

# **APPENDIX B**



**Geotechnical Investigation  
Val-Comeau Wharf**

Val-Comeau, New Brunswick  
March 7, 2013

Prepared for PWGSC  
**Project No. 6489.17-R01**





# GEMTEC

CONSULTING ENGINEERS  
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March 7, 2013

File: 6489.17 – R01

Public Works and Government Services Canada  
1045 Main Street Unit 100  
Moncton, NB  
E1C 1H1

Attention: Garth Holder, Project Manager

**Re: Geotechnical Investigation, Val-Comeau Wharf  
Val-Comeau, New Brunswick**

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Enclosed is our geotechnical report for the above noted project in Val-Comeau, New Brunswick.

Contact the undersigned if you have any questions or comments concerning this report.



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Adrian Thompson, M.Sc.E, P.Eng  
GEMTEC Limited

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Enclosures

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**Geotechnical Investigation  
Val-Comeau Wharf  
Val-Comeau, New Brunswick**

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**Geotechnical Investigation  
Val-Comeau Wharf  
Val-Comeau, New Brunswick**

## **1.0 Introduction**

GEMTEC Limited was retained by Public Works and Government Services Canada to undertake a geotechnical investigation at the Val-Comeau Wharf in Val-Comeau, New Brunswick. We understand that wharf improvements to Structures 401, 402 and 405 will include the incorporation of a Berlin wall along the face of the wharf are proposed for this location. We further understand the following:

- We understand that the proposed HP 310 x 79 steel H piles will require a finalized depth into bedrock of about 1.0 metre, with pre-cast concrete panels between the piles on 2.4 metre centres.
- Based on drawing provided to us by VALRON Engineers Inc., we understand that the upper portion of the existing timber crib wharf (1.3 metres  $\pm$ ) will be removed.
- The remaining cribs will be filled with crushed rock fill to the underside of slab-on-grade deck.

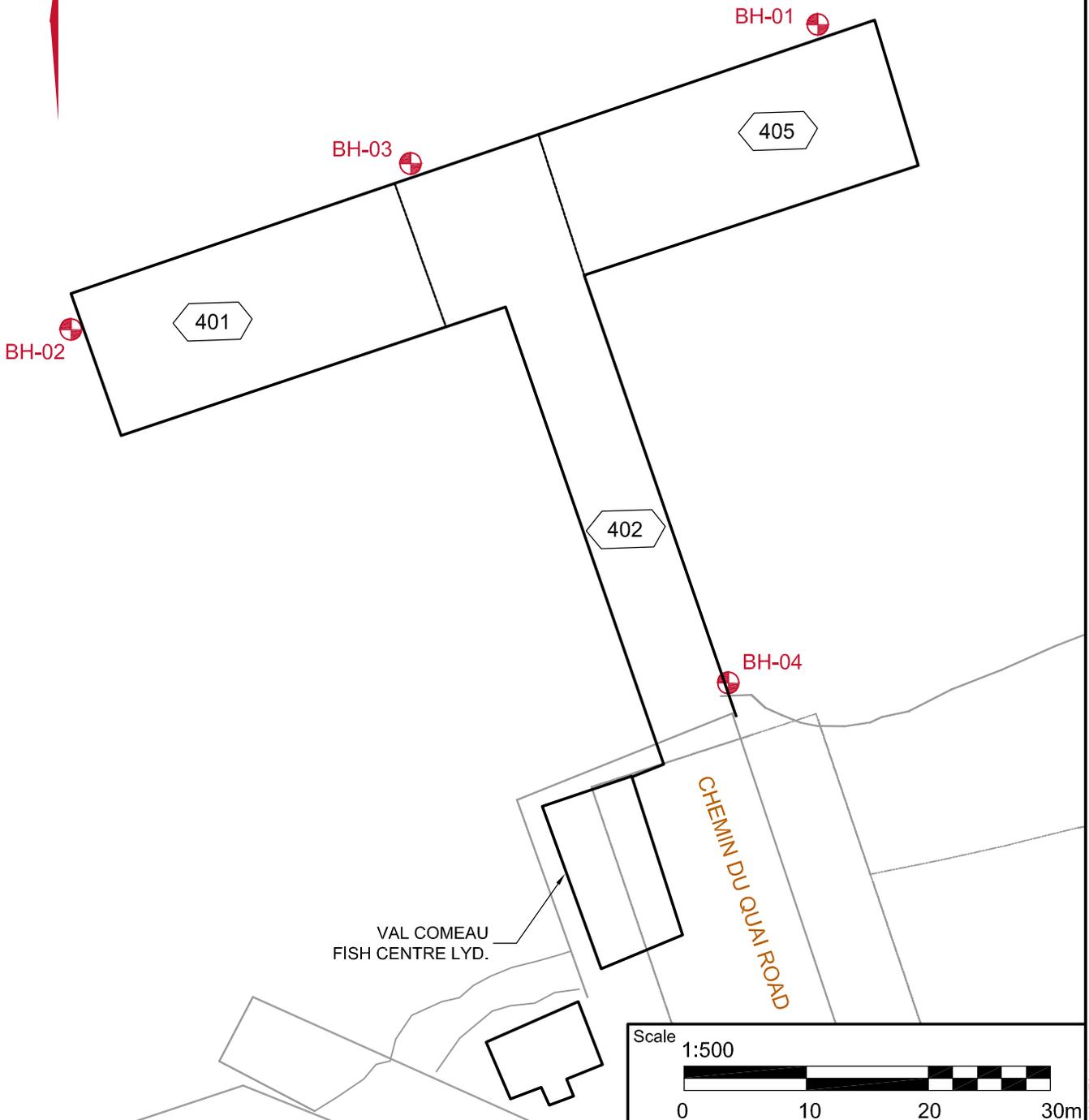
In order to assess the existing soil and bedrock conditions, four boreholes (BH) were put down on February 12, 2013 using a geotechnical drill rig subcontracted to MEG Drilling. Boreholes were put down to depths ranging from 4.6 to 5.9 metres in the presence of one of our geotechnical engineers. Bedrock was cored at each borehole location. Detailed borehole logs (Appendix A) and bedrock core photos (Appendix B) are appended.

A site plan showing borehole locations and general site layout is presented in Figure 1. Boreholes were surveyed by GEMTEC Limited and reference control point 88B9001 with a published chart datum (CD) elevation +1.929 metres.

## **2.0 Site Conditions**

The Val-Comeau Wharf is located in Val-Comeau, New Brunswick. Structures 401, 402 and 405 consist of a timber crib structure with a concrete panel deck. The existing concrete deck elevation ranges from about +1.4 to +1.7 metres CD. The harbour bottom elevation adjacent to the wharf varied at the borehole locations from -1.8 to -2.3 metres CD. The structure shows signs of deterioration throughout the visible timber crib structure.

At the time of our investigation the harbour was ice covered and snow covered much of the concrete deck. Therefore we were unable to visually assess the overall condition of the existing timber wharf structure and measure the harbour bottom around the entire wharf.



Project  
GEOTECHNICAL INVESTIGATION,  
STRUCTURES 401, 402 & 405  
VAL COMEAU WHARF, VAL COMEAU, NB.

Drawing  
BOREHOLE LOCATION PLAN

Drawn By  
CHG

Date  
FEB 2013

File No.  
64891701

Drawing No.  
FIGURE 1

Revision No.  
0



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### 3.0 Soil and Bedrock Conditions

The soil and bedrock conditions encountered at the four borehole locations consist of a relatively thin layer of overburden fill to sandstone bedrock.

The overburden soils generally consist of deposited material over brown silty sand. The overburden soils ranges in thickness from 0.3 to 0.4 metres, averaging 0.3 metres.

Sandstone bedrock was encountered at all four borehole locations. The bedrock surface elevation ranges from -2.10 (BH-02) to -2.59 metres (CD) (BH-01), averaging elevation -2.33 metres (CD). On this basis the bedrock elevation is relatively flat across the site. The rock quality designation (RQD) ranges between 0 and 35%; therefore the bedrock quality is generally very poor.

Unconfined compressive strength tests were not performed on the bedrock cores, as the retrieved bedrock core samples did not have sufficient lengths.

### 4.0 Discussion and Recommendations

We understand that the Berlin wall design will consist of HP 130 x 79 steel H piles with a penetration depth into bedrock of about 1 metre, with pre-cast concrete panels placed between the piles. Based on drawing provided to us by VALRON Engineers Inc., we understand that the upper portion of the existing timber crib wharf (1.3 metres  $\pm$ ) will be removed. The remaining cribs will be filled with crushed rock fill to the underside of slab-on-grade deck.

Based on required steel H piles penetration depths in the order of 1 metre into bedrock and the bedrock quality encountered at the site, it is our opinion that driven piles would be able to penetrate into the bedrock a depth of 1 metre provided that the hammer and piles are properly sized. While it is our opinion that H piles could be advanced to a depth of 1 metre, rock socketing may be required if more competent zones of bedrock are encountered along the proposed alignment of the Berlin wall.

We understand that a nearby structure was carried out using the rock socket method. This may be an indication that more competent rock zones exist within the area.

In order to drive the piles into the bedrock, we offer the following recommendations:

- It is our opinion that the proposed H Pile 310x79 pile section should be reviewed, and possibly increased, if driving piles into bedrock is the selected method of installation. Due to the shallow bedrock depth, there will be a high transfer of energy directly to the pile toe. Pile stresses at the toe will be of concern.

- Driving shoes, such as Standard Titus HHP-S pile points or approved alternate, are recommended.
- The estimated rated hammer energy used for finalization shall be at least 2,000 ft-lbs/in<sup>2</sup>.
- GEMTEC would be pleased to carry out a drivability analysis once the hammer and pile specifics have been finalized.
- Should the penetration depth increase beyond 1 metre into bedrock, GEMTEC should be consulted to reassess the recommendations for pile installation.

We are also providing the following design recommendations:

- The passive resistance of the bedrock may be computed using a friction angle of 45 degrees.
- The Berlin wall should be backfilled using NBDOT 75 mm minus crushed rock or gravel subbase placed in 300 mm thick lifts and compacted to 95% of the maximum dry density as determined by ASTM D698 (Standard Proctor).
- A 150 mm thick layer of NBDOT 31.5 mm minus crushed rock or gravel base should be placed directly below the slab-on-grade. This layer should be compacted to 95% of standard proctor.
- The friction angle and bulk unit weight of the compacted crushed rock backfill may be taken as 35 degrees and 22 kN/m<sup>3</sup>, respectively. Therefore, the active ( $K_a$ ), passive ( $K_p$ ) and at-rest ( $K_o$ ) pressure coefficients may be taken as;  $K_a = 0.27$ ,  $K_p = 3.69$  and  $K_o = 0.43$ .
- During construction, an engineer should assess the bottom of timber crib wharf excavation to ensure that the remaining timber crib and sandstone fill is suitable to support the new granular backfill. Some isolated settlement may occur if voids are present within the existing sandstone fill or if the remaining timber crib decays significantly over the years. The reinforced concrete slab-on-grade deck should be designed to bridge some minor localized settlements.

## 5.0 General

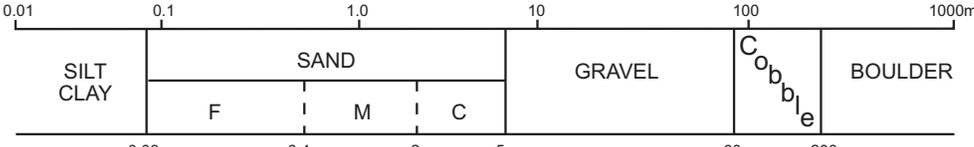
This report solely addresses the geotechnical aspects of the site and cannot be regarded as an environmental assessment of the site.

Boreholes put down on this site were widely separated and bedrock conditions may vary from those determined at the borehole locations. Although representative samples have been collected throughout the site, GEMTEC Limited should be contacted immediately if the bedrock encountered during excavation differs from those encountered in our geotechnical investigation in order to reassess our recommendations.

## **Appendix A**

Descriptive Terms and Detailed Borehole Logs

# DESCRIPTIVE TERMS- BOREHOLE/TEST PIT LOG

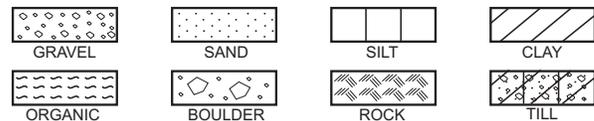
SOILS	GRAIN SIZE																
	DESCRIPTIVE TERMINOLOGY	<table border="1"> <tr> <td>TRACE</td> <td>SOME</td> <td>ADJECTIVE</td> <td colspan="2">and &gt; 35% noun &gt; 35% and main fraction</td> </tr> <tr> <td>trace clay, etc.</td> <td>some gravel, etc.</td> <td>silty, etc.</td> <td colspan="2">sand and gravel, etc.</td> </tr> </table>					TRACE	SOME	ADJECTIVE	and > 35% noun > 35% and main fraction		trace clay, etc.	some gravel, etc.	silty, etc.	sand and gravel, etc.		
	TRACE	SOME	ADJECTIVE	and > 35% noun > 35% and main fraction													
	trace clay, etc.	some gravel, etc.	silty, etc.	sand and gravel, etc.													
COMPACTNESS gravels, sands, tills	<table border="1"> <tr> <td>N, RANGE</td> <td>0 - 4</td> <td>4 - 10</td> <td>10 - 30</td> <td>30 - 50</td> <td>&gt; 50</td> </tr> <tr> <td>DENSITY</td> <td>V. LOOSE</td> <td>LOOSE</td> <td>MEDIUM</td> <td>DENSE</td> <td>V. DENSE</td> </tr> </table>					N, RANGE	0 - 4	4 - 10	10 - 30	30 - 50	> 50	DENSITY	V. LOOSE	LOOSE	MEDIUM	DENSE	V. DENSE
N, RANGE	0 - 4	4 - 10	10 - 30	30 - 50	> 50												
DENSITY	V. LOOSE	LOOSE	MEDIUM	DENSE	V. DENSE												
CONSISTENCY silt, clay	<table border="1"> <tr> <td>S, KPa</td> <td>&lt; 12.5</td> <td>12.5 - 25</td> <td>25 - 50</td> <td>50 - 100</td> <td>100 - 200</td> </tr> <tr> <td>CONSISTENCY</td> <td>V. SOFT</td> <td>SOFT</td> <td>MEDIUM</td> <td>STIFF</td> <td>V. STIFF</td> </tr> </table>					S, KPa	< 12.5	12.5 - 25	25 - 50	50 - 100	100 - 200	CONSISTENCY	V. SOFT	SOFT	MEDIUM	STIFF	V. STIFF
S, KPa	< 12.5	12.5 - 25	25 - 50	50 - 100	100 - 200												
CONSISTENCY	V. SOFT	SOFT	MEDIUM	STIFF	V. STIFF												

ROCK	RQD	OVERALL QUALITY			FRACTURE SPACING	
	0 - 25	VERY POOR			VERY CLOSE 20 - 60 mm	
	25 - 50	POOR			CLOSE 60 - 200 mm	
	50 - 75	FAIR			MODERATE 200 - 600 mm	
	75 - 90	GOOD			WIDE 600 - 2000 mm	
	90 - 100	EXCELLENT			VERY WIDE 2 - 6 m	
COMP. STR. MPa	1 - 5	5 - 25	25 - 50	50 - 100	100 - 250	
DESCRIPTION	V. WEAK	WEAK	MODERATE	STRONG	V. STRONG	

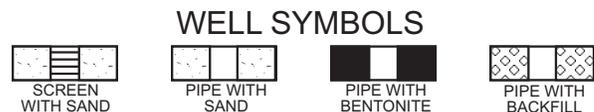
## SAMPLE TYPES (location to scale on log)

S SPLIT TUBE	G SHOVEL
T SHELBY TUBE	H CARVED BLOCK
P PISTON	K SLOTTED
F AUGER	V IN SITU VANE
W WASH	NR NO RECOVERY

## LOG SYMBOLS



## ROCK CORES A(30mm); B(41mm); N(54mm)



- N - standard penetration test; blows by 475 J drop hammer to advance Std. 50mm O.D. split tube sampler 0.3m
- RQD - percent of core consisting of hard, sound pieces in excess of 100mm long (excluding machine breaks)
- RECOVERY - sample recovery expressed as percent or length
- S - shear strength, kPa; vane  $\oplus$ ; penetrometer  $\blacksquare$ ; unconfined  $\circ$ ;  $U_c$  unconfined compressive strength
- Sr - shear strength, remoulded; vane  $\otimes$ ; penetrometer  $\square$
- Dd - dry density;  $t/m^3$
- W - natural moisture content, percent \*
- PL - plastic limit, percent  $\text{---}$
- LL - liquid limit, percent  $\text{---}$
- ND - non detect, total petroleum hydrocarbons (TPH) not detected in soil
- Groundwater Level  $\nabla$  ; Seepage  $\nabla$

Client Public Works and Government Services Canada

Proj No. 6489.17

BOREHOLE

Project Structure 401, 402 and 405

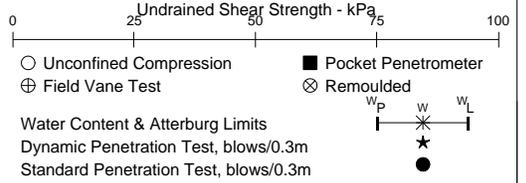
Date Drilled 12Feb2103

 BH-01  
 Page 1 of 1

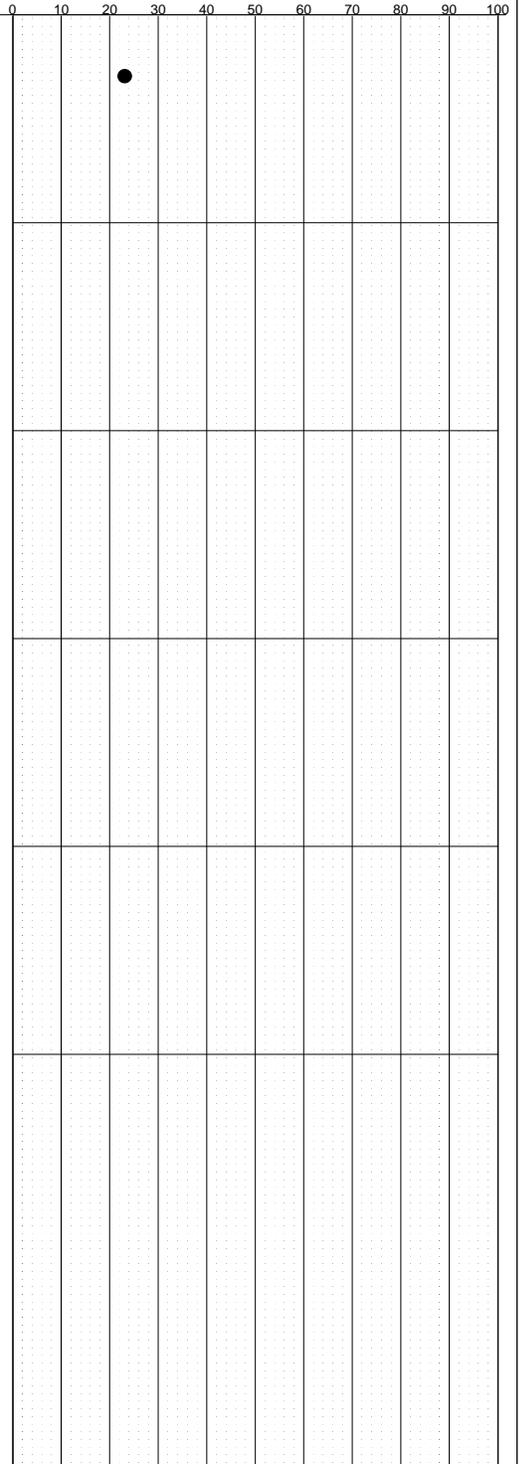
Location Val Comeau Wharf, Val Comeau, NB

 Ground Level, m  
 -2.31

 Datum:  
 Chart

 Logged By  
 RB


DEPTH m	SAMPLE				LOG	DESCRIPTION
	No	TYPE	N (RQD)	REC (mm)		
0	1	SS	23	560	0.13	Very loose black silty sand with some roots 2.44
					0.28	Loose to compact green brown silty SAND (SM) with some sandstone cobbles 2.59
						Green brown severely fractured Sandstone BEDROCK
	2	HQ	0%	82%		
1						
	3	HQ	0%	80%		
2						
	4	HQ	15%	99%		
3						
	5	HQ	0%	48%		
4						
5						
					5.85	-8.16
					End of BH-01 at 5.85 metres below harbour bottom	



Client Public Works and Government Services Canada

Proj No. 6489.17

BOREHOLE

Project Structure 401, 402 and 405

Date Drilled 12Feb2103

 BH-02  
 Page 1 of 1

Location Val Comeau Wharf, Val Comeau, NB

Ground Level, m -1.80

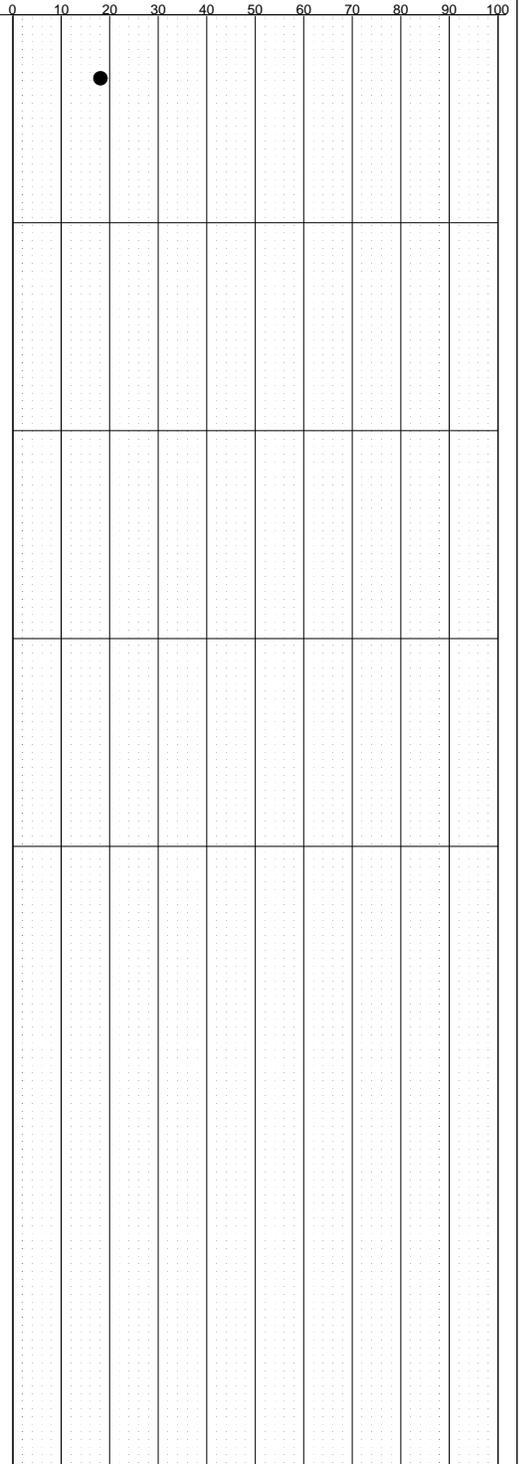
Datum: Chart

Logged By RB

 0 25 50 75 100  
 Undrained Shear Strength - kPa

 ○ Unconfined Compression  
 ⊕ Field Vane Test  
 ■ Pocket Penetrometer  
 ⊗ Remoulded  
 Water Content & Atterburg Limits  
 Dynamic Penetration Test, blows/0.3m  
 Standard Penetration Test, blows/0.3m  
 W<sub>p</sub> W<sub>L</sub>

DEPTH m	SAMPLE				LOG	DESCRIPTION
	No	TYPE	N (RQD)	REC (mm)		
0	1	SS	18	460		Loose to compact green brown silty SAND (SM) with some sandstone cobbles - some muscels at ground surface Green brown severely fractured Sandstone BEDROCK
1	2	HQ	0%	34%		
2	3	HQ	0%	73%		
3	4	HQ	33%	100%		
4						End of BH-02 at 4.72 metres below harbour bottom



Client Public Works and Government Services Canada

Proj No. 6489.17

BOREHOLE

Project Structure 401, 402 and 405

Date Drilled 12Feb2103

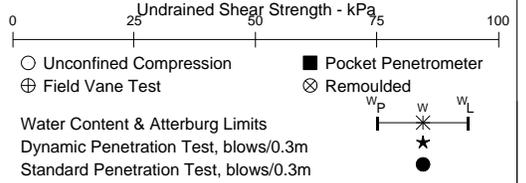
 BH-03  
 Page 1 of 1

Location Val Comeau Wharf, Val Comeau, NB

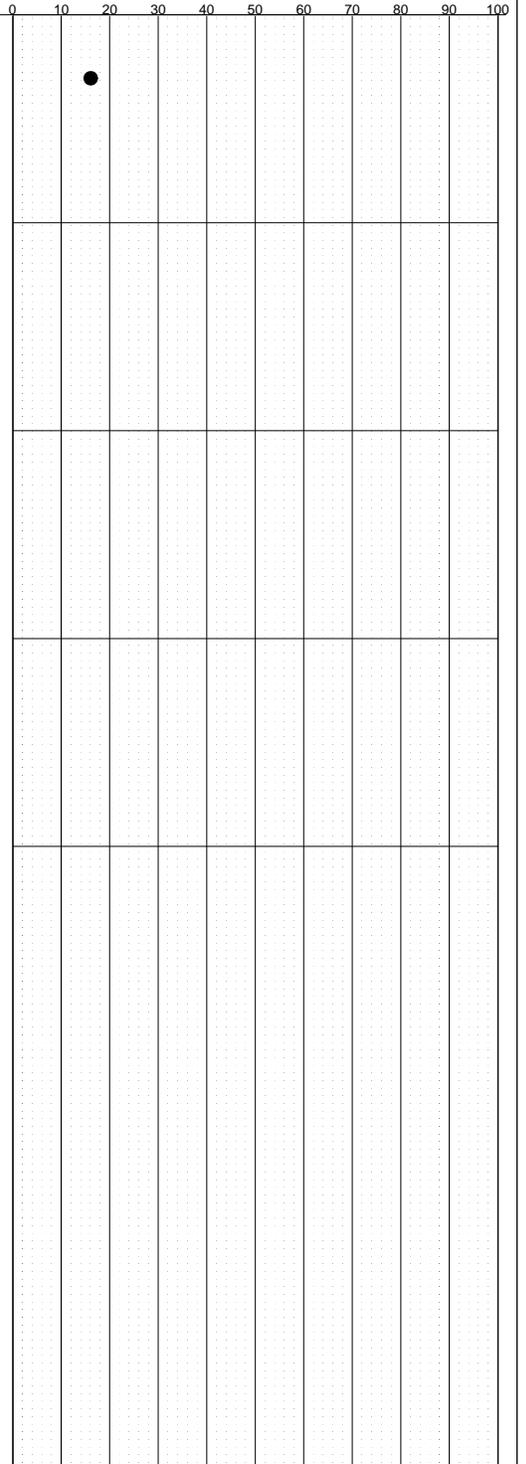
Ground Level, m -1.93

Datum: Chart

Logged By RB



DEPTH m	SAMPLE				LOG	DESCRIPTION
	No	TYPE	N (RQD)	REC (mm)		
0	1	SS	16	585	0.15 - 2.08	Very loose black silty sand
					0.45 - 2.38	Compact green brown silty SAND (SM) with some sandstone cobbles
						Fractured Sandstone BEDROCK
1	2	HQ	35%	86%		
2	3	HQ	13%	80%		
3	4	HQ	17%	95%		
4					4.60 - 6.53	End of BH-03 at 4.60 metres below harbour bottom



Client Public Works and Government Services Canada

Proj No. 6489.17

BOREHOLE

Project Structure 401, 402 and 405

Date Drilled 12Feb2103

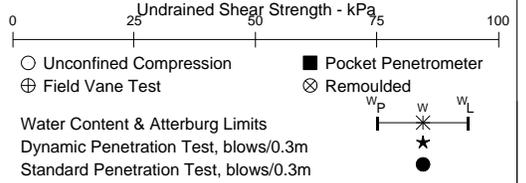
BH-04  
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Location Val Comeau Wharf, Val Comeau, NB

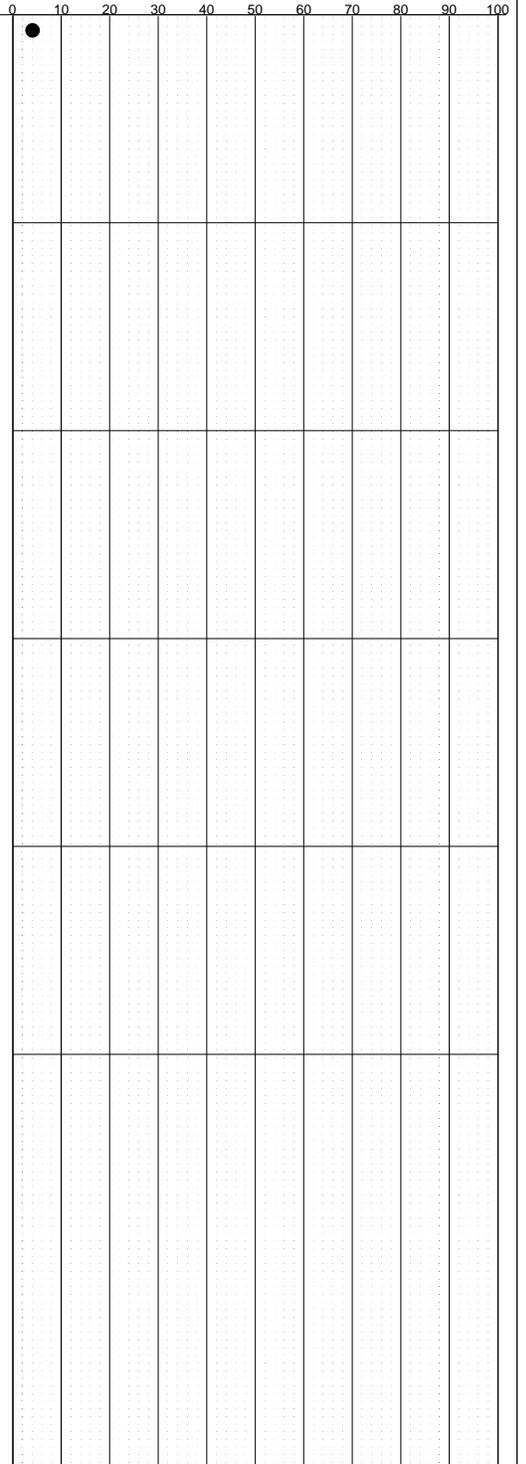
Ground Level, m -1.97

Datum: Chart

Logged By RB



DEPTH m	SAMPLE				LOG	DESCRIPTION
	No	TYPE	N (RQD)	REC (mm)		
0	1	SS	4	75	F F F	0.15 Black wood/timber pieces -2.12
	2	SS	55/75mm	230	F F F	0.31 Very loose brown to green brown silty SAND (SM) with some clay and sandstone cobbles -2.28
	3	HQ	10%	100%		Green brown fractured Sandstone BEDROCK
1						
	4	HQ	22%	98%		
2						
3	5	HQ	35%	95%		
4						
	6	HQ	28%	80%		
5						
						5.67 -7.64 End of BH-04 at 5.67 metres below harbour bottom



## **Appendix B**

Sandstone Bedrock Core Photos



**Photo 1 - Borehole 1**



**Photo 2 - Borehole 2**



**Photo 3 - Borehole 3**



**Photo 4 - Borehole 4**