GEMTEC

# Factual Report
# Geotechnical Investigation
# Proposed Gully and Channel Dredging

Pigeon Hill, New Brunswick
December 1, 2016

Prepared for Public Works and Government Services Canada
**Project No. 90015.02 – R01**

GEMTEC
Consulting Engineers and Scientists

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December 1, 2016

File: 90015.02 – R01

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

Attention: Shane Doiron, Project Manager

**Re: Factual Report, Geotechnical Investigation – Proposed Gully & Channel Dredging Pigeon Hill, New Brunswick (Call Up EC373-152028//001/PWB)**

Please find enclosed our factual report for the geotechnical investigation in support of gully and channel dredging in Pigeon Hill, New Brunswick.

This report was prepared by Caroline McKay, P.Eng. and reviewed by Corey Keats, M.Sc.E., P.Eng.

Sincerely,

Caroline McKay, P.Eng.

Corey Keats, M.Sc.E., P.Eng.

Enclosures

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**Factual Report, Geotechnical Investigation**
**Proposed Gully & Channel Dredging**
**Pigeon Hill, New Brunswick**

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# 1.0 Introduction

Public Works and Government Services Canada (PWGSC) retained GEMTEC Limited to conduct a geotechnical investigation in support of the proposed dredging of the channel and the gully entrances at the Pigeon Hill Wharf in Pigeon Hill, New Brunswick. This investigation was conducted according to the requirements of the Standing Offer Contract (EC373-152028/A) between PWGSC and GEMTEC Limited.

The purpose of this investigation was to characterize the soil conditions in the wharf gully and channel to determine dredging methods. This report presents all of our findings for geotechnical purposes only. The investigation outlined in this report is strictly geotechnical in nature and should not be viewed as an environmental assessment of the site.

# 2.0 Project and Site Description

## 2.1 Project and Site Description

The Pigeon Hill site is located at the northeastern tip of New Brunswick, approximately 90 km northeast of the city of Bathurst and Highway 8. The site is located approximately 4 km north of the town of Pigeon Hill on Highway 305 and 0.5 km north of the Pigeon Hill Wharf. The test pits were advanced within the gully and channel just north of the Pigeon Hill Wharf.

## 2.2 Review of Geology Maps

The Generalized Surficial Geology Map of New Brunswick (Map NR-8, 2002) indicates that the subsurface conditions in the vicinity of the site consist of organic sediments: bogs, fens, swamps, generally 1 to 5 metres thick; or beaches, bars and spits: gravel, sand, minor silt generally more than 1 metre thick.

Based on the Bedrock Geology of New Brunswick (Map NR-1, 2008) the bedrock in the vicinity of the site is mapped as late carboniferous of the Pictou Group.

## 3.0 Subsurface Investigation

Twenty-five test pits (TP16-1 to TP16-25) were excavated at the Site between November 21 and 25, 2016 in the presence of one of our Geotechnical Technicians. All twenty-five of the test pits were excavated to elevation of -2.5 metres chart datum (CD). The work was carried out using a self-propelled floating dredge plan, Amphibex, equipped with an excavator using a 1 cubic meter hydraulic bucket subcontracted to ECO Technologies. Based on observations made in the field, the excavator (Amphibex) was suitable to excavate all soils encountered within the twenty-five test pits.

During the test pit advancement, soil samples were collected by GEMTEC personnel and local soil stratigraphy was visually catalogued throughout the investigation.

Test pit locations were provided by PWGSC. GEMTEC Limited surveyed the test pit locations in the field using a Leica GPS. All elevations on appended test pit logs are based on chart datum and are referenced to benchmark 90B9020 with a published elevation of +4.158 metres at the Pigeon Hill Wharf.

Descriptive terms and detailed test pit logs are included in Appendix A. Laboratory testing results are included in Appendix B and select photos in Appendix C.


-1.30 TP16-25 Test Pit Locations

-1.30 TP16-25 Ground Elevation - Chart Test Pit Number

All elevations listed on this drawing are in Chart Datum and referenced to mon.90b9020 with an elevation of +4.158m

| Drawn By | Checked By |
|---|---|
| DA | CM |
| **Calculations By** | **Checked By** |
| DA | CM |

Date
November, 2016

Project
Geotechnical Investigation
Pigeon Hill Wharf

Drawing
Test Pit Locations

Scale
1:5000
0 100 200 300m

| File No. | Drawing | Revision No. |
|---|---|---|
| 9001502 | D01 | 0 |

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# 4.0 Subsurface Conditions

## 4.1 General

The soil stratigraphy presented in the test pit logs are representative of subsurface conditions at the specific test pit locations only. Boundaries between soil zones on the logs are often not distinct, but rather are transitional and have been interpreted. Subsurface conditions at locations other than the test pit locations may vary from the conditions reported in the test pit logs. The soil descriptions in this report are based on commonly accepted methods of classification and identification employed in geotechnical practice. Classification and identification of soil involves judgement and GEMTEC does not guarantee descriptions as exact, but infers accuracy to the extent that is common in current geotechnical practice.

The soil conditions encountered during this geotechnical investigation generally consist of sand with gravel, silty sand, or gravel with sand. Organics, shells, and cobbles were also encountered throughout the sand and gravel deposits. Laboratory testing was undertaken on select samples and the results are presented in Appendix B.

The existing ground surface elevation at Test Pit TP16-12 was below -2.5 metres chart datum and deeper than the reach of the excavator.

## 4.2 Sand and Gravel

The sand and gravel deposits encountered at the site are described as grey or brown silty sand, sand with gravel, or gravel with sand. The sand and gravel deposits were encountered to the full extent of the test pits (Chart Elevation -2.5 metres). Trace of organics and shells were encountered in twelve of the twenty-five test pits within the sand and gravel. Trace cobbles were encountered in nineteen of the twenty-five test pits within the sand and gravel.

Laboratory index testing undertaken on five representative samples of the sand deposit shows less than 1% to 31% Gravel, 57% to 83% Sand, and less than 1% to 38% Silt and Clay sized particles.

Laboratory index testing undertaken on a representative sample of the gravel deposit from TP16-4 shows 51% Gravel, 49% Sand, and less than 1% Silt and Clay sized particles.

# 5.0 Closure

This report has been prepared for the sole benefit of our client, Public Works and Government Services Canada. The report may not be relied upon by any other person or entity without the express written consent of both GEMTEC Limited and our client, Public Works and Government Services Canada.

Any use that a third party makes of this report, or any reliance or decisions made based on it, is the responsibility of such third parties. GEMTEC Limited accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

# Appendix A

Descriptive Terms and Test Pit Logs

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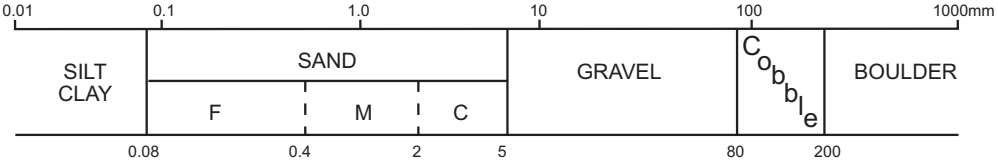
FREDERICTON, MONCTON, BATHURST, GRAND FALLS, SAINT JOHN, NB

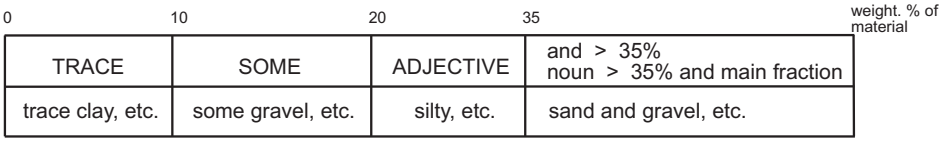
# DESCRIPTIVE TERMS- BOREHOLE/TEST PIT LOG

## SOILS

### GRAIN SIZE




### DESCRIPTIVE TERMINOLOGY




| TRACE | SOME | ADJECTIVE | and > 35%<br>noun > 35% and main fraction |
|---|---|---|---|
| trace clay, etc. | some gravel, etc. | silty, etc. | sand and gravel, etc. |

### COMPACTNESS gravels, sands, tills

| N, RANGE | 0 - 4 | 4 - 10 | 10 - 30 | 30 - 50 | > 50 |
|---|---|---|---|---|---|
| DENSITY | V. LOOSE | LOOSE | MEDIUM | DENSE | V. DENSE |

### CONSISTENCY silt, clay

| 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 |

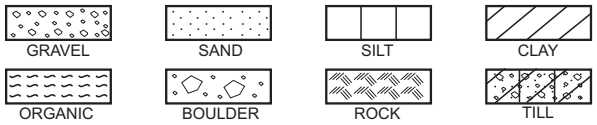
## SAMPLE TYPES (location to scale on log)

| | | | |
|---|---|---|---|
| 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 |

## ROCK CORES

A(30mm); B(41mm); N(54mm)

## LOG SYMBOLS




## WELL SYMBOLS


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 ⊕ ; penetrometer ■; unconfined ○ ; Uc unconfined compressive strength

Sr - shear strength, remoulded; vane ⊗ ; penetrometer □

Dd - dry density; $t/m^3$

W - natural moisture content, percent ✳

PL - plastic limit, percent ⊢

LL - liquid limit, percent ⊣

ND - non detect, total petroleum hydrocarbons (TPH) not detected in soil

Groundwater Level ▼ ; Seepage ▽

Revised Oct, 2009

BHDESCRM-2009.CDR

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# TEST PIT LOG

| | | | |
|---|---|---|---|
| Client | Public Works and Government Services Canada | Proj No. 9001502 | Test pit TP16-1 |
| Project | Geotechnical Investigation - Gully & Channel Dredging | Date End 21/11/2016 | Page 1 of 1 |
| Location | Pigeon Hill, New Brunswick | | |
| Ground Level, m -1.30 | Datum: Chart | Logged By DA | |

Undrained Shear Strength - kPa
0 25 50 75 100
☐ Pocket Penetrometer <225 ■ Pocket Penetrometer
⊕ Field Vane Test ⊗ Remoulded
Water Content & Atterberg Limits $w_P$ w $w_L$
Dynamic Penetration Test, blows/0.3m
Standard Penetration Test, blows/0.3m
0 10 20 30 40 50 60 70 80 90 100

| DEPTH m | SAMPLE No | SAMPLE TYPE | SAMPLE N (RQD) | SAMPLE REC mm | LOG | DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | | **SAND** Grey silty sand, trace gravel and organics |
| 1 | 1 | G | | | | |
| | | | | | | 1.20 -2.50 **End of Test Pit at Chart Elevation -2.5 m** |

TEST PIT WITH GRAPH 90015.02.GPJ GEMTEC 2004.GDT 29/11/16

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# TEST PIT LOG

| | | | |
|---|---|---|---|
| Client | Public Works and Government Services Canada | Proj No. 9001502 | Test pit TP16-2 |
| Project | Geotechnical Investigation - Gully & Channel Dredging | Date End 21/11/2016 | Page 1 of 1 |
| Location | Pigeon Hill, New Brunswick | | |
| Ground Level, m -1.10 | Datum: Chart | Logged By DA | |

Undrained Shear Strength - kPa: 0, 25, 50, 75, 100

☐ Pocket Penetrometer <225 ■ Pocket Penetrometer
⊕ Field Vane Test ⊗ Remoulded

Water Content & Atterberg Limits $w_P$ $w$ $w_L$
Dynamic Penetration Test, blows/0.3m ★
Standard Penetration Test, blows/0.3m ●

0 10 20 30 40 50 60 70 80 90 100

| DEPTH m | SAMPLE No | SAMPLE TYPE | SAMPLE N (RQD) | SAMPLE REC mm | LOG | DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | | **SAND** Grey silty sand, trace organics |
| 1 | 1 | G | | | | |
| | | | | | 1.40 / -2.50 | **End of Test Pit at Chart Elevation -2.5 m** |

TEST PIT WITH GRAPH 90015.02.GPJ GEMTEC 2004.GDT 29/11/16

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# TEST PIT LOG

| | | | |
|---|---|---|---|
| Client | Public Works and Government Services Canada | Proj No. 9001502 | Test pit TP16-3 |
| Project | Geotechnical Investigation - Gully & Channel Dredging | Date End 21/11/2016 | Page 1 of 1 |
| Location | Pigeon Hill, New Brunswick | | |
| Ground Level, m -1.00 | Datum: Chart | Logged By DA | |

Undrained Shear Strength - kPa
0 25 50 75 100
☐ Pocket Penetrometer <225 ■ Pocket Penetrometer
⊕ Field Vane Test ⊗ Remoulded
Water Content & Atterberg Limits $w_P$ w $w_L$
Dynamic Penetration Test, blows/0.3m
Standard Penetration Test, blows/0.3m
0 10 20 30 40 50 60 70 80 90 100

| DEPTH m | SAMPLE No | TYPE | N (RQD) | REC mm | LOG | DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | | **SAND** Brown sand with gravel, trace silt and organics (shells) |
| | 1 | G | | | | |
| 1 | | | | | 1.50 | -2.50 |
| | | | | | | **End of Test Pit at Chart Elevation -2.5 m** |

TEST PIT WITH GRAPH 90015.02.GPJ GEMTEC 2004.GDT 29/11/16

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# TEST PIT LOG

| | | | |
|---|---|---|---|
| Client | Public Works and Government Services Canada | Proj No. 9001502 | Test pit TP16-4 |
| Project | Geotechnical Investigation - Gully & Channel Dredging | Date End 21/11/2016 | Page 1 of 1 |
| Location | Pigeon Hill, New Brunswick | | |
| Ground Level, m -0.20 | Datum: Chart | Logged By DA | |

Undrained Shear Strength - kPa
0 25 50 75 100
☐ Pocket Penetrometer <225 ■ Pocket Penetrometer
⊕ Field Vane Test ⊗ Remoulded
Water Content & Atterberg Limits $w_P$ w $w_L$
Dynamic Penetration Test, blows/0.3m
Standard Penetration Test, blows/0.3m
0 10 20 30 40 50 60 70 80 90 100

| DEPTH m | SAMPLE No | SAMPLE TYPE | SAMPLE N (RQD) | SAMPLE REC mm | LOG | DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | | **GRAVEL** Brown gravel with sand, trace cobbles |
| 1 | 1 | G | | | | |
| 2 | | | | | 2.30 | -2.50 **End of Test Pit at Chart Elevation -2.5 m** |

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# TEST PIT LOG

| | | | |
|---|---|---|---|
| Client | Public Works and Government Services Canada | Proj No. 9001502 | Test pit TP16-5 |
| Project | Geotechnical Investigation - Gully & Channel Dredging | Date End 21/11/2016 | Page 1 of 1 |
| Location | Pigeon Hill, New Brunswick | | |
| Ground Level, m -1.30 | Datum: Chart | Logged By DA | |

Undrained Shear Strength - kPa: 0, 25, 50, 75, 100

☐ Pocket Penetrometer <225 ■ Pocket Penetrometer
⊕ Field Vane Test ⊗ Remoulded
Water Content & Atterberg Limits ($w_P$, $w$, $w_L$)
Dynamic Penetration Test, blows/0.3m
Standard Penetration Test, blows/0.3m

0 10 20 30 40 50 60 70 80 90 100

| DEPTH m | SAMPLE No | SAMPLE TYPE | SAMPLE N (RQD) | SAMPLE REC mm | LOG | DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | | **SAND**<br>Brown sand with gravel, trace cobbles |
| | | | | | | 0.50 -1.80 |
| | 1 | G | | | | **SAND**<br>Grey silty sand, trace organics |
| 1 | | | | | | 1.20 -2.50 |
| | | | | | | **End of Test Pit at Chart Elevation -2.5 m** |

TEST PIT WITH GRAPH 90015.02.GPJ GEMTEC 2004.GDT 29/11/16

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# TEST PIT LOG

| | | | |
|---|---|---|---|
| Client | Public Works and Government Services Canada | Proj No. 9001502 | Test pit TP16-6 |
| Project | Geotechnical Investigation - Gully & Channel Dredging | Date End 21/11/2016 | Page 1 of 1 |
| Location | Pigeon Hill, New Brunswick | | |
| Ground Level, m -1.20 | Datum: Chart | Logged By DA | |

Undrained Shear Strength - kPa: 0, 25, 50, 75, 100

□ Pocket Penetrometer <225 ■ Pocket Penetrometer
⊕ Field Vane Test ⊗ Remoulded

Water Content & Atterberg Limits ($w_P$, $w$, $w_L$)
Dynamic Penetration Test, blows/0.3m
Standard Penetration Test, blows/0.3m

0 10 20 30 40 50 60 70 80 90 100

| DEPTH m | SAMPLE No | SAMPLE TYPE | SAMPLE N (RQD) | SAMPLE REC mm | LOG | DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | | **SAND** Grey silty sand, trace gravel and cobbles |
| | 1 | G | | | | |
| 1 | | | | | | |
| | | | | | 1.30 | -2.50 |
| | | | | | | **End of Test Pit at Chart Elevation -2.5 m** |

TEST PIT WITH GRAPH 90015.02.GPJ GEMTEC 2004.GDT 29/11/16

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# TEST PIT LOG

| | | | |
|---|---|---|---|
| Client | Public Works and Government Services Canada | Proj No. 9001502 | Test pit TP16-7 |
| Project | Geotechnical Investigation - Gully & Channel Dredging | Date End 21/11/2016 | Page 1 of 1 |
| Location | Pigeon Hill, New Brunswick | | |
| Ground Level, m -1.40 | Datum: Chart | Logged By DA | |

Undrained Shear Strength - kPa
0 25 50 75 100
☐ Pocket Penetrometer <225 ■ Pocket Penetrometer
⊕ Field Vane Test ⊗ Remoulded
Water Content & Atterberg Limits $w_P$ w $w_L$
Dynamic Penetration Test, blows/0.3m ★
Standard Penetration Test, blows/0.3m ●
0 10 20 30 40 50 60 70 80 90 100

| DEPTH m | SAMPLE No | SAMPLE TYPE | SAMPLE N (RQD) | SAMPLE REC mm | LOG | DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | | **SAND** Grey silty sand, trace gravel, cobbles, and organics (shells) |
| 1 | 1 | G | | | | 1.10 -2.50 **End of Test Pit at Chart Elevation -2.5 m** |

TEST PIT WITH GRAPH 90015.02.GPJ GEMTEC 2004.GDT 29/11/16

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# TEST PIT LOG

| | | | |
|---|---|---|---|
| Client | Public Works and Government Services Canada | Proj No. 9001502 | Test pit TP16-8 |
| Project | Geotechnical Investigation - Gully & Channel Dredging | Date End 21/11/2016 | Page 1 of 1 |
| Location | Pigeon Hill, New Brunswick | | |
| Ground Level, m -1.10 | Datum: Chart | Logged By DA | |

Undrained Shear Strength - kPa
0 25 50 75 100
☐ Pocket Penetrometer <225 ■ Pocket Penetrometer
⊕ Field Vane Test ⊗ Remoulded
Water Content & Atterberg Limits $w_P$ w $w_L$
Dynamic Penetration Test, blows/0.3m
Standard Penetration Test, blows/0.3m
0 10 20 30 40 50 60 70 80 90 100

| DEPTH m | SAMPLE No | SAMPLE TYPE | SAMPLE N (RQD) | SAMPLE REC mm | LOG | DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | | **SAND** Brown sand with gravel, trace cobbles |
| 1 | 1 | G | | | | |
| 1.40 | | | | | | **End of Test Pit at Chart Elevation -2.5 m** |
| -2.50 | | | | | | |

TEST PIT WITH GRAPH 90015.02.GPJ GEMTEC 2004.GDT 29/11/16

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# TEST PIT LOG

| | | | |
|---|---|---|---|
| Client | Public Works and Government Services Canada | Proj No. 9001502 | Test pit TP16-9 |
| Project | Geotechnical Investigation - Gully & Channel Dredging | Date End 21/11/2016 | Page 1 of 1 |
| Location | Pigeon Hill, New Brunswick | | |
| Ground Level, m -1.10 | Datum: Chart | Logged By DA | |

Undrained Shear Strength - kPa
0 25 50 75 100
☐ Pocket Penetrometer <225 ■ Pocket Penetrometer
⊕ Field Vane Test ⊗ Remoulded
Water Content & Atterberg Limits $w_P$ w $w_L$
Dynamic Penetration Test, blows/0.3m
Standard Penetration Test, blows/0.3m
0 10 20 30 40 50 60 70 80 90 100

| DEPTH m | SAMPLE No | SAMPLE TYPE | SAMPLE N (RQD) | SAMPLE REC mm | LOG | DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | | **SAND** Brown sand with gravel, trace cobbles |
| 1 | 1 | G | | | | |
| | | | | | 1.40 / -2.50 | **End of Test Pit at Chart Elevation -2.5 m** |

TEST PIT WITH GRAPH 90015.02.GPJ GEMTEC 2004.GDT 29/11/16

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# TEST PIT LOG

| | | | |
|---|---|---|---|
| Client | Public Works and Government Services Canada | Proj No. 9001502 | Test pit TP16-10 |
| Project | Geotechnical Investigation - Gully & Channel Dredging | Date End 21/11/2016 | Page 1 of 1 |
| Location | Pigeon Hill, New Brunswick | | |
| Ground Level, m -0.90 | Datum: Chart | Logged By DA | |

Undrained Shear Strength - kPa
0 25 50 75 100
☐ Pocket Penetrometer <225 ■ Pocket Penetrometer
⊕ Field Vane Test ⊗ Remoulded
Water Content & Atterberg Limits $w_P$ w $w_L$
Dynamic Penetration Test, blows/0.3m
Standard Penetration Test, blows/0.3m
0 10 20 30 40 50 60 70 80 90 100

| DEPTH m | SAMPLE No | SAMPLE TYPE | SAMPLE N (RQD) | SAMPLE REC mm | LOG | DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | | **SAND** Brown sand with gravel, trace cobbles |
| | 1 | G | | | | |
| 1 | | | | | | |
| | | | | | 1.60 -2.50 | **End of Test Pit at Chart Elevation -2.5 m** |

TEST PIT WITH GRAPH 90015.02.GPJ GEMTEC 2004.GDT 29/11/16

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# TEST PIT LOG

| | | | |
|---|---|---|---|
| Client | Public Works and Government Services Canada | Proj No. 9001502 | Test pit TP16-11 |
| Project | Geotechnical Investigation - Gully & Channel Dredging | Date End 21/11/2016 | Page 1 of 1 |
| Location | Pigeon Hill, New Brunswick | | |
| Ground Level, m -0.90 | Datum: Chart | Logged By DA | |

Undrained Shear Strength - kPa
0 25 50 75 100
☐ Pocket Penetrometer <225 ■ Pocket Penetrometer
⊕ Field Vane Test ⊗ Remoulded
Water Content & Atterberg Limits $w_P$ w $w_L$
Dynamic Penetration Test, blows/0.3m
Standard Penetration Test, blows/0.3m
0 10 20 30 40 50 60 70 80 90 100

| DEPTH m | SAMPLE No | TYPE | N (RQD) | REC mm | LOG | DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | | **SAND** Brown sand with gravel, trace cobbles up to 200 mm, trace organics (shells) |
| 1 | 1 | G | | | | |
| | | | | | 1.60 -2.50 | **End of Test Pit at Chart Elevation -2.5 m** |

TEST PIT WITH GRAPH 90015.02.GPJ GEMTEC 2004.GDT 29/11/16

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# TEST PIT LOG

| | | | |
|---|---|---|---|
| Client | Public Works and Government Services Canada | Proj No. 9001502 | Test pit TP16-12 |
| Project | Geotechnical Investigation - Gully & Channel Dredging | Date End 21/11/2016 | Page 1 of 1 |
| Location | Pigeon Hill, New Brunswick | | |
| Ground Level, m -2.50 | Datum: Chart | Logged By DA | |

Undrained Shear Strength - kPa
0 25 50 75 100
☐ Pocket Penetrometer <225 ■ Pocket Penetrometer
⊕ Field Vane Test ⊗ Remoulded
Water Content & Atterberg Limits $w_P$ w $w_L$
Dynamic Penetration Test, blows/0.3m ★
Standard Penetration Test, blows/0.3m ●
0 10 20 30 40 50 60 70 80 90 100

| DEPTH m | SAMPLE No | SAMPLE TYPE | SAMPLE N (RQD) | SAMPLE REC mm | LOG | DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | | Ground elevation below Chart Elevation -2.5 m; excavator could not reach |

TEST PIT WITH GRAPH 90015.02.GPJ GEMTEC 2004.GDT 29/11/16

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# TEST PIT LOG

| | | | |
|---|---|---|---|
| Client | Public Works and Government Services Canada | Proj No. 9001502 | Test pit TP16-13 |
| Project | Geotechnical Investigation - Gully & Channel Dredging | Date End 21/11/2016 | Page 1 of 1 |
| Location | Pigeon Hill, New Brunswick | | |
| Ground Level, m -1.80 | Datum: Chart | Logged By DA | |

Undrained Shear Strength - kPa
0 25 50 75 100
☐ Pocket Penetrometer <225 ■ Pocket Penetrometer
⊕ Field Vane Test ⊗ Remoulded
Water Content & Atterberg Limits $w_P$ w $w_L$
Dynamic Penetration Test, blows/0.3m
Standard Penetration Test, blows/0.3m
0 10 20 30 40 50 60 70 80 90 100

| DEPTH m | SAMPLE No | TYPE | N (RQD) | REC mm | LOG | DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | 1 | G | | | | **SAND**<br>Brown sand with gravel, trace silt |
| | | | | | 0.70 | -2.50 |
| | | | | | | **End of Test Pit at Chart Elevation -2.5 m** |

TEST PIT WITH GRAPH 90015.02.GPJ GEMTEC 2004.GDT 29/11/16

GEMTEC
CONSULTING ENGINEERS AND SCIENTISTS

# TEST PIT LOG

| | | | |
|---|---|---|---|
| Client | Public Works and Government Services Canada | Proj No. 9001502 | Test pit TP16-14 |
| Project | Geotechnical Investigation - Gully & Channel Dredging | Date End 21/11/2016 | Page 1 of 1 |
| Location | Pigeon Hill, New Brunswick | | |
| Ground Level, m -2.20 | Datum: Chart | Logged By DA | |

Undrained Shear Strength - kPa
0 25 50 75 100
□ Pocket Penetrometer <225 ■ Pocket Penetrometer
⊕ Field Vane Test ⊗ Remoulded
Water Content & Atterberg Limits $w_P$ w $w_L$
Dynamic Penetration Test, blows/0.3m ★
Standard Penetration Test, blows/0.3m ●
0 10 20 30 40 50 60 70 80 90 100

| DEPTH m | SAMPLE No | SAMPLE TYPE | SAMPLE N (RQD) | SAMPLE REC mm | LOG | DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | | |
| 0.10 | 1 | G | | | | **GRAVEL** -2.30<br>Brown clean gravel |
| 0.30 | | | | | | **SAND**<br>Grey silty sand, trace gravel and organics (shells) -2.50 |
| | | | | | | **End of Test Pit at Chart Elevation -2.5 m** |

TEST PIT WITH GRAPH 90015.02.GPJ GEMTEC 2004.GDT 29/11/16

GEMTEC
CONSULTING ENGINEERS AND SCIENTISTS

# TEST PIT LOG

| | | | |
|---|---|---|---|
| Client | Public Works and Government Services Canada | Proj No. 9001502 | Test pit TP16-15 |
| Project | Geotechnical Investigation - Gully & Channel Dredging | Date End 25/11/2016 | Page 1 of 1 |
| Location | Pigeon Hill, New Brunswick | | |
| Ground Level, m -2.40 | Datum: Chart | Logged By DA | |

Undrained Shear Strength - kPa
0 25 50 75 100
☐ Pocket Penetrometer <225 ■ Pocket Penetrometer
⊕ Field Vane Test ⊗ Remoulded
Water Content & Atterberg Limits $w_P$ w $w_L$
Dynamic Penetration Test, blows/0.3m ★
Standard Penetration Test, blows/0.3m ●
0 10 20 30 40 50 60 70 80 90 100

| DEPTH m | SAMPLE No | SAMPLE TYPE | SAMPLE N (RQD) | SAMPLE REC mm | LOG | DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | 0.10 | **SAND** -2.50<br>Brown sand with gravel, trace cobbles<br>**End of Test Pit at Chart Elevation -2.5 m** |

TEST PIT WITH GRAPH 90015.02.GPJ GEMTEC 2004.GDT 29/11/16

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CONSULTING ENGINEERS AND SCIENTISTS

# TEST PIT LOG

| | | | |
|---|---|---|---|
| Client | Public Works and Government Services Canada | Proj No. 9001502 | Test pit TP16-16 |
| Project | Geotechnical Investigation - Gully & Channel Dredging | Date End 22/11/2016 | Page 1 of 1 |
| Location | Pigeon Hill, New Brunswick | | |
| Ground Level, m 1.00 | Datum: Chart | Logged By DA | |

Undrained Shear Strength - kPa
0 25 50 75 100
□ Pocket Penetrometer <225 ■ Pocket Penetrometer
⊕ Field Vane Test ⊗ Remoulded
Water Content & Atterberg Limits $w_P$ w $w_L$
Dynamic Penetration Test, blows/0.3m
Standard Penetration Test, blows/0.3m
0 10 20 30 40 50 60 70 80 90 100

| DEPTH m | SAMPLE No | SAMPLE TYPE | SAMPLE N (RQD) | SAMPLE REC mm | LOG | DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | | **SAND** Brown sand with gravel, trace cobbles |
| 1 | | | | | | |
| | 1 | G | | | | |
| 2 | | | | | | |
| 3 | | | | | | |
| | | | | | 3.50 / -2.50 | **End of Test Pit at Chart Elevation -2.5 m** |

TEST PIT WITH GRAPH 90015.02.GPJ GEMTEC 2004.GDT 29/11/16

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CONSULTING ENGINEERS AND SCIENTISTS

# TEST PIT LOG

| | | | |
|---|---|---|---|
| Client | Public Works and Government Services Canada | Proj No. 9001502 | Test pit TP16-17 |
| Project | Geotechnical Investigation - Gully & Channel Dredging | Date End 25/11/2016 | Page 1 of 1 |
| Location | Pigeon Hill, New Brunswick | | |
| Ground Level, m -2.40 | Datum: Chart | Logged By DA | |

Undrained Shear Strength - kPa
0 25 50 75 100
☐ Pocket Penetrometer <225 ■ Pocket Penetrometer
⊕ Field Vane Test ⊗ Remoulded
Water Content & Atterberg Limits $w_P$ w $w_L$
Dynamic Penetration Test, blows/0.3m ★
Standard Penetration Test, blows/0.3m ●
0 10 20 30 40 50 60 70 80 90 100

| DEPTH m | SAMPLE No | SAMPLE TYPE | SAMPLE N (RQD) | SAMPLE REC mm | LOG | DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | 0.10 | **SAND** -2.50<br>Brown sand with gravel, trace cobbles<br>**End of Test Pit at Chart Elevation -2.5 m** |

TEST PIT WITH GRAPH 90015.02.GPJ GEMTEC 2004.GDT 29/11/16

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# TEST PIT LOG

| | | | |
|---|---|---|---|
| Client | Public Works and Government Services Canada | Proj No. 9001502 | Test pit TP16-18 |
| Project | Geotechnical Investigation - Gully & Channel Dredging | Date End 25/11/2016 | Page 1 of 1 |
| Location | Pigeon Hill, New Brunswick | | |
| Ground Level, m -1.80 | Datum: Chart | Logged By DA | |

Undrained Shear Strength - kPa
0 25 50 75 100
☐ Pocket Penetrometer <225 ■ Pocket Penetrometer
⊕ Field Vane Test ⊗ Remoulded
Water Content & Atterberg Limits $w_P$ w $w_L$
Dynamic Penetration Test, blows/0.3m ★
Standard Penetration Test, blows/0.3m ●
0 10 20 30 40 50 60 70 80 90 100

| DEPTH m | SAMPLE No | TYPE | N (RQD) | REC mm | LOG | DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | | |
| | 1 | G | | | | **SAND** Brown sand with gravel, trace cobbles up to 250 mm |
| | | | | | 0.70 | -2.50 |
| | | | | | | **End of Test Pit at Chart Elevation -2.5 m** |

TEST PIT WITH GRAPH 90015.02.GPJ GEMTEC 2004.GDT 29/11/16

GEMTEC
CONSULTING ENGINEERS AND SCIENTISTS

# TEST PIT LOG

| | | | |
|---|---|---|---|
| Client | Public Works and Government Services Canada | Proj No. 9001502 | Test pit TP16-19 |
| Project | Geotechnical Investigation - Gully & Channel Dredging | Date End 25/11/2016 | Page 1 of 1 |
| Location | Pigeon Hill, New Brunswick | | |
| Ground Level, m -1.60 | Datum: Chart | Logged By DA | |

Undrained Shear Strength - kPa: 0, 25, 50, 75, 100

☐ Pocket Penetrometer <225 ■ Pocket Penetrometer
⊕ Field Vane Test ⊗ Remoulded

Water Content & Atterberg Limits $w_P$ $w$ $w_L$
Dynamic Penetration Test, blows/0.3m ★
Standard Penetration Test, blows/0.3m ●

0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100

| DEPTH m | SAMPLE No | SAMPLE TYPE | SAMPLE N (RQD) | SAMPLE REC mm | LOG | DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | | |
| | 1 | G | | | | **SAND**<br>Brown sand with gravel, trace cobbles up to 250 mm |
| | | | | | | 0.90 -2.50<br>**End of Test Pit at Chart Elevation -2.5 m** |

TEST PIT WITH GRAPH 90015.02.GPJ GEMTEC 2004.GDT 29/11/16

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# TEST PIT LOG

| | | | |
|---|---|---|---|
| Client | Public Works and Government Services Canada | Proj No. 9001502 | Test pit TP16-20 |
| Project | Geotechnical Investigation - Gully & Channel Dredging | Date End 25/11/2016 | Page 1 of 1 |
| Location | Pigeon Hill, New Brunswick | | |
| Ground Level, m -1.50 | Datum: Chart | Logged By DA | |

Undrained Shear Strength - kPa
0 25 50 75 100
□ Pocket Penetrometer <225 ■ Pocket Penetrometer
⊕ Field Vane Test ⊗ Remoulded
Water Content & Atterberg Limits $w_P$ w $w_L$
Dynamic Penetration Test, blows/0.3m
Standard Penetration Test, blows/0.3m
0 10 20 30 40 50 60 70 80 90 100

| DEPTH m | SAMPLE No | TYPE | N (RQD) | REC mm | LOG | DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | 1 | G | | | | **SAND** Brown sand with gravel, some cobbles, trace silt |
| 1 | | | | | 1.00 -2.50 | **End of Test Pit at Chart Elevation -2.5 m** |

TEST PIT WITH GRAPH 90015.02.GPJ GEMTEC 2004.GDT 29/11/16

GEMTEC
CONSULTING ENGINEERS AND SCIENTISTS

# TEST PIT LOG

| | | | |
|---|---|---|---|
| Client | Public Works and Government Services Canada | Proj No. 9001502 | Test pit TP16-21 |
| Project | Geotechnical Investigation - Gully & Channel Dredging | Date End 25/11/2016 | Page 1 of 1 |
| Location | Pigeon Hill, New Brunswick | | |
| Ground Level, m -1.40 | Datum: Chart | Logged By DA | |

Undrained Shear Strength - kPa
0 25 50 75 100
□ Pocket Penetrometer <225 ■ Pocket Penetrometer
⊕ Field Vane Test ⊗ Remoulded
Water Content & Atterberg Limits $w_P$ w $w_L$
Dynamic Penetration Test, blows/0.3m
Standard Penetration Test, blows/0.3m
0 10 20 30 40 50 60 70 80 90 100

| DEPTH m | SAMPLE No | SAMPLE TYPE | SAMPLE N (RQD) | SAMPLE REC mm | LOG | DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | | **SAND** Brown sand with gravel, trace cobbles and organics (shells) |
| | 1 | G | | | | |
| 1 | | | | | | |
| | | | | | | 3.00 -4.40 **End of Test Pit at Chart Elevation -2.5 m** |

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# TEST PIT LOG

| | | | |
|---|---|---|---|
| Client | Public Works and Government Services Canada | Proj No. 9001502 | Test pit TP16-22 |
| Project | Geotechnical Investigation - Gully & Channel Dredging | Date End 25/11/2016 | Page 1 of 1 |
| Location | Pigeon Hill, New Brunswick | | |
| Ground Level, m 0.50 | Datum: Chart | Logged By DA | |

Undrained Shear Strength - kPa
0 25 50 75 100
☐ Pocket Penetrometer <225 ■ Pocket Penetrometer
⊕ Field Vane Test ⊗ Remoulded
Water Content & Atterberg Limits $w_P$ w $w_L$
Dynamic Penetration Test, blows/0.3m
Standard Penetration Test, blows/0.3m
0 10 20 30 40 50 60 70 80 90 100

| DEPTH m | SAMPLE No | SAMPLE TYPE | SAMPLE N (RQD) | SAMPLE REC mm | LOG | DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | | **SAND** Brown and grey sand with gravel, trace cobbles and organics (shells) |
| 1 | | | | | | |
| | 1 | G | | | | |
| 2 | | | | | | |
| 3 | | | | | 3.00 | -2.50 **End of Test Pit at Chart Elevation -2.5 m** |

TEST PIT WITH GRAPH 90015.02.GPJ GEMTEC 2004.GDT 30/11/16

GEMTEC
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# TEST PIT LOG

| | | | |
|---|---|---|---|
| Client | Public Works and Government Services Canada | Proj No. 9001502 | Test pit TP16-23 |
| Project | Geotechnical Investigation - Gully & Channel Dredging | Date End 25/11/2016 | Page 1 of 1 |
| Location | Pigeon Hill, New Brunswick | | |
| Ground Level, m -0.40 | Datum: Chart | Logged By DA | |

Undrained Shear Strength - kPa
0 25 50 75 100
☐ Pocket Penetrometer <225 ■ Pocket Penetrometer
⊕ Field Vane Test ⊗ Remoulded
Water Content & Atterberg Limits $w_P$ w $w_L$
Dynamic Penetration Test, blows/0.3m
Standard Penetration Test, blows/0.3m
0 10 20 30 40 50 60 70 80 90 100

| DEPTH m | SAMPLE No | SAMPLE TYPE | SAMPLE N (RQD) | SAMPLE REC mm | LOG | DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | | **SAND** Brown sand with gravel, trace cobbles and organics (shells) |
| 1 | | | | | 1.20 -1.60 | **End of Test Pit at Chart Elevation -2.5 m** |
| 2 | | | | | | |

TEST PIT WITH GRAPH 90015.02.GPJ GEMTEC 2004.GDT 29/11/16

GEMTEC
CONSULTING ENGINEERS AND SCIENTISTS

# TEST PIT LOG

| | | | |
|---|---|---|---|
| Client | Public Works and Government Services Canada | Proj No. 9001502 | Test pit TP16-24 |
| Project | Geotechnical Investigation - Gully & Channel Dredging | Date End 25/11/2016 | Page 1 of 1 |
| Location | Pigeon Hill, New Brunswick | | |
| Ground Level, m -1.30 | Datum: Chart | Logged By DA | |

Undrained Shear Strength - kPa
0 25 50 75 100
☐ Pocket Penetrometer <225 ■ Pocket Penetrometer
⊕ Field Vane Test ⊗ Remoulded
Water Content & Atterberg Limits $w_P$ $w$ $w_L$
Dynamic Penetration Test, blows/0.3m
Standard Penetration Test, blows/0.3m
0 10 20 30 40 50 60 70 80 90 100

| DEPTH m | SAMPLE No | TYPE | N (RQD) | REC mm | LOG | DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | | **SAND** Brown sand with gravel, trace cobbles and organics (shells) |
| 1 | | | | | 1.20 | |
| | | | | | -2.50 | **End of Test Pit at Chart Elevation -2.5 m** |

TEST PIT WITH GRAPH 90015.02.GPJ GEMTEC 2004.GDT 29/11/16

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# TEST PIT LOG

| | | | |
|---|---|---|---|
| Client | Public Works and Government Services Canada | Proj No. 9001502 | Test pit TP16-25 |
| Project | Geotechnical Investigation - Gully & Channel Dredging | Date End 25/11/2016 | Page 1 of 1 |
| Location | Pigeon Hill, New Brunswick | | |
| Ground Level, m -1.30 | Datum: Chart | Logged By DA | |

Undrained Shear Strength - kPa
0 25 50 75 100
☐ Pocket Penetrometer <225 ■ Pocket Penetrometer
⊕ Field Vane Test ⊗ Remoulded
Water Content & Atterberg Limits $w_P$ w $w_L$
Dynamic Penetration Test, blows/0.3m
Standard Penetration Test, blows/0.3m
0 10 20 30 40 50 60 70 80 90 100

| DEPTH m | SAMPLE No | TYPE | N (RQD) | REC mm | LOG | DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | | **SAND** Brown sand with gravel, trace cobbles and organics (shells) |
| 1 | | | | | 1.20 | |
| | | | | | -2.50 | **End of Test Pit at Chart Elevation -2.5 m** |

TEST PIT WITH GRAPH 90015.02.GPJ GEMTEC 2004.GDT 29/11/16

# Appendix B

Laboratory Testing Results

GEMTEC
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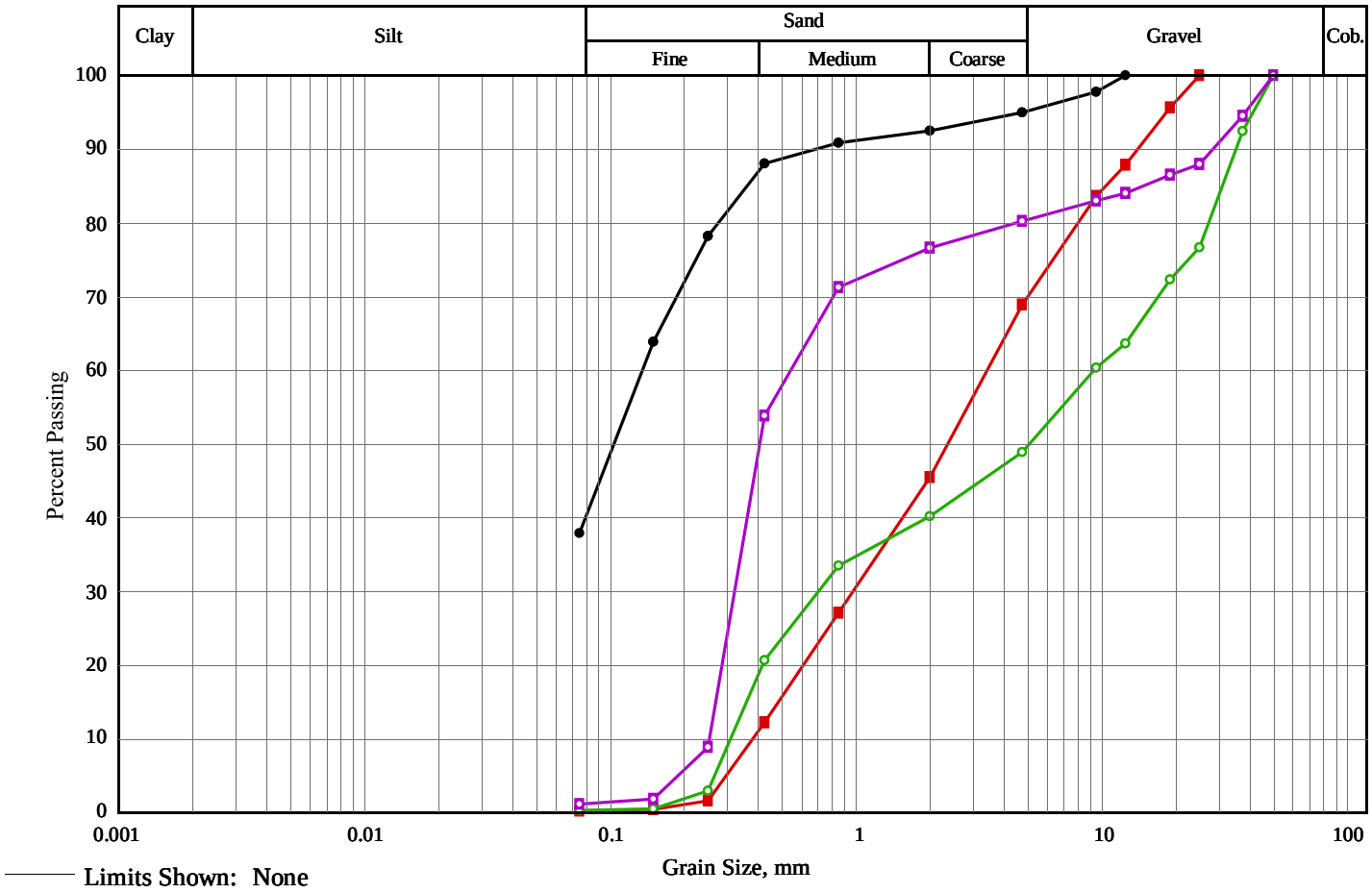
| | |
|---|---|
| Client: | Public Works and Government Services Canada |
| Project: | Geotechnical Investigation - Pigeon Hill |
| Project #: | 9001502 |

# Soils Grading Chart



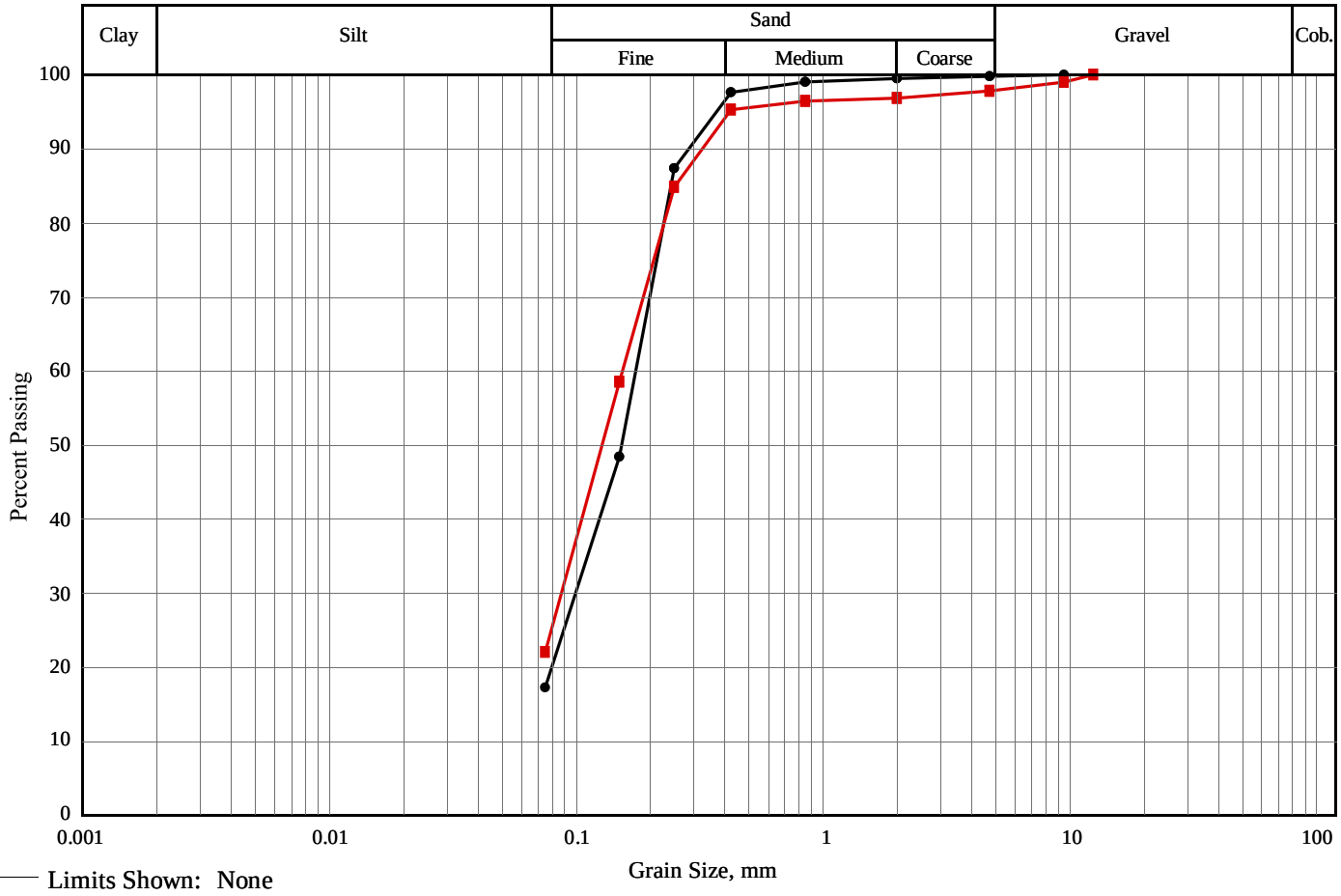

| Line Symbol | Description | Borehole/ Test Pit | Sample Number | Depth | % Cob.+ Gravel | % Sand | % Silt | % Clay | Date Sampled |
|---|---|---|---|---|---|---|---|---|---|
| | Sand | TP16-6 | 1 | 1.1 m | 5.0 | 57.1 | 37.9 | | 16/11/23 |
| | Sand | TP16-13 | 1 | 0.1 m | 31.1 | 68.7 | 0.2 | | 16/11/23 |
| | Gravel | TP16-4 | 1 | 1.0 m | 51.1 | 48.6 | 0.3 | | 16/11/23 |
| | Sand | TP16-9 | 1 | 1.0 m | 19.8 | 79.1 | 1.1 | | 16/11/23 |

| Line Symbol | Sample Description | ASTM | $D_{10}$ | $D_{15}$ | $D_{50}$ | $D_{85}$ | % 5-75µm |
|---|---|---|---|---|---|---|---|
| | silty sand | SM | --- | --- | 0.10 | 0.36 | --- |
| | sand with gravel | SP | 0.38 | 0.48 | 2.36 | 10.39 | --- |
| | gravel with sand | GP | 0.31 | 0.36 | 5.08 | 30.98 | --- |
| | sand with gravel | SW | 0.25 | 0.27 | 0.41 | 14.76 | --- |

GEMTEC
Consulting Engineers and Scientists

| | |
|---|---|
| Client: | Public Works and Government Services Canada |
| Project: | Geotechnical Investigation - Pigeon Hill |
| Project #: | 9001502 |

# Soils Grading Chart




| Line Symbol | Description | Borehole/ Test Pit | Sample Number | Depth | % Cob.+ Gravel | % Sand | % Silt | % Clay | Date Sampled |
|---|---|---|---|---|---|---|---|---|---|
| | Sand | TP16-14 | 1 | 0.2 m | 0.2 | 82.6 | 17.2 | | 16/11/23 |
| | Sand | TP16-1 | 1 | 1.1 m | 2.2 | 75.8 | 22.0 | | 16/11/28 |
| | | | | | | | | | |
| | | | | | | | | | |

| Line Symbol | Sample Description | ASTM | $D_{10}$ | $D_{15}$ | $D_{50}$ | $D_{85}$ | % 5-75µm |
|---|---|---|---|---|---|---|---|
| | silty sand | SM | --- | --- | 0.15 | 0.24 | --- |
| | silty sand | SM | --- | --- | 0.13 | 0.25 | --- |
| | | | | | | | |
| | | | | | | | |

# Appendix C

Select Photos


ECO Technologies Amphibious Excavator. November 21, 2016.

Test Pit TP16-1. November 21, 2016.

Test Pit TP16-2. November 21, 2016.

Measuring depth to ground surface. November 21, 2016.

Test Pit TP16-3. November 21, 2016.

Test Pit TP16-5. November 21, 2016.


Test Pit TP16-6. November 21, 2016.

Test Pit TP16-4. November 21, 2016.

Test Pit TP16-7. November 21, 2016.

Test Pit TP16-8. November 21, 2016.

Test Pit TP16-10. November 21, 2016.

Test Pit TP16-11. November 21, 2016.

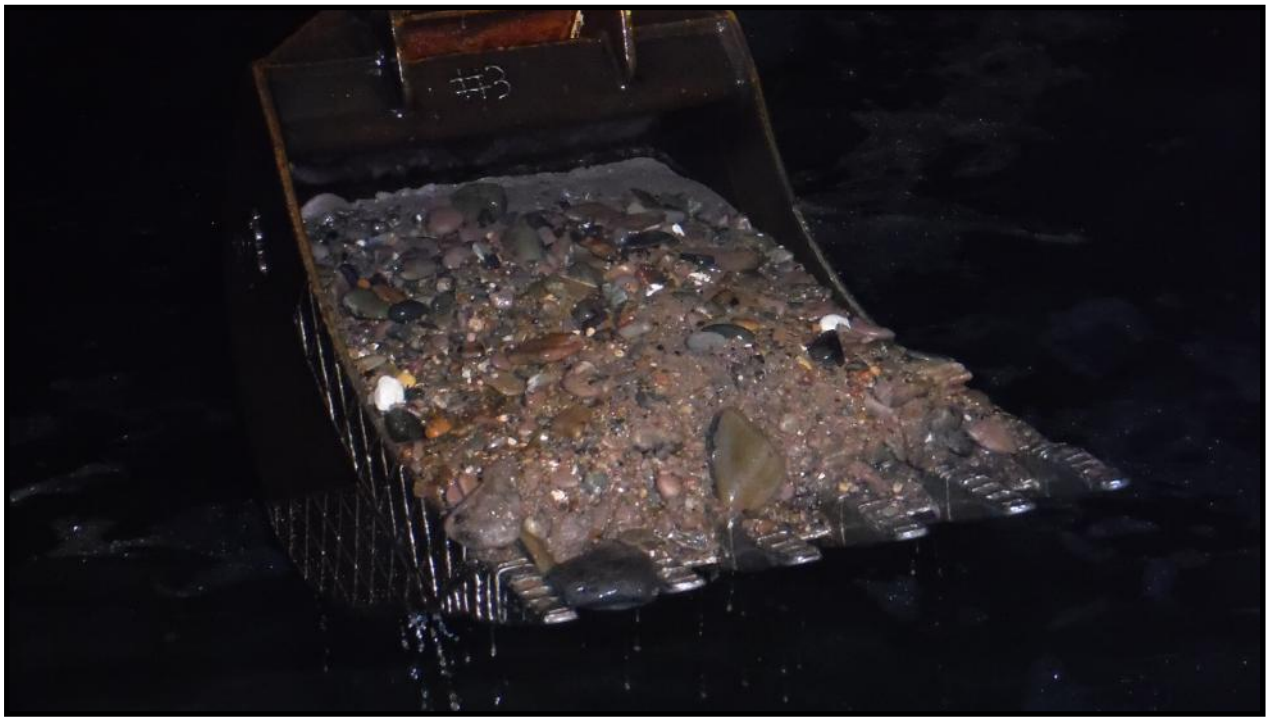
Test Pit TP16-14. November 21, 2016.

Test Pit TP16-13. November 21, 2016.

View of Test Pit TP16-16 location and excavation. November 25, 2016.

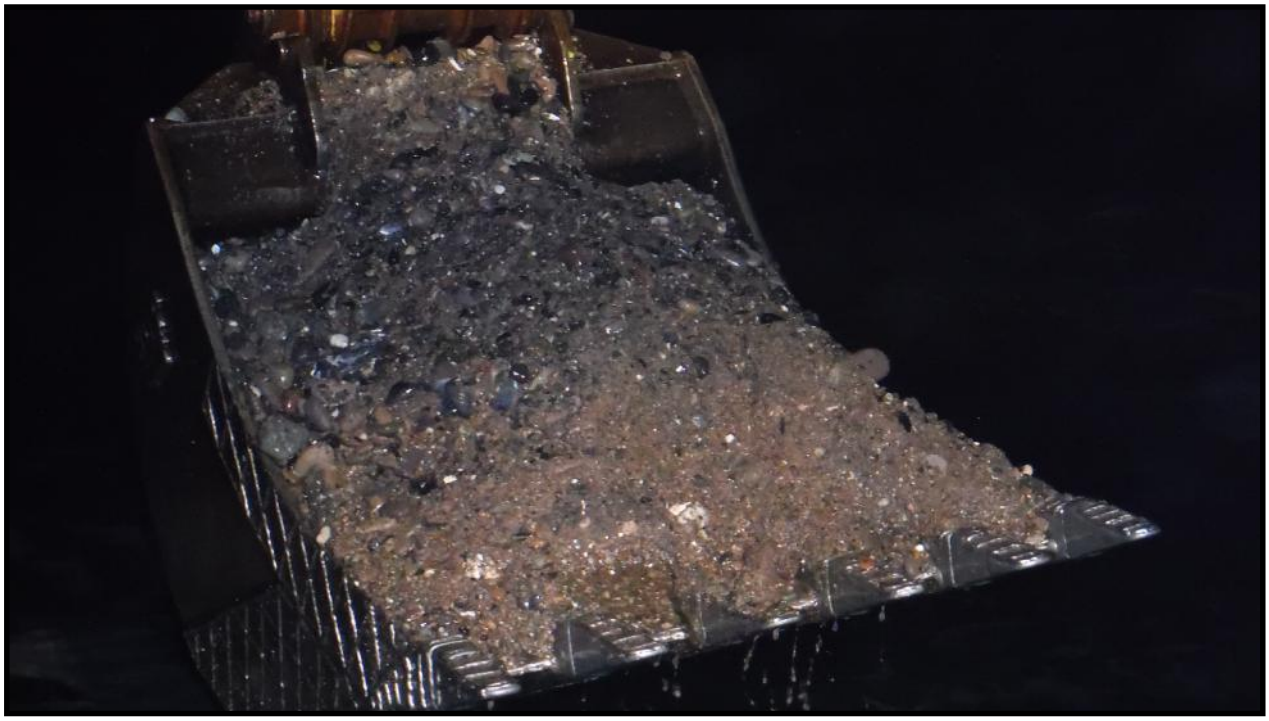
Test Pit TP16-16. November 25, 2016.

Test Pit TP16-18. November 25, 2016.



Test Pit TP16-20. November 25, 2016.

Test Pit TP16-21. November 25, 2016.



Test Pit TP16-22. November 25, 2016.