

Serene Cachelin, Project Manager  
Stantec  
300-175 2nd Avenue  
Kamloops, BC  
V2C 5W1

**Re: HWY #3 SNASS CREEK BRIDGE (Bridge 01214) REPLACEMENT  
FACTUAL GEOTECHNICAL INVESTIGATION REPORT**

## **1.0 INTRODUCTION**

The existing Snass Creek Bridge (Bridge 01214) is approaching its design life. It was originally constructed in 1949 with additional widening in 1963. The Ministry of Transportation and Infrastructure (the Ministry) is planning to replace the existing bridge with a new bridge. In order to support the design of the proposed new bridge and required highway realignment, a subsurface geotechnical investigation has been completed by the Ministry.

This report presents the factual data obtained from the geotechnical investigation and provides a summary of the subsoil and groundwater conditions encountered.

## **2.0 SITE DESCRIPTION**

### **2.1 General**

The existing Snass Creek Bridge is located approximately 37.8 km east of Hope, BC on Hwy #3. The existing bridge is a single span structure carrying one eastbound and one westbound lane over Snass Creek. The location of the existing Bridge is shown on Figure 1 Key Plan attached in Appendix A.

### **2.2 Proposed Bridge**

Based on 50% Structural drawings, the proposed new bridge will be a single-span structure located at the same location as the existing bridge. The proposed new bridge will be designed to carry three travel lanes and the width of the proposed new bridge will be adequate for future expansion to 4 travel lanes. The alignment of the existing highway (approximately 400m on each side of the bridge) will be slightly shifted to match the wider and higher new bridge.

### **2.3 Surficial Geology**

Based on the Geological Survey of Canada Map 41-1989, sheet 1, Hope, BC, the subsoil conditions at the site are anticipated to consist of thick colluvium deposits over bedrock (PMu, Ultramafic Rock, local Gabbro).

### 3.0 GEOTECHNICAL INVESTIGATION

#### 3.1 GENERAL

In order to assess the subsoil and groundwater conditions, the Ministry completed a field geotechnical investigation program between September 20 and 23, 2018. A total of 10 test holes were completed during the site investigation, including 2 deep mud rotary bore holes and 8 shallow solid stem auger holes. The test hole locations are shown on Figure 2 Test Hole Location Plan attached in Appendix A.

All test holes were completed using a subcontracted truck mounted drill rig supplied and operated by Sea-To-Sky Drilling Ltd. of Burnaby. The mud rotary bore holes were designated as BH18-01 to BH18-02, and solid stem auger holes were designated as AH18-01 to AH18-10.

Two deep mud rotary bore holes were drilled within the proposed abutment footprints as shown on Figure 2. BH18-01 (east abutment) and BH18-02 (west abutment) were drilled to depths of 30.33m (99.5 ft.) and 29.26m (96 ft.), respectively. Standard Penetration Tests (SPTs) were conducted at regular intervals of 1.5m (5 ft.) within the mud rotary bore holes. Where obstacles (cobbles or boulders) were encountered, a Tricone drill bit was used to drill through making it necessary to skip SPTs at some depths. Once the target depths were achieved, the bore holes were terminated and backfilled using bentonite chips and sand in accordance with the *Groundwater Protection Regulation* of British Columbia.

As the Hwy #3 repaving work around the existing Snass Creek Bridge was completed a few days previous to the to the drilling, all eight (8) shallow solid stem auger holes were drilled on the paved shoulder close to the fog line to minimize disturbance. The auger holes were generally drilled to auger refusal between depths of 1.07m (3.5 ft.) and 3.66m (12 ft.). The auger holes were backfilled using the drilling spoils with cold asphalt patch at the road surface.

A summary of the completed test holes is presented in Table 1 below.

**Table 1: Summary of Geotechnical Site Investigation**

Testhole	Location (UTM Zone 10)*		Test Hole Depth (m)	Exploration Method	Location Comments
	Northing	Easting			
BH18-01	5454751	641343	30.33	Mud Rotary	Proposed East Abutment
BH18-02	5454752	641323	29.26	Mud Rotary	Proposed West Abutment
AH18-01	5454565	641158	1.98	Solid Stem Auger	
AH18-02	5454627	641183	3.05	Solid Stem Auger	
AH18-03	5454686	641209	3.05	Solid Stem Auger	
AH18-04	5454730	641251	1.07	Solid Stem Auger	
AH18-05	5454731	641411	1.37	Solid Stem Auger	
AH18-06	5454685	641458	2.29	Solid Stem Auger	
AH18-07	5454630	641477	3.66	Solid Stem Auger	
AH18-08	5454564	641486	2.74	Solid Stem Auger	

\* Please note, the UTM coordinates are approximate and derived from Google Earth 2018.

Due to the nature of the Mud Rotary drilling (using mud), the depth of the Groundwater table couldn't be located in the Mud Rotary bore holes. All the solid stem auger holes were terminated between depths of between 1.07m and 3.66m, and no groundwater was encountered in the auger holes.

### 3.2 IN-SITU TESTING

Standard Penetration Tests (SPTs) were conducted in BH18-01 and BH18-02 to evaluate the in-situ density of the subsoils as well as the soil consistency. The testing was undertaken in accordance with ASTM D1586 using an automatic trip hammer with a nominal mass of 63.5 kg (140 lb.) and a drop height of 762 mm (30 in.). The SPTs were driven to a terminus depth of 600 mm (24 in.) or effective refusal, whichever occurred first. SPT blow counts were recorded in 150 mm (6 in.) increments and are presented in the test hole logs.

Please note that the SPT N-values presented on the bore hole logs (BH18-01 and BH18-02 in Appendix B) are the field-measured values, and have not been corrected for hammer energy, overburden stress, hole diameter, sampler dimensions, or rod length.

### 3.3 LABORATORY TESTING

Representative soil samples recovered from the test holes, including samples from the SPT split spoon sampler (BH18-01 and BH18-02) and grab samples from auger flights of the solid stem auger holes were transported to the Ministry's Coquitlam office for review and visual classification. Selected soil samples were sent to Golder Associates Ltd. Burnaby Lab for routine index tests. A total of eight (8) moisture content determinations (ASTM D2216), four (4) grand size analyses (ASTM D7928), four (4) Sulphate Content determination (CSA A23.2-3B) and four (4) Chloride Content determination (ASTM C1218) were completed. The results of the laboratory tests are presented on the test hole logs in Appendix B and provided separately in Appendix C.

### 4.0 Closure

We trust this report meet your current requirements. If you have any question or comment, please contact the undersigned.

Prepared by:



Jian Zhong (James) Jin, M.Eng., P.Eng.  
Geotechnical Engineer  
Geotechnical and Materials Engineering  
MoTI, South Coast Region

Reviewed by:

Scott Cosman, P.Eng.  
Lead Geotechnical Engineer,  
Materials and Standards  
MoTI, South Coast Region

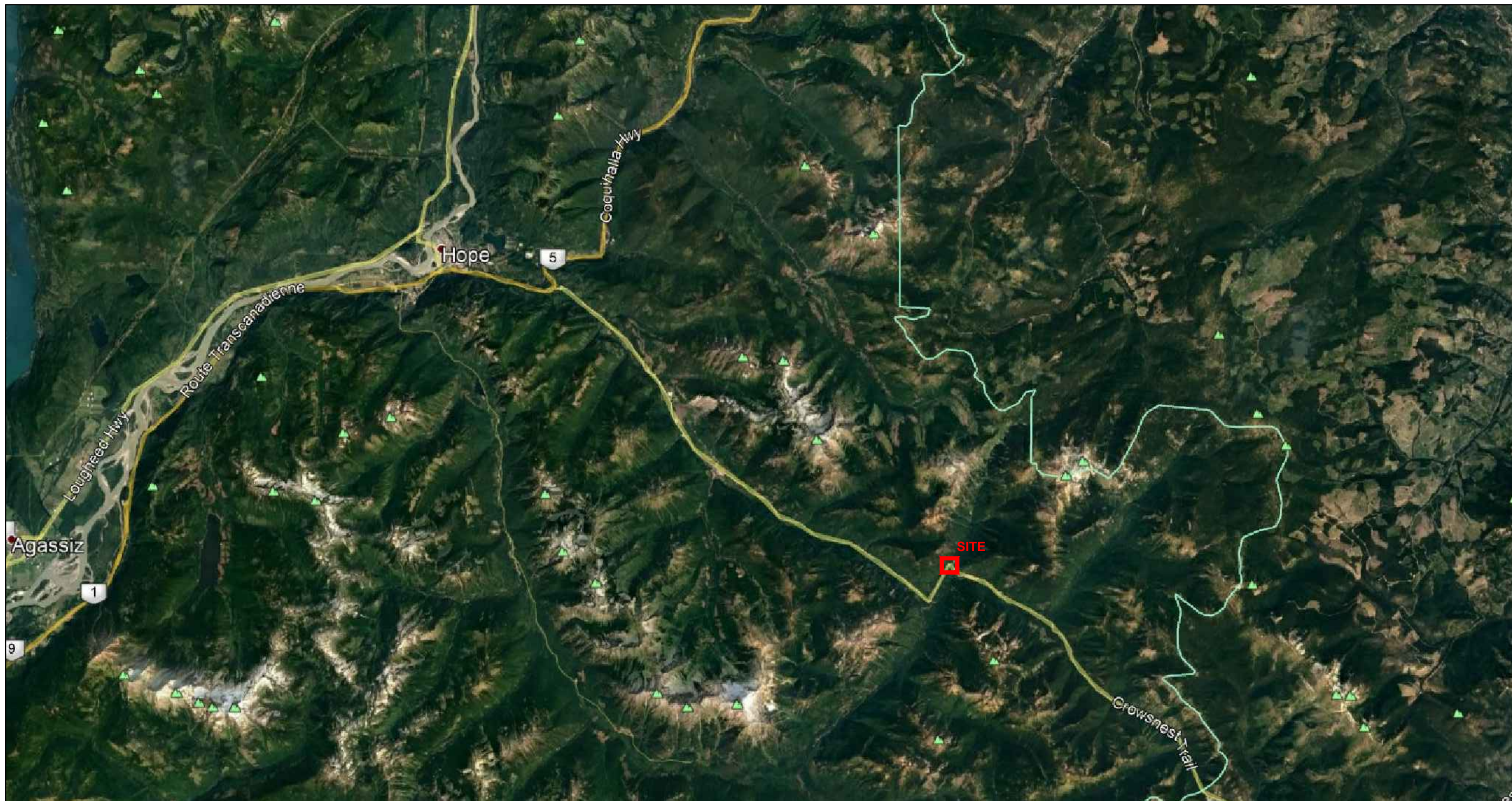
Enclosures: Appendix A – Figures  
Appendix B – Test Hole Logs  
Appendix C – Laboratory Testing Results

## **Appendix A**

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**Figure 1 Key Plan**

**Figure 2 Test Hole Location Plan**



**NOTES:**

1. BASE PLAN GOOGLE EARTH 2018 IMAGE.



**AND INFRASTRUCTURE**  
SOUTHCOAST REGION  
GEOTECHNICAL AND MATERIALS ENGINEERING

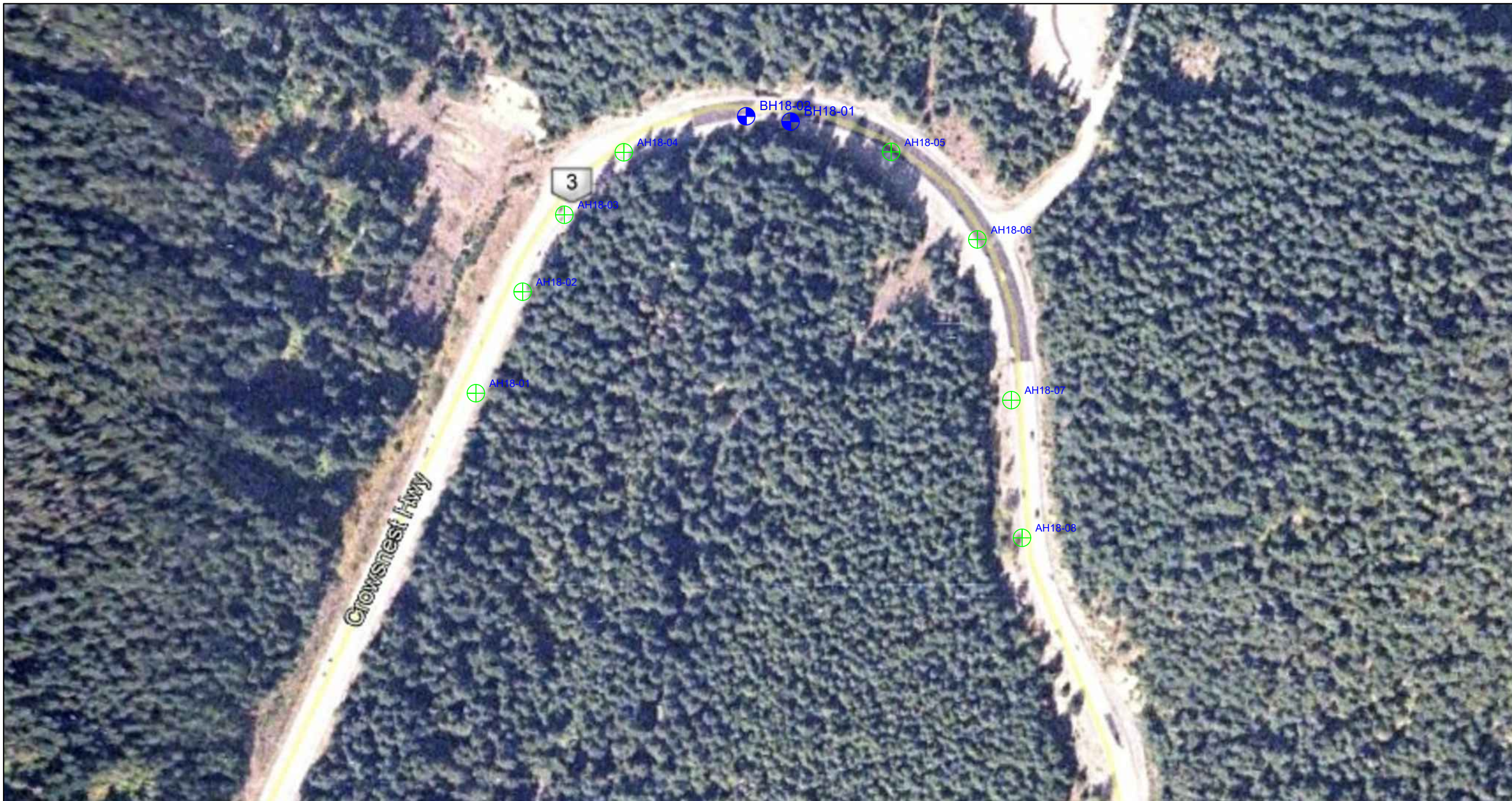


SCALE \_\_\_\_\_ CAD FILENAME \_\_\_\_\_  
PLOT DATE 2018-10-22



REV	DATE	REVISIONS	NAME

**KEY PLAN**  
HWY#3 SNASS CREEK BRIDGE  
REPLACEMENT

DATE 2018-10-22	PROJECT NUMBER 12712-000	REG 1	DRAWING NUMBER FIGURE 1	REV
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**LEGEND:**

-  BH18-01 MUD ROTARY BORE HOLES
-  AH18-01 SOLID STEM AUGER HOLES

**NOTES:**

1. BASE PLAN GOOGLE EARTH 2018 IMAGE.
2. THE TEST HOLE LOCATIONS ARE APPROXIMATE.

SCALE 0 10 1:1000 50m  
 CAD FILENAME \_\_\_\_\_  
 PLOT DATE 2018-10-22

REV	DATE	REVISIONS	NAME
A	2017-07-01		

 **BRITISH COLUMBIA** MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE  
 SOUTH COAST REGION  
 GEOTECHNICAL AND MATERIALS ENGINEERING 

**TEST HOLE LOCATION PLAN**  
 HWY#3 SNASS CREEK BRIDGE REPLACEMENT

DATE 2018-10-22	PROJECT NUMBER 12712-000	REG 1	DRAWING NUMBER FIGURE 2	REV
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## **Appendix B**

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### **Soil Classification Table**

### **Test Hole Logs**

## SOIL CLASSIFICATION

Major Divisions		Symbol	Soil Type
Coarse Grained Soils	Gravel and Gravelly Soils	<b>GW</b>	Well-graded gravels or gravel-sand mixtures, little or no fines
		<b>GP</b>	Poorly-graded gravels or gravel-sand mixtures, little or no fines
		<b>GM*</b>	Silty gravels, gravel-sand-silt mixtures
		<b>GC*</b>	Clayey gravels, gravel-sand-clay mixtures
	Sand and Sandy Soils	<b>SW*</b>	Well-graded sands or gravelly sands, little to no fines
		<b>SP</b>	Poorly-graded sands or gravelly sands, little or no fines
		<b>SM*</b>	Silty sands, sand-silt mixtures
		<b>SC*</b>	Clayey sands, sand-clay mixtures
Fine Grained Soils	Silt and Clays LL<50	<b>ML</b>	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity
		<b>CL</b>	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
		<b>OL</b>	Organic silts and organic silt-clays of low palsticity
	Silt and Clays LL>50	<b>MH</b>	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
		<b>CH</b>	Inorganic clays of high plasticity, fat clays
		<b>OH</b>	Organic clays of medium to high plasticity, organic silts
<b>Organic Soils</b>	<b>Pt</b>	Peat and other highly organic soils	
<b>Topsoil</b>	<b>TS</b>	Topsoil with roots, etc.	
<b>Cobbles</b>	<b>SB</b>	Rock fragments and cobbles, particle size 75mm to 300mm diameter	
<b>Boulders</b>	<b>LB</b>	Boulders, particle size over 300mm in diameter	
<p>*GP-GM ; GP-GC; SP-SM; SP-SC; 6-12% Passing #200 (0.075mm) Sieve</p> <p>* GM1; GC1; SM1; SC1; 12-20% Passing #200 (0.075mm) Sieve</p> <p>* GM2; GC2; SM2; SC2; 20-30% Passing #200 (0.075mm) Sieve</p> <p>* GM3; GC3; SM3; SC3; 30-40% Passing #200 (0.075mm) Sieve</p> <p>* GM4; GC4; SM4; SC4; 40-50% Passing #200 (0.075mm) Sieve</p>			





Ministry of Transportation and Infrastructure

### SUMMARY LOG

Drill Hole #: **BH18-01**

Project: **Snass Creek Bridge (Bridge #01214) Replacement**

Date(s) Drilled: September 20-22, 2018

Location: Hwy#3 Snass Creek Bridge, East Abutment

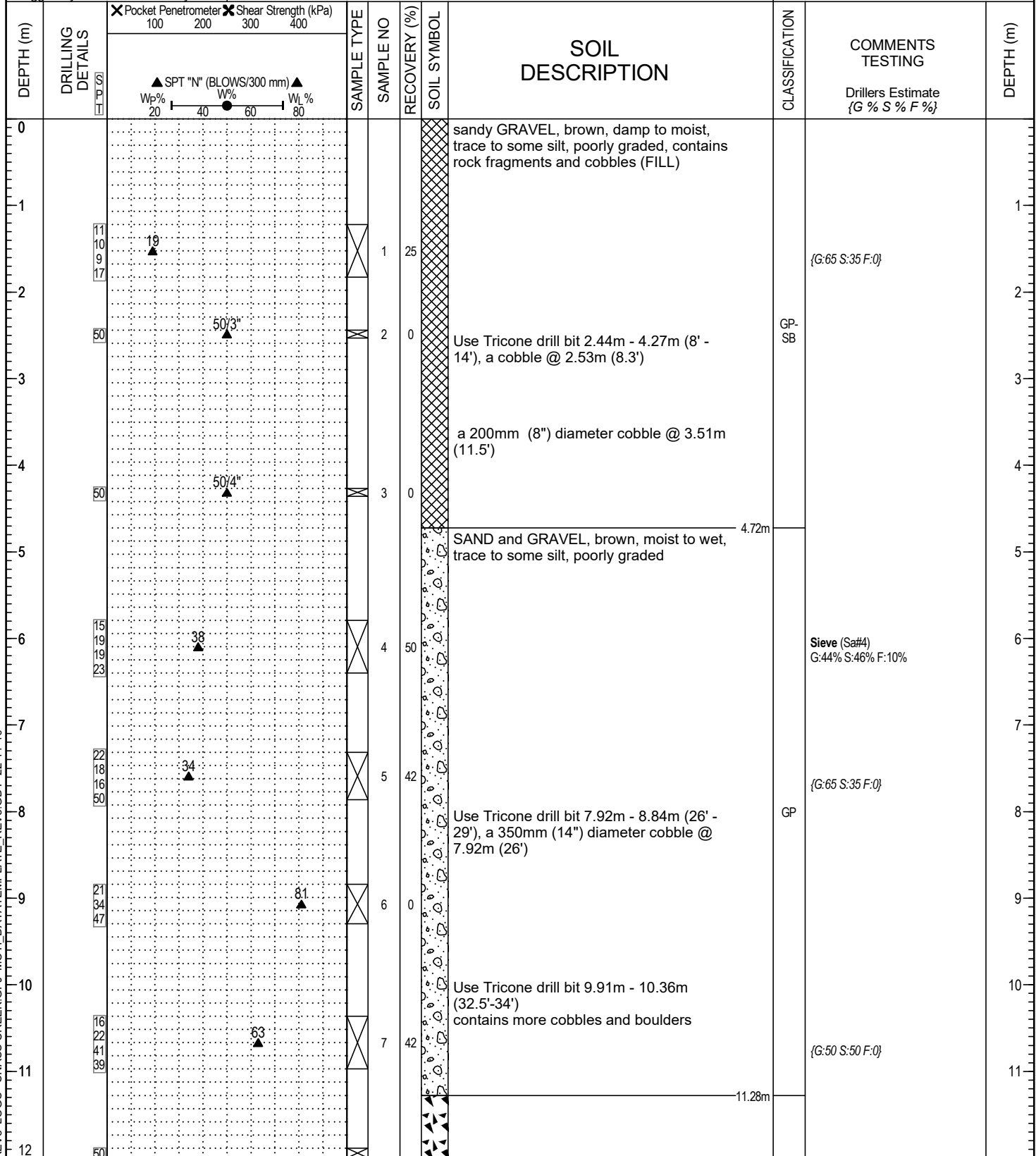
Company: Sea To Sky Drilling Ltd.

Prepared by: Ministry of Transportation & Infrastructure  
 Logged by: MS Reviewed by: JZJ

Datum: Ground Surface  
 Northing/Easting: 5454751, 641343  
 Elevation:

Alignment: n/a  
 Station/Offset: n/a

Driller: Chad Brown  
 Drill Make/Model: Mobile B-53 Truck  
 Drilling Method: Mud Rotary



MOTI-SOIL-REV3 LOGS - SNASS CREEK.GPJ MOTI\_DATATEMPLATE\_REV3.GDT 22-11-10

Legend	
	A-Auger
	B-Becker
	C-Core
	G-Grab
	V-Vane
	L#-Lab Sample
	S-Split Spoon
	O-Odex (air rotary)
	W-Wash (mud return)
	T-Shelby Tube

Final Depth of Hole: 30.3 m  
 Depth to Top of Rock:  
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Ministry of  
Transportation  
and Infrastructure

### SUMMARY LOG

Drill Hole #: **BH18-01**

Project: **Snass Creek Bridge (Bridge #01214) Replacement**

Date(s) Drilled: September 20-22, 2018

Location: Hwy#3 Snass Creek Bridge, East Abutment

Company: Sea To Sky Drilling Ltd.

Prepared by:  
Ministry of Transportation &  
Infrastructure

Datum: Ground Surface

Alignment: n/a

Driller: Chad Brown

Northing/Easting: 5454751, 641343

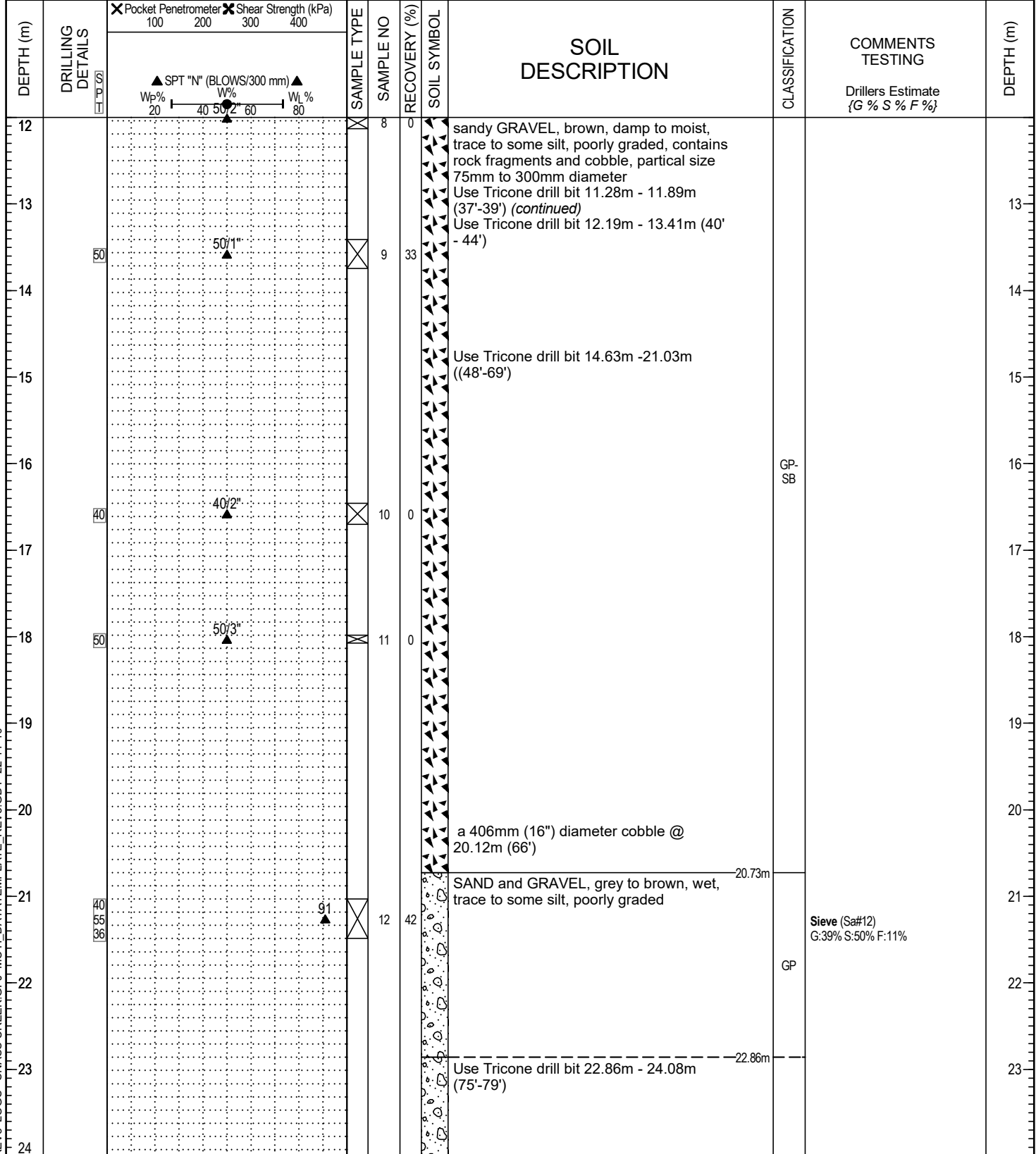
Station/Offset: n/a

Drill Make/Model: Mobile B-53 Truck

Logged by: MS Reviewed by: JZJ

Elevation:

Drilling Method: Mud Rotary



MOTI-SOIL-REV3 LOGS - SNASS CREEK.GPJ MOTI\_DATATEMPLATE\_REV3.GDT 22-11-10

Legend	A-Auger	B-Becker	C-Core	G-Grab	V-Vane
Type:	● Lab Sample	⊗ Split Spoon	⊙ Odex (air rotary)	⊠ Wash (mud return)	▨ T-Shelby Tube

Final Depth of Hole: 30.3 m  
Depth to Top of Rock:  
Page 2 of 3



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### SUMMARY LOG

Drill Hole #: **BH18-01**

Project: **Snass Creek Bridge (Bridge #01214) Replacement**

Date(s) Drilled: September 20-22, 2018

Location: Hwy#3 Snass Creek Bridge, East Abutment

Company: Sea To Sky Drilling Ltd.

Prepared by: Ministry of Transportation & Infrastructure

Datum: Ground Surface

Alignment: n/a

Driller: Chad Brown

Northing/Easting: 5454751, 641343

Station/Offset: n/a

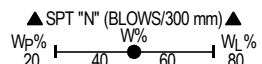
Drill Make/Model: Mobile B-53 Truck

Logged by: MS Reviewed by: JZJ

Elevation:

Drilling Method: Mud Rotary

DEPTH (m)	DRILLING DETAILS	X Pocket Penetrometer X Shear Strength (kPa)		SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL SYMBOL	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING Drillers Estimate {G % S % F %}	DEPTH (m)
		100	200								
24	103 86			X	13	33		Use Tricone drill bit 22.86m - 24.08m (75'-79') (continued)	GP-SB	{G:60 S:40 F:0}	24
25											25
26											26
27	57 77			X	14	42				{G:55 S:45 F:0}	27
28											28
29											29
30	114			X	15	0		Target depth achieved. Test hole terminated at 30.33m	GP		30
31										1) Coordinates were approximated based on the field measurements and Google Earth. 2) Groundwater conditions could not be observed during mud rotary drilling. 3) The testhole was advanced using an open faced bit, but switched to a tricone drill bit when suspected cobbles or boulders were encountered at depths 2.4m to 4.3m, 7.9m to 8.8m, 9.9m to 10.4m, 11.3m to 11.9m, 12.2m to 13.4m, 14.6m to 21.0m, 22.9m to 24.1m. 4) Drill hole was backfilled in accordance with Groundwater Protection Regulation.	31
32											32
33											33
34											34
35											35
36											36



MOTI-SOIL-REV3 LOGS - SNASS CREEK.GPJ MOTI\_DATATEMPLATE\_REV3.GDT 22-11-10

A-Auger	B-Becker	C-Core	G-Grab	V-Vane
L#-Lab Sample	S-Split Spoon	O-Odex (air rotary)	W-Wash (mud return)	T-Shelby Tube

Final Depth of Hole: 30.3 m  
Depth to Top of Rock:  
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Ministry of Transportation and Infrastructure

### SUMMARY LOG

Drill Hole #: **BH18-02**

Project: **Snass Creek Bridge (Bridge #01214) Replacement**

Date(s) Drilled: September 22 -23, 2018

Location: Hwy#3 Snass Creek Bridge, West Abutment

Company: Sea To Sky Drilling Ltd.

Prepared by: Ministry of Transportation & Infrastructure  
 Logged by: MS Reviewed by: JZJ

Datum: Ground Surface  
 Northing/Easting: 5454752, 641323  
 Elevation:

Alignment: n/a  
 Station/Offset: n/a

Driller: Chad Brown  
 Drill Make/Model: Mobile B-53 Truck  
 Drilling Method: Mud Rotary

DEPTH (m)	DRILLING DETAILS	Pocket Penetrometer		Shear Strength (kPa)		SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL SYMBOL	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING Drillers Estimate {G % S % F %}	DEPTH (m)
		100	200	300	400								
0										sandy GRAVEL, grey to brown, damp to moist, trace to some silt, poorly graded, contains rock fragments and cobbles (FILL)			
1											GP		1
2	20 22 16 13						1	0					2
3										a 250mm (10") diameter cobble @ 2.59m (8.5')		{G:65 S:35 F:0}	3
4	25 21 20 26						2	42					4
5													5
6	11 11 31 12						3	0					6
7													7
8	30 34 34 42						4	33		sandy GRAVEL, brown, damp to moist, trace to some silt, poorly graded, contains rock fragments, cobbles and boulders Use Tricone drill bit 5.33m - 5.79m (17.5'-19'), a 457mm (18") diameter boulder @ 5.33m (17.5')		{G:65 S:35 F:0}	8
9													9
10	50						5	0		Use Tricone drill bit 7.62m - 8.84m (25'-29')			10
11													11
12	25 21 13 14						6	21		SAND and GRAVEL, brown, trace to some silt, poorly graded, contain rock fragments and cobbles		{G:70 S:30 F:0}	12

MOTI-SOIL-REV3 LOGS - SNASS CREEK.GPJ MOTI\_DATATEMPLATE\_REV3.GDT 22-11-10

	A-Auger		B-Becker		C-Core		G-Grab		V-Vane
	L#-Lab Sample		S-Split Spoon		O-Odex (air rotary)		W-Wash (mud return)		T-Shelby
	Tube								

Final Depth of Hole: 29.3 m  
 Depth to Top of Rock:  
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Ministry of Transportation and Infrastructure

### SUMMARY LOG

Drill Hole #: **BH18-02**

Project: **Snass Creek Bridge (Bridge #01214) Replacement**

Date(s) Drilled: September 22 -23, 2018

Location: Hwy#3 Snass Creek Bridge, West Abutment

Company: Sea To Sky Drilling Ltd.

Prepared by: Ministry of Transportation & Infrastructure

Datum: Ground Surface

Alignment: n/a

Driller: Chad Brown

Northing/Easting: 5454752, 641323

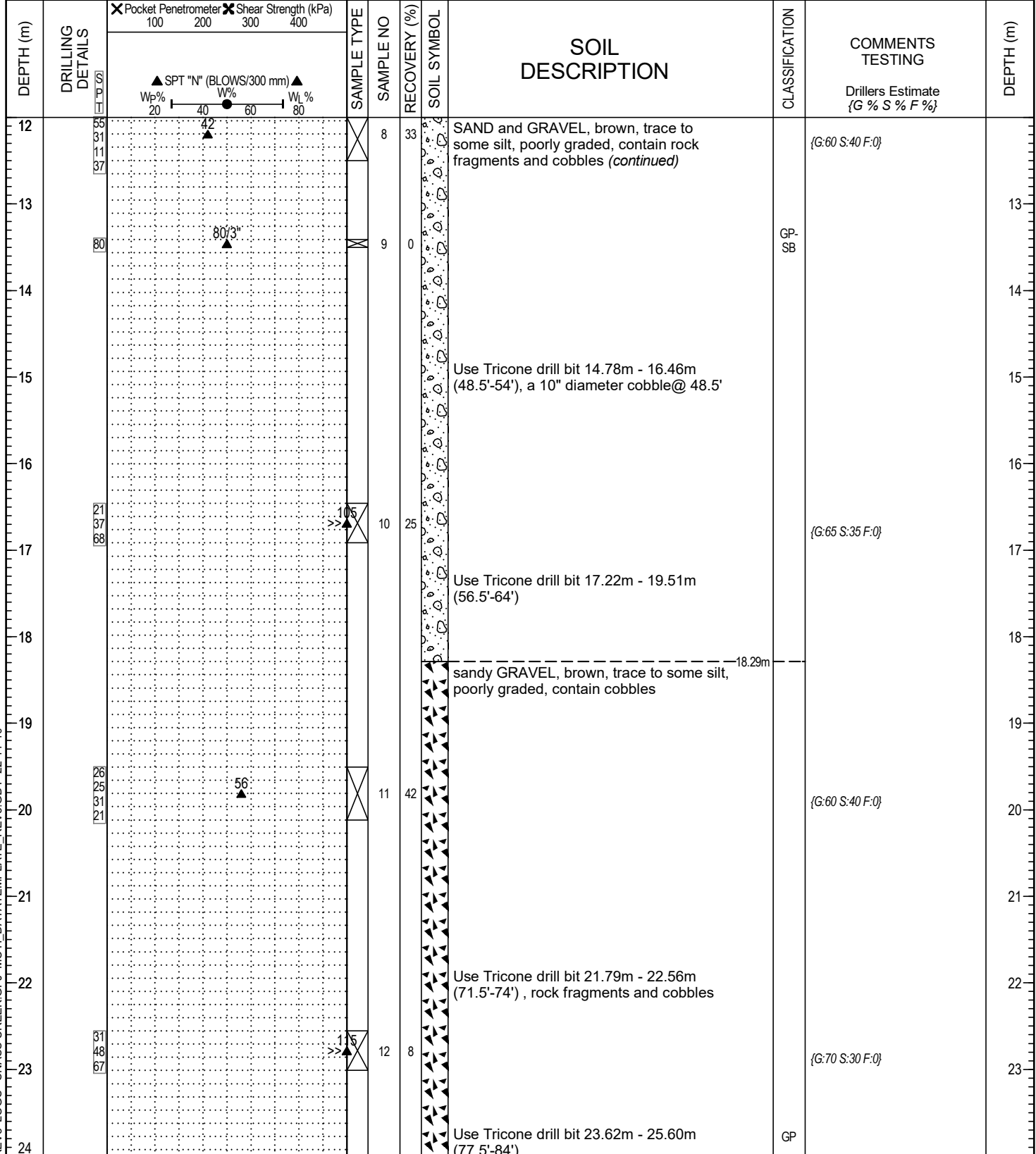
Station/Offset: n/a

Drill Make/Model: Mobile B-53 Truck

Logged by: MS Reviewed by: JZJ

Elevation:

Drilling Method: Mud Rotary



MOTI-SOIL-REV3 LOGS - SNASS CREEK.GPJ MOTI\_DATATEMPLATE\_REV3.GDT 22-11-10

Legend	
	A-Auger
	B-Becker
	C-Core
	G-Grab
	V-Vane
	L#-Lab Sample
	S-Split Spoon
	O-Odex (air rotary)
	W-Wash (mud return)
	T-Shelby Tube

Final Depth of Hole: 29.3 m  
 Depth to Top of Rock:  
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Ministry of Transportation and Infrastructure

### SUMMARY LOG

Drill Hole #: **BH18-02**

Project: **Snass Creek Bridge (Bridge #01214) Replacement**

Location: Hwy#3 Snass Creek Bridge, West Abutment

Date(s) Drilled: September 22 -23, 2018

Company: Sea To Sky Drilling Ltd.

Driller: Chad Brown

Drill Make/Model: Mobile B-53 Truck

Drilling Method: Mud Rotary

Prepared by: Ministry of Transportation & Infrastructure

Datum: Ground Surface

Alignment: n/a

Northing/Easting: 5454752, 641323

Station/Offset: n/a

Logged by: MS Reviewed by: JZJ

Elevation:

DEPTH (m)	DRILLING DETAILS	Pocket Penetrometer		Shear Strength (kPa)		SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL SYMBOL	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING Drillers Estimate {G % S % F %}	DEPTH (m)
		100	200	300	400								
24		▲ SPT "N" (BLOWS/300 mm) ▲		Wp%      Wl%      Wp%      Wl%						sandy GRAVEL, brown, trace to some silt, poorly graded, contain cobbles (continued)			24
25													25
26	28 36 36					13	33			Turn to grey and brown	{G:65 S:35 F:0}		26
27													27
28													28
29	27 28 34 44					14	25				{G:70 S:30 F:0}		29
30										Target depth achieved. Test hole terminated at 29.26m			30
31											1) Coordinates were approximated based on the field measurements and Google Earth. 2) Groundwater conditions could not be observed during mud rotary drilling. 3) The testhole was advanced using an open faced bit, but switched to a tricone drill bit when suspected cobbles or boulders were encountered at depths 5.3m to 5.8m, 7.6m to 8.8m, 14.8m to 16.5m, 17.2m to 19.5m, 21.8m to 22.6m, 23.6m to 25.6m. 4) Drill hole was backfilled in accordance with Groundwater Protection Regulation.		31
32													32
33													33
34													34
35													35
36													36

MOTI-SOIL-REV3 LOGS - SNASS CREEK.GPJ MOTI\_DATATEMPLATE\_REV3.GDT 22-11-10

A-Auger	B-Becker	C-Core	G-Grab	V-Vane
L#-Lab Sample	S-Split Spoon	O-Odex (air rotary)	W-Wash (mud return)	T-Shelby Tube

Final Depth of Hole: 29.3 m  
Depth to Top of Rock:  
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Ministry of Transportation and Infrastructure

### SUMMARY LOG

Drill Hole #: **AH18-01**

Project: **Snass Creek Bridge (Bridge #01214) Replacement**

Date(s) Drilled: September 21, 2018

Location: Hwy#3 Snass Creek Bridge, West Side

Company: Sea To Sky Drilling Ltd.

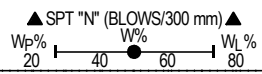
Prepared by: Ministry of Transportation & Infrastructure  
 Logged by: MS Reviewed by: JZJ

Datum: Ground  
 Northing/Easting: 5454565, 641158  
 Elevation:

Alignment: n/a  
 Station/Offset: n/a

Driller: Chad Brown  
 Drill Make/Model: Mobile B-53 Truck  
 Drilling Method: Solid Stem Auger

DEPTH (m)	DRILLING DETAILS	X Pocket Penetrometer X Shear Strength (kPa)		SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL SYMBOL	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING Drillers Estimate {G % S % F %}	DEPTH (m)
		100	200								
0								Asphalt 8"			
					1			SAND and GRAVEL, damp, brown, trace silt, 25mm minus (FILL)	GP	{G:50 S:50 F:0}	
					2			SAND and GRAVEL, damp, brown, trace to some silt, 38mm minus (FILL)	GP	{G:55 S:45 F:0}	
1					3			SAND and GRAVEL, damp, redish brown, trace to some silt, 75mm minus (FILL)	GP	{G:55 S:40 F:5}	
2								Auger Refusal. Test hole terminated at 1.98m.		1) Coordinates were approximated based on the field measurements and Google Earth. 2) Auger hole was drilled at the center of the paved east bound shoulder.	
3											
4											
5											
6											



MOTI-SOIL-REV3 LOGS - SNASS CREEK GPJ MOTI\_DATATEMPLATE\_REV3.GDT 22-11-10

	A-Auger		B-Becker		C-Core		G-Grab		V-Vane
	L#-Lab Sample		S-Split Spoon		O-Odex (air rotary)		W-Wash (mud return)		T-Shelby Tube

Final Depth of Hole: 2.0 m  
 Depth to Top of Rock:  
 Page 1 of 1



Ministry of Transportation and Infrastructure

### SUMMARY LOG

Drill Hole #: **AH18-02**

Project: **Snass Creek Bridge (Bridge #01214) Replacement**

Location: Hwy#3 Snass Creek Bridge, West Side

Date(s) Drilled: September 21, 2018

Company: Sea To Sky Drilling Ltd.

Prepared by: Ministry of Transportation & Infrastructure

Datum: Ground Surface  
Northing/Easting: 5454627, 641183

Alignment: n/a  
Station/Offset: n/a

Driller: Chad Brown

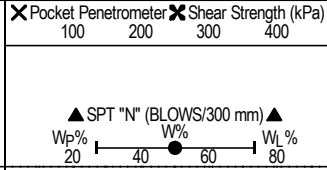
Drill Make/Model: Mobile B-53 Truck

Drilling Method: Solid Stem Auger

Logged by: MS Reviewed by: JZJ

Elevation:

DEPTH (m)	DRILLING DETAILS	X Pocket Penetrometer X Shear Strength (kPa)		SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL SYMBOL	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING Drillers Estimate {G % S % F %}	DEPTH (m)
		100	200								
0								Asphalt 8"			
					1			SAND and GRAVEL, damp, brown, trace silt, 25mm minus (FILL)	GP	{G:55 S:45 F:0}	
					2			sandy GRAVEL, damp, reddish brown, trace to some silt, contains cobbles (FILL)	GP	{G:60 S:35 F:5}	
					3				GP	{G:60 S:35 F:5}	
								Target depth achieved. Test hole terminated at 3.05 m			1) Coordinates were approximated based on the field measurements and Google Earth. 2) Auger hole was drilled at the center of the paved east bound shoulder.




Final Depth of Hole: 3.0 m  
 Depth to Top of Rock:  
 Page 1 of 1

MOTI-SOIL-REV3 LOGS - SNASS CREEK.GPJ MOTI\_DATATEMPLATE\_REV3.GDT 22-11-10





Ministry of Transportation and Infrastructure

### SUMMARY LOG

Drill Hole #: **AH18-03**

Project: **Snass Creek Bridge (Bridge #01214) Replacement**

Location: Hwy#3 Snass Creek Bridge, West Side

Date(s) Drilled: September 21, 2018

Company: Sea To Sky Drilling Ltd.

Driller: Chad Brown

Drill Make/Model: Mobile B-53 Truck

Drilling Method: Solid Stem Auger

Prepared by: Ministry of Transportation & Infrastructure  
 Logged by: MS Reviewed by: JZJ

Datum: Ground Surface

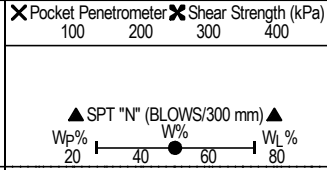
Alignment: n/a

Northing/Easting: 5454686, 641209

Station/Offset: n/a

Elevation:

DEPTH (m)	DRILLING DETAILS	X Pocket Penetrometer X Shear Strength (kPa)		SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL SYMBOL	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING Drillers Estimate {G % S % F %}	DEPTH (m)
		100	200								
0								Asphalt 9"			
0.23					1			SAND and GRAVEL, damp, brown, trace silt (FILL)	SP	Sieve (Sa#1) G:39% S:52% F:9%	0.23
0.46					2			silty SAND and GRAVEL, damp, brown (FILL)		{G:60 S:35 F:5}	0.46
1.83					3			SAND and GRAVEL, damp, brown, trace to some silt, contain cobble (FILL)	SM-GP	Sieve (Sa#3) G:36% S:26% F:38%	1.83
3.05					4			SAND and GRAVEL, damp, brown, trace to some silt, contain cobble (FILL)	SP	{G:50 S:50 F:0}	3.05
3.05								Target depth achieved. Test hole terminated at 3.05 m		1) Coordinates were approximated based on the field measurements and Google Earth. 2) Auger hole was drilled at the center of the paved east bound shoulder.  2) Auger hole was drilled at inner side of the east bound fogline.	3.05



A-Auger	B-Becker	C-Core	G-Grab	V-Vane
L#-Lab Sample	S-Split Spoon	O-Odex (air rotary)	W-Wash (mud return)	T-Shelby Tube

Final Depth of Hole: 3.0 m  
 Depth to Top of Rock:  
 Page 1 of 1

MOTI-SOIL-REV3 LOGS - SNASS CREEK.GPJ MOTI\_DATATEMPLATE\_REV3.GDT 22-11-10



Ministry of  
Transportation  
and Infrastructure

### SUMMARY LOG

Drill Hole #: **AH18-04**

Project: **Snass Creek Bridge (Bridge #01214) Replacement**

Location: Hwy#3 Snass Creek Bridge, West Side

Date(s) Drilled: September 21, 2018

Company: Sea To Sky Drilling Ltd.

Prepared by:  
Ministry of Transportation &  
Infrastructure

Datum: Ground Surface

Alignment: n/a

Northing/Easting: 5454730, 641251

Station/Offset: n/a

Logged by: MS Reviewed by: JZJ

Elevation:

Driller: Chad Brown

Drill Make/Model: Mobile B-53 Truck

Drilling Method: Solid Stem Auger

DEPTH (m)	DRILLING DETAILS	<input checked="" type="checkbox"/> Pocket Penetrometer <input checked="" type="checkbox"/> Shear Strength (kPa) 100    200    300    400		SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL SYMBOL	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING  Drillers Estimate {G % S % F %}	DEPTH (m)
		▲ SPT "N" (BLOWS/300 mm) ▲ Wp%    Wl% 20    40    60    80									
0					1			Asphalt 5" / 0.05m	SP	{G:40 S:60 F:0}	
					2			gravelly SAND to SAND and GRAVEL, damp, brown, trace silt, 25mm minus (FILL) / 0.15m	GP	{G:60 S:40 F:0}	
								sandy GRAVEL, damp, brown, trace to some silt, 25mm minus (FILL) / 0.61m	GP-SB		
								Very boney drilling, contains rock fragments and cobbles / 1.07m			
								Auger Refusal. Test hole terminated at 1.07m.		1) Coordinates were approximated based on the field measurements and Google Earth. 2) Auger hole was drilled at the paved road shoulder, about 0.3m outside the east bound fogline.	
1											1
2											2
3											3
4											4
5											5
6											6

MOTI-SOIL-REV3 LOGS - SNASS CREEK GPJ MOTI\_DATATEMPLATE\_REV3.GDT 22-11-10

**Legend**

A-Auger	B-Becker	C-Core	G-Grab	V-Vane
L#-Lab Sample	S-Split Spoon	O-Odex (air rotary)	W-Wash (mud return)	T-Shelby Tube

Final Depth of Hole: 1.1 m  
Depth to Top of Rock:  
Page 1 of 1



Ministry of  
Transportation  
and Infrastructure

### SUMMARY LOG

Drill Hole #: **AH18-05**

Project: **Snass Creek Bridge (Bridge #01214) Replacement**

Date(s) Drilled: September 21, 2018

Location: Hwy#3 Snass Creek Bridge, east side

Company: Sea To Sky Drilling Ltd.

Prepared by:  
Ministry of Transportation &  
Infrastructure

Datum: Ground Surface  
Northing/Easting: 5454731, 641411

Alignment: n/a  
Station/Offset: n/a

Driller: Chad Brown  
Drill Make/Model: Mobile B-53 Truck  
Drilling Method: Solid Stem Auger

Logged by: MS Reviewed by: JZJ

Elevation:

DEPTH (m)	DRILLING DETAILS	<input checked="" type="checkbox"/> Pocket Penetrometer 100 200 300 400 <input checked="" type="checkbox"/> Shear Strength (kPa)	SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL SYMBOL	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING  Drillers Estimate {G % S % F %}	DEPTH (m)
0				1			Asphalt 6"			
							SAND and GRAVEL, damp, brown, trace silt, 25mm minus (FILL)	GP	{G:45 S:55 F:0}	
							sandy GRAVEL, damp, brown, trace to some silt, contain rock fragments and cobbles (FILL)	GP-SB	{G:70 S:30 F:0}	
1.37							Auger Refusal. Test hole terminated at 1.37m.		1) Coordinates were approximated based on the field measurements and Google Earth. 2) Auger hole was drilled at the center of the paved east bound shoulder.	

MOTI-SOIL-REV3 LOGS - SNASS CREEK.GPJ MOTI\_DATATEMPLATE\_REV3.GDT 22-11-10

**Legend**

A-Auger	B-Becker	C-Core	G-Grab	V-Vane
L#-Lab Sample	S-Split Spoon	O-Odex (air rotary)	W-Wash (mud return)	T-Shelby Tube

Final Depth of Hole: 1.4 m  
Depth to Top of Rock:  
Page 1 of 1



Ministry of Transportation and Infrastructure

### SUMMARY LOG

Drill Hole #: **AH18-06**

Project: **Snass Creek Bridge (Bridge #01214) Replacement**

Date(s) Drilled: September 21, 2018

Location: Hwy#3 Snass Creek Bridge, east side

Company: Sea To Sky Drilling Ltd.

Prepared by: Ministry of Transportation & Infrastructure

Datum: Ground Surface

Alignment: n/a

Driller: Chad Brown

Northing/Easting: 5454685, 641458

Station/Offset: n/a

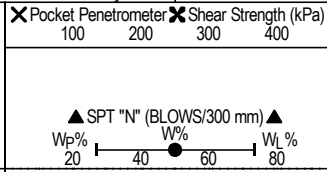
Drill Make/Model: Mobile B-53 Truck

Logged by: MS Reviewed by: JZJ

Elevation:

Drilling Method: Solid Stem Auger

DEPTH (m)	DRILLING DETAILS	X Pocket Penetrometer X Shear Strength (kPa)		SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL SYMBOL	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING Drillers Estimate {G % S % F %}	DEPTH (m)
		100	200								
0					1		Asphalt 6"	0.05m	SP	{G:35 S:65 F:0}	
					2		gravelly SAND, damp, dark brown, trace silt, 25mm minus (FILL)	0.46m	SP	{G:40 S:60 F:0}	
					3		SAND and GRAVEL, damp, brown, trace to some silt, 25mm minus (FILL)	0.91m	SP	{G:45 S:50 F:5}	
					4		sandy GRAVEL, damp, brown, trace to some silt, contains cobbles, 75mm minus (FILL)	2.29m	GP	{G:60 S:40 F:0}	
							Auger Refusal. Test hole terminated at 2.29m.			1) Coordinates were approximated based on the field measurements and Google Earth. 2) Auger hole was drilled at the center of the paved east bound shoulder.	




Final Depth of Hole: 2.3 m  
Depth to Top of Rock:  
Page 1 of 1

MOTI-SOIL-REV3 LOGS - SNASS CREEK.GPJ MOTI\_DATATEMPLATE\_REV3.GDT 22-11-10



Ministry of Transportation and Infrastructure

### SUMMARY LOG

Drill Hole #: **AH18-07**

Project: **Snass Creek Bridge (Bridge #01214) Replacement**

Date(s) Drilled: September 21, 2018

Location: Hwy#3 Snass Creek Bridge, east side

Company: Sea To Sky Drilling Ltd.

Prepared by: Ministry of Transportation & Infrastructure

Datum: Ground Surface  
Northing/Easting: 5454630, 641477

Alignment: n/a  
Station/Offset: n/a

Driller: Chad Brown  
Drill Make/Model: Mobile B-53 Truck  
Drilling Method: Solid Stem Auger

Logged by: MS Reviewed by: JZJ

Elevation:

DEPTH (m)	DRILLING DETAILS	X Pocket Penetrometer X Shear Strength (kPa)		SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL SYMBOL	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING Drillers Estimate {G % S % F %}	DEPTH (m)
		100	200								
0		▲ SPT "N" (BLOWS/300 mm) ▲ Wp% 20 40 60 80 Wl%						Asphalt 5"			
0.13m					1			gravelly SAND, damp, dark brown, trace to some silt, 25mm minus (FILL)	SP	{G:40 S:60 F:0}	
0.2m					2			sandy GRAVEL, damp, brown and grey, trace to some silt, 75mm minus (FILL)		{G:70 S:30 F:0}	
2.29m					3			sandy GRAVEL, damp, brown and grey, some silt to silty, contains cobbles (FILL)	GP-GM	{G:65 S:30 F:5}	
3.66m								Auger Refusal. Test hole terminated at 3.66m.		1) Coordinates were approximated based on the field measurements and Google Earth. 2) Auger hole was drilled at the inside of the east bound fogline.	

MOTI-SOIL-REV3 LOGS - SNASS CREEK.GPJ MOTI\_DATATEMPLATE\_REV3.GDT 22-11-10

**Legend**

A-Auger Sample	B-Becker	C-Core	G-Grab	V-Vane
L#-Lab Sample	S-Split Spoon	O-Odex (air rotary)	W-Wash (mud return)	T-Shelby Tube

Final Depth of Hole: 3.7 m  
Depth to Top of Rock:  
Page 1 of 1



Ministry of  
Transportation  
and Infrastructure

### SUMMARY LOG

Drill Hole #: **AH18-08**

Project: **Snass Creek Bridge (Bridge #01214) Replacement**

Location: Hwy#3 Snass Creek Bridge, East Side

Date(s) Drilled: September 21, 2018

Company: Sea To Sky Drilling Ltd.

Driller: Chad Brown

Drill Make/Model: Mobile B-53 Truck

Drilling Method: Solid Stem Auger

Prepared by:  
Ministry of Transportation &  
Infrastructure

Datum: Ground Surface

Alignment: n/a

Northing/Easting: 5454564, 641486

Station/Offset: n/a

Logged by: MS Reviewed by: JZJ

Elevation:

DEPTH (m)	DRILLING DETAILS	X Pocket Penetrometer X Shear Strength (kPa)		SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	SOIL SYMBOL	SOIL DESCRIPTION	CLASSIFICATION	COMMENTS TESTING  Drillers Estimate {G % S % F %}	DEPTH (m)
		100	200								
0								Asphalt 4" 0.1m	GP	{G:55 S:45 F:0}	
								SAND and GRAVEL, damp, brown, trace silt, 25mm minus (FILL) 0.25m			
								sandy GRAVEL, damp, brown and grey, trace to some silt, 75mm minus (FILL)			
1					2				GP	{G:65 S:35 F:0}	1
2											2
					3						
								sandy GRAVEL, damp, brown and grey, trace to some silt, contain cobbles (FILL) 2.29m	GP-SB	{G:65 S:35 F:0}	
3								Auger Refusal. Test hole terminated at 2.74m. 2.74m		1) Coordinates were approximated based on the field measurements and Google Earth. 2) Auger hole was drilled at the inside of the east bound fogline.	3
4											4
5											5
6											6

MOTI-SOIL-REV3 LOGS - SNASS CREEK GPJ MOTI DATATEMPLATE REV3.GDT 22-11-10

A-Auger Sample	B-Becker	C-Core	G-Grab	V-Vane
L#-Lab Sample	S-Split Spoon	O-Odex (air rotary)	W-Wash (mud return)	T-Shelby Tube

Final Depth of Hole: 2.7 m  
Depth to Top of Rock:  
Page 1 of 1

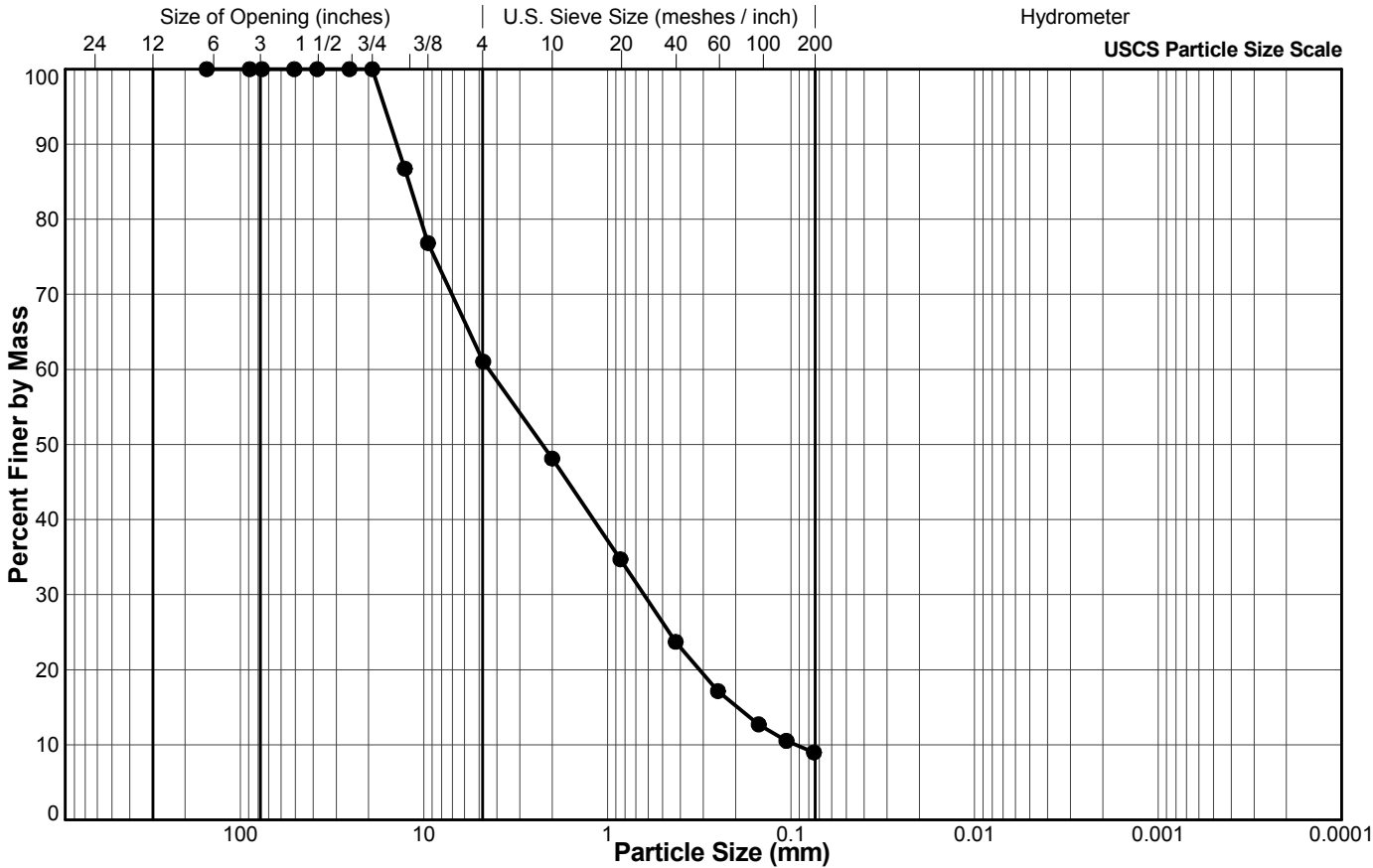
## **Appendix C**

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### **Laboratory Testing Results**

**Client:** Ministry of Transportation and Infrastructure  
**Project:** Highway #3, Snass Creek Bridge Replacement  
**Location:** Highway #3, Snass Creek Bridge, BC  
**Project No.:** 1414739 **Phase:** 13000

**Sample Location:** AH18-03  
**Sample No.:** 1  
**Depth Interval (m):** 0.23 to 0.33  
**Lab Schedule No.:**



**Legend**

Sieve Size (USS)	Particle Size (mm)	Percent Passing
6"	152.4	100.0
3.5"	88.9	100.0
3"	76.2	100.0
2"	50.8	100.0
1 1/2"	38.1	100.0
1"	25.4	100.0
3/4"	19.1	100.0
1/2"	12.7	86.7
3/8"	9.5	76.8
#4 US MESH	4.75	61.0
#10 US MESH	2	48.1
#20 US MESH	0.85	34.7
#40 US MESH	0.425	23.7
#60 US MESH	0.25	17.2
#100 US MESH	0.15	12.7
#140 US MESH	0.106	10.5
#200 US MESH	0.075	9.0

BOULDER	COBBLE	GRAVEL		SAND			FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	

**SJ** 10/10/2018  
 Tech Date

**LH** 10/12/2018  
 Checked Date



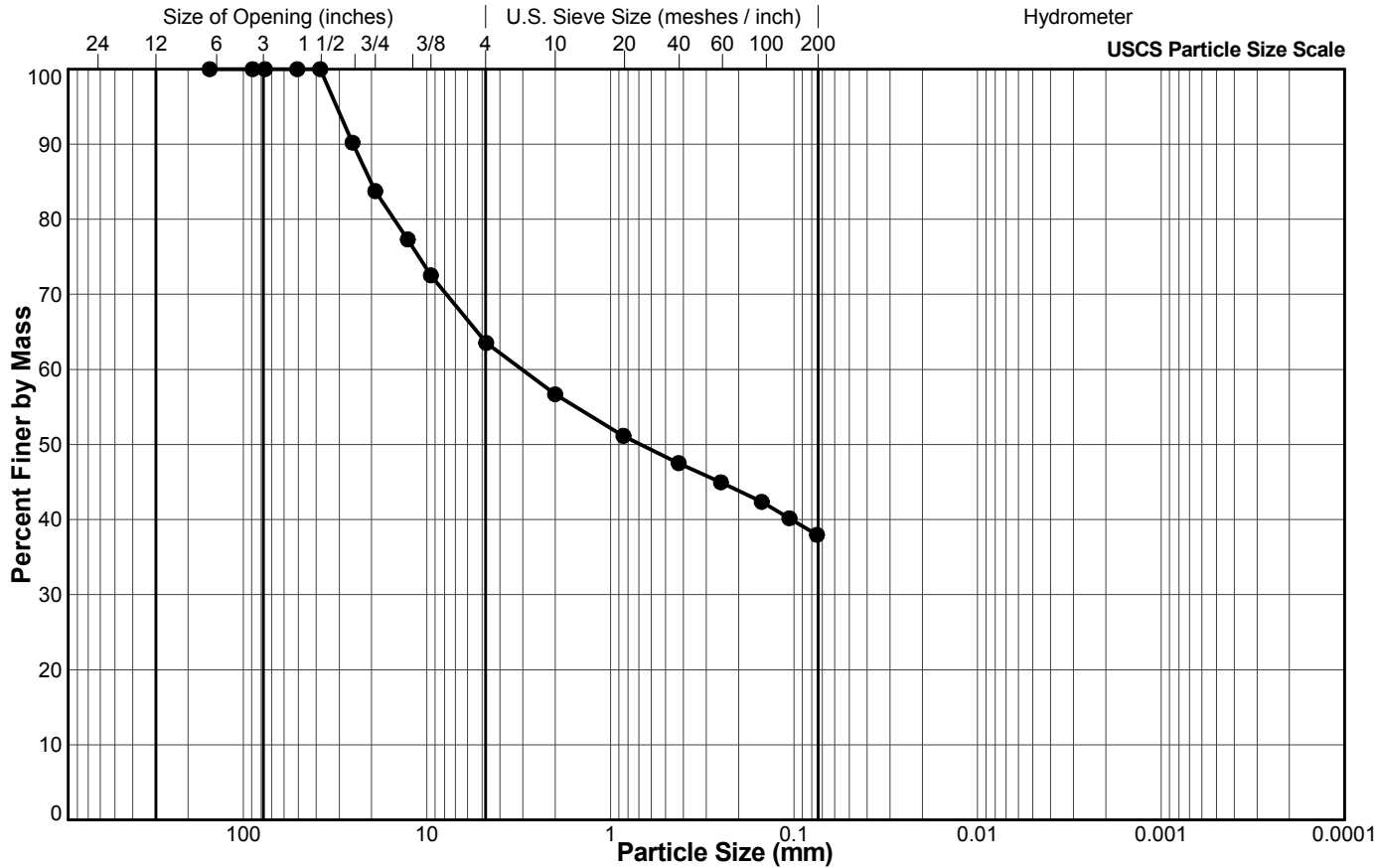


# SUMMARY OF PARTICLE SIZE DISTRIBUTION

ASTM D6913

**Client:** Ministry of Transportation and Infrastructure  
**Project:** Highway #3, Snass Creek Bridge Replacement  
**Location:** Highway #3, Snass Creek Bridge, BC  
**Project No.:** 1414739 **Phase:** 13000

**Sample Location:** AH18-03  
**Sample No.:** 3  
**Depth (m):** 1.37  
**Lab Schedule No.:**



### Legend

Sieve Size (USS)	Particle Size (mm)	Percent Passing
6"	152.4	100.0
3.5"	88.9	100.0
3"	76.2	100.0
2"	50.8	100.0
1 1/2"	38.1	100.0
1"	25.4	90.2
3/4"	19.1	83.7
1/2"	12.7	77.3
3/8"	9.5	72.5
#4 US MESH	4.75	63.5
#10 US MESH	2	56.7
#20 US MESH	0.85	51.2
#40 US MESH	0.425	47.5
#60 US MESH	0.25	45.0
#100 US MESH	0.15	42.4
#140 US MESH	0.106	40.2
#200 US MESH	0.075	38.0

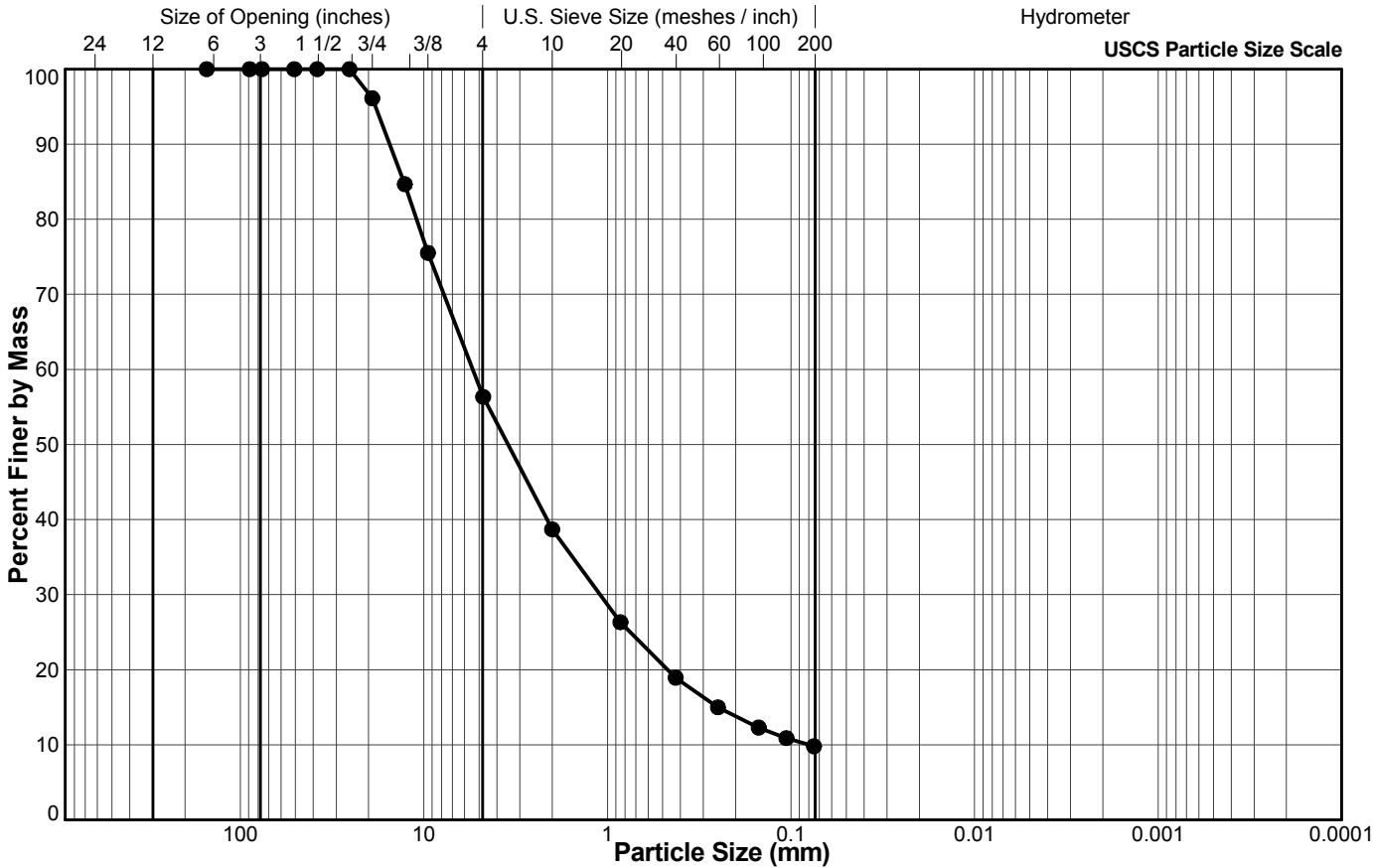
BOULDER	COBBLE	GRAVEL		SAND			FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	

**SJ**                      **10/10/2018**  
 Tech                      Date

**LH**                      **10/12/2018**  
 Checked                      Date

**Client:** Ministry of Transportation and Infrastructure  
**Project:** Highway #3, Snass Creek Bridge Replacement  
**Location:** Highway #3, Snass Creek Bridge, BC  
**Project No.:** 1414739 **Phase:** 13000

**Sample Location:** BH18-01  
**Sample No.:** 4  
**Depth Interval (m):** 5.79 to 6.40  
**Lab Schedule No.:**



**Legend**

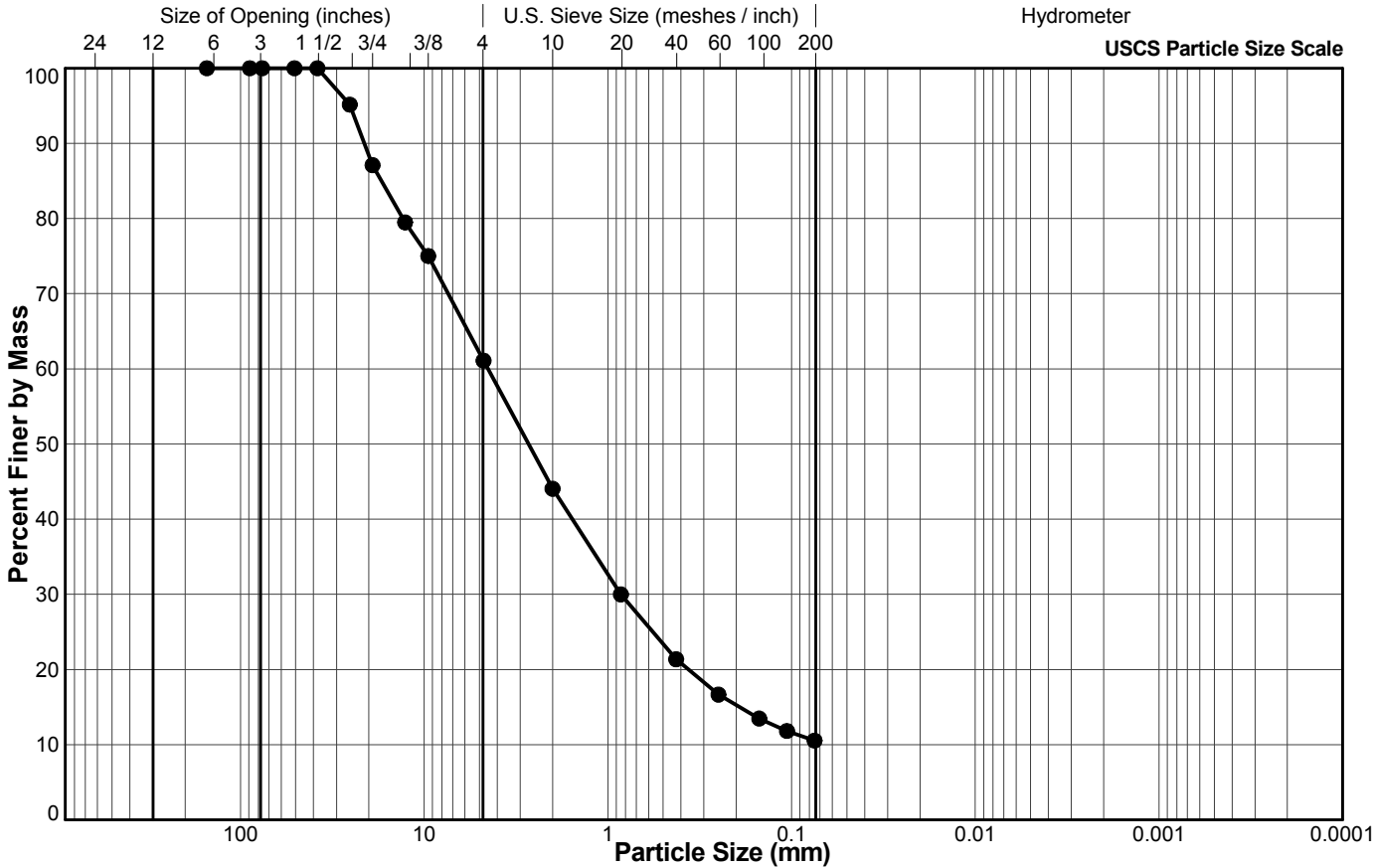
Sieve Size (USS)	Particle Size (mm)	Percent Passing
6"	152.4	100.0
3.5"	88.9	100.0
3"	76.2	100.0
2"	50.8	100.0
1 1/2"	38.1	100.0
1"	25.4	100.0
3/4"	19.1	96.1
1/2"	12.7	84.7
3/8"	9.5	75.5
#4 US MESH	4.75	56.3
#10 US MESH	2	38.7
#20 US MESH	0.85	26.3
#40 US MESH	0.425	18.9
#60 US MESH	0.25	15.0
#100 US MESH	0.15	12.3
#140 US MESH	0.106	10.9
#200 US MESH	0.075	9.8

BOULDER	COBBLE	GRAVEL		SAND			FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	

**SJ** **10/10/2018** **LH** **10/12/2018**  
 Tech Date Checked Date

**Client:** Ministry of Transportation and Infrastructure  
**Project:** Highway #3, Snass Creek Bridge Replacement  
**Location:** Highway #3, Snass Creek Bridge, BC  
**Project No.:** 1414739 **Phase:** 13000

**Sample Location:** BH18-01  
**Sample No.:** 12  
**Depth Interval (m):** 21.03 to 21.49  
**Lab Schedule No.:**



### Legend

Sieve Size (USS)	Particle Size (mm)	Percent Passing
6"	152.4	100.0
3.5"	88.9	100.0
3"	76.2	100.0
2"	50.8	100.0
1 1/2"	38.1	100.0
1"	25.4	95.2
3/4"	19.1	87.1
1/2"	12.7	79.5
3/8"	9.5	75.0
#4 US MESH	4.75	61.1
#10 US MESH	2	44.1
#20 US MESH	0.85	30.0
#40 US MESH	0.425	21.4
#60 US MESH	0.25	16.7
#100 US MESH	0.15	13.5
#140 US MESH	0.106	11.8
#200 US MESH	0.075	10.5

BOULDER	COBBLE	GRAVEL		SAND			FINES (Silt, Clay)
		Coarse	Fine	Coarse	Medium	Fine	

**SJ** 10/10/2018  
 Tech Date

**LH** 10/12/2018  
 Checked Date



# WATER CONTENT DETERMINATION

ASTM D 2216

**Client:** Ministry of Transportation and Infrastructure  
**Project:** Highway #3, Snass Creek Bridge Replacement  
**Location:** Highway #3, Snass Creek Bridge, BC  
**Project No.:** 1414739 **Phase:** 13000

**Lab Schedule No.:**

Sample Location	Sample No.	Specimen No.	Depth Interval		Water Content (%)
			Depth (m)	Bottom (m)	
AH18-03	1		0.23	0.33	4.3
AH18-03	2		0.46	0.46	10.9
AH18-03	3		1.37	1.37	18.0
AH18-03	4		2.44	2.44	15.8
AH18-06	1		0.05	0.10	3.8
AH18-06	2		0.30	0.30	4.6
AH18-06	3		0.61	0.61	8.2
AH18-06	4		1.37	1.37	6.1

National IM Server:GINT\_GAL\_NATIONAL\IM Unique Project ID: Output Form: LAB\_WATER\_CONTENT (REPORT) 2018.Lhu 12/10/18

LH

10/12/2018

Checked

Date

**Golder Associates Ltd.**

#300 - 3811 North Fraser Way Burnaby, British Columbia, Canada V5J 5J2  
 Tel: +1 (604) 412 6899 Fax: +1 (604) 412 6816 www.golder.com



# DETERMINATION OF TOTAL OR WATER-SOLUBLE SULPHATE ION CONTENT OF SOIL CSA A23.2-3B

Client:	Ministry of Transportation and Infrastructure	Project No.:	1792837
Project:	Snass Creek Bridge	Phase No.:	19000
Date sampled:	September, 2018	Date tested:	September 17, 2019
Sampled by:	Client	Tested by:	R. Zhu

Sample ID	Horizon Depth	Total Sulphate Ion Content %	Water-Soluble Sulphate Ion Content %
TH18-02, SA2	10'-12'	0.07	Not Applicable *
TH18-02, SA4	19'-21'	0.09	Not Applicable *
TH18-02, SA6	29'-29'9"	0.08	Not Applicable *
TH18-02, SA7	34'-36'	0.01	Not Applicable *

**Notes:**

- \* Per Clause 9.1.4, the water-soluble sulphate ion content need not be tested when the total sulphate ion content is less than 0.20%
- Detection limit for the test is 0.005%

Reported by: R. Zhu

Reviewed by: \_\_\_\_\_  
S. John, AScT



**Notice:** The test data given herein pertain to the samples provided. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.



# WATER-SOLUBLE CHLORIDE ION CONTENT (ASTM C1218)

Ministry of Transportation and Infrastructure

September 20, 2019


Golder Project Number: 1792837-19000

Sample Description: **Snass Creek Bridge, TH18-02**

Date Sampled: September, 2018	Date Tested: September 19, 2019
Date Received: September 12, 2019	Tested By: J. Allen

Core ID	Golder Laboratory Number	Horizon Depth	Chloride Ion Content (% by weight)
2	C-19-945	10'-12'	0.000
4	C-19-946	19'-21'	0.000
6	C-19-947	29'-29'9"	0.000
7	C-19-948	34'-36'	0.000

Reviewed by:

  
Jeremy Rose, Laboratory Supervisor



Notice: The test data given herein pertain to the sample provided, and may not be applicable to material from other production zones/periods.  
This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.