

Appendix A:  
Geotechnical Report

**GEOTECHNICAL FACTUAL REPORT  
SARS SITE, BURIN, NEWFOUNDLAND**

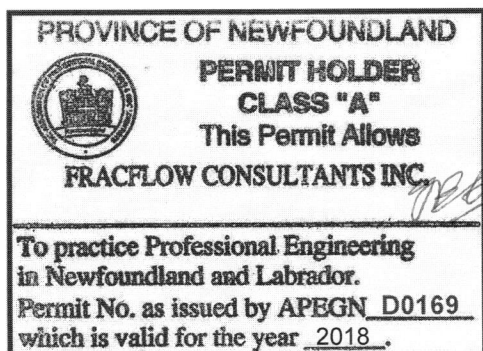
(FFC File: 3118)

**Prepared by:**

**FRACFLOW CONSULTANTS INC.  
154 Major's Path  
St. John's, Newfoundland A1A 5A1**

**Submitted to:**

**Public Works and Government Services Canada  
Public Services and Procurement Canada  
1 Regent Square  
Corner Brook, NL, A2H**



April 2018



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## **Preface**

Public Works and Government Services Canada (PWGSC) retained Fracflow Consultants Inc. to undertake a marine geotechnical site investigation at the SARS site in Burin, Newfoundland. This investigation was conducted according to the stipulations outlined in the current Standing Offer Contract (No. EA003-160505/001/PWD) between PWGSC and Fracflow Consultants Inc.

The proposed scope of work for the Burin SARS site project consisted of drilling three (3) boreholes from a barge and four (4) boreholes from the edge of the wharf using an extended drilling platform. The field work for this investigation was conducted between March 16 and 28, 2018, and the revised scope of work due to high winds and poor weather conditions included drilling part of BH1 with two (2) split-spoon samples followed by driving a DCPT to refusal at the BH1, BH2 and BH3 locations. Environmental samples were collected at each location using a grab sampler and split-spoon assembly where ground conditions permitted. Equipment on the wharf, including several fuel storage tanks, prevented access to two (2) of the four (4) borehole locations on the edge of the wharf. Also, the large lifeboat and floating dock could not be moved to permit drilling of the holes within 2.2 m of the edge of the wharf. Two (2) boreholes were drilled over the edge of the wharf, and into bedrock, at locations specified by PWGSC.

Environmental samples were collected at those two (2) ground locations where the ground conditions permitted. Split-spoon sampling and Standard Penetration Tests (SPTs) were conducted every 1.5 m using a NW/NQ diamond drilling string. A visual inspection of the subsurface soil conditions encountered, based on the split-spoon samples that were recovered during the field program, and the laboratory data for the collected overburden samples were used to describe the soil conditions at the site. The depths for the two (2) boreholes ranged from -1.16 m LNT to -13.45 m LNT. Refusal to the three DCPTs ranged from -7.00 m LNT to -15.56 m LNT for the locations that were investigated. Bedrock was proven in the two (2) boreholes that were drilled from the edge of the wharf by coring up to 3 m into rock at each location or until it was obvious that bedrock was being cored. The bedrock type(s) encountered in these boreholes has been identified and is described in the logs attached to this report.

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## **1.0 INTRODUCTION**

Public Works and Government Services Canada (PWGSC) retained Fracflow Consultants Inc. to undertake a marine geotechnical site investigation at the Burin SARS site on the Burin Peninsula, on the south coast of Newfoundland. This investigation was conducted according to the stipulations outlined in the current Standing Offer Contract (No. EA003-160505/001/PWD) between PWGSC and Fracflow Consultants Inc.

The proposed scope of work for the Burin SARS site project consisted of drilling three (3) boreholes from a barge and four (4) boreholes from the edge of the wharf using an extended drilling platform. The field work for this investigation was conducted between March 16 and 28, 2018, and the revised scope of work due to high winds and poor weather conditions included drilling part of BH1 with two (2) split-spoon samples followed by driving a DCPT to refusal at the BH1, BH2 and BH3 locations. Environmental samples were collected at each location using a grab sampler and split-spoon assembly where ground conditions permitted. Equipment on the wharf, including several fuel storage tanks, prevented access to two (2) of the four (4) borehole locations on the edge of the wharf. Also, the large lifeboat and floating dock could not be moved to permit drilling of the holes within 2.2 m of the edge of the wharf. Two (2) boreholes were drilled over the edge of the wharf, and into bedrock, at locations specified by PWGSC. Environmental samples were collected at those two (2) ground locations where the ground conditions permitted. Split-spoon sampling and Standard Penetration Tests (SPTs) were conducted every 1.5 m using a NW/NQ diamond drilling string.

A visual inspection of the subsurface soil conditions encountered, based on the split-spoon samples that were recovered during the field program, and the laboratory data for the collected overburden samples were used to describe the soil conditions at the site. The depths for the two (2) boreholes ranged from -11.16 m LNT to -13.45 m LNT. Refusal to the three (3) DCPTs ranged from -7.00 m LNT to -15.56 m LNT for the locations that were investigated. Bedrock was proven in the two (2) boreholes that were drilled from the edge of the wharf by coring up to

3 m into rock at each location or until it was obvious that bedrock was being cored. The bedrock type(s) encountered in these boreholes has been identified and is described in the logs attached to this report. A summary of the field work that was conducted is provided in **Table 1.1**, **Table 1.2** and **Table 1.3**.

This report contains a factual presentation and full disclosure of all findings of the subsurface investigation. The following sections provide: (1) a description of the site and the general geology of the area; (2) a summary of the investigative procedures used; and (3) a detailed description of the subsurface soil conditions. Appended to this report is a site plan showing the borehole locations, the detailed geotechnical logs for each borehole and the grain size analysis reports.

Table 1.1 Summary of Geotechnical Investigations at Burin, Newfoundland.

<b>Borehole (BH)</b>	<b>Overburden Drilled (m)</b>	<b>Bedrock Drilled (m)</b>	<b>Total Depth Drilled (m)</b>	<b>Total Depth Below LNT (m)</b>	<b>Split-spoon Samples Attempted</b>	<b>Split-spoon Samples Tested</b>
<b>BH1</b>	2.86	0.00	2.86	7.69	2	2
<b>BH2</b>	--	--	--	--	-	1*
<b>BHA</b>	6.18	4.13	10.31	13.45	5	2
<b>BHB</b>	6.32	1.96	8.29	11.16	4	1
<b>Totals</b>	15.36	6.09	21.46	--	11	6

\* The remaining samples from the marine sediment samples were analyzed for the grain size analysis.

Table 1.2 Summary of Dynamic Cone Penetration Test, Burin, Newfoundland.

<b>DCPT #</b>	<b>DCPT depth below seabed (m)</b>	<b>Water Depth below LNT (m)</b>	<b>Total depth below LNT (m)</b>	<b>Comments</b>
BH1PC	5.53	4.84	10.37	Refusal at -10.37 m LNT
BH2PC	9.41	6.15	15.56	Refusal at -15.56 m LNT
BH3PC	1.43	5.58	7.01	Refusal at -7.00 m LNT

Table 1.3 Summary of Sampling Depths for the Marine Sediment Samples.

<b>Sample ID</b>	<b>Sampling Date</b>	<b>Sample Type</b>	<b>Sampling Depth (m below sea bed)</b>
<b>3118-BH1-GS-0z</b>	March 18, 2018	Soil	Harbour bottom
<b>3118-BH1-0.3-1z</b>	March 21, 2018	Soil	0.3 - 1.0
<b>3118-BH1-1-2z</b>	March 21, 2018	Soil	1.3 - 2.0
<b>3118-BH2-GS-0z</b>	March 21, 2018	Soil	Harbour bottom
<b>3118-BH2-0.3-1z</b>	March 21, 2018	Soil	0.3 - 1.0
<b>3118-BH2-1-2z</b>	March 21, 2018	Soil	1.3 - 2.0
<b>3118-BH3-0.3-1z</b>	March 21, 2018	Soil	0.3 - 1.0
<b>3118-BHA-GS-0z</b>	March 26, 2018	Soil	Harbour bottom



## **2.0 SITE DESCRIPTION AND GENERAL GEOLOGY**

The community of Burin is located on the Burin Peninsula, on the south coast of Newfoundland. It is located approximately 10 kilometres from Marystown. Overburden in the area of Burin is characterized as, “*Exposed bedrock plains, knobs and ridges, includes areas of thin till veneer and colluvium*” (Golder, 1985). The overburden encountered in the boreholes consisted mainly of sand and gravel with trace silt/clay and soft organic material. Bedrock units in the area are under Burin Group and composed of “*mafic volcanics, minor grey and green siltstone, sandstone, conglomerate, shale, dolomite*” (Golder, 1985).

### **3.0 INVESTIGATIVE PROCEDURES**

At the Burin site, two (2) boreholes were drilled at two (2) locations and DCPTs were driven at three (3) locations, and environmental samples were collected at all locations where ground conditions permitted. Drilling and part of the environmental sampling was completed using a Mobile B-47 drill rig drilling from a barge and also using an extended platform to drill from the edge of the wharf. The borehole, DCPT and environmental sample locations are shown on the site plan in **Appendix A**.

Overburden material was drilled using 'NW' (OD 88.9 mm, ID 76.2 mm) flush joint casing. Soil samples were collected using a 51 mm OD, 610 mm long, split-spoon sampler. In conjunction with this split-spoon soil sampling, Standard Penetration Tests (SPT) were performed to estimate relative soil densities. The standard procedure is to drive each SPT, the split-spoon, into the ground using a 63.5 kg weight falling a distance of 760 mm. The number of blows is recorded for each 150 mm the split-spoon is advanced. After the first 150 mm advance, a N-value is calculated as the sum of the blow counts required to drive the spoon an additional 300 mm (i.e., the sum of the second and third set of blow counts). The calculated N-value is a direct reflection of the relative density of the soil strata as defined in the Canadian Foundation Engineering Manual (CGS, 1992).

In addition to borehole sampling, three (3) Dynamic Cone Penetration Tests (DCPTs) were performed. During the driving of the pen cone, the cone was driven into the ground using a 63.5 kg weight falling a distance of 760 mm and the number of blow counts recorded for each 150 mm the cone advanced. The cone was driven into the soil until practical refusal occurred (50 blows per 150 mm or equivalent).

Rock was drilled using an 'NQ' (OD 69.9 mm, ID 60.3 mm) diamond drill string, cored up to 3 m depth into rock to prove bedrock, where required.

Both the soil samples and rock core are logged and labelled in the field immediately after collection. Soil samples are stored in moisture proof containers and rock cores are stored in wooden core boxes in the field. All soil and rock samples are returned to Fracflow's office where any soil samples collected during the investigation are tested. Soil testing in the laboratory consists of standard mechanical sieve analyses, hydrometer tests and water contents that are performed according to ASTM standards. If clays are encountered and recovered, additional tests are performed to characterize the clay material. The soil and rock core samples are stored by Fracflow for a two-year period.

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## **4.0 SUBSURFACE CONDITIONS AND CHARACTERIZATION**

Subsurface characterization is based on the field data collected from the two (2) vertical boreholes drilled in conjunction with the Standard Penetration Test data and the three (3) Dynamic Cone Penetration Tests. A description of the soil profiles is provided below using both terminologies defined in the Unified Soil Classification System (USCS) and in the Canadian Foundation Engineering Manual (CGS, 1992). Detailed logs of the geological conditions at each borehole location are provided in **Appendix B**. **Appendix C** contains the grain size analysis information for each soil sample tested.

### **4.1 Soil Description**

Overburden in the area of Burin is characterized as, “*Exposed bedrock plains, knobs and ridges, includes areas of thin till veneer and colluvium*” (Golder, 1985). The overburden encountered in the boreholes consisted mainly of sand and gravel with trace silt/clay and soft organic material.

Six (6) samples were analyzed in the lab using mechanical grain size analysis. Under the main category by USCS, one (1) sample was classified as gravel ‘GW (Well-graded gravel with sand). The other five (5) samples were classified as sand and SP (Poorly graded sand with gravel), SW (Well-graded sand with gravel), SM (Silty sand with gravel), and SP-SM (Poorly graded sand with silt and gravel). By CFEM, the samples are mainly described as “Gravelly Sand, trace Silt/Clay”, “Sand and Gravel”, and “Gravel and Sand, trace Silt/Clay”.

First refusal to the SPT was encountered on rock mattress or scour protection rock in one (1) borehole, BHB at -3.433 m LNT. The boreholes and the depths of final refusal or depths to bedrock are: Boreholes A and B with depths of -9.32 m LNT, and - 9.19 m LNT, respectively. SPT refusal was encountered on boulders or broken bedrock at shallower depths. The depth at

which each DCPT (BH1PC, BH2PC and BH3PC) met refusal, assumed to be on bedrock or boulder, is -10.37 m LNT, -15.56 m LNT, and -7.01 m LNT, respectively. It is important to note that the DCPT data indicate a measurable thickness of soft material in each DCPT location. The summary of depths of each borehole is provided in **Table 1.1** and each DCPT in **Table 1.2**. In addition, eight (8) marine sediment samples were collected at the proposed borehole locations and submitted to AGAT Laboratories for Marine Sediment Analysis Package. The details of sampling depths are provided in **Table 1.3**.

Detailed information for each borehole and DCPT is contained in **Appendix B** and the sieve analysis data are provided in **Appendix C**.

## **4.2 Bedrock Description**

Bedrock was encountered in two (2) boreholes. Bedrock was proven after SPT refusal by coring up to 3.0 m in to bedrock or to a depth that was sufficient to confirm bedrock had been encountered.

The core samples had sample recoveries in the range of 40% to 100%. Fracture intensity varied over the length cored and between boreholes and RQD values ranged from 0% to 73%. Detailed bedrock information is provided in the borehole logs in **Appendix B**.

Bedrock units in the area are under Burin Group and composed of “*mafic volcanics, minor grey and green siltstone, sandstone, conglomerate, shale, dolomite*” (Golder, 1985). Fractured metamorphic rock was encountered in the two (2) boreholes.

## **5.0 REFERENCES**

Canadian Geotechnical Society (CGS), 1992. *Canadian Foundation Engineering Manual*, 3<sup>rd</sup> Edition, Technical Committee on Foundations, 512 p.

Golder Associates (Golder), 1985. *Hydrogeology Of The Burin Peninsula Area, Water Resouces Report 2-7, Groundwater Series*. Department of Environment, Water Resources Division, St. John's, Newfoundland.

## ***APPENDIX A***

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### ***Borehole and DCPT Location Map***

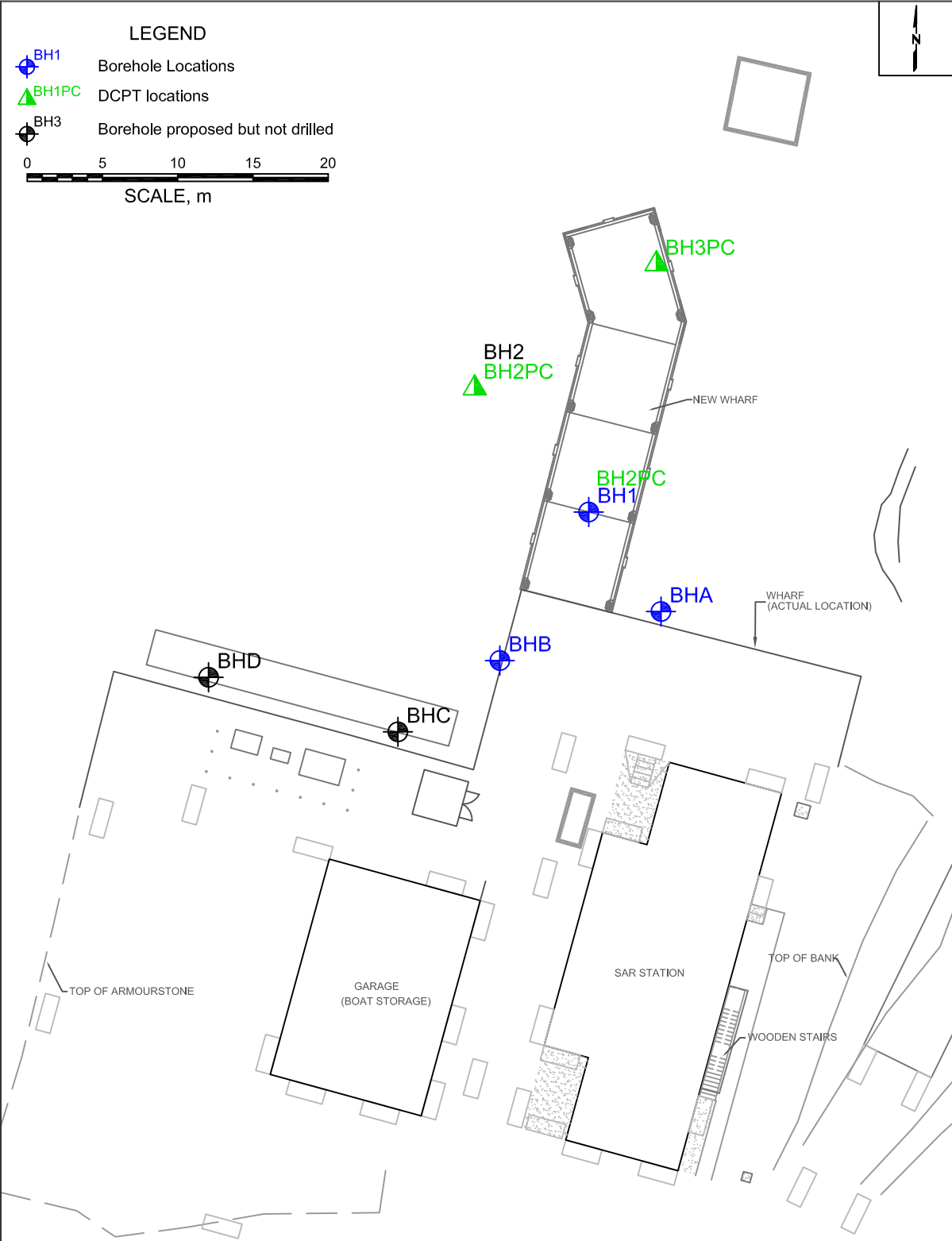



Figure 1 Locations of the boreholes and DCPTs at Burin, NL.

Project No. 3118	Document No. FFC-NL-3118	
Location Burin, NL	Date April 2018	



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***APPENDIX B***  
***Borehole and DCPT Logs***

Project: Marine Geotechnical Investigation

**Log of Borehole: BH1**

Client: Public Works Government Services Canada

Project No: 3118

Location: Burin, NL

Date: March 17, 2018

SUBSURFACE PROFILE				SAMPLE					Standard Penetration Test "N" Value per 300 mm
Depth below LNT	Symbol	Geologic Description	Elevation (m)	Sample Type	Sample No.	"N" Value	Recovery (%)	RQD (%)	
0 m		0 m LNT	0						20 40 60 80
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15		Harbour Bottom (-4.83 m LNT)	-4.83						
16									
17		SPT: 1 for 0.30 m / 1 for 0.15 m / 1 for 0.46 m		SS	1	1	16		
18		CFEM: Sand, some Gravel, trace Silt/Clay Sulfur odour	-5.95						
19									
20		No recovery	-6.34	OB	--		0		
21		Split-spoon sank 0.57 m under own weight into soft sediments	-6.9						
22									
23		Split-spoon sank 0.08 m before SPT SPT: 1 for 0.30 m / 1 for 0.15 m / 1 for 0.38 m		SS	2	1	18		
24		CFEM: Gravelly Sand, some Silt/Clay	-7.69						
25									
26		End of Borehole							



Fracflow Consultants Inc.  
154 Major's Path  
St. John's, NL A1A 5A1  
Phone: (709) 739-7270  
Fax: (709) 753-5101

Drilling Method: NW Casing / NQ Coring

Datum: Geodetic

Driller: Formation Drilling Ltd.

Sheet: 1 of 1

Project: Marine Geotechnical Investigation

**Log of Borehole: BHA**

Client: Public Works Government Services Canada

Project No: 3118

Location: Burin, NL

Date: March 25 - 26, 2018

SUBSURFACE PROFILE				SAMPLE					Standard Penetration Test "N" Value per 300 mm
Depth below LNT	Symbol	Geologic Description	Elevation (m)	Sample Type	Sample No.	"N" Value	Recovery (%)	RQD (%)	
0 m		0 m LNT	0						20 40 60 80
1									
2									
3									
4									
5									
6									
7									
8									
9									
10		Harbour Bottom (-3.14 m LNT)	-3.14						
11		SPT: 4 / 6 / 9 / 27 Gravel	-3.72	SS	1	15	12		
12									
13		SPT: 13 / 14 / 10 / 8 Gravel with rock chips	-4.3	SS	2	24	19		
14									
15		Gravel		OB	--		25		
16			-5.18						
17		SPT: 5 / 3 / 4 / 4 Gravelly sand	-5.78	SS	3	7	1		
18									
19		Gravel		OB	--		7		
20			-6.72						
21		SPT: 5 / 7 / 8 / 14 CFEM: Gravel and Sand, trace Silt/Clay Sulfurous odour	-7.33	SS	4	15	27		
22									
23		Gravel					8		
24									
25									
26									



Fracflow Consultants Inc.  
154 Major's Path  
St. John's, NL A1A 5A1  
Phone: (709) 739-7270  
Fax: (709) 753-5101

Drilling Method: NW Casing / NQ Coring

Driller: Formation Drilling Ltd.

Datum: Geodetic

Sheet: 1 of 2

Project: Marine Geotechnical Investigation

**Log of Borehole: BHA**

Client: Public Works Government Services Canada

Project No: 3118

Location: Burin, NL

Date: March 25 - 26, 2018

SUBSURFACE PROFILE				SAMPLE					Standard Penetration Test "N" Value per 300 mm
Depth below LNT	Symbol	Geologic Description	Elevation (m)	Sample Type	Sample No.	"N" Value	Recovery (%)	RQD (%)	
27			-8.23	OB	--		8		
28		SPT: 14 / 22 / 19 / 12 CFEM: Gravelly Sand, trace Silt/Clay	-8.84	SS	5	41	29		
29									
30		Boulders	-9.32	OB	--		7		
31									
32				RC	--		45	0	
33									
34				RC	--		100	22	
35									
36									
37				RC	--		40	0	
38		Bedrock: Metamorphic rock							
39									
40									
41									
42				RC	--		52	0	
43									
44			-13.4						
45		End of Borehole							
46									
47									
48									
49									
50									
51									
52									



Fracflow Consultants Inc.  
 154 Major's Path  
 St. John's, NL A1A 5A1  
 Phone: (709) 739-7270  
 Fax: (709) 753-5101

Drilling Method: NW Casing / NQ Coring

Datum: Geodetic

Driller: Formation Drilling Ltd.

Sheet: 2 of 2

Project: Marine Geotechnical Investigation

**Log of Borehole: BHB**

Client: Public Works Government Services Canada

Project No: 3118

Location: Burin, NL

Date: March 27, 2018

SUBSURFACE PROFILE				SAMPLE					Standard Penetration Test "N" Value per 300 mm
Depth below LNT	Symbol	Geologic Description	Elevation (m)	Sample Type	Sample No.	"N" Value	Recovery (%)	RQD (%)	
0 m		0 m LNT	0						20 40 60 80
1									
2									
3									
4									
5									
6									
7									
8									
9		Harbour Bottom (-2.87 m LNT)	-2.87						
10		SPT: 5 / 2 / 1 / 52 for 0.11 m (Refusal) No recovery		SS	1	3	0		
11			-3.43	OB	2	54	0		
12		Boulders		SS	2	54	0		
13		SPT: 54 for 0.10 m (Refusal) No recovery							
14									
15									
16									
17		Boulders		OB	--		25		
18									
19									
20									
21									
22			-6.79						
23		SPT: 3 / 3 / 4 / 5 CFEM: Sand and Gravel		SS	3	7	35		
24			-7.39						
25		Gravel		OB	--		8		
26			-8.08						



Fracflow Consultants Inc.  
154 Major's Path  
St. John's, NL A1A 5A1  
Phone: (709) 739-7270  
Fax: (709) 753-5101

Drilling Method: NW Coring / NQ Casing

Datum: Geodetic

Driller: Formation Drilling Ltd.

Sheet: 1 of 2

Project: Marine Geotechnical Investigation

**Log of Borehole: BHB**

Client: Public Works Government Services Canada

Project No: 3118

Location: Burin, NL

Date: March 27, 2018

SUBSURFACE PROFILE				SAMPLE					Standard Penetration Test "N" Value per 300 mm
Depth below LNT	Symbol	Geologic Description	Elevation (m)	Sample Type	Sample No.	"N" Value	Recovery (%)	RQD (%)	
27		SPT: 14 / 21 / 16 / 13 Gravel	-8.69	SS	4	37	6		20 40 60 80
28									
29		Boulders	-9.19	OB	--		38		
30									
31		Bedrock: Metamorphic rock		RC	--		100	0	
32				RC	--		95	73	
33				RC	--		100	51	
34				RC	--		100	41	
35				RC	--		97	0	
36		End of Borehole	-11.2						
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									
48									
49									
50									
51									
52									



Fracflow Consultants Inc.  
 154 Major's Path  
 St. John's, NL A1A 5A1  
 Phone: (709) 739-7270  
 Fax: (709) 753-5101

Drilling Method: NW Coring / NQ Casing

Datum: Geodetic

Driller: Formation Drilling Ltd.

Sheet: 2 of 2

Project: Marine Geotechnical Investigation  
 Client: Public Works Government Services Canada  
 Location: Burin, NL

## Log of DCPT: BH1PC

Project No: 3118  
 Date: March 18, 2018

Depth ft m	Geologic Description	Elevation (m)	Blows per 150 mm	Standard Penetration Test "N" Value per 300 mm			
				20	40	60	80
0	0 m LNT	0					
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16	Harbour Bottom (-4.84 m LNT)	-4.84					
17	Pencone immediately sank 0.64 m into soft sediments under own weight	-5.47					
18							
19	Pencone sank additional 1.03 m after setting up the test hammer due to additional weight.						
20							
21		-6.5					
22			1				
23			1				
24			1				
25			1				
26			1				
			2				
			2				
			2				
			2				

DCPT:  
 1 for 0.44 m / 1  
 / 1 / 1 / 1 / 1  
 / 2 / 2 / 2 / 3



Fracflow Consultants Inc.  
 154 Major's Path  
 St. John's, NL A1A 5A1  
 Phone: (709) 739-7270  
 Fax: (709) 753-5101

Drilling Method: Dynamic Cone Penetration Test

Datum: Geodetic

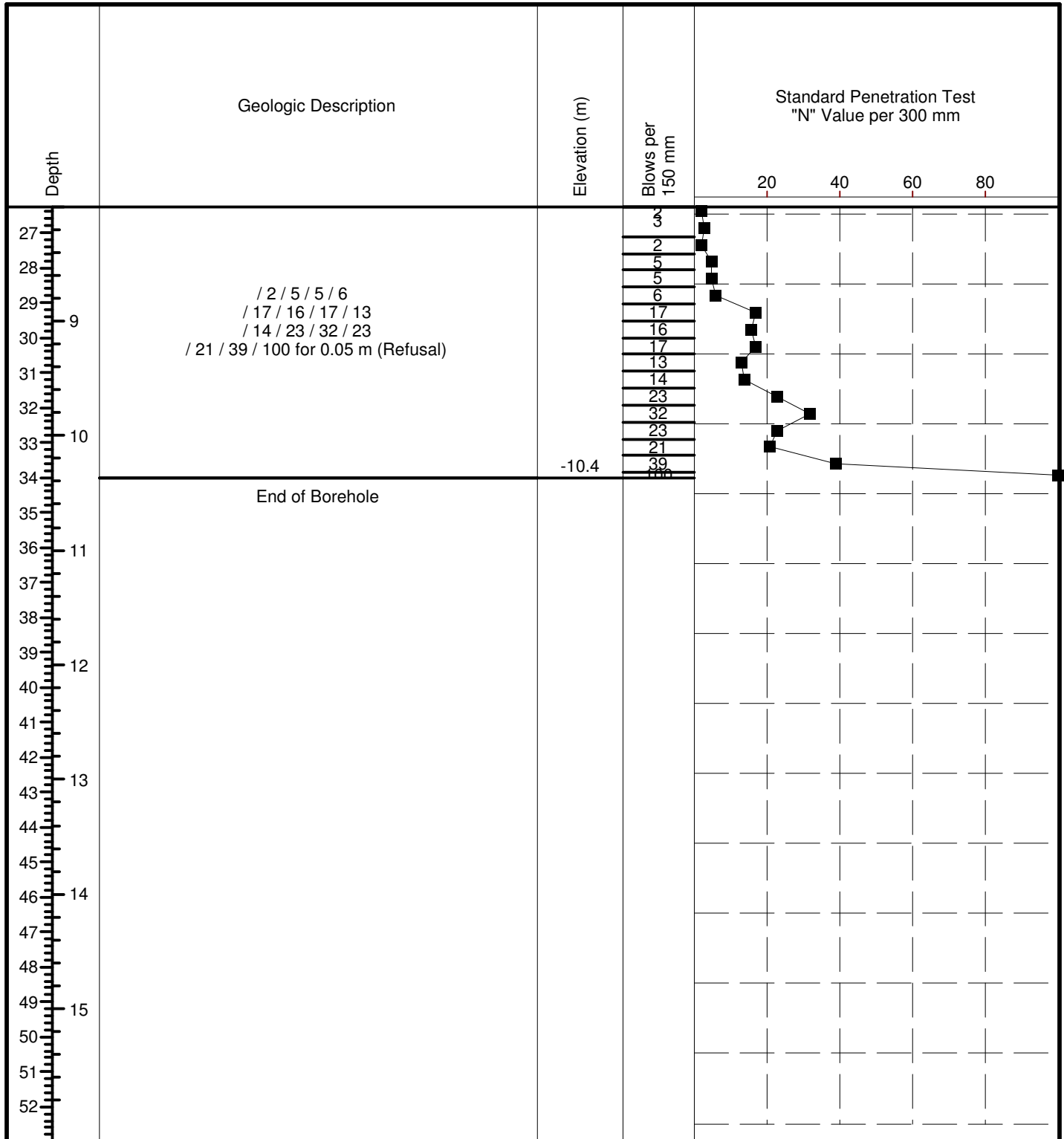
Driller: Formation Drilling Ltd.

Sheet: 1 of 2

Project: Marine Geotechnical Investigation  
 Client: Public Works Government Services Canada  
 Location: Burin, NL

## Log of DCPT: BH1PC

Project No: 3118  
 Date: March 18, 2018



Fracflow Consultants Inc.  
 154 Major's Path  
 St. John's, NL A1A 5A1  
 Phone: (709) 739-7270  
 Fax: (709) 753-5101

Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Sheet: 2 of 2



Project: Marine Geotechnical Investigation  
 Client: Public Works Government Services Canada  
 Location: Burin, NL

## Log of DCPT: BH2PC

Project No: 3118  
 Date: March 21, 2018

Depth ft m	Geologic Description	Elevation (m)	Blows per 150 mm	Standard Penetration Test "N" Value per 300 mm			
				20	40	60	80
0	0 m LNT	0					
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20	Harbour Bottom (-6.15 m LNT)	-6.15					
21							
22	Pencone sank 1.28 m into soft sediments under own weight						
23							
24		-7.42					
25			1				
26							



Fracflow Consultants Inc.  
 154 Major's Path  
 St. John's, NL A1A 5A1  
 Phone: (709) 739-7270  
 Fax: (709) 753-5101

Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Sheet: 1 of 2

Project: Marine Geotechnical Investigation

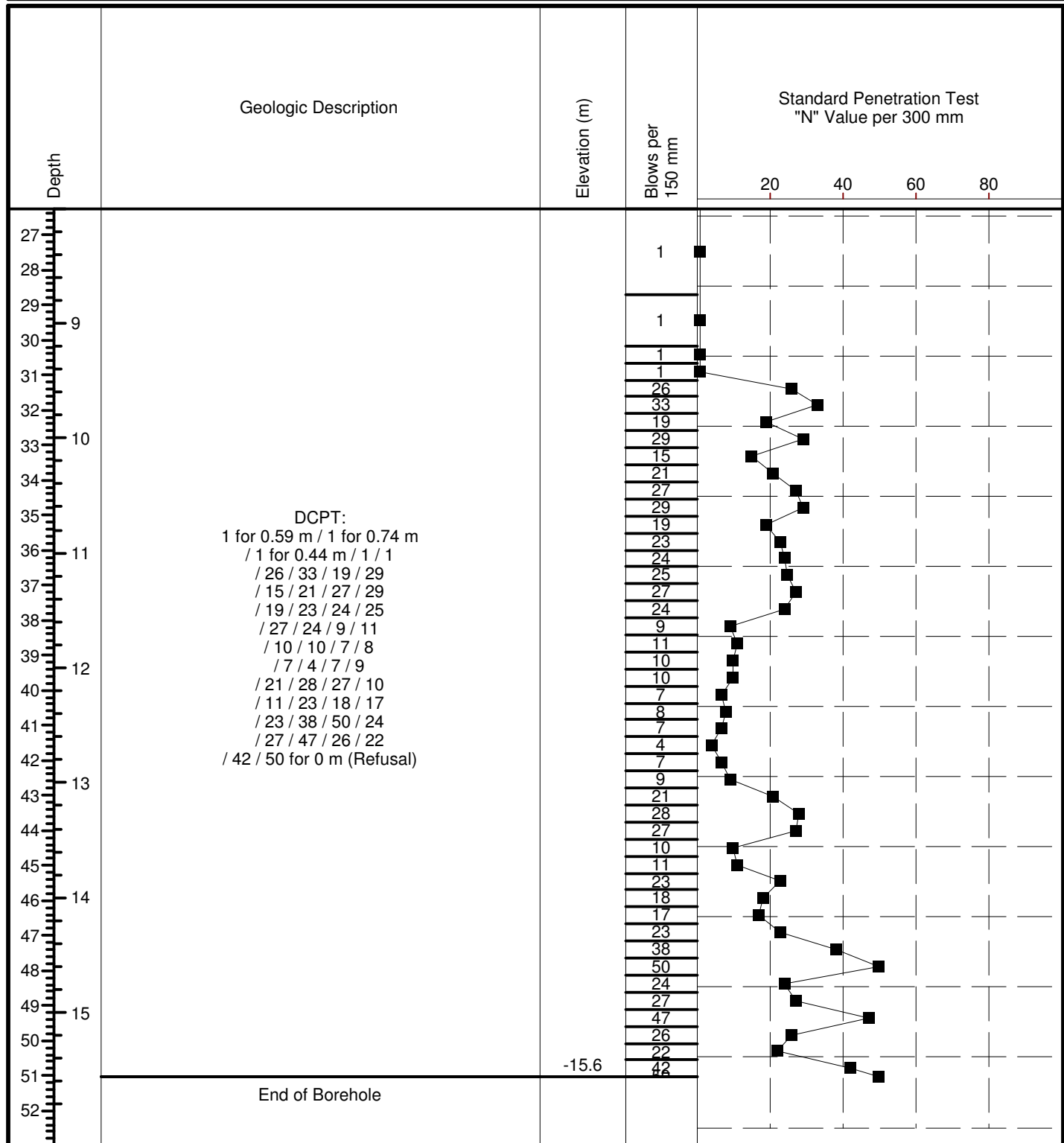
Client: Public Works Government Services Canada

Location: Burin, NL

## Log of DCPT: BH2PC

Project No: 3118

Date: March 21, 2018



Fracflow Consultants Inc.  
 154 Major's Path  
 St. John's, NL A1A 5A1  
 Phone: (709) 739-7270  
 Fax: (709) 753-5101

Drilling Method: Dynamic Cone Penetration Test

Driller: Formation Drilling Ltd.

Datum: Geodetic

Sheet: 2 of 2



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***APPENDIX C***  
***Grain Size Analysis***

# GRAIN SIZE ANALYSIS

Project : 3118 - Burin, NL

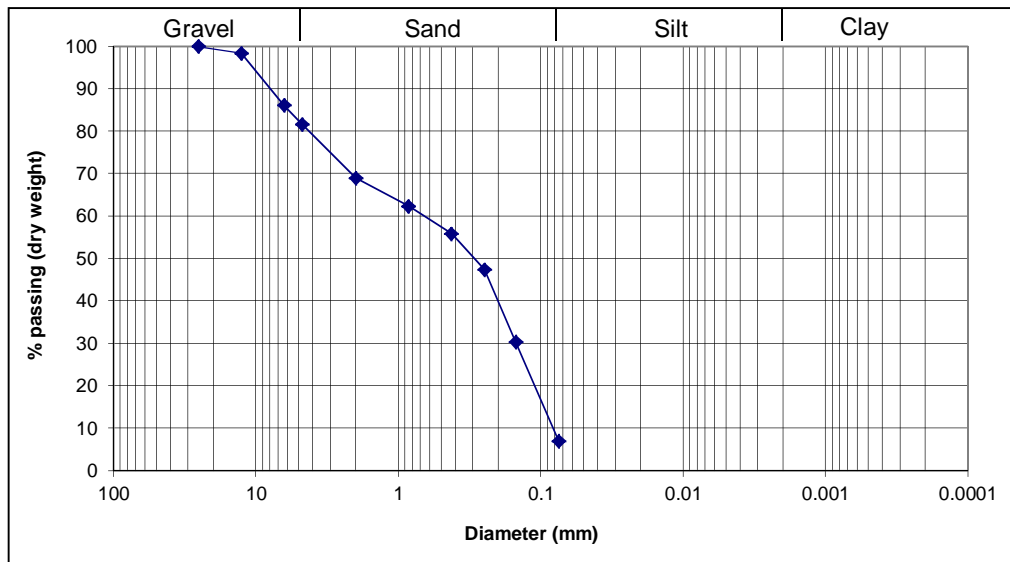
Sample No. : BH1-SS1

Depth below LNT : 4.83 m - 5.95 m

Sieve Analysis

Dry weight of sample (g) = 115.45

Sieve	Opening (mm)	Retained (g)	% Retained	Cumulative % Ret	% Passing
2	50.8	-	-		
1	25.4	0.00	0.00	0.00	100.00
1/2"	12.7	1.88	1.63	1.63	98.37
1/4"	6.35	14.14	12.25	13.88	86.12
4	4.76	5.09	4.41	18.28	81.72
10	2.00	14.71	12.74	31.03	68.97
20	0.85	7.69	6.66	37.69	62.31
40	0.425	7.43	6.44	44.12	55.88
60	0.25	9.77	8.46	52.59	47.41
100	0.15	19.75	17.11	69.69	30.31
200	0.075	26.85	23.26	92.95	7.05
pan	---	8.14	7.05	100.00	---
		115.45			



$$D_{10} = 0.081$$

$$D_{30} = 0.15$$

$$D_{60} = 0.66$$

$$Cu = 8.15$$

$$Cc = 0.42$$

**USCS:** SP-SM (Poorly graded sand with silt and gravel) or SP-SC (Poorly graded sand with clay and gravel)

$$R_{200} = 92.95$$

$$R_4 = 18.28$$

$$R_4/R_{200} = 0.20$$

$$SF = 74.66$$

$$GF = 18.28$$

$$\% \text{ Gravel} = 18.28$$

$$\% \text{ Sand} = 74.66$$

$$\% \text{ Silt \& Clay} = 7.05$$

$$\% \text{ Clay} = \text{NA}$$

**CFEM:** Sand, some Gravel, trace Silt/Clay

**Moisture Content (%):** 95.37

# GRAIN SIZE ANALYSIS

Project : 3118 - Burin, NL

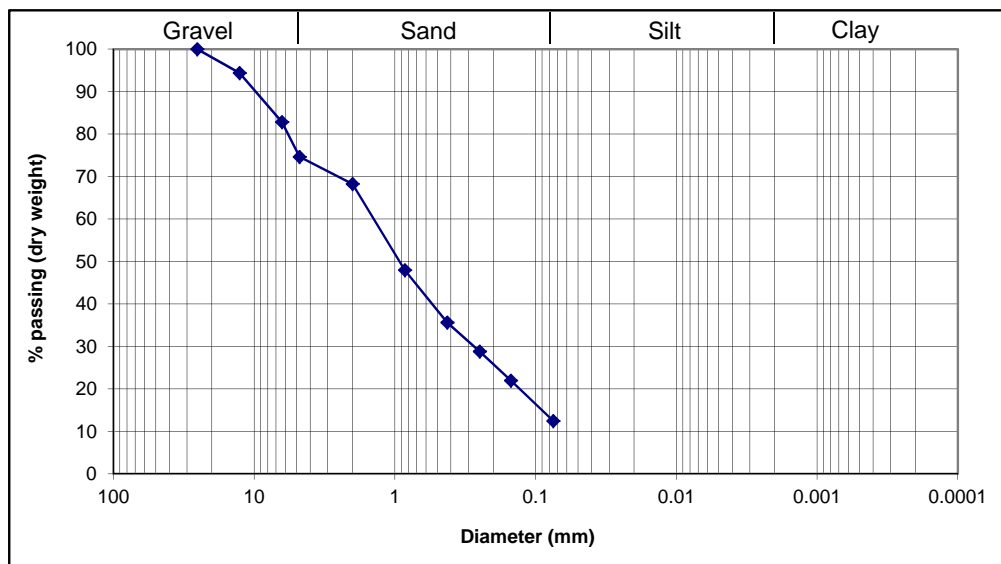
Sample No. : BH1-SS2

Depth below LNT : 6.90 m - 7.69 m

Sieve Analysis

Dry weight of sample (g) = 105.46

Sieve	Opening (mm)	Retained (g)	% Retained	Cumulative % Ret	% Passing
2	50.8	-	-		
1	25.4	0.00	0.00	0.00	100.00
1/2"	12.7	5.92	5.61	5.61	94.39
1/4"	6.35	12.20	11.57	17.18	82.82
4	4.76	8.62	8.17	25.36	74.64
10	2.00	6.73	6.38	31.74	68.26
20	0.85	21.41	20.30	52.04	47.96
40	0.425	13.00	12.33	64.37	35.63
60	0.25	7.20	6.83	71.19	28.81
100	0.15	7.22	6.85	78.04	21.96
200	0.075	10.04	9.52	87.56	12.44
pan	---	13.12	12.44	100.00	---
		105.46			



$$D_{10} = 0.06$$

$$D_{30} = 0.27$$

$$D_{60} = 1.4$$

$$Cu = 23.33$$

$$Cc = 0.87$$

**USCS:** SM (Silty sand with gravel) or SC (Clayey sand with gravel)

$$R_{200} = 87.56$$

$$\% \text{ Gravel} = 25.36$$

$$R_4 = 25.36$$

$$\% \text{ Sand} = 62.20$$

$$R_4/R_{200} = 0.29$$

$$\% \text{ Silt \& Clay} = 12.44$$

$$SF = 62.20$$

$$\% \text{ Clay} = \text{NA}$$

$$GF = 25.36$$

**CFEM:** Gravelly Sand, some Silt/Clay

**Moisture Content (%):** 94.52

# GRAIN SIZE ANALYSIS

Project : 3118 - Burin, NL

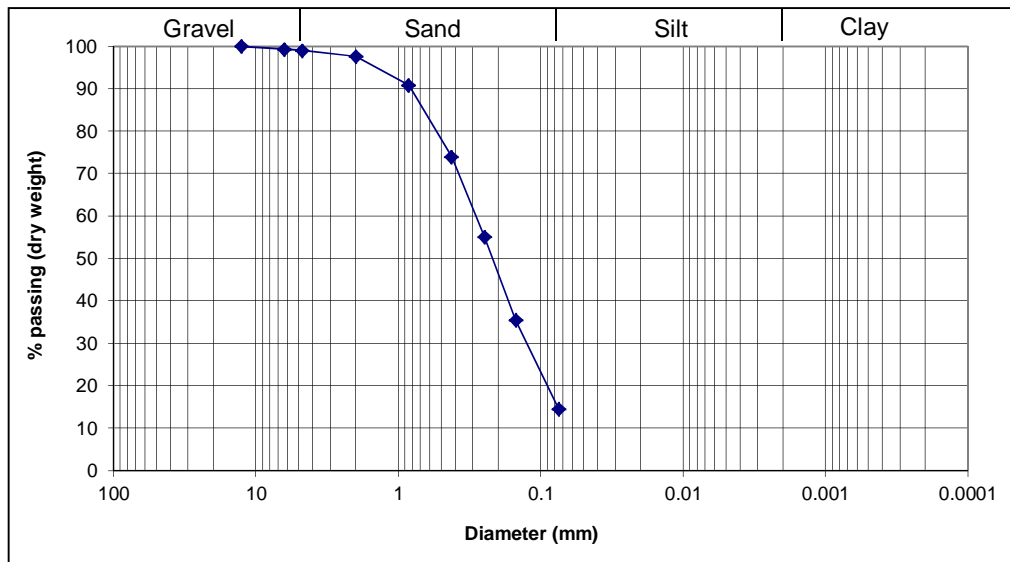
Sample No. : BH2-GS-0Z

Depth below LNT : 0 m, harbour  
bottom

Sieve Analysis

Dry weight of sample (g) = 75.88

Sieve	Opening (mm)	Retained (g)	% Retained	Cumulative % Ret	% Passing
2	50.8	-	-		
1	25.4	-	-		
1/2"	12.7	0.00	0.00	0.00	100.00
1/4"	6.35	0.51	0.67	0.67	99.33
4	4.76	0.27	0.36	1.03	98.97
10	2.00	0.97	1.28	2.31	97.69
20	0.85	5.20	6.85	9.16	90.84
40	0.425	12.76	16.82	25.98	74.02
60	0.25	14.35	18.91	44.89	55.11
100	0.15	14.93	19.68	64.56	35.44
200	0.075	15.85	20.89	85.45	14.55
pan	---	11.04	14.55	100.00	---
		75.88			



$$D_{10} = 0.06$$

$$D_{30} = 0.125$$

$$D_{60} = 0.285$$

$$Cu = 4.75$$

$$Cc = 0.91$$

**USCS:** SM (Silty Sand) or SC (Clayey Sand)

$$R_{200} = 85.45$$

$$R_4 = 1.03$$

$$R_4/R_{200} = 0.01$$

$$SF = 84.42$$

$$GF = 1.03$$

$$\% \text{ Gravel} = 1.03$$

$$\% \text{ Sand} = 84.42$$

$$\% \text{ Silt \& Clay} = 14.55$$

$$\% \text{ Clay} = \text{NA}$$

**CFEM:** Sand, some Silt/Clay, trace Gravel

**Moisture Content (%):** 282.73

# GRAIN SIZE ANALYSIS

Project : 3118 - Burin, NL

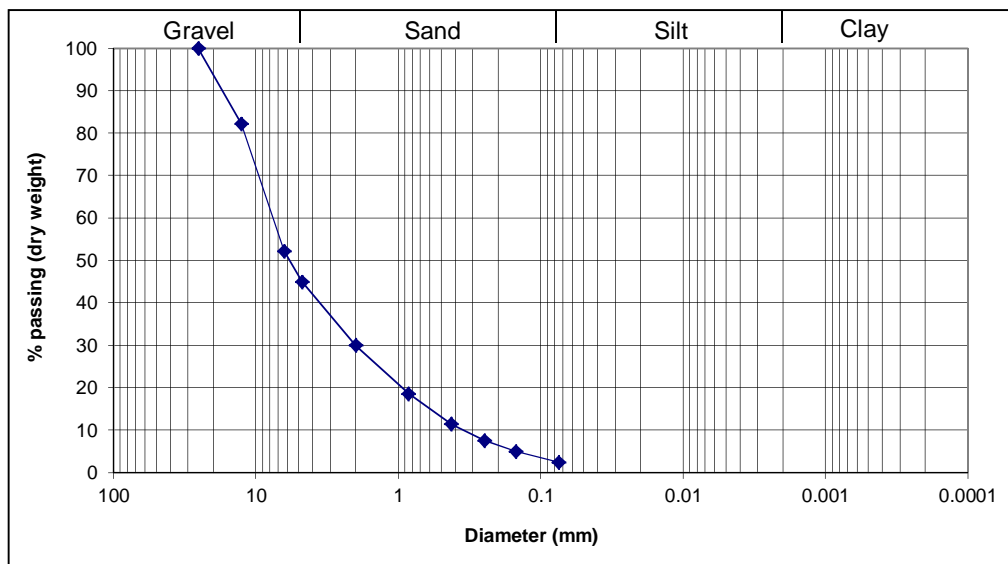
Sample No. : BHA-SS4

Depth below LNT : 6.72 m - 7.33 m

Sieve Analysis

Dry weight of sample (g) = 210.40

Sieve	Opening (mm)	Retained (g)	% Retained	Cumulative % Ret	% Passing
2	50.8	-	-		
1	25.4	0.00	0.00	0.00	100.00
1/2"	12.7	37.27	17.71	17.71	82.29
1/4"	6.35	63.21	30.04	47.76	52.24
4	4.76	15.15	7.20	54.96	45.04
10	2.00	31.62	15.03	69.99	30.01
20	0.85	23.87	11.35	81.33	18.67
40	0.425	15.18	7.21	88.55	11.45
60	0.25	7.94	3.77	92.32	7.68
100	0.15	5.39	2.56	94.88	5.12
200	0.075	5.65	2.69	97.57	2.43
pan	---	5.12	2.43	100.00	---
		210.40			



$$D_{10} = 0.34$$

$$D_{30} = 2$$

$$D_{60} = 7.5$$

$$Cu = 22.06$$

$$Cc = 1.57$$

**USCS:** GW (Well-graded gravel with sand)

$$R_{200} = 97.57$$

$$R_4 = 54.96$$

$$R_4/R_{200} = 0.56$$

$$SF = 42.61$$

$$GF = 54.96$$

$$\% \text{ Gravel} = 54.96$$

$$\% \text{ Sand} = 42.61$$

$$\% \text{ Silt \& Clay} = 2.43$$

$$\% \text{ Clay} = \text{NA}$$

**CFEM:** Gravel and Sand, trace Silt/Clay

**Moisture Content (%):** 32.05



# GRAIN SIZE ANALYSIS

Project : 3118 - Burin, NL

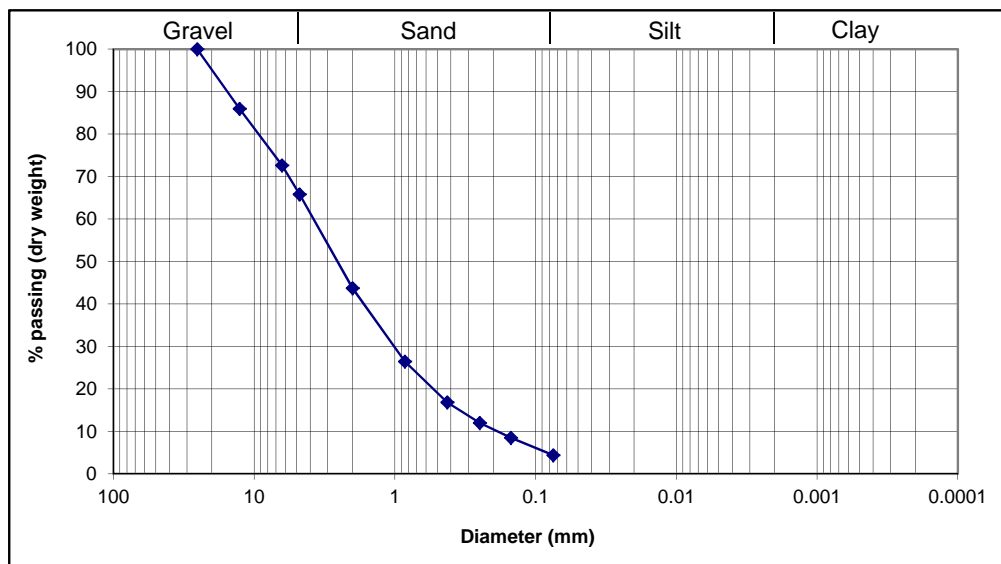
Sample No. : BHA-SS5

Depth below LNT : 8.23 m - 8.84 m

Sieve Analysis

Dry weight of sample (g) = 247.28

Sieve	Opening (mm)	Retained (g)	% Retained	Cumulative % Ret	% Passing
2	50.8	-	-		
1	25.4	0.00	0.00	0.00	100.00
1/2"	12.7	34.75	14.05	14.05	85.95
1/4"	6.35	32.91	13.31	27.36	72.64
4	4.76	16.84	6.81	34.17	65.83
10	2.00	54.68	22.11	56.28	43.72
20	0.85	42.68	17.26	73.54	26.46
40	0.425	23.79	9.62	83.16	16.84
60	0.25	11.97	4.84	88.01	11.99
100	0.15	8.64	3.49	91.50	8.50
200	0.075	10.15	4.10	95.60	4.40
pan	---	10.87	4.40	100.00	---
		247.28			



$$D_{10} = 0.185$$

$$D_{30} = 1$$

$$D_{60} = 3.75$$

$$Cu = 20.27$$

$$Cc = 1.44$$

**USCS:** SW (Well-graded sand with gravel)

$$R_{200} = 95.60$$

$$R_4 = 34.17$$

$$R_4/R_{200} = 0.36$$

$$SF = 61.43$$

$$GF = 34.17$$

$$\% \text{ Gravel} = 34.17$$

$$\% \text{ Sand} = 61.43$$

$$\% \text{ Silt \& Clay} = 4.40$$

$$\% \text{ Clay} = \text{NA}$$

**CFEM:** Gravelly Sand, trace Silt/Clay

**Moisture Content (%):** 12.88

# GRAIN SIZE ANALYSIS

Project : 3118 - Burin, NL

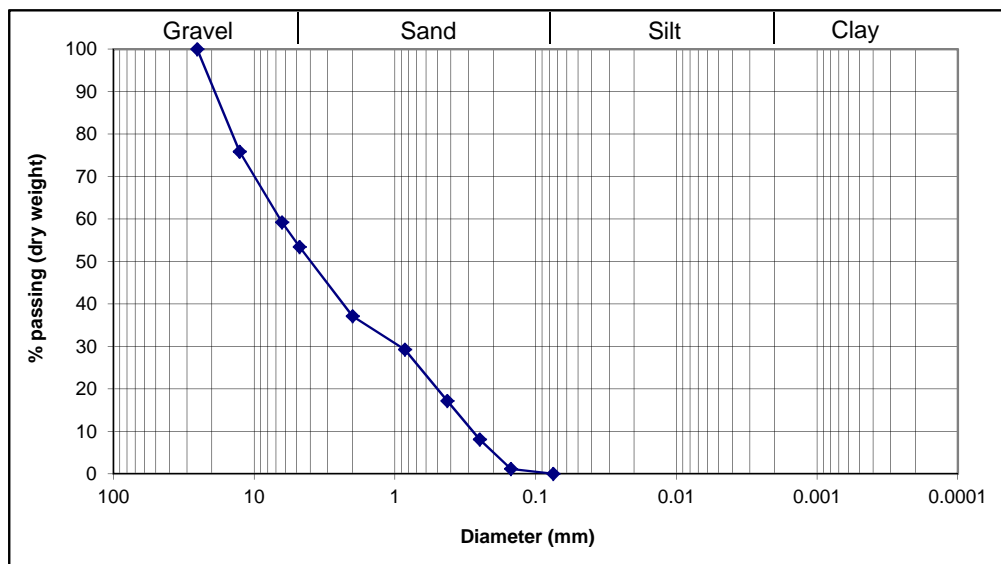
Sample No. : BHB-SS3

Depth below LNT : 6.79 m - 7.40 m

Sieve Analysis

Dry weight of sample (g) = 209.61

Sieve	Opening (mm)	Retained (g)	% Retained	Cumulative % Ret	% Passing
2	50.8	-	-		
1	25.4	0.00	0.00	0.00	100.00
1/2"	12.7	50.54	24.11	24.11	75.89
1/4"	6.35	34.92	16.66	40.77	59.23
4	4.76	12.16	5.80	46.57	53.43
10	2.00	34.13	16.28	62.85	37.15
20	0.85	16.54	7.89	70.75	29.25
40	0.425	25.29	12.07	82.81	17.19
60	0.25	19.06	9.09	91.90	8.10
100	0.15	14.52	6.93	98.83	1.17
200	0.075	2.40	1.14	99.98	0.02
pan	---	0.05	0.02	100.00	---
		209.61			



$$D_{10} = 0.275$$

$$D_{30} = 0.91$$

$$D_{60} = 6.6$$

$$Cu = 24.00$$

$$Cc = 0.46$$

**USCS:** SP (Poorly graded sand with gravel)

$$R_{200} = 99.98$$

$$R_4 = 46.57$$

$$R_4/R_{200} = 0.47$$

$$SF = 53.40$$

$$GF = 46.57$$

$$\% \text{ Gravel} = 46.57$$

$$\% \text{ Sand} = 53.40$$

$$\% \text{ Silt \& Clay} = 0.02$$

$$\% \text{ Clay} = \text{NA}$$

**CFEM:** Sand and Gravel

**Moisture Content (%):** 19.60