78	100	150
Vol (L/m of casing)* (C)	1.1	2.0	4.5	7.9	17.7

*double for filter pack

One well volume ((B – A) * C): litres
Purge volume to aim for: litres
or until parameters stabilize: ✓
Pump inlet depth (m bTOC): ~3.1 (m bTOC)

TIME	PURGE RATE (L/min)	VOLUME REMOVED (L)	TEMP (°C)	pH (UNITS)	COND. (uS/cm)	Redox (mV)	DIS.O2 (mg/L) or %	Water Level (m bTOC)	REMARKS (colour, odour, sheen, brittle film, silt content, etc.)
Stabilisation Criteria			+/- 0.5	+/-0.1	+/- 5%		0.2mg/L or +/- 10%	+/- 0.1m if low flow	Visual observations (colour, turbidity, odour etc should be stable)
13:41		0.6	1.9	7.78	298.4	-56.1	12.15	1.929	- mod very turbid,
13:46		1.1	1.4	7.70	276.8	-28.8	11.73	1.938	orangey Brown, high
13:51		1.6	1.6	7.61	265.5	-12.3	11.78	1.937	Sus. Sed, No odor
13:56		2.1	1.6	7.58	263.6	-1.1	11.77	1.940	
14:01		2.6	1.5	7.55	260.1	5.4	11.61	1.943	
14:06		3.1	1.4	7.55	253.2	10.5	11.36	1.947	
14:11		3.6	1.5	7.51	252.4	16.2	11.20	1.950	- less turbid, less tanned orange/Brown

SAMPLING Water Odour: ☒ No ☐ Yes (describe) | Sheen ☒ No ☐ Yes (describe)
Turbidity: NTU or relative scale (circle as appropriate): Clear 1 (2) 3 4 5 6 7 8 9 10 Very Silty

QA/QC Sample/s - ☐ Yes ☒ No | **QA/QC Type and ID –**

Other (comments, notes, observations, recovery if well dried up, headspace measurements):
- Line frozen Beginning - Before YSI, thawed then added YSI - will monitor during sampling
- didn't freeze again.