CANADIAN ROYALTIES INC.

Montréal, May 15, 2013

Ms. Anne-Marie Gaudet
Executive Secretary COFEX/FRP
1550 D'Estimauville, 9th Floor
Québec (Quebec) G1J 0C1

**O/Ref.:** **101-53046-03**

**Subject:** **Nunavik Nickel Project, Canadian Royalties Inc.**
**Environmental and Social Impact Assessment for the Development of Port Infrastructure and Sediment Management in Deception Bay**
**Additional Information**

Dear Ms. Gaudet:

A copy of the above-mentioned report was sent to you in November of 2012. Following its analysis, questions from COFEX-N were emailed to Ms. Gail Amyot of Canadian Royalties Inc. (CRI), on May 1st, 2013.

The following provides the requested clarifications and additional information.

Please note that the preliminary design of the permanent wharf presented in the assessment submitted in November 2012 has been revised by CRI's design engineers. The revised plans are included in Appendix 1.

The main changes made to the design of the permanent wharf are:

- The north cell has been moved nearer to the south cell and on the same axis;
- The design of the bridge connecting the shore with the south cell has been revised; a bridge with a central support is proposed;
- Loading and unloading operations will be conducted on sheet pile cells;
- The two cells will be connected by a catwalk wide enough for a side by side ATV to pass;
- Signal lights have been added to the north and south cells;
- De-icing systems for sheet pile walls have been removed as they were deemed unnecessary.

The sheet pile cells' new approximate coordinates and UTM projection coordinates (datum NAD 83, Zone 18 N) are indicated on the included plans. They are:

- South cell
  - 62°08'20.7''N
  - 74°40'50.6''W
  - X = 516631.484m East
  - Y = 6889715.450m North
- North cell
  - 62°08'22''N
  - 74°40'54.2''W
  - X = 516594.735m East
  - Y = 6889756.371m North

It was decided to carry out the ship loading and unloading operations directly from the sheet pile cells. As CRI will own the ship, the need to reduce the time required for these operations is no longer a constraint. These operations will be just as safe; the ship will dock directly on the sheet pile cells which will be protected by defense systems.

Development of the bridge will require the construction of an intermediary support. This will consists in posts driven down right to the bedrock, which will have riprap protection. The latter is required to prevent ice from damaging the posts, and thus to preserve their integrity. The bridge's intermediary support will be constructed from the bridge's deck, which will be temporarily supported by a jack-up barge.

The sheet pile cells will be constructed from the bridge's other span for the south cell and from a barge for the north cell.

It should be noted that in order to counteract the impact of ice on the cells, the sheet pile walls will be strengthened with vertical reinforced concrete panels fixed onto their inner side (plan 506117_8000_41D1_0009, plan 506117_8000_42D1_004).

A reinforced concrete ring will top the sheet pile wall to eventually anchor ladders and defense systems (plan 506117_8000_41D1_0010). Concrete slabs will also be attached. These slabs, of varying lengths and widths depending on their use, will be used to install the following facilities:

- Catwalk supports connecting the two sheet pile cells: one support for each cell;
- Bridge support: one support on the south cell only;
- Anchoring of bollards;
- Anchoring of signal lights and related electric system.

Plans 506117_8000_41D1_0009 and 506117_8000_42D1_0001 show the general layout of these facilities.

This new design has considerably diminished the volumes of sediment needing to be dredged. The installation of cell 1 (north) will require some 15,000 $m^3$ of dredging (initially 23,000 $m^3$), whereas the dredging for cell 2 (south) is estimated

at around 7,000 $m^3$ (initially 20,000 $m^3$). Thus, an approximate total of 22,000 $m^3$ of sediment will be dredged. The volume was determined by comparing the surfaces using a computer assisted design (CAD) software program.

The volume of rock required for the riprap protection around the cells has also been reduced. It will consist of different-calibre rock placed as shown on plan 506117_8000_41-D1_0007. Around cell 1 (north), the volume is estimated at 13,100 $m^3$, covering 2,920 $m^2$, whereas the revised volume for cell 2 (south) is 5,700 $m^3$ over 1,535 $m^2$.

The permanent wharf's revised design concept will modify some 5,400 $m^2$ of fish habitat: the sheet pile cells will cover the same area, that is around 940 $m^2$, while the riprap surrounding them will cover around 4,455 $m^2$. The intermediary support installed in the tidal range area will also be protected from the impact of ice by riprap, covering some 470 $m^2$. Contrary to the initial design, the riprap surrounding the sheet pile cells will be permanently submerged, thus only the riprap around the intermediary support will be above water at low tide.

Therefore, despite the fact that the riprap shall be colonized by aquatic vegetation and epibenthos, thus generating fish habitats for feeding, as well as the spaces between rocks providing protection against predators or resting areas, an area estimated at 5,400 $m^2$ will be considered and be the subject of fish compensation measures under the Fisheries Act (LCR, 1985, c.F-14) as for fish habitat protection measures.

For any questions regarding this document, please do not hesitate to contact the undersigned.

Best regards,

Gail Amyot, Eng. M.Sc.
Vice-President Environment, Health and Safety
Canadian Royalties Inc.

Encl. Answers to Questions and Comments
Appendix 1 – Revised Permanent Wharf Plans (signed and sealed)
Appendix 2 – Stantec Consulting Ltd.: Geotechnical Reports
Appendix 3 – GENIVAR: Technical Note: Dredging Methods

c.c.: Mr. Claude D'Astous, MDDEFP (central)
Ms. Alexandra Roio, MDDEFP (central)
Ms. Isabelle Dorion, MDDEFP (regional)
Mr. Michael Barrett, KRG-KEAC
Ms. Mishall Naseer, ARTIN
Ms. Natalie Gagné, GENIVAR INC.

# COFEX-N Questions and Comments

***Issues***

*1- Detail checks made to the slope stability (slope justification), the dredging and the riprap protection that will be installed.*

*2- Information regarding the choice and anchoring of structures and their long-term stability (plans show that the material surrounding the 2 sheet pile cells is excavated to be replaced with stone). If the riprap protection is not efficient due to improper calibre of stone or non-compliance with filtering criteria, would the stability of the 2 cells be compromised?*

*3- Information regarding extreme conditions (studies on agitation, winds, ice, earthquakes, etc.) and the way they are considered in the infrastructure design (conceptual criteria to be used).*

**Answers – Issues:**

1- CRI mandated Stantec Consulting Ltd. (Stantec) to prepare a complete geotechnical report including the required design parameters for the construction of the proposed Deception Bay permanent wharf. A copy of this report is included in Appendix 2 of the present document.
2- The stability analyses are presented in the geotechnical report (Stantec, 2013). Calculations were made regarding the type of riprap to be placed around the cells so as to ensure the overall stability of the sheet pile cells considering the loads as well as the impact of ice, in addition to offering protection against the potential scouring of the sea bed generated by ship motors. It is important to note that work will be conducted under the supervision of work site supervisors mandated by CRI to ensure compliance with the requirements of the plans and specifications.
3- Extreme conditions were taken into account when designing the permanent wharf and related structures.

***Detailed Questions***

a. *The slope will need to be checked to see if it has stabilized after the landslide. Has corrective work been carried out?*

Answer:

Following the events of July 2011, large rocks were removed so as to maintain navigability near the bank. As for the slope, it has stabilized naturally. The design that was finally chosen by the engineers, together with CRI specialists, for the development of port infrastructure at Deception Bay is based on an exhaustive characterization of the proposed site, surveys having been conducted in the

summer of 2012, after the landslide. The site chosen for the construction of the sheet pile cells is optimal considering the nature of soils and bedrock as well as the navigational constraints.

b. *There is probably a fault/weakness in the slope, is there ongoing erosion?*

Answer:

The clay to silty clay layer has a low bearing capacity. This layer shall be dredged prior to the installation of the sheet pile cells following the recommendations of Stantec's 2012 and 2013 geotechnical reports. The sea bed is stable and there are no signs of ongoing erosion.

*Dredging*

a. *The clay could be sensitive. We do not have the physical properties of the clay.*

Answer:

The clay's properties are clearly defined in Stantec's geotechnical reports (Stantec, 2012; Stantec, 2013).

b. *Have detailed geotechnical studies been carried out?*

Answer:

The geotechnical reports (Stantec, 2012; Stantec, 2013) are available in Appendix 2 of the present document.

c. *Have the geotechnical survey's data been analyzed with recommendations by a geological engineer?*

Answer:

The geotechnical reports including recommendations from a geological engineer (Stantec, 2012; Stantec, 2013) are available in Appendix 2 of this document.

d. *Has the stability of the excavation slope during dredging work been assessed?*

Answer:

The geotechnical reports including slope stability analyses (Stantec, 2012; Stantec, 2013) are available in Appendix 2 of this document.

e. *The 3:1 slopes might not be stable (given the presence of clay) during the work period. The dredging volumes could be larger with a greater production of suspended matter.*

Answer:

Experts estimate that a 3:1 excavation slope is realistic, but it could reach 5:1, in which case the land-based facilities for the management of sediment have an adequate storage capacity.

f. *How can we be sure of the stability of slopes?*

Answer:

See Stantec's 2013 geotechnical report included in Appendix 2.

g. *The 1-month at 16-h/day dredging scenario, dredging 100 $m^3$/hour, is really highly optimistic (the pace of dredging will create lots of turbidity). Is there a more realistic Option B if dredging work was to be slowed down by weather conditions and the schedule could not be changed (critical path)?*

Answer:

Sediment dredging could be conducted over a period which could reach hours per day. An estimated 15 days of dredging will be required for each of the sheet pile cells.

A technical note comparing various dredging methods is presented in Appendix 3. CRI favours the use of an environmental clamshell that would reduce the resuspension of fine particles during dredging, which is why this method was presented in the ESIA. However, a hydraulic method could be accepted if the compliance of that water returning to Deception Bay with the water quality criteria applicable to the Deception Bay is demonstrated. As indicated in the technical note, the hydraulic dredging method seems to be faster when conditions are optimal (absence of rock).

The contractor mandated by CRI to carry out the dredging work is aware of the conditions and constraints specific to the Deception Bay. The contract documents stipulate that the contractor must chose the work method to be used and demonstrate that it meets the performance requirements specified in the tender documents.

*Section 7: Project Description*

a. *Has an agitation report been completed? The wind data only covers 10 years and are over 40 years old. The range of data seems insufficient and unrepresentative.*

   Answer:

   Wind measurements at Deception Bay are rare (private data not available). The winds measured at the Salluit A (airport) weather station, situated over 50 km to the east, are used to give a general portrait, for the period from 1992 to 2012. Specialists had to work with available data.

   During the development of the first wharf design in 2010, the environmental conditions were considered when determining the minimum required height of the wharf. This assessment was based on tide variations, wave heights and the possible rise in water levels due to climate changes. The height of the sheet pile cells was set based on these considerations, this has not changed from the first design.

b. *Have the structures been designed for extreme conditions (only averages, not extremes, considered)? Have the riprap sizes been based on extreme wave, wind and tide conditions?*

   Answer:

   Riprap is required to counteract the effects of ice and not wind. As disclosed in the geotechnical report, the cells are stable on their own against the wind and waves.

c. *Have ship-generated waves been studied? In relation to sediment dynamics: the speed and presence of docked ships could generate erosion (this also depends on the presence of vegetation).*

   Answer:

   Ship-generated waves have not been studied as there is little risk of erosion due to the nature of Deception Bay's banks (outcropping rock or at low depth). Moreover, certain conditions and constraints imposed on navigation and the development of wharves in Deception Bay can indirectly limit the impact of waves generated by ships, namely:

   - Ship speed is limited to 7 knots;
   - The riprap planned at the foot of sheet pile cells, on the ship side, will prevent sea bed scouring.

   Consulted hydraulic engineers and geomorphologists are of the opinion that it is not pertinent to study the effects of ship-generated waves in Deception Bay.

d. *Why has the wharf not been designed with moorings? (the dredged volume would thus be reduced).*

Answer:

Moorings are prescribed when foundation soil allows for pipe driving (sand or clay). When the bottom is rocky, moorings are then developed in the form of massive structures (caissons) which consider applicable loads and constraints (wind, ice, ships, etc.).

Further, the riprap surrounding the intermediary pile will break the ice when the tide falls, which is not possible between moorings and ships.

e. *What guarantee is there that the sheet pile cell (which is not anchored to the rock) will not move over time?*

Answer:

The design of the sheet pile cells was developed considering all applicable constraints and loads to which factors of safety have been applied. See Stantec's 2013 geotechnical report included in Appendix 2.

f. *Why is there no riprap on either side of one of the cells?*

Answer:

Plan 506117_8000_41-D1_0006 included in Appendix 1 illustrates the distribution of riprap around the two sheet pile cells.

g. *For riprap on clay, how can we be assured that the stone will not sink into the clay (as was the case with the 2011 landslide) – there are no indication regarding the calibre of stone to be used, the filter criteria are not being respected as there is no grain size transition between the clay and the protective stone?*

Answer:

During the 2011 event, the stone placed on the sea bed did not sink into the clay layer as anticipated: the riprap remained over the clay layer without penetrating it, overloading the clay layer until its rupture which created the landslide.

In the revised design, the proposed riprap will replace the volume of clay that is removed. While the weight of the riprap is around 10% greater than the clay it replaces, if a landslide was to occur, the stone would form a significant part of the shear plane. The riprap reinforces the slope in comparison with its original condition, thus the specialists consider that the factor of safety against slope failure provided by the riprap is equal to or better than the pre-construction condition.

h. *Question regarding the anchoring of the permanent infrastructure: the action of ice and waves could destabilize the riprap protection and generate scouring or erosion.*

Answer:

As presented in the geotechnical report (Stantec, 2013), the cells are stable on their own against wind and waves. The riprap surrounding the sheet pile cells increases the cells' stability against the impact of ice (shore) and scouring (ships).

i. *Has the possibility that the base of the sheet piles loosens due to ships' propellers been assessed? Has a solution been considered?*

Answer:

The riprap planned for the foot of the cells on the ship side serves to counter this scouring.

j. *Question regarding slope stability even after riprap has been added: There may be no problem once the riprap has been added but until then, have the necessary studies been conducted to ensure the slope's stability (wave dimensioning, effects of ice, filter criterion and grain-size transition)?*

Answer:

As previously mentioned, experts estimate that a 3:1 excavation slope will ensure slope stability, but it could reach 5:1 on the ship side. The stability studies were conducted considering all applicable constraints. It should be noted that the clay excavation, cell development and riprap installation work will be conducted over a period of around 4 months (June to September 2013), thus before the ice has formed.

k. *Have earthquakes been considered? Is risk being managed or have the structures been designed to resist earthquakes? (if the risk of earthquakes, landslides, etc. is not taken into account during the construction, this should be documented, especially when work is conducted in clayey formations).*

Answer:

As for analyses in pseudostatic conditions, a site peak ground acceleration (PGA) of 0.102 g was considered (seismic hazard value of 2% obtained from Natural Resources Canada for Deception Bay using a 1/50 year recurrence ratio).

As for pseudostatic slope stability analysis, the following seismic coefficient values were used: $k_h$ = 0.051 g and $k_v$ = 0 g. The recommended value of $k_h$ is based on Hynes-Griffin and Franklin (1984) criteria which suggest that for pseudostatic analysis, 50% of the PGA is appropriate.

To calculate the factor of safety in pseudostatic conditions, we have assumed that the seismic loading does not act simultaneously with the thermal ice loading, since they are both considered to be extraordinary loads. Analyses for the north cell yield a factor of safety of 1.63 , compared to 2.63 under dead loads alone (see additional answer email from Stantec, May 7, 2013).

Since the south cell has a higher factor of safety under dead loads (3.05) than the north cell (2.63), it was not deemed useful to determine its factor of safety in pseudostatic conditions but it will be greater than 1.63.

Appendix 1

Revised Permanent Wharf Plans (signed and sealed)

CANADIAN ROYALTIES INC.

# PROJET NUNAVIK NICKEL

## 8000 SERIES

## STEEL SHEET PILE CELLS
## BRIDGED OPTION/
## CELLULES DE PALPLANCHES D'OPTIONS
## COMBLE

**ISSUED FOR PERMIT**
**EMIS POUR PERMIS**

SNC·LAVALIN

REGISTERED PROFESSIONAL ENGINEER
PEGNL
CHRISTOPHER M. FUDGE
SIGNATURE
2013-04-05
DATE
NEWFOUNDLAND & LABRADOR

ORDRE DES INGÉNIEURS DU QUÉBEC
Permis Temporaire / Temporary Licence
Nom / Name Christopher Fudge
No. OIQ PT01760
Nul après / Void after 2013-10-29
Site: NUNAVIK NICKEL PROJECT / NOTHERN QUEBEC

FOR PERMIT
NOT FOR CONSTRUCTION

POUR PERMIS
PAS POUR CONSTRUCTION

## LIST OF DRAWINGS

MARINE

| | |
|---|---|
| 506117-8000-41D1-0001 | GENERAL NOTES & DESIGN CRITERIA |
| 506117-8000-41D1-0002 | SITE PLAN |
| 506117-8000-41D1-0003 | SSP CELLS - GENERAL ARRANGEMENT |
| 506117-8000-41D1-0004 | DREDGING PLAN |
| 506117-8000-41D1-0005 | DREDGING SECTIONS |
| 506117-8000-41D1-0006 | RIP RAP/ ROCK FILL BERMS |
| 506117-8000-41D1-0007 | ROCK FILL SECTIONS |
| 506117-8000-41D1-0008 | SSP CELLS PLAN VIEW |
| 506117-8000-41D1-0009 | SSSP CELLS DECK PLAN |
| 506117-8000-41D1-0010 | LADDER & BULLRAIL DETAILS |
| 506117-8000-41D1-0011 | FENDER DETAILS |
| 506117-8000-41D1-0012 | MOORING ARRANGEMENT |
| 506117-8000-41D1-0013 | MOORING DETAILS |
| 506117-8000-41D1-0014 | MOORING DETAILS |
| 506117 8000-41D1-0015 | PILE PLAN AND SECTIONS |
| 506117-8000-42D1-0001 | CONCRETE CAP REINFORCING PLANS |
| 506117-8000-42D1-0002 | CONCRETE CAP REINFORCING DETAILS -NORTH CELL |
| 506117-8000-42D1-0003 | CONCRETE CAP REINFORCING DETAILS -SOUTH CELL |
| 506117-8000-42D1-0004 | MOORING CONCRETE REINFORCING DETAILS |
| 506117-8000-42D1-0005 | ICE IMPACT BEAMS |
| 506117-8000-42D1-0006 | REINFORCED CONCRETE ABUTMENT DETAILS |
| 506117-8000-42D1-0007 | SSP CELLS - CONCRETE ABUTMENT DETAILS |
| 506117-8000-42D1-0008 | SSP CELLS - CONCRETE CAP REINFOREMENT |

## LISTÉ DES DESSINS

| | |
|---|---|
| 506117-8000-41D1-0001 | REMARQUES GÉNÉRALES ET CRITÈRES DE CONCEPTION |
| 506117-8000-41D1-0002 | PLAN DU SITE |
| 506117-8000-41D1-0003 | SSP CELLULES - GÉNÉRALE ARRANGEMENT |
| 506117-8000-41D1-0004 | PLAN DE DRAGAGE |
| 506117-8000-41D1-0005 | SECTIONS DE DRAGAGE |
| 506117-8000-41D1-0006 | RIP RAP/ ROCK BERMES DE REMPLISSAGE |
| 506117-8000-41D1-0007 | BASCULEZ SECTIONS DE REMPLISSAGE |
| 506117-8000-41D1-0008 | LES CELLULES SSP PLANIFIER VUE |
| 506117-8000-41D1-0009 | PLAN DE PONT SSP CELLULES |
| 506117-8000-41D1-0010 | DÉTAILS ÉCHELLE ET BULLRAIL |
| 506117-8000-41D1-0011 | DÉTAILS PARE-CHOCS |
| 506117-8000-4101-0012 | DISPOSITIF D'AMARRAGE |
| 506117-8000-41D1-0013 | LES DÉTAILS D'AMARRAGE |
| 506117-8000-41D1-0014 | LES DÉTAILS D'AMARRAGE |
| 506117-8000-4101-0015 | PLAN DE PILE ET SECTIONS |
| 506117-8000-42D1-0001 | BOUCHON A BÉTON PLANS |
| 506117-8000-42D1-0002 | BOUCHON A BÉTON DE DÉTAILS - CELLULE OU NORD |
| 506117-8000-42D1-0003 | BOUCHON A BÉTON DE DÉTAILS - CELLULE DU SUD |
| 506117-8000-4201-0004 | AMARRAGE DE DÉTAILS CONRETS DE RENFORT |
| 506117-8000-42D1-0005 | POUTRELLES DE GLACE |
| 506117-8000-4201-0006 | RENFORCES COORDONNÉES CULÉE EN BÉTON |
| 506117-8000-42D1-0007 | SSP CELLULES COORDONNÉES CULÉE EN BÉTON |
| 506117-8000-42D1-0008 | SSP CELLULES COURONNÉMENT EN BÉTON |

**05 APRIL 2013**
**05 AVRIL 2013**

**PROJECT No./ PROJET No.**
**506117**

## DESIGN CRITERIA

CODES AND STANDARDS

1. DESIGN OF THE WHARF CONFORMS TO THE FOLLOWING CODES AND STANDARDS: CAN/CSA–A23.3 – DESIGN OF CONCRETE STRUCTURES.

SERVICE LIFE AND DURABILITY

1. THE STRUCTURE IS DESIGNED FOR A SERVICE LIFE OF 15 YEARS.

ICE DATA AND LOADS

DATA:

| | |
|---|---|
| EXTREME MAXIMUM LEVEL ICE THICKNESS: | 2.1m |
| BREAK–UP ICE THICKNESS: | 1.4m |
| ICE BUSTLE THICKNESS (AVG.): | 4.3m |

LOADS:

| | |
|---|---|
| THERMAL: | 275kN/m |
| FLOE IMPACT: | 8.6 MN |
| ICE LOAD DUE TO ICE BREAKING SHIP: | 8.9 MN |
| GLOBAL PRESSURE: | 700kPa |

SEISMIC

1. GROUND ACCELERATION:

| | |
|---|---|
| PEAK GROUND ACCELERATION: | 0.16 |
| PROBABILITY OF EXCEEDANCE IN 50 YEARS: | 2% |
| AVERAGE RETURN PERIOD IN YEARS: | 475 |

MARINE CRITERIA

1. TIDES REFERENCED TO CHART DATUM (CD), BASED ON CANADIAN HYDROGRAPHIC SERVICE (CHS) CHART No. 5457 ARE AS FOLLOWS:

| | |
|---|---|
| EXTREME HIGH WATER LEVEL (EHWL): | 5.9 m (ESTIMATED) |
| HIGHER HIGH WATER LEVEL, LARGE TIDE (HHWL): | 5.6 m |
| HIGHER HIGH WATER LEVEL, MEAN TIDE: | 4.7 m |
| MEAN WATER LEVEL (MWL): | 2.9 m |
| LOWER LOW WATER LEVEL, MEAN TIDE: | 1.0 m |
| LOWER LOW WATER LEVEL, LARGE TIDE (LLWL): | 0.2 m |
| EXTREME LOW WATER LEVEL (ELWL): | 0.0 m |

2. CURRENT
   CURRENT SET PARALLEL TO THE BERTH FACE: 1.0 KNOT (ESTIMATED)
   CURRENT SET PERPENDICULAR TO THE BERTH FACE: 0.5 KNOT (ESTIMATED)
3. WIND
   WIND LOADS FOR ASSESSING MOORING LOADS ARE BASED ON WIND SPEEDS AS PROVIDED BY ATMOSPHERIC ENVIRONMENT SERVICE.
   RETURN PERIOD WIND: 50 YEAR
   WIND SPEED (30 SEC DURATION): 140 KILOMETERS PER HOUR
4. WAVE CLIMATE
   FOR ESTABLISHING DECK ELEVATION (ZERO OVERTOPPING):
   RETURN PERIOD: 1 YEAR
   MAXIMUM WAVE HEIGHT: 1.0 METERS
5. WAVE LOADS:
   RETURN PERIOD: 50 YEAR
   SIGNIFICANT WAVE HEIGHT 2.0 METERS

DESIGN VESSELS

| VESSEL TYPE | DEADWEIGHT TONNES | LOA (m) | BEAM (m) | MINIMUM FREEBOARD (m) | MAXIMUM DRAFT (m) |
|---|---|---|---|---|---|
| HANDYSIZE | 25,000 | 189 | 26.6 | 3.95 | 11.75 |

BERTHING IMPACT AND MOORING LOADS

VESSEL APPROACH VELOCITY PERPENDICULAR TO THE BERTH FACE:

| | |
|---|---|
| VESSEL: | 0.2 m/sec |

MOORING LOADS:

| | |
|---|---|
| FORE AND AFT SHORE MOORINGS: | 200 TONNES |
| BREAST LINE SHORE BOLLARDS: | 200 TONNES |
| SPRING LINE CELL BOLLARDS: | 100 TONNES |

DOCK LOADS

VEHICLE AND OTHER DECK LOADS ARE LISTED IN THE FOLLOWING SUBSECTIONS:

1. UNIFORM AND STORAGE LOADS 50 kPa
2. SHIPLOADER: HOLD

## GENERAL NOTES

1.0 CONCRETE AND REINFORCEMENT

1.1 CONCRETE SHALL BE C–XL CLASS, 35MPa.

1.2 CAST IN PLACE CLEAR CONCRETE COVER TO THE REINFORCING STEEL SHALL BE AS FOLLOWS, UNLESS OTHERWISE NOTED:

BOTTOM SURFACES 100mm
SIOE SURFACES 75mm
TOP SURFACES 75mm

1.3 NO MORE THAN 25% OF THE LONGITUDINAL REINFORCING IN MEMBERS EXCEEDING 500mm DEEP SHALL BE SPLICED AT THE SAME LOCATION. ADJACENT BARS SHALL NOT BE SPLICED AT THE SAME LOCATION.

1.4 SPLICES IN MEMBERS LESS THAN OR EQUAL TO 500mm DEEP SHALL BE STAGGERED SO THAT NO MORE THAN EVERY THIRD BAR IS SPLICED AT ANY ONE SECTION.

1.5 MINIMUM LAP LENGTHS FOR ANY REINFORCING SPLICES SHALL BE AS FOLLOWS UNLESS OTHERWISE NOTED.

| BAR SIZE | BARS OTHER THAN TOP BARS | TOP BARS |
|---|---|---|
| 10M | 400 | 500 |
| 15M | 500 | 600 |
| 20M | 600 | 800 |
| 25M | 1000 | 1300 |
| 30M | 1200 | 1600 |
| 35M | 1500 | 2000 |

TOP BARS ARE HORIZONTAL REINFORCING BARS SO PLACED THAT MORE THAN 300mm OF CONCRETE IS CAST IN THE MEMBER BELOW THE REINFORCEMENT.

1.6 UNLESS NOTED OTHERWISE, ALL CORNERS TO BE CHAMFERED/FILLETED 25mm.

2.0 GROUT

2.1 GROUT BETWEEN SHEET PILE CELLS AND PRECAST CONCRETE ICE IMPACT BEAMS SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 20MPa.

2.2 MIX PROPORTIONS FOR GROUT FOR PRECAST CONCRETE ICE IMPACT BEAMS SHALL BE AS FOLLOWS, TO YIELD APPROXIMATE ONE CUBIC METER:

| | |
|---|---|
| CEMENT (TYPE 10): | 160kg |
| FLY ASH OR SLAG: | 200kg |
| SILICA FUME: | 40kg |
| CONCRETE SAND, SSD: | 1500kg |
| WATER: | 200±kg |

WATER CONTENT SHALL BE ADJUSTED AS REQUIRED TO PROVIDE GROUT HAVING SUFFICENT FLOW OF 25± 3 SECONDS, AS PER CSA–A23.2–1B.

AIR ENTRANING ADMIXTURE AS NECESSARY FOR AIR CONTENT OF 9% ±1%

2.3 SAND FOR GROUT SHALL CONFORM TO CSA–A23.1 WITH A MAXIMUM FINENESS MODULUS OF 2.6 MASONRY SAND CONFORMING TO CSA–A179 MAY BE USED AS AN ALTERNATE.

2.4 UPON APPROVAL FROM THE COMPANY'S REPRESENTATIVE, A PORTION OF THE SAND MAY BE SUBSTITUTED WITH AGGREGATE CONFORMING TO CSA–A23.1 HAVING A MAXIMUM SIZE OF 10mm.

2.5 GROUT SHALL BE TESTED IN ACCORDANCE WITH CSA–A23.1. THE TESTING FREQUENCY SHALL BE DETERMINED BY THE COMPANY'S REPRESENTATIVE.

3.0 STEEL

3.1 FOR SHEET PILE STEEL GRADES, SEE SPECIFICATIONS.

3.2 UNLESS NOTED OTHERWISE, ALL MISCELLANEOUS METAL FABRICATIONS SHALL BE HOT–DIP GALVANIZED TO CSA G164.

3.3 FABRICATION, ERECTION, CONNECTION DESIGN AND DETAILING OF ALL STRUCTURAL STEEL AND CONNECTIONS SHALL BE IN ACCORDANCE WITH CAN/CSA S16.1–01.

3.4 WELDING SHALL CONFORM TO CAN/CSA W59–03 AND SHALL BE PERFORMED BY CERTIFIED WELDERS. FABRICATION SHOPS SHALL BE APPROVED BY THE CANADIAN WELDING BUREAU TO CAN/CSA W47.1–03.

3.5 STRUCTURAL STEEL SHALL MEET CAN/CSA G40.20–04 FOR GENERAL REQUIREMENTS, AND CAN/CSA G40.21–04 FOR QUALITY.

3.6 GRADES OF MATERIAL, UNLESS NOTED OTHERWISE:

| | |
|---|---|
| STRUCTURAL STEEL AND MISC. METAL | 350W |
| BOLTS, NUTS, AND WASHERS | ASTM A325M |
| ANCHOR BOLTS | ASTM A307 |
| STEEL PIPE PILES | ASTM A252 GR. |

3.7 ALL STEEL SHALL BE CHARPY IMPACT TESTED IN ACCORDANCE WITH CLAUSE 10.23.31 OF CAN/CSA S6 FOR A SERVICE TEMPERATURE OF –50°C. STEEL PIPE.

3.8 REFER TO SPECIFICATIONS FOR ADDITIONAL INFORMATION

FOR PERMIT
NOT FOR CONSTRUCTION

## CRITÈRES DE CONCEPTION

CODES ET NORMES

1. CONCEPTION DU QUAI EST CONFORME AUX CODES SUIVANTS CAN/CSA–A23.3 – LA CONCEPTION DES STRUCTURES EN BÉTON.

DURÉE DE VIE ET DURABILITE

1. LA STRUCTURE EST CONCUE POUR UNE OURÉE DE VIE DE 15 ANS

DONNEES SUR LES GLACES ET LES CHARGES

DONNEES:

| | |
|---|---|
| EXTREME EPAISSEUR MAXIMALE DE LA GLACE UNIFORME: | 2.1m |
| ÉCLATEMENT EPAISSEUR DE LA GLACE: | 1.4m |
| EPAISSEUR DE LA GLACE AGITATION (AVG.): | 4.3m |

CHARGES:

| | |
|---|---|
| THERMIQUE: | 275kN/m |
| L'IMPACT FLOE: | 8.6 MN |
| CHARGE DE GLACE EN RAISON DE NAIVRE BRISE–GLACE: | 8.9 MN |
| PRESSION GLOBALE: | 700kPa |

SISMIQUE

1. ACCÉLÉRATION DU SOL:

| | |
|---|---|
| ACCÉLÉRATION MAXIMALE DU SOL: | 0.16 |
| PROBABILITE DE DÉPASSEMENT EN 5 ANS: | 2% |
| PÉRIODE DE RETOUR MOYENNE AU COURS DES ANNEES: | 475 |

CRITÈRES MARINES

1. TIDES RÉFERENCES AU ZÉRO DES CARTES (CD) BASÉE SUR LE SERVICE HYDROGRAPHIC DU CANADA (SHC) NO. 5457 SONT LES SUIVANTS:

| | |
|---|---|
| EXTREME NIVEAU D'EAU ÉLEVÉ (ENDE): | 5.9 m (ESTIMEE) |
| NIVEAU D'EAU SUPERIEUR ÉLEVÉ, GRANOE MARÉE(NDSE): | 5.6 m |
| HIGHER HIGH WATER LEVEL, MOYEN DE LA MARÉE: | 4.7 m |
| LE NIVEAU MOYEN DE L'EAU (NML): | 2.9 m |
| BAS NIVEAU D'EAU BAS, MOYEN DE LA MARÉE: | 1.0 m |
| BAS NIVEAU D'EAU BAS, GRANDE MAREÉ (BNDB): | 0.2 m |
| EXTREME FAIBLE NIVEAU D'EAU (EFND): | 0.0 m |

2. COURANT
   PARALLÉLEMENT ENSEMBLE ACTUEL SUR LE VISAGE COUCHETTE: 1.0 KNOT (ESTIMEE)
   PERPENDICULAIRE ENSEMBLE ACTUAL SUR LE VISAGE COUCHETTE: 0.5 KNOT (ESTIMEE)
3. VENT
   LES CHARGES DE VENT POUR ÉVALEUR LES CHARGES D'AMARRAGE SONT BASES SUR LA VITESSE DU VENT COMME PREVU PAR LE SERVICE DE L'ENVIRONNEMENT ATMOSPHÉRIQUE.
   RETOUR VENT PÉRIODE 50 YEAR
   LA VITESSE DE VENT (30 SEC DURÉE): 140 KILOMETERS PAR HEURE
4. CLIMAT DES VAGUES
   POUR ÉTABLIR ÉLEVATION DE PONT (ZÉRO FRANCHISSEMENT):
   PÉRIODE DE RÉTOUR: 1 AN
   HAUTEUR MAXINALE DES VAGUES: 1.0m
5. CHARGES DES VAGUES:
   PÉRIODE DE RETOUR: 50 ANS
   HAUTEUR SIGNIFICATIVE DES VAGUES 2.0m

DESIGN VESSELS

| TYPE DE NAVIRE | TONNES DE PORT EN LOURD | LHT (m) | FAISCEAU (m) | FRANC–BOARD MINIMAL (m) | TIRANT D'EAU MAXIMAL (m) |
|---|---|---|---|---|---|
| HANDYSIZE | 25,000 | 189 | 26.6 | 3.95 | 11.75 |

L'IMPACT ACCOSTAGE ET D'AMARRAGE DES CHARGES

VITESSE PERPENDICULAIRE NAVIRE APPROCHÉ DE LA SURFACE COUCHETTE:

| | |
|---|---|
| NAVIRE | 0.2 m/sec |

CHARGES DES AMARRAGE:

| | |
|---|---|
| AVANT ET ARRIERE AMARRES A TERRE: | 200 TONNES |
| SEIN LUNE BORNES RIVE: | 200 TONNES |
| BORNES A RESSORT DE LIGNEES CELLULAIRES: | 100 TONNES |

CHARGES DOCK

VEHICULE ET D'AUTRES CHARGES DE PONT SONT ÉNUMERES DANS LES PARAGRAPHES SUIVANTS:

1. CHARGES UNIFORMES ET DE STOCKAGE 50 kPa
3. CHARGEUR DE NAVIRES: TENIR

POUR PERMIS
PAS POUR CONSTRUCTION

## REMARGUES GÉNÉRALES

1.0 BÉTON ET DES ARMATURES

1.1 LE BÉTON OUIT ÊTRÉ C–XL CLASSE, 35MPa

1.2 COULÉ EN PLACE ENROBAGE DE BÉTON CLAIR POUR L'ACIER D'ARATURE SONT FIXÉES COMME SUIT, SAUF INOICATION CONTRAIRE:

SURFACES INFERIEURES 100mm
LES SURFACES LATERALES 75mm
SURFACES SUPERIEURES 75mm

1.3 PAS PLUS DE 25% DE LAXÉ LONGITUDINAL DE RENFORT DANS LES MAMBRES DÉPASSANT 500mm DE PROFONDEUR DOIVENT ÊTRÉ RACCORDÉES AU MEME ENDROIT. LES BARRES ADJANCENTES NE DOIVENT PAS ÊTRÉ RACCORDÉES AU MEME ENDROIT.

1.4 EPISSEURS DANS LES MEMBRES DE MOINS DE 500mm DE PROFONDEUR ÉGALE À OT DOIVENT SORTE QUE PAS PLUS DE CHAQUE TROISIEME BARRE EST ÉPISSE À TOUT PRÉMIERE SECTION.

1.5 LONGUEUERS TOUR MINIMALE RÉQUISE POUR LES EPISSURES DE RENFORT EST FIXÉ COMME SUIT, SAUF INDINCATION CONTRAIRE

.

| TAILLE DE LA BARRE | BAR AUTRE QUE DES BARRES SUPERIEURES | BARRES SUPERIEURES |
|---|---|---|
| 10M | 400 | 500 |
| 15M | 500 | 600 |
| 20M | 600 | 800 |
| 25M | 1000 | 1300 |
| 30M | 1200 | 1600 |
| 35M | 1500 | 2000 |

BARRES SPUERIEURES BARRES HORIZONTALES DE RENFORT SONT PLACES DE SORTE QUE PLUS DE 300mm DE BÉTON EST COULÉ DANS L'ÉLEMENT DE RENFORT AU–DESSOUS DE L'.

1.6 SAUF INDICATION CONTRAIRE, TOUS LES COINS SONT CHANFERED/ FILETS 25mm.

2.0 LE COULIS

2.1 LE COULIS ENTRÉ LESS CELLULES DE PALPLANCHES ET DU BÉTON PRÉFABRIQUE POUTRES D'IMPACT GLACE DOIT AVIOR UNE RESISTANCE MINIMALE À LA COMPREEION OE 20MPa.

2.2 PROPORTIONS DU MÉLANGE DE VCOULIS DE BÉTON PRÉFABRIQUE POUTRELLES DE GLACE EST LA SUIVANTE, POUR DONNER ENVIRON IN MÉTRE CUBE:

| | |
|---|---|
| CIMENT (TYPE 10): | 160kg |
| LES CENDRES VOLANTES OU DE LATTIER: | 200kg |
| LE FUMÉE DE SILICE: | 40kg |
| SABLE A BÉTON, SSD: | 1500kg |
| L'EAU: | 200±kg |

LE TENEUR EN EAU DOIT ÊTRÉ ADJUSTÉE AU BESOIN POUR FOURNIR COULIS AYANT UN DEBIT SUFFISANT DE LA 25± 3 SÉCONDES COMME PAR CSA–A23.2–1B.

MÉLANGE DE FORMATION D'AIR EN TANT QUE DE DESOIN POUR LA TENEUR EN AIR DU 9% ±1%

2.3 SABLE POUR COULIS DOIVANT ÊTRÉ CONFORMES À LA NORME CSA–A23.1 AVEC UN MODULE DE FINESSE MAXIMALE DE 2.6 OE SABLE A GRANULOMETRIE CONFORMÉ A CSA–A179 PEUT ÊTRÉ UTILISE COMME UN SUBSTITUT.

2.4 LORS DE L'APPROBATION DU RÉPRESENTANT DE L'ÉNTERPRISE, UNE PARTIE DU SABLE PEUT ETRÉ SUBSTITUE AVEC DES GRANULATS CONFORMES À LA NORME CSA–A23.1 AYANT UNE TAILLE MAXIMALE 10mm.

2.5 LE COULIS DOIT ÊTRÉ TESTÉE CONFORMÉMENT À LA NORME CSA–A–23.1. LA FRÉQUENCE DES TESTS SERA DETERMINÉE PAR LE RÉPRESENTANT OE L'ÉNTERPRISE.

3.0 ACIER

3.1 POUR LES GRADES DE PALPLANCHES EN ACIER, VOIR LES SPÉCIFICATIONS

3.2 SAUF INDICATION CONTRAIRE, TOUTES LES FABRICATIONS MÉTALLIQUES DIVERS SONT GALVANISES A CHAUD–SÉLON LEA NORME CSA–G164.

3.3 FABRICATION, DE MONTAGE CONNEXION DES, ET LES DÉTAILS DE TOUT L'ACIER STRUCTEREL ET LES RACCORDS DOIVENT ÊTRÉ CONFORMES À CAN/CSA S16.1–01.

3.4 SOUDAGE DOIVENT ÊTRÉ CONFORMES AUX CAN/CSA W59–03 ET DOIVENT ÊTRÉ ÉXÉCUTES PAR DES SOUDEURS CERTIFIES, LES ATELIERS DE FABRICATION DOIT ÊTRÉ APPROUVE PAR LE BUREAU DE SOUDAGE TO CAN/CSA W47.1–03.

3.5 ACIER DE CONSTRUCTION DOIVENT STAISFAIRE CAN/CSA G40.20–04 POUR EXIGENCES GÉNÉRALES ET CAN/CSA G40.21–04 POUR LA QUALITÉ.

3.6 GRADES DE MATERIAUX, SAUF INDICATION CONTRAIRE:

| | |
|---|---|
| ACIER DE CONSTRUCITON ET DIVERS METAUX | 350W |
| BOULONS, ÉCROUS ET RONDELLES | ASTM A325M |
| LES BOULONS D'ANCRAGE | ASTM A307 |
| PIEUX TUBULAIRES EN ACIER | ASTM A252 GR. |

3.7 TOUT EN ACIER DOIT ÊTRÉ TESTE AU CHOC CHARPY CONFORMÉMENT À L'ARTICLE 23.10.31 DE LA NORME CAN/CSA S6 POUR UNE TEMPERATURE DE SERVICE DE –50°C, DE TUYAUX EN ACIER.

3.8 RÉPORTEZ–VOUS AUX SPÉCIFICATIONS POUR PLUS D'INFORMATIONS

ISSUE REGISTER

| ISSUE No | REV. | DATE (Y/M/D) | PURPOSE OF ISSUE | TRANSMISSION LETTER No |
|---|---|---|---|---|

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PROFESSIONAL SEAL

REGISTERED PROFESSIONAL ENGINEER
PEGL
PROVINCE OF NEWFOUNDLAND AND LABRADOR
CHRISTOPHER H. FUDGE
SIGNATURE
2013-04-05
DATE
PROFESSIONAL ENGINEER – NEWFOUNDLAND AND LABRADOR

SNC·LAVALIN
455, René–Lévesque Blvd. West
Montréal (Québec)
Canada H2Z 1Z3

| PREPARATION | APPROVAL |
|---|---|
| DESIGNED: C. FUDGE | PROJECT DISCIPLINE ENGINEER: N. GILLIS |
| DRAWN: T. YOUNG | CLIENT: |
| CHECKED: C. FUDGE | DATE: 2013/03/22 |
| SCALE: AS NOTED | |

CLIENT: NUNAVIKNICKEL

PROJECT: DECEPTION BAY PORT

TITLE: SITE 2
GENERAL NOTES & DESIGN CRITERIA
SITE 2 – REMARGUES GÉNÉRALES ET CRITÈRES DE CONCEPTION

| PROJECT No | SUBDIVISION | SUBJECT | SERIAL | REV. |
|---|---|---|---|---|
| 506117 | 8000 | 41 D1 | 0001 | P1 |

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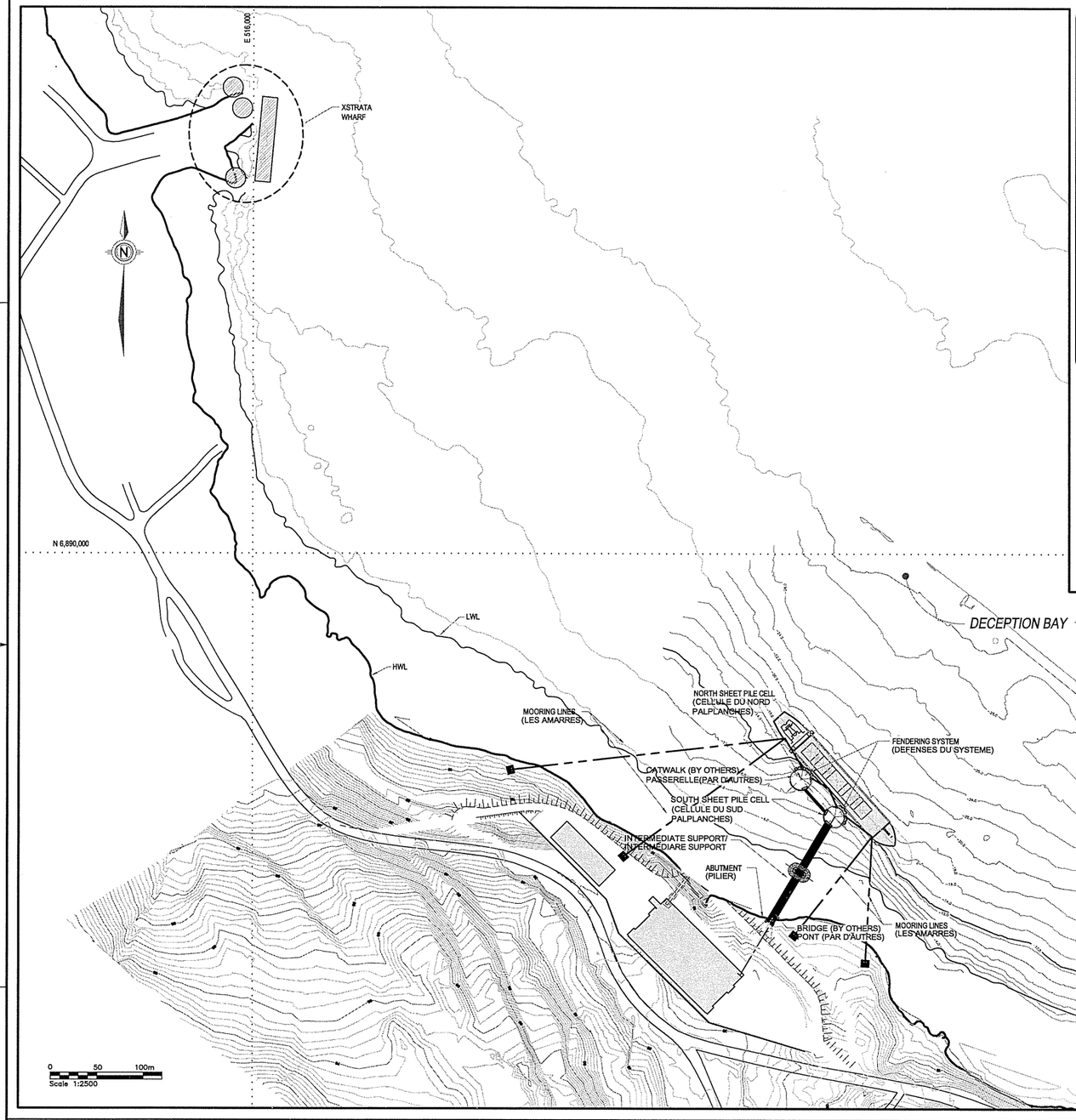


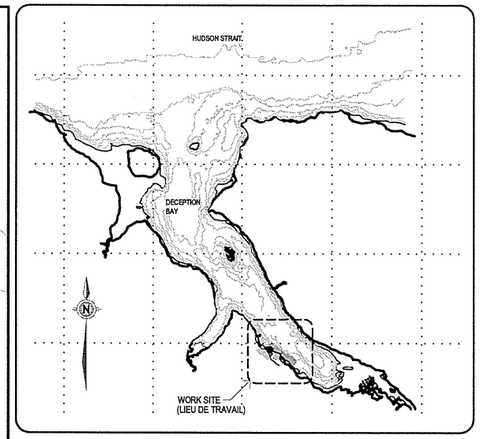


LOCATION PLAN

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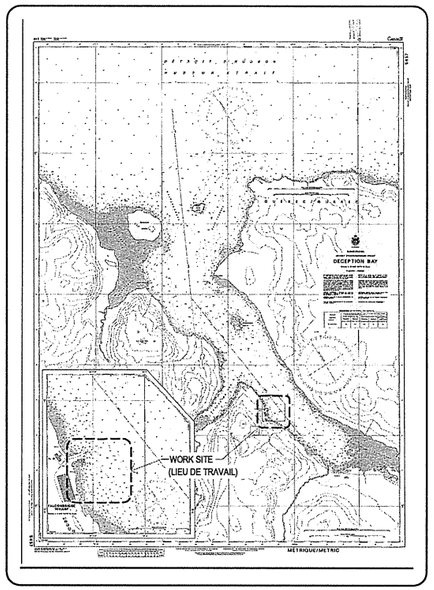


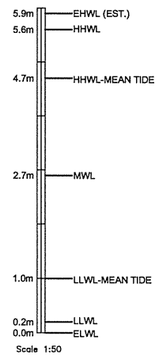

LOCATION PLAN - CHART 5457

## GENERAL NOTES:

1. GRID REFERENCE : UTM NAD83.
2. DEPTHS ARE IN METRES AND ARE REDUCED TO CHART DATUM (LOWEST NORMAL TIDE) WHICH AT DECEPTION BAY IS 2.5m BELOW MEAN WATER LEVEL.
3. HYDROGRAPHIC CONTOURS BASED ON CHS CHART 5457 AND SOUNDING SURVEY BY FUGRO JACQUES GEOSURVEYS JULY 2008

## INDICATIONS GÉNÉRALES:

1. GRILLE DE REFERENCE : UTM NAD83.
2. LES PROFONDEURS SONT EN MÈTRES ET REDUIT AU ZÉRO DES CATES (BASSE MAREÉ MORNALE) QUI EST A DOECEPTION BAY 2.5m SOUS LE NIVEAU MOYEN DE L'EAU.
3. CONTOURS HYDROGRAPHIQUES EN FONCTION OT TABLEAU CHS 5457 ET LEVEBATHYMÉTRIQUES PAR FUGRO JACQUES GEOSURVEYS JUILLET 2008.

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PROFESSIONAL SEAL

REGISTERED PROFESSIONAL ENGINEER PROVINCE OF NEWFOUNDLAND & LABRADOR PEGNL CHRISTOPHER M. FUDGE SIGNATURE 2013-04-05 DATE

SNC·LAVALIN
455, René-Lévesque Blvd. West
Montréal (Québec)
Canada H2Z 1Z3

| PREPARATION | APPROVAL |
|---|---|
| DESIGNED: C. FUDGE | PROJECT DISCIPLINE ENGINEER: N. GILLIS |
| DRAWN: T. YOUNG | CLIENT: |
| CHECKED: C. FUDGE | DATE: 2013/04/22 |

SCALE: AS NOTED

CLIENT: CANADIAN ROYALTIES INC.

PROJECT: NUNAVIK NICKEL — DECEPTION BAY PORT

TITLE: SITE PLAN
PLAN DU SITE

| PROJECT No | SUBDIVISION | SUBJECT | SERIAL | REV. |
|---|---|---|---|---|
| 505117 | 8000 | 41 D1 | 0002 | P1 |

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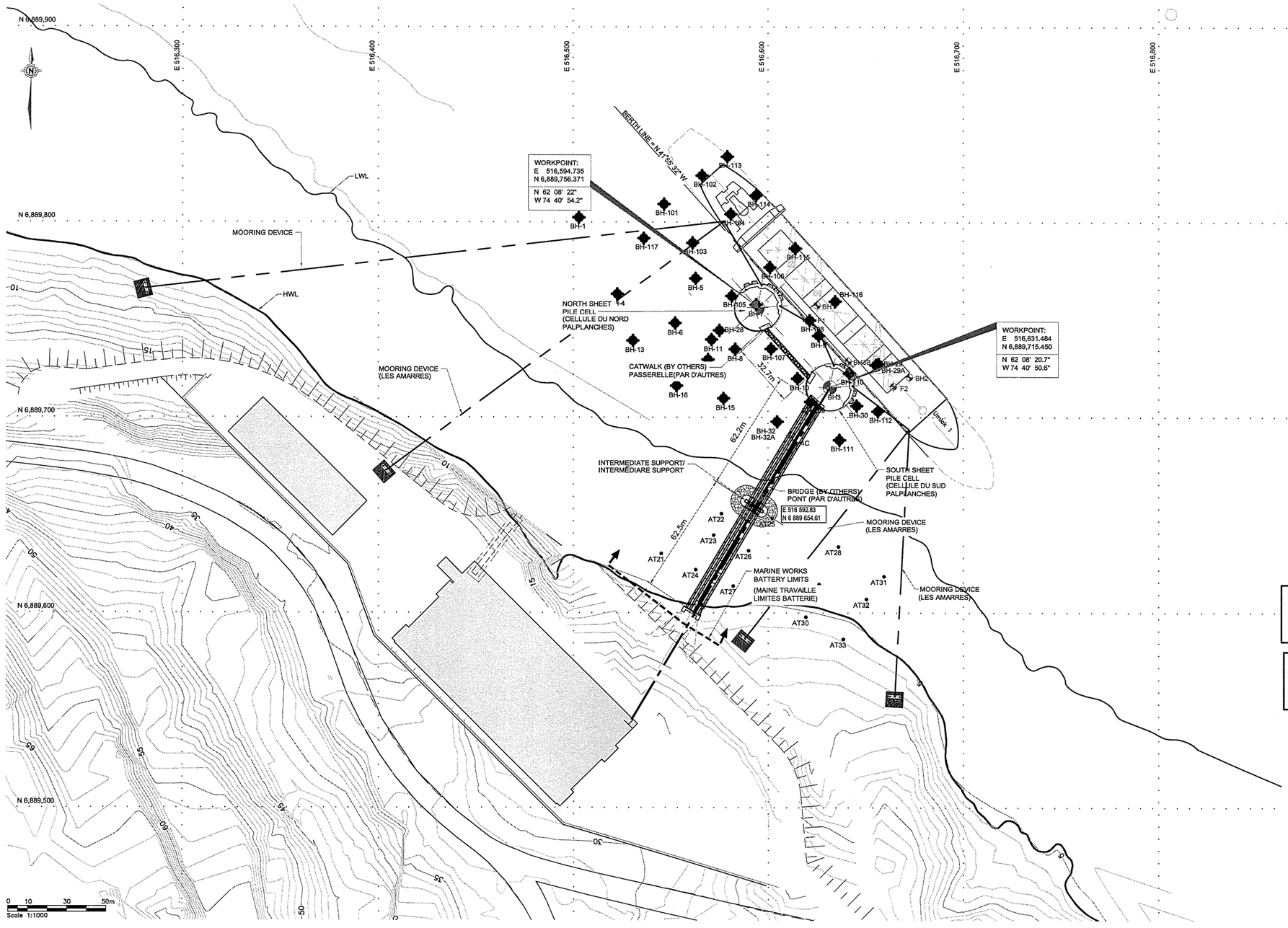


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INITIALS: * DESIGNED ** APPROVED

REVISION REGISTER

| No | REFERENCE DRAWINGS NUMBER |
|---|---|

PROFESSIONAL SEAL

ASSOCIATION OF PROFESSIONAL ENGINEERS AND GEOSCIENTISTS NEWFOUNDLAND & LABRADOR
PEGNL
PERMIT TO PRACTICE
CHRISTOPHER M. FUDGE
SIGNATURE
DATE
2013-04-05

SNC·LAVALIN
455, René-Lévesque Blvd. West
Montréal (Québec)
Canada H2Z 1Z3

| PREPARATION | APPROVAL |
|---|---|
| DESIGNED<br>C. FUDGE | PROJECT DISCIPLINE ENGINEER<br>N. GILLIS |
| DRAWN<br>T.YOUNG | CLIENT |
| CHECKED<br>C. FUDGE | DATE<br>2013/03/22 |
| SCALE<br>AS NOTED | |

CLIENT
CANADIAN ROYALTIES INC.

PROJECT
NUNAVIK NICKEL
DECEPTION BAY PORT

TITLE
GENERAL ARRANGEMENT
ARRAGEMENT DU GÉNÉRALE

| PROJECT No | SUBDIVISION | SUBJECT | SERIAL | REV. |
|---|---|---|---|---|
| 506117 | 8000 | 41 D1 | 0003 | P1 |

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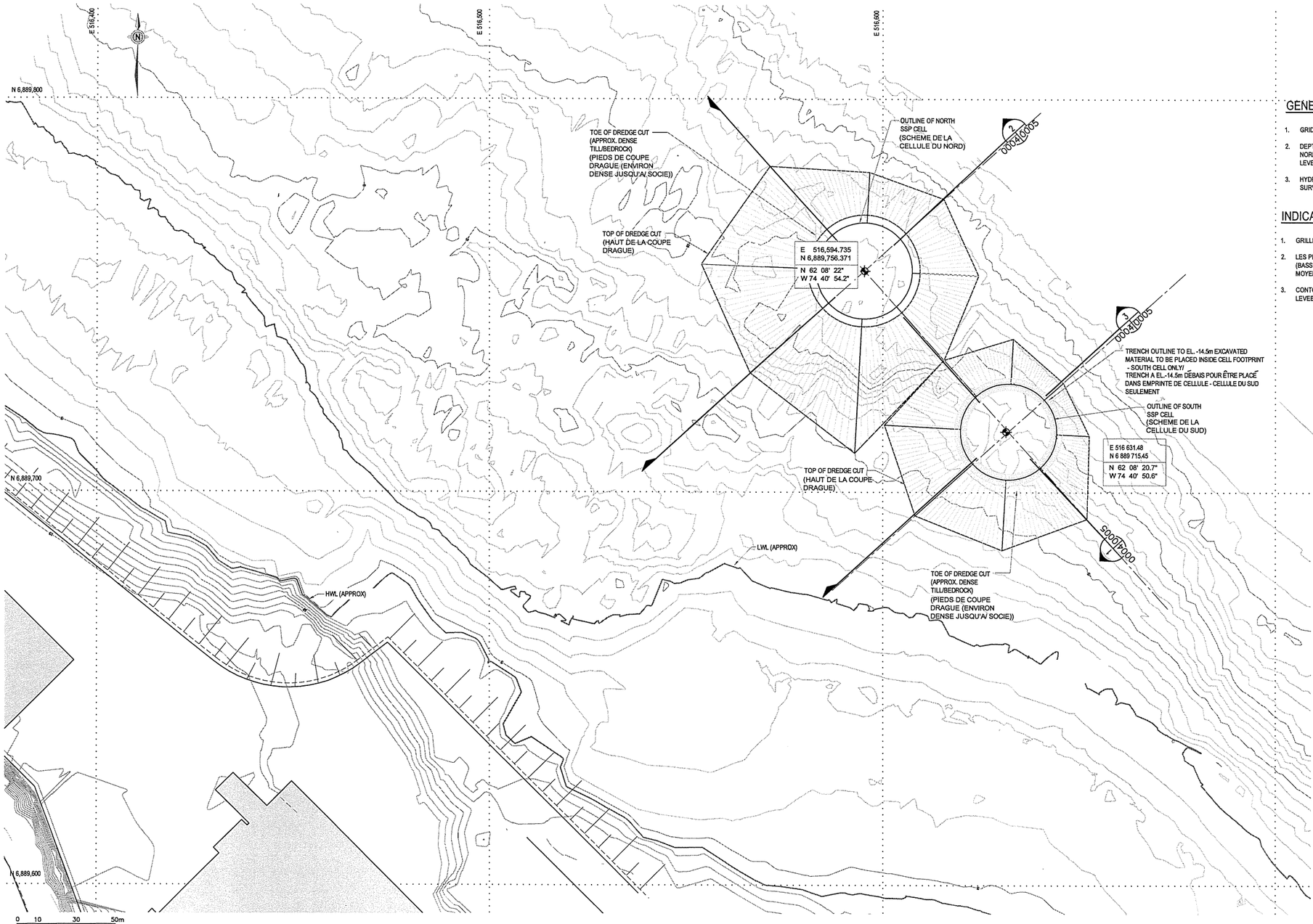


| DREDGING VOLUMES ($m^3$) | |
|---|---|
| NORTH CELL | 15,000 |
| SOUTH CELL | 7,000 |

| VOLUMES DE DRAGAGE ($m^3$) | |
|---|---|
| CELLULE NORD | 15,000 |
| CELLULE SUD | 7,000 |

## GENERAL NOTES:

1. GRID REFERENCE : UTM NAD83.
2. DEPTHS ARE IN METRES AND ARE REDUCED TO CHART DATUM (LOWEST NORMAL TIDE) WHICH AT DECEPTION BAY IS 2.9m BELOW MEAN WATER LEVEL.
3. HYDROGRAPHIC CONTOURS BASED ON CHS CHART 5457 AND SOUNDING SURVEY BY FUGRO JACQUES GEOSURVEYS JULY 2008

## INDICATIONS GÉNÉRALES:

1. GRILLE DE RÉFERENCE : UTM NAD83.
2. LES PROFONDEURS SONT EN MÈTRES ET REDUIT AU ZÉRO DES CATES (BASSE MARÉE MORNALE) QUI EST A DDECEPTION BAY 2.9m SOUS LE NIVEAU MOYEN DE L'EAU.
3. CONTOURS HYDROGRAPHIQUES EN FONCTION OT TABLEAU CHS 5457 ET LEVEBATHYMETRIQUES PAR FUGRO JACQUES GEOSURVEYS JUILLET 2008.

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**NOT FOR CONSTRUCTION**

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**PAS POUR CONSTRUCTION**

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INITIALS: * DESIGNED ** APPROVED

REVISION REGISTER

| No | REFERENCE DRAWINGS NUMBER |
|---|---|

PROFESSIONAL SEAL

REGISTERED PROFESSIONAL ENGINEER
PEGL
PERMISSION TO PRACTICE NEWFOUNDLAND & LABRADOR
CHRISTOPHER M. FUDGE
SIGNATURE
2013-04-05
DATE
NEWFOUNDLAND & LABRADOR

SNC·LAVALIN
455, René-Lévesque Blvd. West
Montréal (Québec)
Canada H2Z 1Z3

| PREPARATION | APPROVAL |
|---|---|
| DESIGNED: C. FUDGE | PROJECT DISCIPLINE ENGINEER: N. GILLIS |
| DRAWN: T. YOUNG | CLIENT: |
| CHECKED: C. FUDGE | DATE: 2013/03/22 |
| SCALE: AS NOTED | |

CLIENT: CANADIAN ROYALTIES INC.

PROJECT: NUNAVIK NICKEL — DECEPTION BAY PORT

TITLE: DREDGING PLAN
PLAN DU DRAGAGE

| PROJECT No | SUBDIVISION | SUBJECT | SERIAL | REV. |
|---|---|---|---|---|
| 506117 | 8000 | 41 | D1 0004 | P1 |

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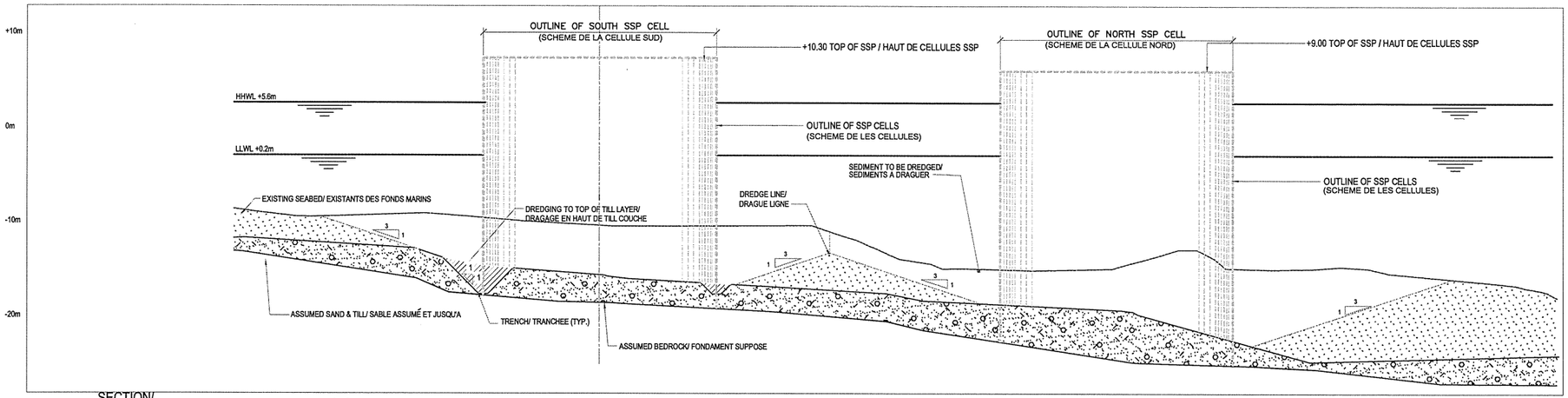


SECTION/
SECTION 1
0004|0005

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GENERAL NOTES:

1. EXISTING BEDROCK INFERRED FROM FUGRO JACQUES GEOSURVEYS, JULY 2008.
2. ASSUMED SEABED, BEDROCK, AND SAND/TILL ELEVATIONS INTERPOLATED FROM FUGRO JACQUES SURVEY AND TOPOGRAPHIC SURVEY.

INDICATIONS GENERALES:

1. SICIÉ EXISTANT DEDUIT DE FUGRO JACQUES GEOSURVEYS, JULIET 2008.
2. SUPPOSE DES FONDS MARINS, LE SUBSTRATUM ROCHEUX ET DE SABLE/ ÉLEVATIONS JUSQU'A INTERPOLÉE A PARTIR DE FUGRO JACQUES GEOSURVEYS ET RÉLEVE TOPOGRAPHIQUE

CLAY/ ARGILE

TILL/ JUSQU'A QUE

ROCK/ROCK

| DREDGING VOLUMES ($m^3$) | |
|---|---|
| NORTH CELL | 15,000 |
| SOUTH CELL | 7,000 |

| VOLUMES DE DRAGAGE ($m^3$) | |
|---|---|
| CELLULE NORD | 15,000 |
| CELLULE SUD | 7,000 |




SECTION/
SECTION 3
0004|0005

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SECTION/
SECTION 2
0004|0005

0 5 10m
Scale 1:250

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REVISION REGISTER

| No | REVISION DESCRIPTION | DATE (Y/M/D) | * | ** |
|---|---|---|---|---|

INITIALS: * DESIGNED ** APPROVED

REVISION REGISTER

| No | REFERENCE DRAWINGS NUMBER |
|---|---|

PROFESSIONAL SEAL

REGISTERED PROFESSIONAL ENGINEER
PEGL
CHRISTOPHER M. FUDGE
SIGNATURE
2013-04-25
DATE
NEWFOUNDLAND & LABRADOR

SNC·LAVALIN
SNC·LAVALIN
455, René-Lévesque Blvd. West
Montréal (Québec)
Canada H2Z 1Z3

| PREPARATION | APPROVAL |
|---|---|
| DESIGNED<br>C. FUDGE | PROJECT DISCIPLINE ENGINEER<br>N. GILLIS |
| DRAWN<br>T. YOUNG | CLIENT |
| CHECKED<br>C. FUDGE | DATE<br>2013/03/22 |
| SCALE<br>AS NOTED | |

CLIENT
CANADIAN ROYALTIES INC.

PROJECT
NUNAVIK NICKEL
DECEPTION BAY PORT

TITLE
DREDGING SECTIONS
SECTIONS DU DRAGAGE

| PROJECT No | SUBDIVISION | SUBJECT | SERIAL | REV. |
|---|---|---|---|---|
| 506117 | 8000 | 41 | D1 0005 | P1 |

020878A1HEN – FRAME A1 HORIZONTAL ENGLISH

LAST SAVE: 2013/04/05 – 2:22pm
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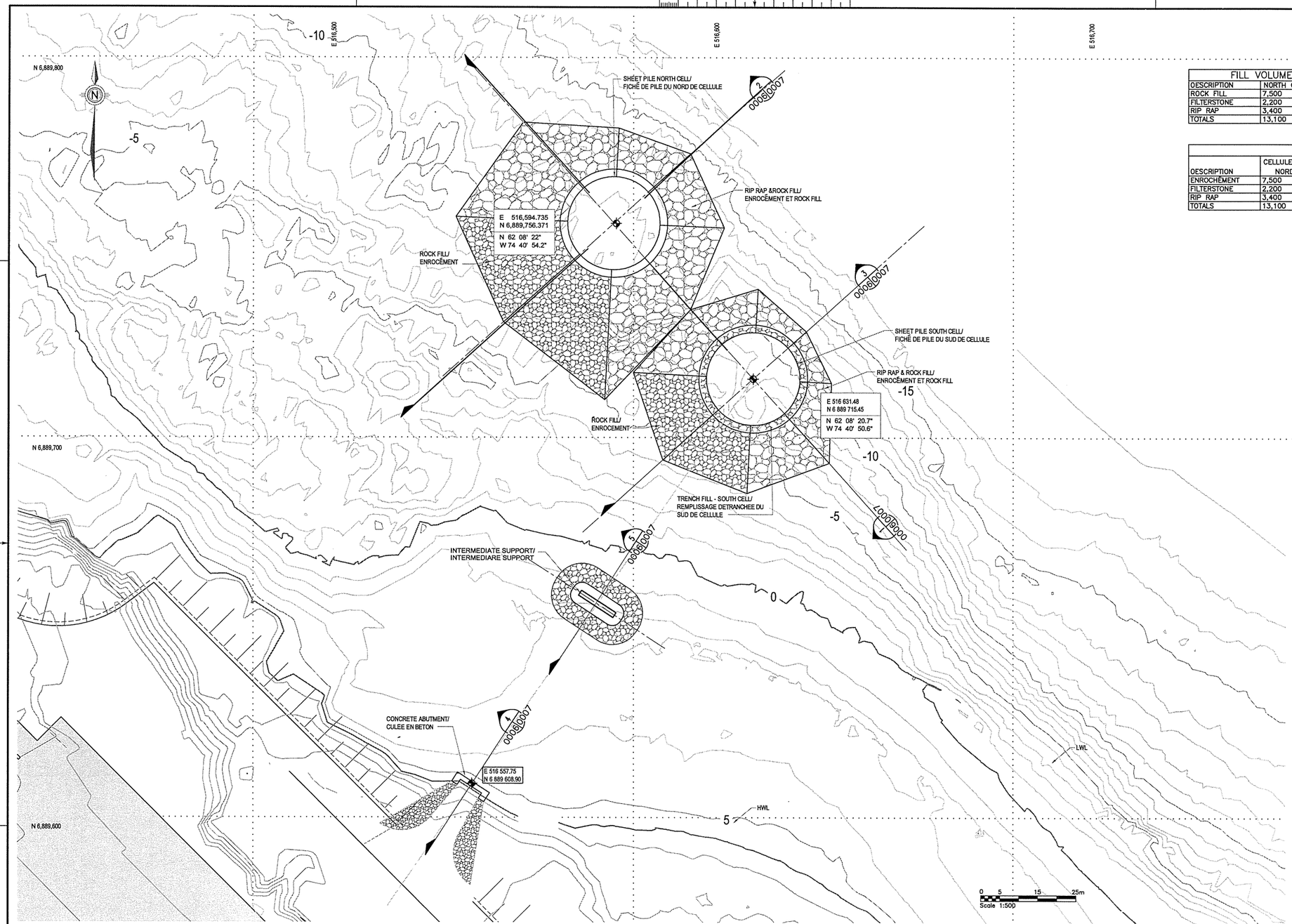


| FILL VOLUMES ($m^3$) | | |
|---|---|---|
| DESCRIPTION | NORTH CELL | SOUTH CELL |
| ROCK FILL | 7,500 | 2,500 |
| FILTERSTONE | 2,200 | 1,100 |
| RIP RAP | 3,400 | 2,100 |
| TOTALS | 13,100 | 5,700 |

| DESCRIPTION | CELLULE DU NORD | CELLULE DU SUD |
|---|---|---|
| ENROCHEMENT | 7,500 | 2,500 |
| FILTERSTONE | 2,200 | 1,100 |
| RIP RAP | 3,400 | 2,100 |
| TOTALS | 13,100 | 5,700 |

FOR PERMIT
NOT FOR CONSTRUCTION

POUR PERMIS
PAS POUR CONSTRUCTION

| ISSUE No | REV. | DATE (Y/M/D) | PURPOSE OF ISSUE | TRANSMISSION LETTER No |
|---|---|---|---|---|
| P1 | | 2013/04/05 | ISSUED FOR PERMIT<br>EMIS POUR PERMIS | |

ISSUE REGISTER

| No | REVISION DESCRIPTION | DATE (Y/M/D) | * | ** |
|---|---|---|---|---|

INITIALS: * DESIGNED ** APPROVED

REVISION REGISTER

| No | REFERENCE DRAWINGS NUMBER |
|---|---|

PROFESSIONAL SEAL

REGISTRATION PROFESSIONAL ENGINEER
PEGL
CHRISTOPHER M. FUDGE
NEWFOUNDLAND & LABRADOR
DATE

SNC·LAVALIN
455, René-Lévesque Blvd. West
Montréal (Québec)
Canada H2Z 1Z3

| PREPARATION | APPROVAL |
|---|---|
| DESIGNED<br>C. FUDGE | PROJECT DISCIPLINE ENGINEER<br>N. GILLIS |
| DRAWN<br>T. YOUNG | CLIENT |
| CHECKED<br>C. FUDGE | DATE<br>2013/03/22 |
| SCALE<br>AS NOTED | |

CLIENT
CANADIAN ROYALTIES INC.

PROJECT
NUNAVIK NICKEL
DECEPTION BAY PORT

TITLE
RIP RAP/ ROCK FILL BERMS
RIP RAP/ ENROCHEMENT BERMES
DE REMPLISSAGE

| PROJECT No | SUBDIVISION | SUBJECT | SERIAL | REV. |
|---|---|---|---|---|
| 506117 | 8000 | 41_D1 | 0006 | P1 |

0208784111HEN – FRAME A1 HORIZONTAL ENGLISH

LAST SAVE: 2013/04/05 – 2:22pm
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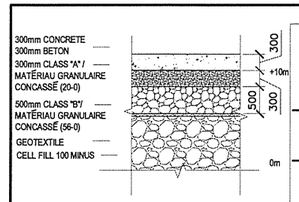


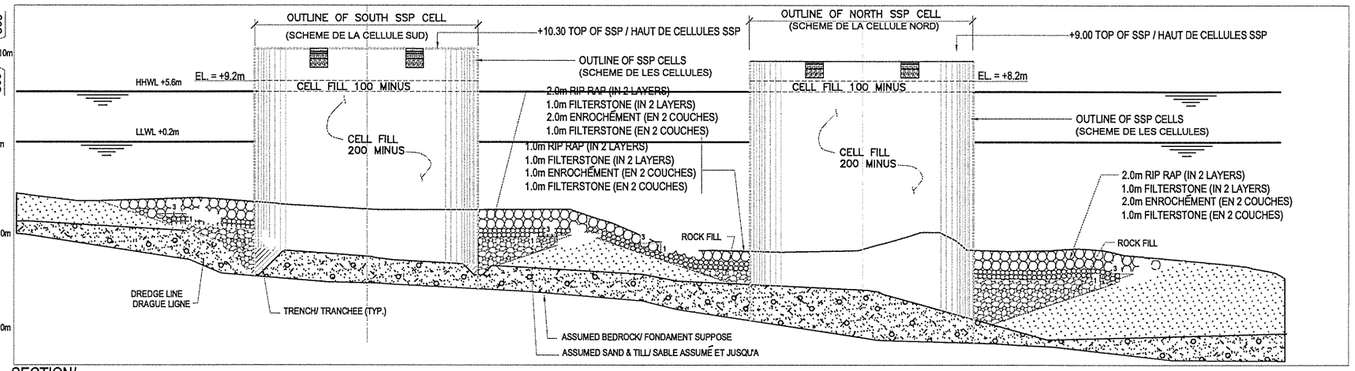


SECTION/
SECTION
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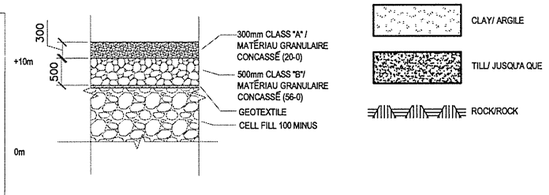
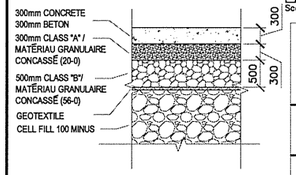
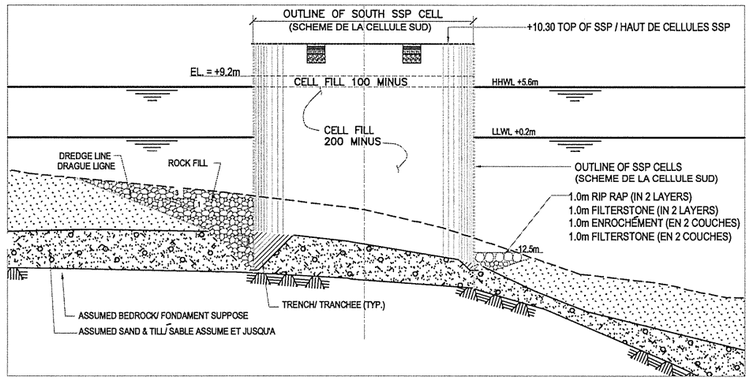
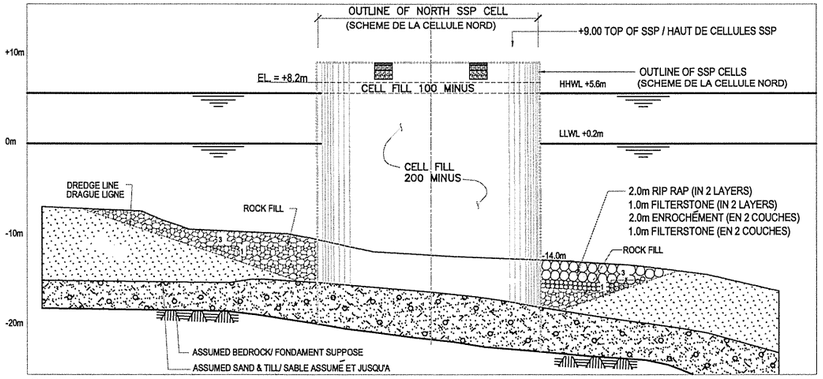
1
0006 0007



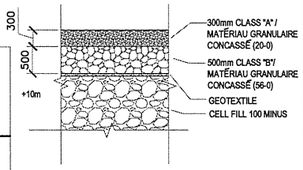




SECTION/
SECTION
0 5 10 15m
Scale 1:300
3
0006 0007

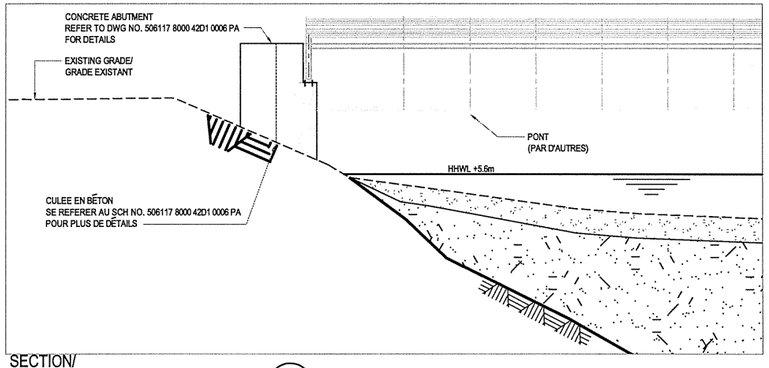



SECTION/
SECTION
0 5 10 15m
Scale 1:300
2
0006 0007

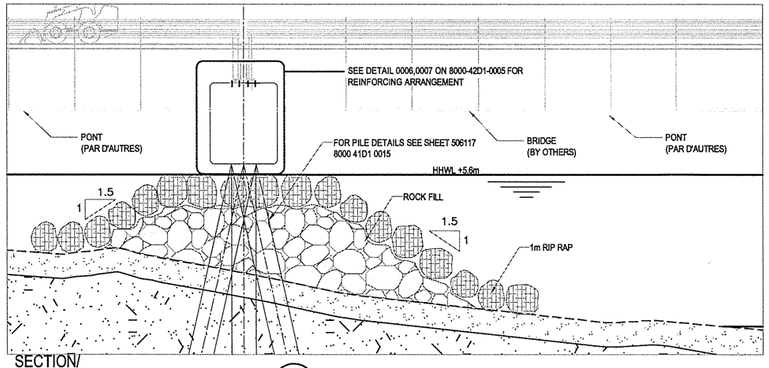



| FILL VOLUMES ($m^3$) | | |
|---|---|---|
| DESCRIPTION | NORTH CELL | SOUTH CELL |
| ROCK FILL | 7,500 | 2,500 |
| FILTERSTONE | 2,200 | 1,100 |
| RIP RAP | 3,400 | 2,100 |
| TOTALS | 13,100 | 5,700 |

| | CELLULE DU NORD | CELLULE DU SUD |
|---|---|---|
| DESCRIPTION | | |
| ENROCHEMENT | 7,500 | 2,500 |
| FILTERSTONE | 2,200 | 1,100 |
| RIP RAP | 3,400 | 2,100 |
| TOTALS | 13,100 | 5,700 |




SECTION/
SECTION
0 1 3 5m
Scale 1:100
4
0006 0007




SECTION/
SECTION
0 1 3 5m
Scale 1:100
5
0006 0007

GENERAL NOTES:

1. EXISTING BEDROCK INFERRED FROM FUGRO JACQUES GEOSURVEYS, JULY 2008.
2. ASSUMED SEABED, BEDROCK, AND SAND/TILL ELEVATIONS INTERPOLATED FROM FUGRO JACQUES SURVEY AND TOPOGRAPHIC SURVEY.

INDICATIONS GENERALES:

1. SICIE EXISTANT DEDUIT DE FUGRO JACQUES GEOSURVEYS, JULIET 2008.
2. SUPPOSE DES FONDS MARINS, LE SUBSTRATUM ROCHEUX ET DE SABLE/ ÉLEVATIONS JUSQU'A INTERPOLÉE A PARTIR DE FUGRO JACQUES GEOSURVEYS ET RÉLEVE TOPOGRAPHIQUE

**FOR PERMIT**
**NOT FOR CONSTRUCTION**

**POUR PERMIS**
**PAS POUR CONSTRUCTION**

| ISSUE No | REV. | DATE (Y/M/D) | PURPOSE OF ISSUE | TRANSMISSION LETTER No |
|---|---|---|---|---|

ISSUE REGISTER

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

ISSUE REGISTER

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|---|---|---|---|---|
| P1 | ISSUED FOR PERMIT EMIS POUR PERMIS | 2013/04/05 | | |

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REVISION REGISTER

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

INITIALS: * DESIGNED ** APPROVED

REVISION REGISTER

| No | REFERENCE DRAWINGS NUMBER |
|---|---|

PROFESSIONAL SEAL
PROFESSIONAL ENGINEERS GOVERNMENT OF NEWFOUNDLAND & LABRADOR
PEGNL
CHRISTOPHER M. FUDGE
2013-04-05

SNC·LAVALIN
455, René-Lévesque Blvd. West
Montréal (Québec)
Canada H2Z 1Z3

| PREPARATION | APPROVAL |
|---|---|
| DESIGNED C. FUDGE | PROJECT DISCIPLINE ENGINEER N. GILLIS |
| DRAWN T.YOUNG | CLIENT |
| CHECKED C. FUDGE | DATE 2013/03/22 |
| SCALE AS NOTED | |

CLIENT
CANADIAN ROYALTIES INC.

PROJECT
NUNAVIK NICKEL
DECEPTION BAY PORT

TITLE
ROCK FILL SECTIONS/
BASCULEZ SECTIONS DE REMPLISSAGE

| PROJECT No | SUBDIVISION | SUBJECT | SERIAL | REV. |
|---|---|---|---|---|
| 506117 | 8000 | 41 D1 | 0007 | P1 |

0208781A1HEN – FRAME A1 HORIZONTAL ENGLISH

LAST SAVE: 2013/04/05 – 3:16pm
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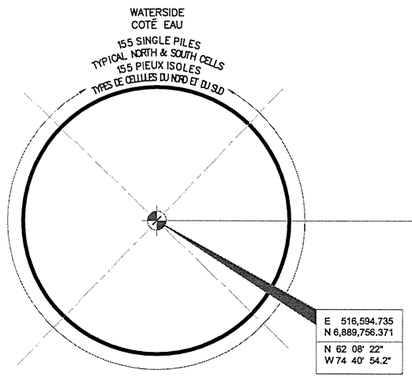
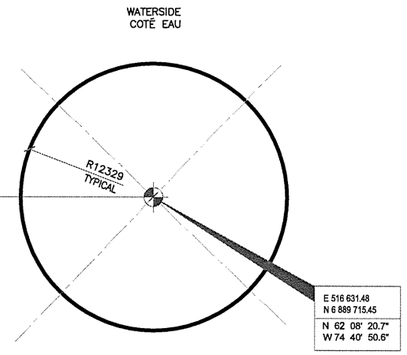



NORTH CELL
CELLULE DU NORD




SOUTH CELL
CELLULE DU SUD

55000

PLAN – SHEET PILE LAYOUT
PLAN–PLAN PALPLANCHE 1 0001 0008

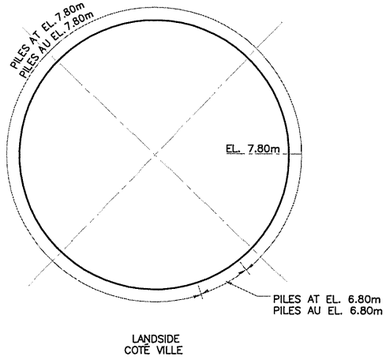
0 5 10m
Scale 1:250

## NOTES:

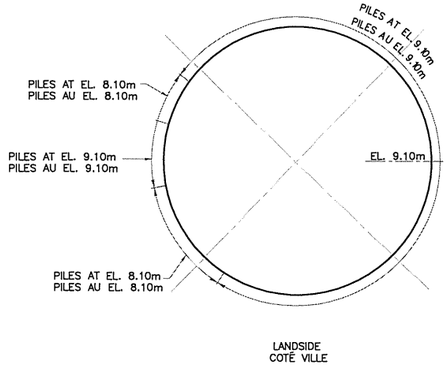
1. STEEL SHEET PILES SHALL BE MANUFACTURED IN ACCORDANCE WITH EUROPEAN STANDARD EN 10248, PARTS 1 AND 2. MINIMUM STEEL GRADE SHALL BE S355 GP.
2. MINIMUM PILE THICKNESS SHALL BE 12.7mm.
3. MINIMUM INTERLOCK STRENGTH SHALL BE 5500 kN PER METRE WHEN TESTED TO EN 10248.
4. ARRANGEMENT OF SHEET PILES IS BASED ON FLAT PILES WITH A NORMAL WIDTH OF 500mm. DIMENSIONS OF CELLS ARE NOMINAL. PRIOR TO EXPANSION FROM FILLING. DIMENSIONS WILL VARY DEPENDING ON EXACT CONSTRUCTION SEQUENCE.
5. FOR TOP ELEVATION OF PILES, SEE SECTIONS AND NOTES ON OWGS 8000–41D1–0005,0007,0010,0011.

## INDICATIONS:

1. PALPLANCHES D'ACIER DOIVENT ÊTRÉ FABRIQUES SELON LA NORME EURPEERINE EN 10248, PARTIE 1 ET 2. NUANCE D'ACIER S355 MINIMALE EST GP.
2. EPAISSEUR MINIMALE EST DE PILE 12.7mm.
3. RESISTANCE MINIMALE INTERLOCK SERA DE 55 KN PAR METRE LORS D'UN ESSAI EN 10248.
4. ARRANGEMENT DE PALPLANCHES RÉPOSE SUR PILES AVEC UN FLT LARGEUR MORNALE DE 500mm. DIMENSIONS DE CELLULES SONT NOMINALES, AVANT L'EXPASION DU REMPLISSAGE. DIMENSIONS VARIE EN FONCTION SEQUENCE DE CONSTRUCTION EXACT.
5. D'ÉLEVATION CONSEIL DES PILES, VOIR LES SECTIONS ET NOTES SUR DESSINS 8000–41D1–0005,0007,0010,0011.




NORTH CELL
CELLULE DU NORD




SOUTH CELL
CELLULE DU SUD

PLAN – SHEET PILE CUT–OFF
PLAN – COUPER FEULLE DE PILE 2 0008 0008

0 5 10m
Scale 1:250

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NOT FOR CONSTRUCTION

POUR PERMIS
PAS POUR CONSTRUCTION

| ISSUE No | REV. | DATE (Y/M/D) | PURPOSE OF ISSUE | TRANSMISSION LETTER No |
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ISSUE REGISTER

| ISSUE No | REV. | DATE (Y/M/D) | PURPOSE OF ISSUE | TRANSMISSION LETTER No |
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|---|---|---|---|---|
| P1 | ISSUED FOR PERMIT<br>EMIS POUR PERMIS | 2013/04/05 | | |

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REVISION REGISTER

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

INITIALS: * DESIGNED ** APPROVED

REVISION REGISTER

| No | REFERENCE DRAWINGS NUMBER |
|---|---|

PROFESSIONAL SEAL

ASSOCIATION OF PROFESSIONAL ENGINEERS, GEOLOGISTS AND GEOPHYSICISTS OF NEWFOUNDLAND & LABRADOR
PEGL
CHRISTOPHER M. FUDGE
2013-04-05

SNC·LAVALIN
455, René-Lévesque Blvd. West
Montréal (Québec)
Canada H2Z 1Z3

| PREPARATION | APPROVAL |
|---|---|
| DESIGNED: C. FUDGE | PROJECT DISCIPLINE ENGINEER: N. GILLIS |
| DRAWN: T. YOUNG | CLIENT: |
| CHECKED: C. FUDGE | DATE: 2013/03/22 |
| SCALE: AS NOTED | |

CLIENT: CANADIAN ROYALTIES INC.

PROJECT: NUNAVIK NICKEL
DECEPTION BAY PORT

TITLE: SSP CELLS–PLAN VIEW
LES CELLULES SSP PLAN VUE

| PROJECT No | SUBDIVISION | SUBJECT | SERIAL | REV. |
|---|---|---|---|---|
| 506117 | 8000 | 41 | D1 | 0008 | P1 |

0208784THEH – FRAME A1 HORIZONTAL ENGLISH

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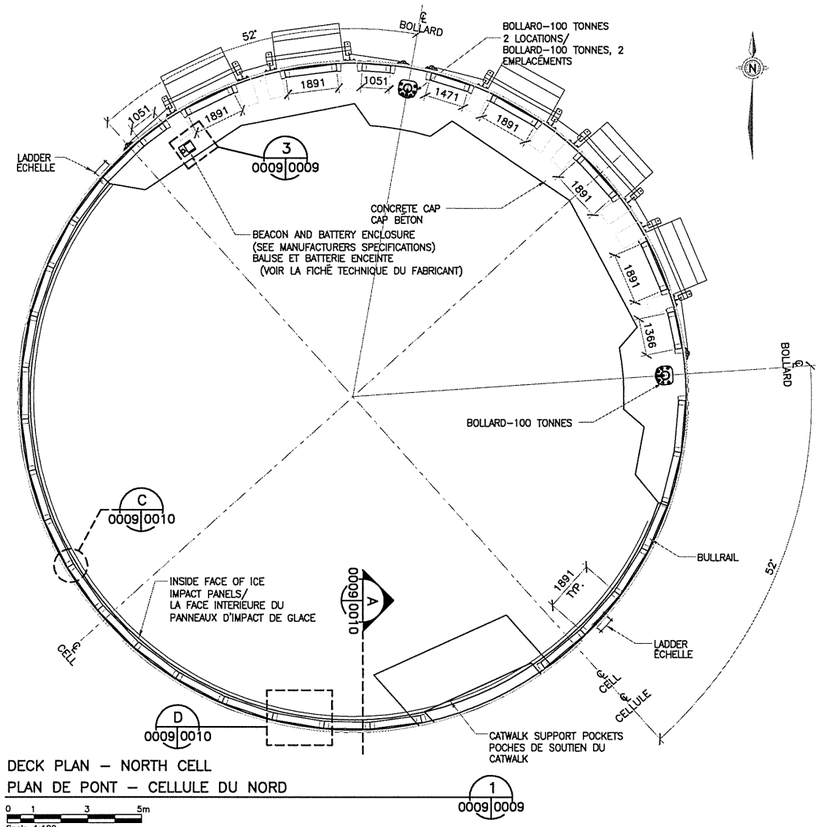
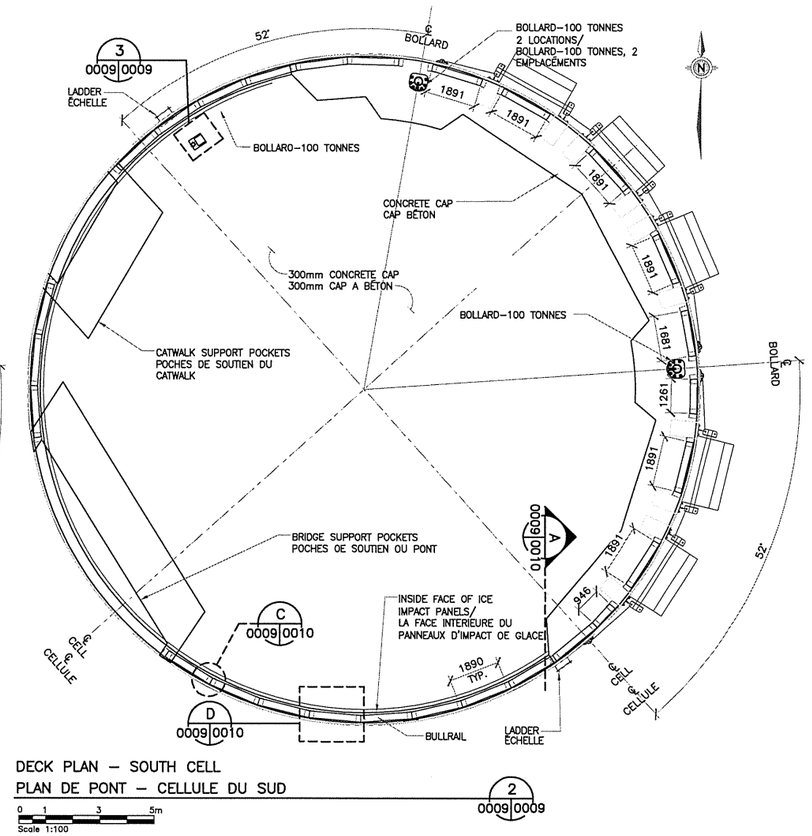



DECK PLAN – NORTH CELL
PLAN DE PONT – CELLULE DU NORD

1
0009 0009

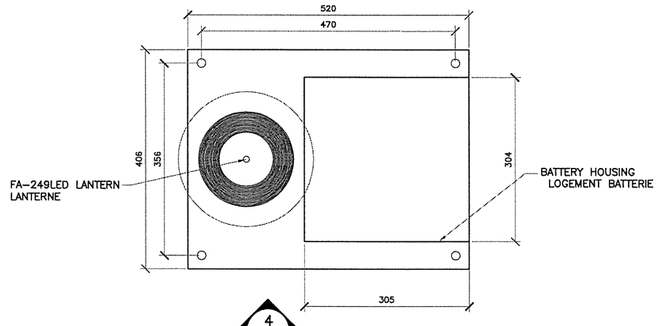
0 1 3 5m
Scale 1:100




DECK PLAN – SOUTH CELL
PLAN DE PONT – CELLULE DU SUD

2
0009 0009

0 1 3 5m
Scale 1:100

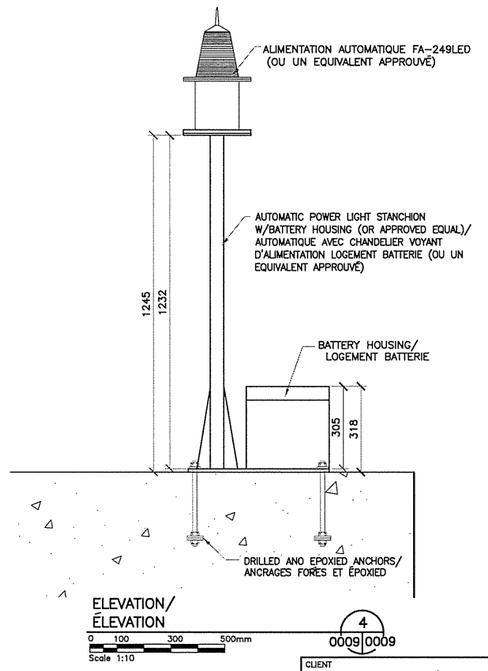



4
0009 0009

PLAN/
PLAN

0 100 300 500mm
Scale 1:10

3
0009 0009




ELEVATION/
ÉLÉVATION

0 100 300 500mm
Scale 1:10

4
0009 0009

NOTES:
1) LIGHT STANCHION TO BE FABRICATED FROM STEEL AND HOT DIPPED GALVANIZED

INDICATIONS:
1) CHANDELIER FEU A ETRE FABRIQUE EN ACIER ET GALVANISE A CHAUD

FOR PERMIT
NOT FOR CONSTRUCTION

POUR PERMIS
PAS POUR CONSTRUCTION

| ISSUE No | REV. | DATE (Y/M/D) | PURPOSE OF ISSUE | TRANSMISSION LETTER No |
|---|---|---|---|---|

ISSUE REGISTER

| ISSUE No | REV. | DATE (Y/M/D) | PURPOSE OF ISSUE | TRANSMISSION LETTER No |
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ISSUE REGISTER

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|---|---|---|---|---|
| P1 | ISSUED FOR PERMIT<br>EMIS POUR PERMIS | 2013/04/05 | | |

INITIALS: * DESIGNED ** APPROVED

REVISION REGISTER

| No | REVISION DESCRIPTION | DATE (Y/M/D) | * | ** |
|---|---|---|---|---|

INITIALS: * DESIGNED ** APPROVED

REVISION REGISTER

| No | REFERENCE DRAWINGS NUMBER |
|---|---|

PROFESSIONAL SEAL

REGISTERED PROFESSIONAL ENGINEER
PEGL
CHRISTOPHER M. FUDGE
2013-04-05
NEWFOUNDLAND & LABRADOR

SNC·LAVALIN
455, René–Lévesque Blvd. West
Montréal (Québec)
Canada H2Z 1Z3

| PREPARATION | APPROVAL |
|---|---|
| DESIGNED<br>C. FUDGE | PROJECT DISCIPLINE ENGINEER<br>N. GILLIS |
| DRAWN<br>T.YOUNG | CLIENT |
| CHECKED<br>C. FUDGE | DATE<br>2013/03/22 |
| SCALE<br>AS NOTED | |

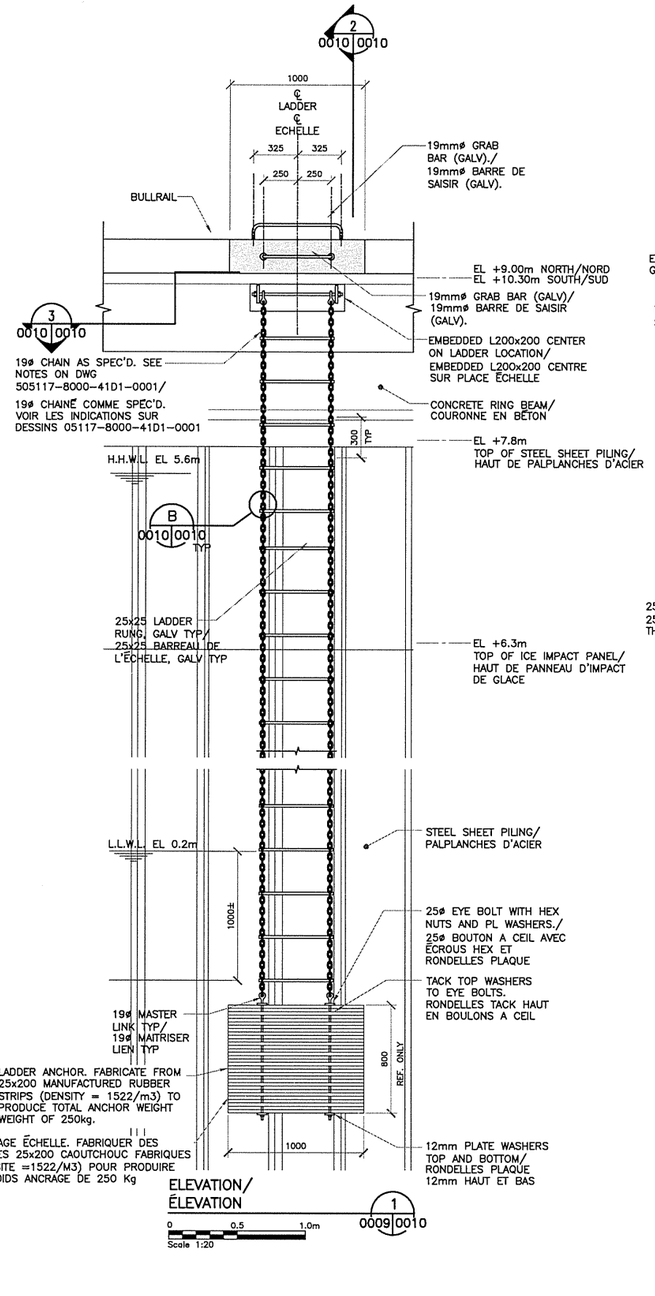
CLIENT
CANADIAN ROYALTIES INC.

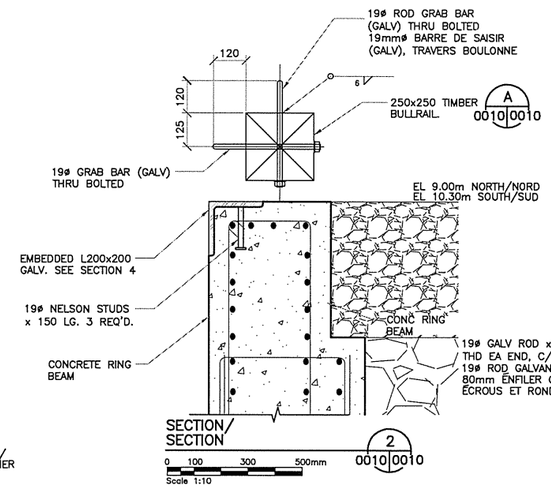
PROJECT
NUNAVIK NICKEL
DECEPTION BAY PORT

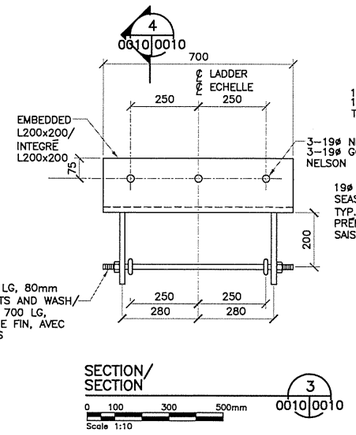
TITLE
SSP CELLS–DECK PLAN
PLAN DE PONT SSP CELLULES

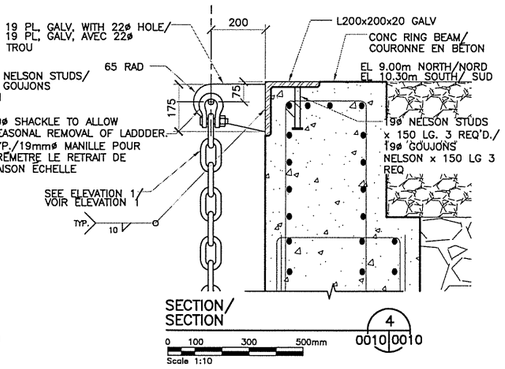
| PROJECT No | SUBDIVISION | SUBJECT | SERIAL | REV. |
|---|---|---|---|---|
| 506117 | 8000 | 41 | 0009 | P1 |

D2087BA11HEN – FRAME A1 HORIZONTAL ENGLISH



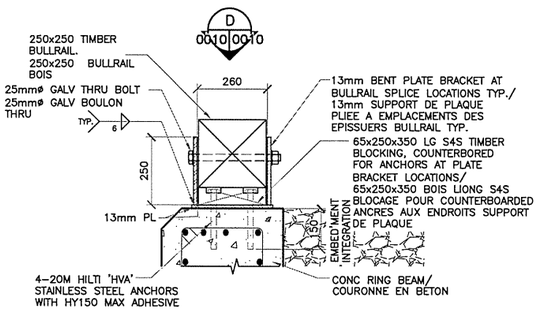
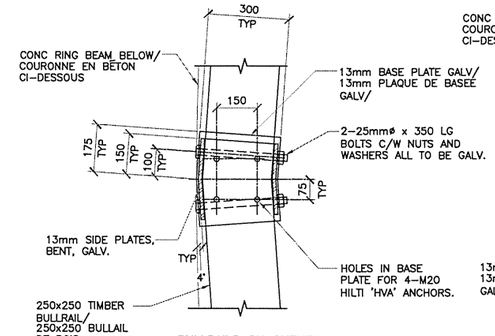
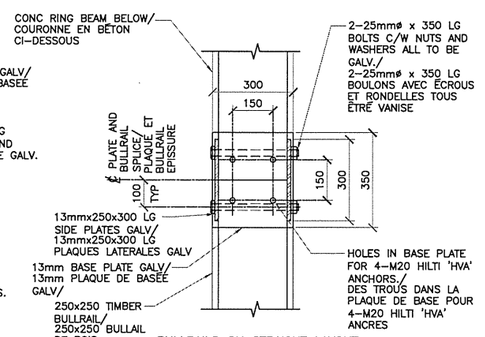




PLATE BRACKET AND BULLRAIL SPLICE DETAIL
SUPPORT DE PLAQUE ET DETAIL EPISSURE BULLRAIL

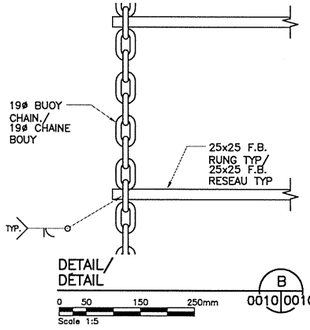



BULLRAILS ON CURVED LAYOUT
BULLRAILS SUR PLAN COURBE



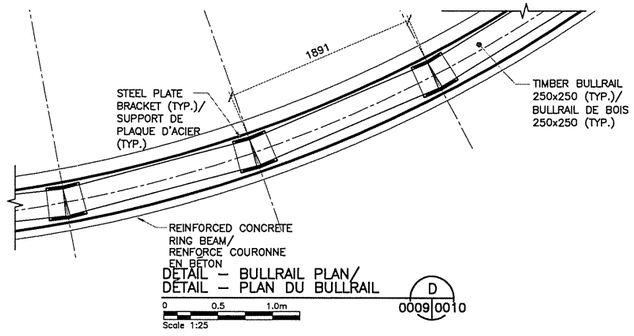

BULLRAILS ON STRAIGHT LAYOUT
BULLRAILS SUR PLAN DROITE

DETAILS/ DETAILS
A
0009 0010
0 100 300 500mm
Scale 1:10




DETAIL/ DÉTAIL
B
0010 0010
0 50 150 250mm
Scale 1:5

DETAILS/ DETAILS
C
0009 0010
0 100 300 500mm
Scale 1:10




DETAIL - BULLRAIL PLAN/
DÉTAIL - PLAN DU BULLRAIL
D
0009 0010
0 0.5 1.0m
Scale 1:25

FOR PERMIT
NOT FOR CONSTRUCTION

POUR PERMIS
PAS POUR CONSTRUCTION

| ISSUE No | REV. | DATE (Y/M/D) | PURPOSE OF ISSUE | TRANSMISSION LETTER No |
|---|---|---|---|---|

ISSUE REGISTER

| ISSUE No | REV. | DATE (Y/M/D) | PURPOSE OF ISSUE | TRANSMISSION LETTER No |
|---|---|---|---|---|

ISSUE REGISTER

| No | REVISION DESCRIPTION | DATE (Y/M/D) | * | ** |
|---|---|---|---|---|
| P1 | ISSUED FOR PERMIT / EMIS POUR PERMIS | 2013/04/05 | | |

INITIALS: * DESIGNED ** APPROVED

REVISION REGISTER

| No | REVISION DESCRIPTION | DATE (Y/M/D) | * | ** |
|---|---|---|---|---|

INITIALS: * DESIGNED ** APPROVED

REVISION REGISTER

| No | REFERENCE DRAWINGS NUMBER |
|---|---|

PROFESSIONAL SEAL

REGISTERED PROFESSIONAL ENGINEER
PEGL
PROVINCE OF NEWFOUNDLAND & LABRADOR
CHRISTOPHER M. FUDGE
24-04-05
DATE

SNC·LAVALIN
455, René-Lévesque Blvd. West
Montréal (Québec)
Canada H2Z 1Z3

| PREPARATION | APPROVAL |
|---|---|
| DESIGNED: C. FUDGE | PROJECT DISCIPLINE ENGINEER: N. GILLIS |
| DRAWN: T.YOUNG | CLIENT: |
| CHECKED: C. FUDGE | DATE: 2013/03/22 |
| SCALE: AS NOTED | |

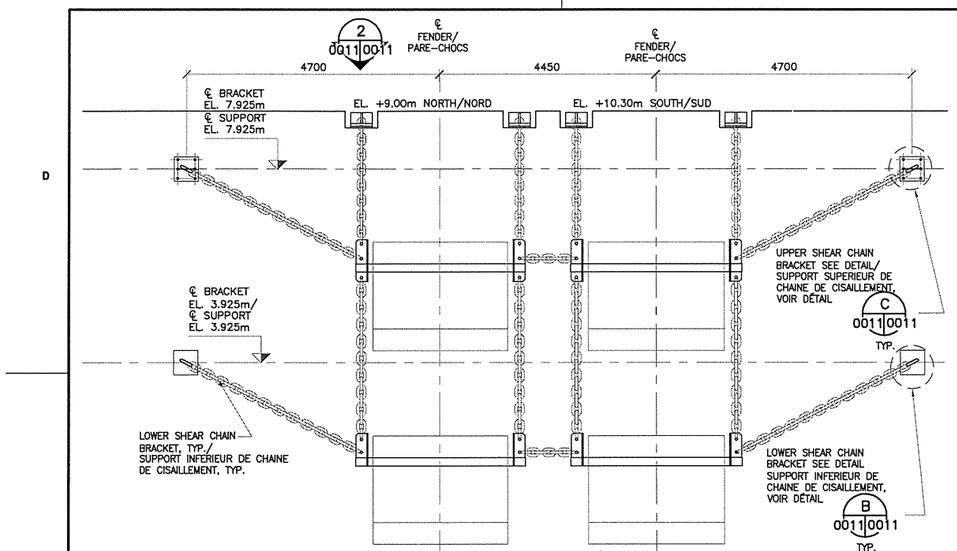
CLIENT
CANADIAN ROYALTIES INC.

PROJECT
NUNAVIK NICKEL
DECEPTION BAY PORT

TITLE
LADDER & BULLRAIL DETAILS
DÉTAILS DES ÉCHELLE ET BULLRAIL

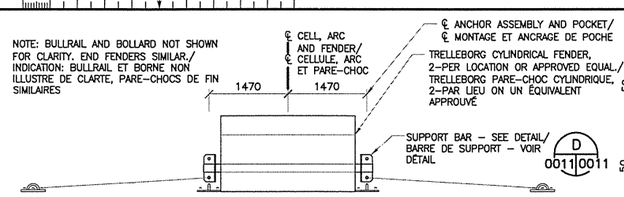
| PROJECT No | SUBDIVISION | SUBJECT | SERIAL | REV. |
|---|---|---|---|---|
| 506117 | 8000 | 41 D1 | 0010 | P1 |

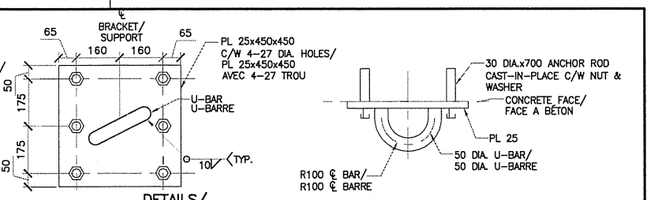
0208784THEN - FRAME A1 HORIZONTAL ENGLISH




ELEVATION – DOUBLE FENDER ARR'T
ELEVATION – ARR'T PARE–CHOCS DOUBLE 1 0011|0011

Scale 1:50



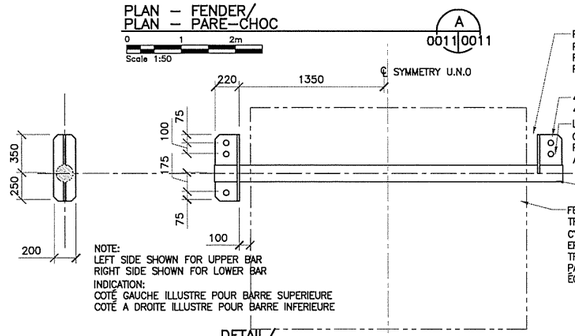




DETAILS/ DETAILS C 0011|0011

Scale 1:10

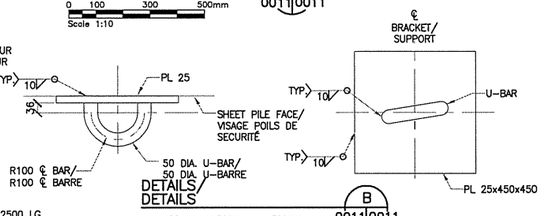
PLAN – FENDER/ PLAN – PARE–CHOC A 0011|0011

Scale 1:50



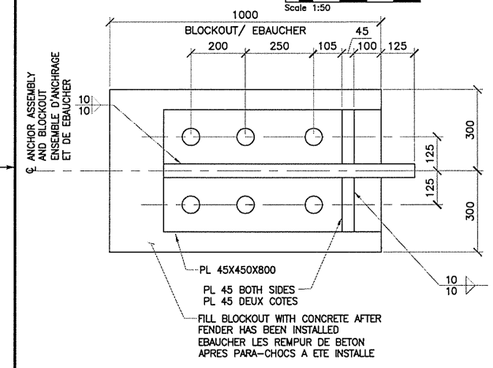

DETAIL/ DÉTAIL D 0011|0011

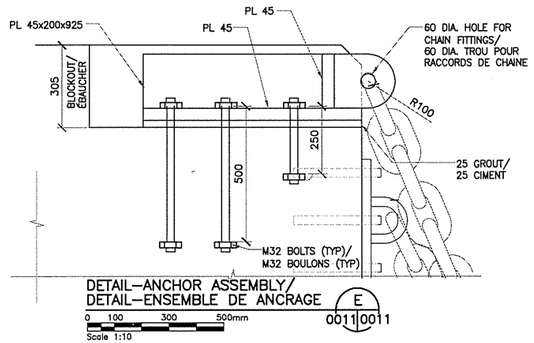
Scale 1:25




DETAILS/ DETAILS B 0011|0011

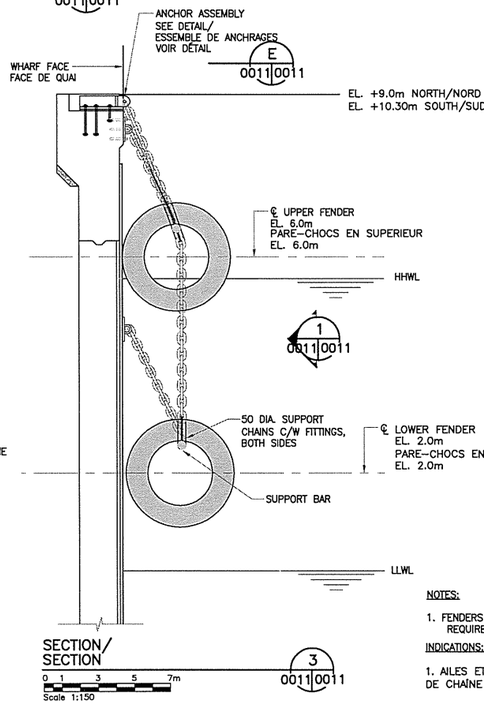
Scale 1:10



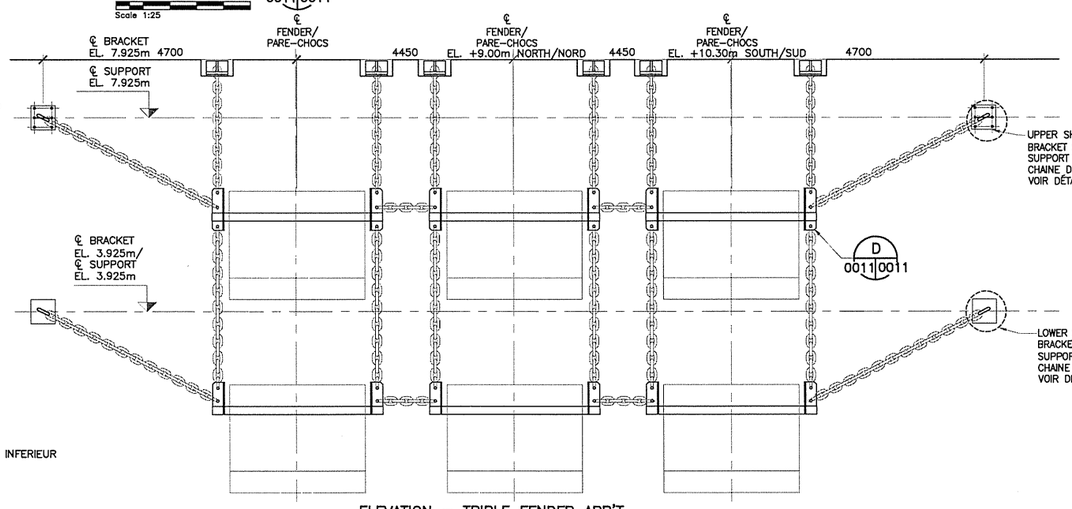

DETAIL–ANCHOR ASSEMBLY/ DETAIL–ENSEMBLE DE ANCRAGE E 0011|0011

Scale 1:10




SECTION/ SECTION 3 0011|0011

Scale 1:150




ELEVATION – TRIPLE FENDER ARR'T
ELEVATION – ARR'T PARE CHOC TRIPLE 4 0011|0011

Scale 1:50

NOTES:

1. FENDERS AND HARDWARE SUPPLIED BY OWNER. MODIFICATION TO CHAIN LENGTHS MAY BE REQUIRED

INDICATIONS:

1. AILES ET MATÉRIEL FOURNI PAR LE PROPRIETAIRE. MODIFICATION DE LA LONGUEUR DE CHAÎNE PEUT ETRE NECESSAIRE

POUR PERMIS
PAS POUR CONSTRUCTION

FOR PERMIT
NOT FOR CONSTRUCTION

| ISSUE No | REV. | DATE (Y/M/D) | PURPOSE OF ISSUE | TRANSMISSION LETTER No |
|---|---|---|---|---|

ISSUE REGISTER

| ISSUE No | REV. | DATE (Y/M/D) | PURPOSE OF ISSUE | TRANSMISSION LETTER No |
|---|---|---|---|---|

ISSUE REGISTER

| No | REVISION DESCRIPTION | DATE (Y/M/D) | * | ** |
|---|---|---|---|---|
| P1 | ISSUED FOR PERMIT EMIS POUR PERMIS | 2013/04/05 | | |

INITIALS: * DESIGNED ** APPROVED

REVISION REGISTER

| No | REVISION DESCRIPTION | DATE (Y/M/D) | * | ** |
|---|---|---|---|---|

INITIALS: * DESIGNED ** APPROVED

REVISION REGISTER

| No | REFERENCE DRAWINGS NUMBER |
|---|---|

PROFESSIONAL SEAL

REGISTERED PROFESSIONAL ENGINEERS PEGNL PROFESSIONAL ENGINEERS GOVERNMENT OF NEWFOUNDLAND & LABRADOR
CHRISTOPHER M. FUDGE
PROVINCE
2013-04-25
DATE

SNC·LAVALIN
455, René–Lévesque Blvd. West
Montréal (Québec)
Canada H2Z 1Z3

| PREPARATION | APPROVAL |
|---|---|
| DESIGNED C. FUDGE | PROJECT DISCIPLINE ENGINEER N. GILLIS |
| DRAWN T.YOUNG | CLIENT |
| CHECKED C. FUDGE | DATE 2013/03/22 |
| SCALE AS NOTED | |

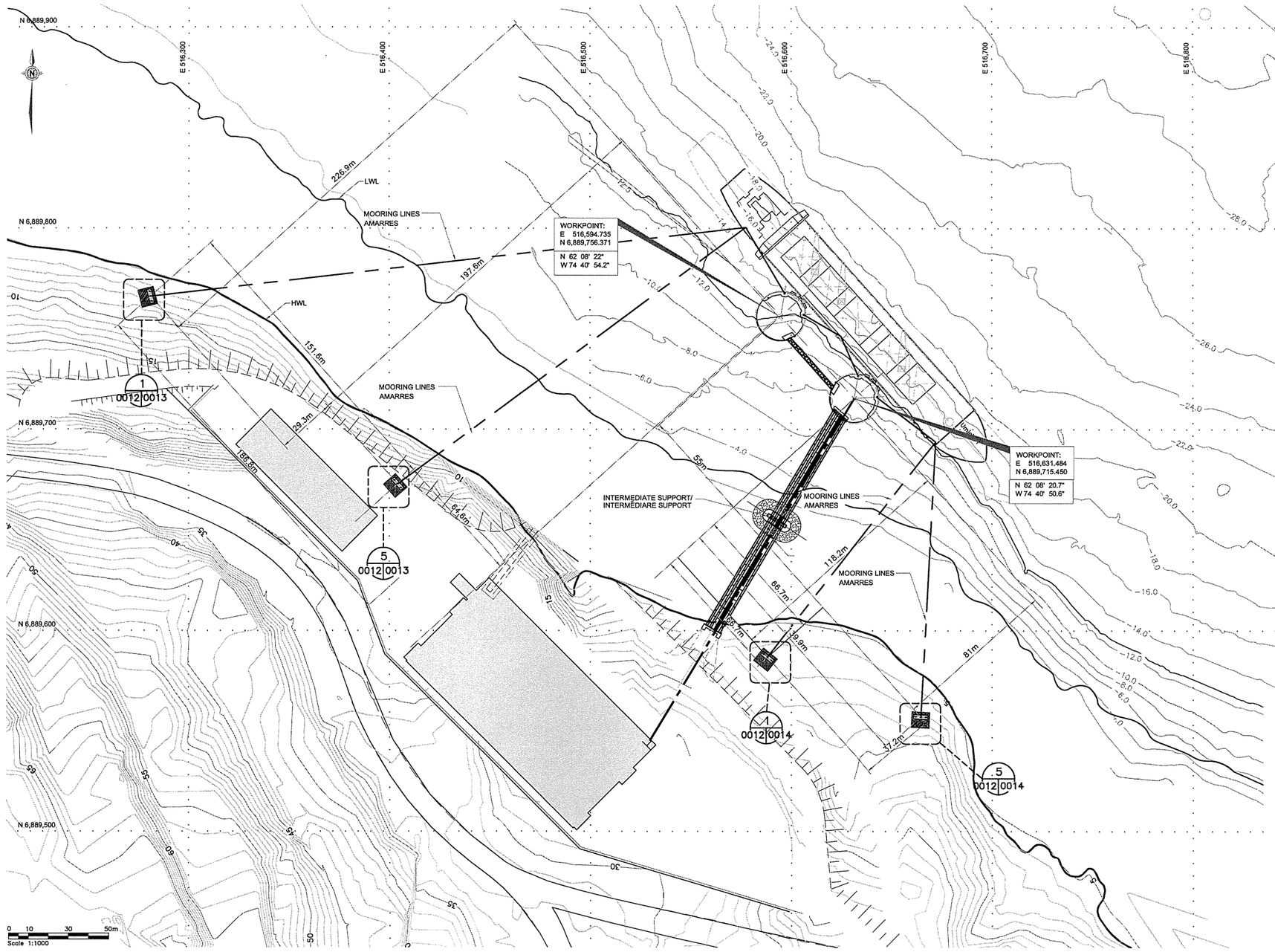
CLIENT
CANADIAN ROYALTIES INC.

PROJECT
NUNAVIK NICKEL
DECEPTION BAY PORT

TITLE
FENDER DETAILS
DÉTAILS DE PARE–CHOCS

| PROJECT No | SUBDIVISION | SUBJECT | SERIAL | REV. |
|---|---|---|---|---|
| 506117 | 8000 | 41 | D1 0011 | P1 |

020878A1.MEN – FRAME A1 HORIZONTAL ENGLISH




NOTES:
1) PRETENSION MOORING LINES TO MINIMIZE OR ELIMINATE LINE SAG.
2) LOCATION OF LAND BASED BOLLARDS MAY VARY DEPENDING ON SITE CONDITIONS./

INDICATIONS:
1) AMARRES PRETENDTION DE REDUIRE OU D'ELIMINER SAG LIGNE.
2) EMPLACEMENT DES BORNES TERRESTRES PEUVENT VARIER SELON LES CONDIONS DU SITE.

**FOR PERMIT**
**NOT FOR CONSTRUCTION**

**POUR PERMIS**
**PAS POUR CONSTRUCTION**

| ISSUE No | REV. | DATE (Y/M/D) | PURPOSE OF ISSUE | TRANSMISSION LETTER No |
|---|---|---|---|---|

ISSUE REGISTER

| ISSUE No | REV. | DATE (Y/M/D) | PURPOSE OF ISSUE | TRANSMISSION LETTER No |
|---|---|---|---|---|

ISSUE REGISTER

| No | REVISION DESCRIPTION | DATE (Y/M/D) | * | ** |
|---|---|---|---|---|
| P1 | ISSUED FOR PERMIT<br>EMIS POUR PERMIS | 2013/04/05 | | |

INITIALS: * DESIGNED ** APPROVED

REVISION REGISTER

| No | REVISION DESCRIPTION | DATE (Y/M/D) | * | ** |
|---|---|---|---|---|

INITIALS: * DESIGNED ** APPROVED

REVISION REGISTER

| No | REFERENCE DRAWINGS NUMBER |
|---|---|

PROFESSIONAL SEAL

PROFESSIONAL ENGINEERS GOVERNMENT OF NEWFOUNDLAND & LABRADOR
PEGNL
CHRISTOPHER M. FUDGE
2013-04-05
DATE

SNC·LAVALIN
SNC·LAVALIN
455, René-Lévesque Blvd. West
Montréal (Québec)
Canada H2Z 1Z3

| PREPARATION | | APPROVAL | |
|---|---|---|---|
| DESIGNED | C. FUDGE | PROJECT DISCIPLINE ENGINEER | N. GILLIS |
| DRAWN | T.YOUNG | CLIENT | |
| CHECKED | C. FUDGE | DATE | 2013/03/22 |
| SCALE | AS NOTED | | |

CLIENT
CANADIAN ROYALTIES INC.

PROJECT
NUNAVIK NICKEL
DECEPTION BAY PORT

TITLE
MOORING ARRANGEMENT
ARRANGEMENT DE AMARRES

| PROJECT No | SUBDIVISION | | SUBJECT | SERIAL | REV. |
|---|---|---|---|---|---|
| 506117 | 8000 | 41 | D1 | 0012 | P1 |

020872A1HEN – FRAME A1 HORIZONTAL ENGLISH

LAST SAVE: 2013/04/05 – 2:36pm
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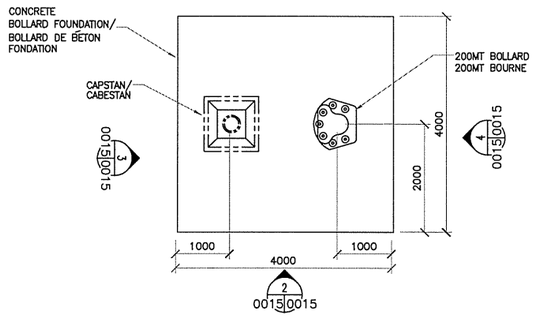
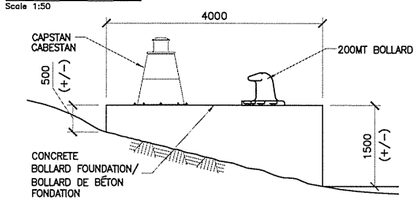


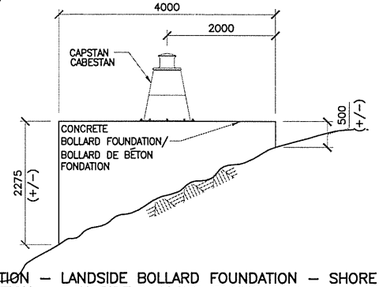

PLAN – LANDSIDE BOLLARD FOUNDATION – SHORE MOORING #1
PLAN – LANDSIDE BOLLARD FOUNDATION – AMMARAGE SHORE No. 1 — 1 — 0012 0013

Scale 1:50



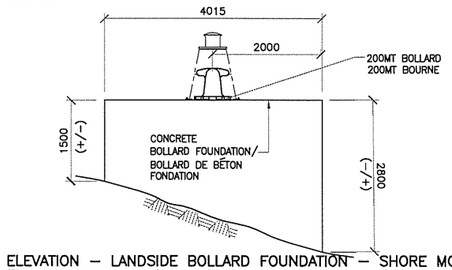

ELEVATION – LANDSIDE BOLLARD FOUNDATION – SHORE MOORING #1
ELEVATION – LANDSIDE BOLLARD FOUNDATION – AMMARAGE SHORE No. 1 — 2 — 0013 0013

Scale 1:50



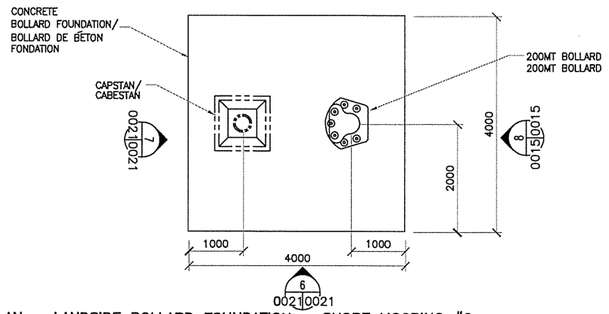

ELEVATION – LANDSIDE BOLLARD FOUNDATION – SHORE MOORING #1
ELEVATION – LANDSIDE BOLLARD FOUNDATION – AMMARAGE SHORE No. 1 — 3 — 0013 0013

Scale 1:50



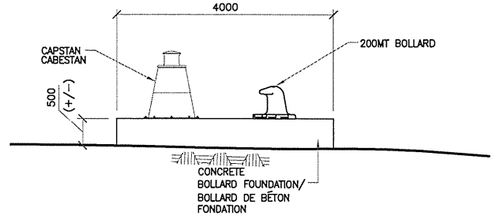

ELEVATION – LANDSIDE BOLLARD FOUNDATION – SHORE MOORING #1
ELEVATION – LANDSIDE BOLLARD FOUNDATION – AMMARAGE SHORE No. 1 — 4 — 0013 0013

Scale 1:50



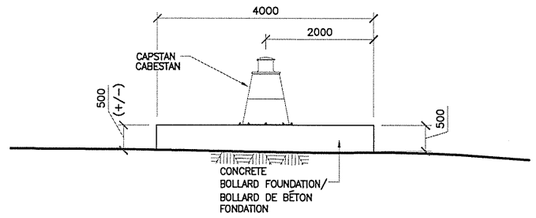

PLAN – LANDSIDE BOLLARD FOUNDATION – SHORE MOORING #2
PLAN – LANDSIDE BOLLARD FOUNDATION – AMMARAGE SHORE No. 2 — 5 — 0012 0013

Scale 1:50



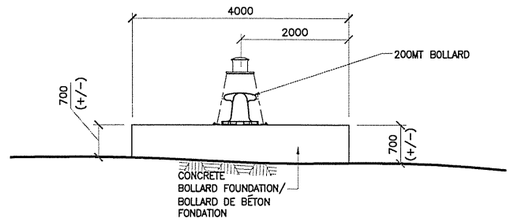

ELEVATION – LANDSIDE BOLLARD FOUNDATION – SHORE MOORING #2
ELEVATION – LANDSIDE BOLLARD FOUNDATION – AMMARAGE SHORE No. 2 — 6 — 0013 0013

Scale 1:50




ELEVATION – LANDSIDE BOLLARD FOUNDATION – SHORE MOORING #2
ELEVATION – LANDSIDE BOLLARD FOUNDATION – AMMARAGE SHORE No. 2 — 7 — 0013 0013

Scale 1:50




ELEVATION – LANDSIDE BOLLARD FOUNDATION – SHORE MOORING #2
ELEVATION – LANDSIDE BOLLARD FOUNDATION – AMMARAGE SHORE No. 2 — 8 — 0013 0013

Scale 1:50

NOTES:
1) ALL BOLLARDS AND CAPSTANS ARE OWNER SUPPLIED.
2) SEE DRAWING 506117 8000 42D1 0004 FOR REINFORCING DETAILS TYPICAL ALL BOLLARD FOUNDATIONS.
3) ROCK SLOPE MAY VARY DEPENDING ON FINAL BOLLARD LOCATION

INDICATIONS:
1) TOUTES LES BOLLARDS ET CABESTANS ÊTES PROPRIETAIRE FOURNI.
2) VOIR 506117 8000 42D1 0004 DESSINS POUR RENFORCER DÉTAILS TYPIQUES TOUTES LES FONDATIONS BOLLARD
3) PENTE ROCK PEUVENT VARIER EN FONCTION DE BOLLARD EMPLACEMENT FINAL

FOR PERMIT
NOT FOR CONSTRUCTION

POUR PERMIS
PAS POUR CONSTRUCTION

| ISSUE No | REV. | DATE (Y/M/D) | PURPOSE OF ISSUE | TRANSMISSION LETTER No |
|---|---|---|---|---|

ISSUE REGISTER

| ISSUE No | REV. | DATE (Y/M/D) | PURPOSE OF ISSUE | TRANSMISSION LETTER No |
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ISSUE REGISTER

| No | REVISION DESCRIPTION | DATE (Y/M/D) | * | ** |
|---|---|---|---|---|
| P1 | ISSUED FOR PERMIT<br>EMIS POUR PERMIS | 2013/04/05 | | |

INITIALS: * DESIGNED ** APPROVED

REVISION REGISTER

| No | REVISION DESCRIPTION | DATE (Y/M/D) | * | ** |
|---|---|---|---|---|

INITIALS: * DESIGNED ** APPROVED

REVISION REGISTER

| No | REFERENCE DRAWINGS NUMBER |
|---|---|

PROFESSIONAL SEAL

REGISTERED PROFESSIONAL ENGINEER
PEGL
Engineers, Geologists and Land Surveyors
CHRISTOPHER M. FUDGE
SIGNATURE 2013-04-05
DATE
NEWFOUNDLAND & LABRADOR

SNC·LAVALIN
SNC·LAVALIN
455, René-Lévesque Blvd. West
Montréal (Québec)
Canada H2Z 1Z3

| PREPARATION | APPROVAL |
|---|---|
| DESIGNED<br>B. TUCKER / C. FUDGE | PROJECT DISCIPLINE ENGINEER<br>N. GILLIS |
| DRAWN<br>T.YOUNG | CLIENT |
| CHECKED<br>C. FUDGE | DATE<br>2013/03/22 |
| SCALE<br>AS NOTED | |

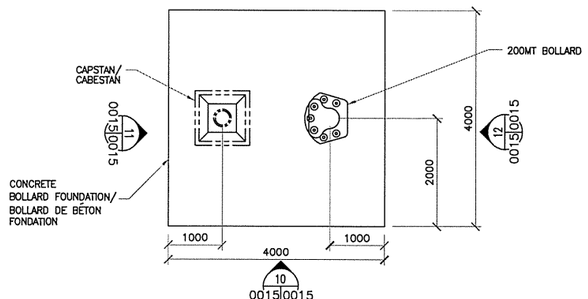
CLIENT
CANADIAN ROYALTIES INC.

PROJECT
NUNAVIK NICKEL
DECEPTION BAY PORT

TITLE
SITE 2
MOORINGS DETAILS
DÉTAILS DE AMMARES

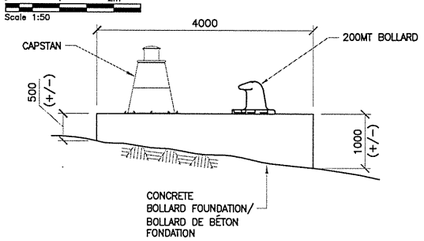
| PROJECT No | SUBDIVISION | SUBJECT | SERIAL | REV. |
|---|---|---|---|---|
| 506117 | 8000 | 41 D1 | 0013 | P1 |

020878A1HEN – FRAME A1 HORIZONTAL ENGLISH



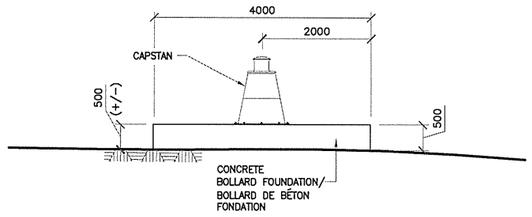

PLAN – LANDSIDE BOLLARD FOUNDATION – SHORE MOORING #3
PLAN – LANDSIDE BOLLARD FOUNDATION – AMMARAGE SHORE No. 3 — 1 / 0014|0014

0 1 2m
Scale 1:50



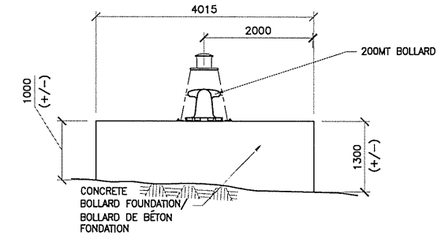

ELEVATION – LANDSIDE BOLLARD FOUNDATION – SHORE MOORING #3
ELEVATION – LANDSIDE BOLLARD FOUNDATION – AMMARAGE SHORE No. 3 — 2 / 0014|0014

0 1 2m
Scale 1:50



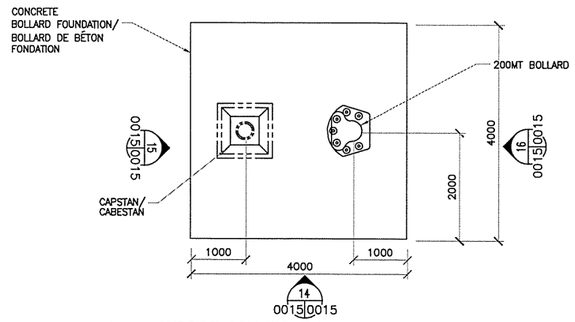

ELEVATION – LANDSIDE BOLLARD FOUNDATION – SHORE MOORING #3
ELEVATION – LANDSIDE BOLLARD FOUNDATION – AMMARAGE SHORE No. 3 — 3 / 0014|0014

0 1 2m
Scale 1:50



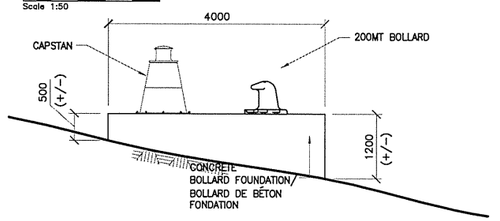

ELEVATION – LANDSIDE BOLLARD FOUNDATION – SHORE MOORING #3
ELEVATION – LANDSIDE BOLLARD FOUNDATION – AMMARAGE SHORE No. 3 — 4 / 0014|0014

0 1 2m
Scale 1:50



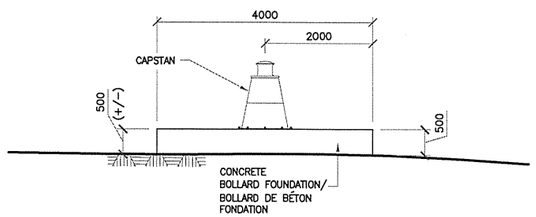

PLAN – LANDSIDE BOLLARD FOUNDATION – SHORE MOORING #4
PLAN – LANDSIDE BOLLARD FOUNDATION – AMMARAGE SHORE No. 4 — 5 / 0014|0014

0 1 2m
Scale 1:50



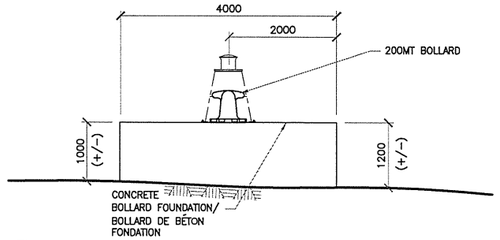

ELEVATION – LANDSIDE BOLLARD FOUNDATION – SHORE MOORING #4
ELEVATION – LANDSIDE BOLLARD FOUNDATION – AMMARAGE SHORE No. 4 — 6 / 0014|0014

0 1 2m
Scale 1:50




ELEVATION – LANDSIDE BOLLARD FOUNDATION – SHORE MOORING #4
ELEVATION – LANDSIDE BOLLARD FOUNDATION – AMMARAGE SHORE No. 4 — 7 / 0014|0014

0 1 2m
Scale 1:50




ELEVATION – LANDSIDE BOLLARD FOUNDATION – SHORE MOORING #4
ELEVATION – LANDSIDE BOLLARD FOUNDATION – AMMARAGE SHORE No. 4 — 8 / 0014|0014

0 1 2m
Scale 1:50

NOTES:
1) ALL BOLLARDS AND CAPSTANS ARE OWNER SUPPLIED.
2) SEE DRAWING 506117 8000 42D1 0004 FOR REINFORCING DETAILS TYPICAL ALL BOLLARD FOUNDATIONS.
3) ROCK SLOPE MAY VARY DEPENDING ON FINAL BOLLARD LOCATION

INDICATIONS:
1) TOUTES LES BOLLARDS ET CABESTANS ÉTES PROPRIETAIRE FOURNI.
2) VOIR 506117 8000 42D1 0004 DESSINS POUR RENFORCER DÉTAILS TYPIQUES TOUTES LES FONDATIONS BOLLARD
3) PENTE ROCK PEUVENT VARIER EN FONCTION DE BOLLARD EMPLACEMENT FINAL

FOR PERMIT
NOT FOR CONSTRUCTION

POUR PERMIS
PAS POUR CONSTRUCTION

| ISSUE No | REV. | DATE (Y/M/D) | PURPOSE OF ISSUE | TRANSMISSION LETTER No |
|---|---|---|---|---|

ISSUE REGISTER

| ISSUE No | REV. | DATE (Y/M/D) | PURPOSE OF ISSUE | TRANSMISSION LETTER No |
|---|---|---|---|---|

ISSUE REGISTER

| No | REVISION DESCRIPTION | DATE (Y/M/D) | * | ** |
|---|---|---|---|---|
| P1 | ISSUED FOR PERMIT<br>EMIS POUR PERMIS | 2013/04/05 | | |

INITIALS: * DESIGNED ** APPROVED

REVISION REGISTER

| No | REVISION DESCRIPTION | DATE (Y/M/D) | * | ** |
|---|---|---|---|---|

INITIALS: * DESIGNED ** APPROVED

REVISION REGISTER

| No | REFERENCE DRAWINGS NUMBER |
|---|---|

PROFESSIONAL SEAL
PEGNL PROFESSIONAL ENGINEERS GOVERNED BY THE ENGINEERING AND GEOSCIENCE ACT
CHRISTOPHER M. FUDGE
2013-04-05
NEWFOUNDLAND & LABRADOR

SNC·LAVALIN
455, René-Lévesque Blvd. West
Montréal (Québec)
Canada H2Z 1Z3

| PREPARATION | APPROVAL |
|---|---|
| DESIGNED: B. TUCKER / C. FUDGE | PROJECT DISCIPLINE ENGINEER: N. GILLIS |
| DRAWN: T.YOUNG | CLIENT: |
| CHECKED: C. FUDGE | DATE: 2013/03/22 |
| SCALE: AS NOTED | |

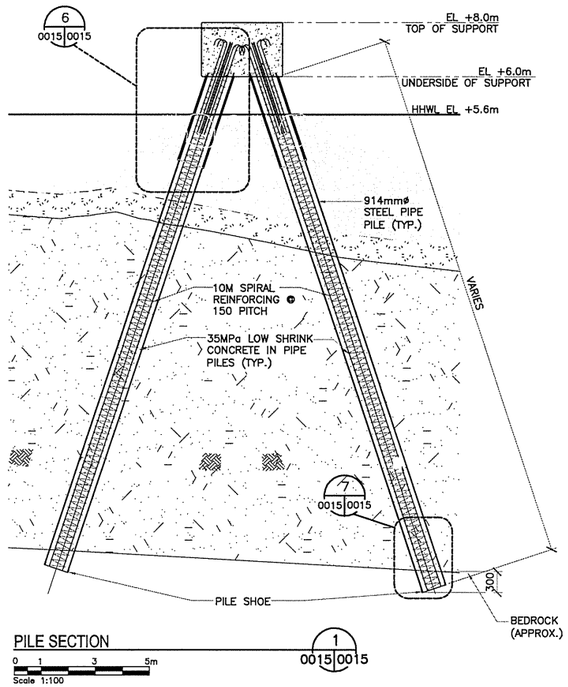
CLIENT
CANADIAN ROYALTIES INC.

PROJECT
NUNAVIK NICKEL
DECEPTION BAY PORT

TITLE
SITE 2
MOORINGS DETAILS
DÉTAILS DE AMMARES

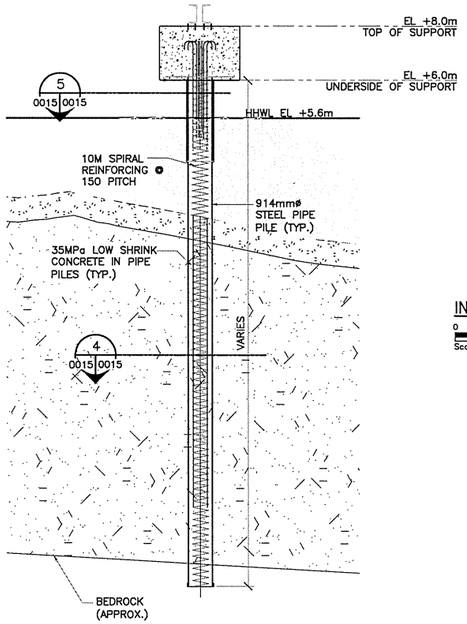
| PROJECT No | SUBDIVISION | SUBJECT | SERIAL | REV. |
|---|---|---|---|---|
| 506117 | 8000 | 41 | D1 0014 | P1 |

020878A1HEN – FRAME A1 HORIZONTAL ENGLISH



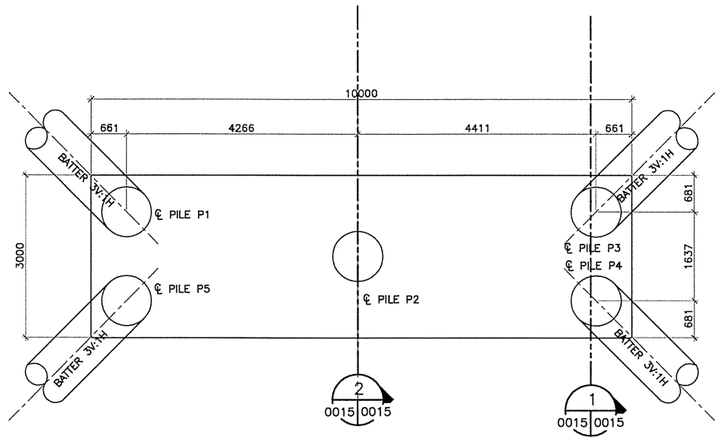

PILE SECTION 1 — 0015 0015

Scale 1:100




PILE SECTION 2 — 0015 0015

Scale 1:100



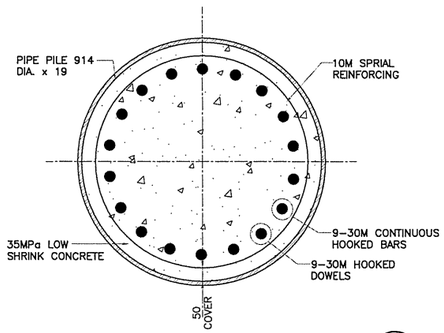

INTERMEDIATE SUPPORT/ PILE PLAN — 3 — 0015 0015

Scale 1:50



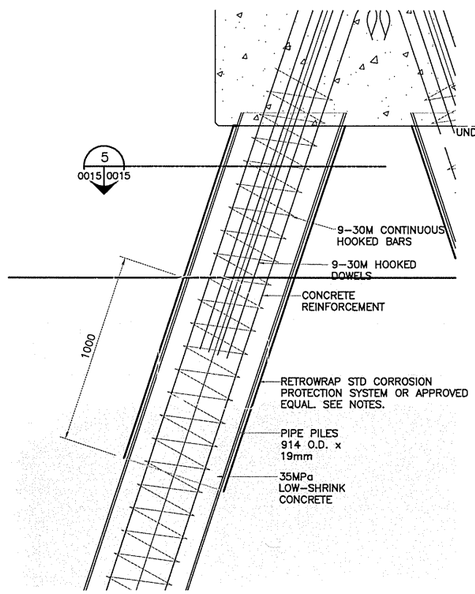

SECTION — 4 — 0015 0015

Scale 1:10



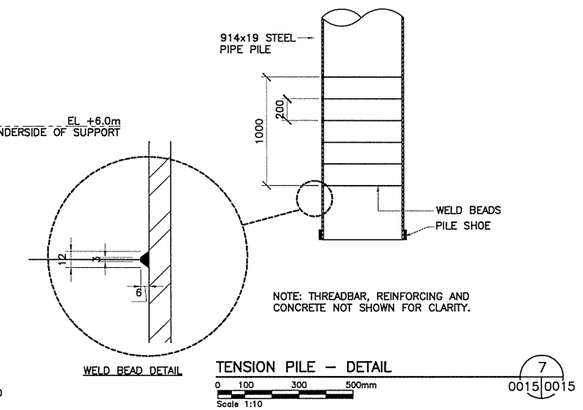

SECTION — 5 — 0015 0015

Scale 1:10




SECTION DETAIL — 6 — 0015 0015

Scale 1:25




TENSION PILE – DETAIL — 7 — 0015 0015

Scale 1:10

FOR PERMIT
NOT FOR CONSTRUCTION

POUR PERMIS
PAS POUR CONSTRUCTION

| ISSUE No | REV. | DATE (Y/M/D) | PURPOSE OF ISSUE | TRANSMISSION LETTER No |
|---|---|---|---|---|

ISSUE REGISTER

| ISSUE No | REV. | DATE (Y/M/D) | PURPOSE OF ISSUE | TRANSMISSION LETTER No |
|---|---|---|---|---|

ISSUE REGISTER

| No | REVISION DESCRIPTION | DATE (Y/M/D) | * | ** |
|---|---|---|---|---|
| P1 | ISSUED FOR PERMIT<br>EMIS POUR PERMIS | 2013/04/05 | | |

INITIALS: * DESIGNED ** APPROVED

REVISION REGISTER

| No | REVISION DESCRIPTION | DATE (Y/M/D) | * | ** |
|---|---|---|---|---|

INITIALS: * DESIGNED ** APPROVED

REVISION REGISTER

| No | REFERENCE DRAWINGS NUMBER |
|---|---|

PROFESSIONAL SEAL

REGISTERED PROFESSIONAL ENGINEER
PEGL
PROVINCE OF NEWFOUNDLAND & LABRADOR
CHRISTOPHER M. FUDGE
SIGNATURE
2013-04-05
DATE

SNC·LAVALIN
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Canada H2Z 1Z3

| PREPARATION | APPROVAL |
|---|---|
| DESIGNED: C. FUDGE | PROJECT DISCIPLINE ENGINEER: N. GILLIS |
| DRAWN: T.YOUNG | CLIENT: |
| CHECKED: C. FUDGE | DATE: 2013/03/22 |
| SCALE: AS NOTED | |

CLIENT: CANADIAN ROYALTIES INC.

PROJECT: NUNAVIK NICKEL — DECEPTION BAY PORT

TITLE: PILE PLAN AND SECTIONS/ PLAN DE PILE ET SECTIONS

| PROJECT No | SUBDIVISION | SUBJECT | SERIAL | REV. |
|---|---|---|---|---|
| 506117 | 8000 | 41 D1 | 0015 | P1 |

020878A1HEN – FRAME A1 HORIZONTAL ENGLISH

LAST SAVE: 2013/04/05 – 3:29pm
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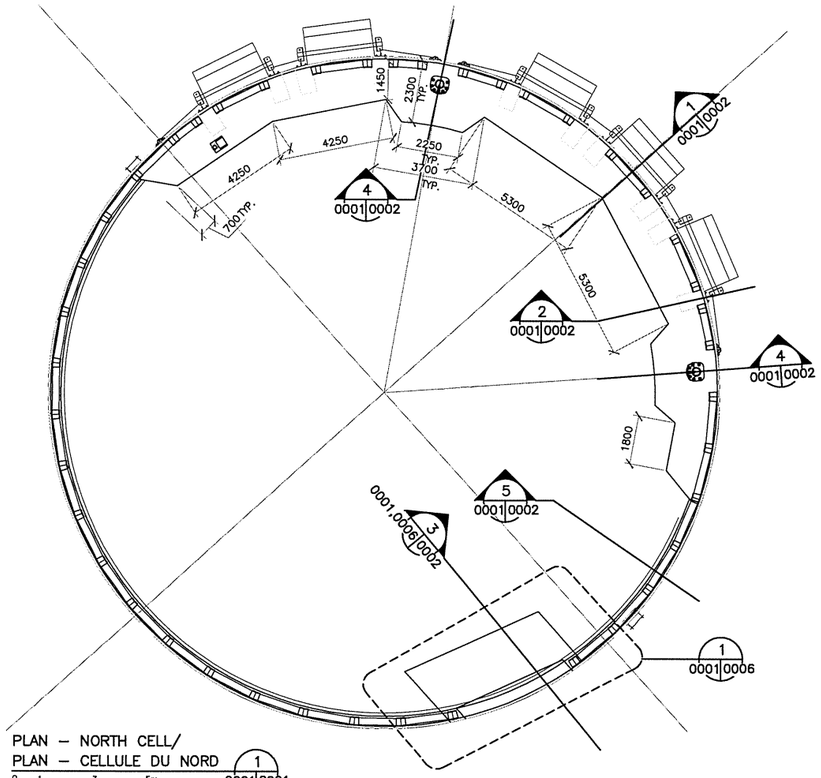
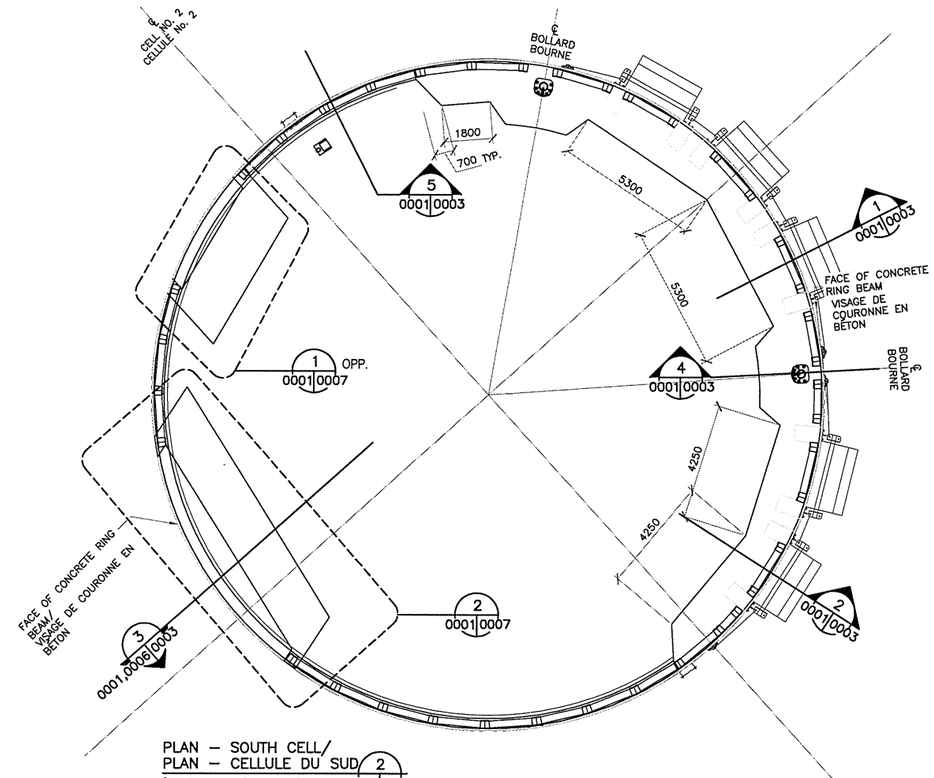



PLAN – NORTH CELL/
PLAN – CELLULE DU NORD 1 0001|0001

0 1 3 5m
Scale 1:100




PLAN – SOUTH CELL/
PLAN – CELLULE DU SUD 2 0001|0001

0 1 3 5m
Scale 1:100

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POUR PERMIS
PAS POUR CONSTRUCTION

| ISSUE No | REV. | DATE (Y/M/D) | PURPOSE OF ISSUE | TRANSMISSION LETTER No |
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ISSUE REGISTER

| ISSUE No | REV. | DATE (Y/M/D) | PURPOSE OF ISSUE | TRANSMISSION LETTER No |
|---|---|---|---|---|

ISSUE REGISTER

| No | REVISION DESCRIPTION | DATE (Y/M/D) | * | ** |
|---|---|---|---|---|
| P1 | ISSUED FOR PERMIT<br>EMIS POUR PERMIS | 2013/04/05 | | |

INITIALS: * DESIGNED ** APPROVED

REVISION REGISTER

| No | REVISION DESCRIPTION | DATE (Y/M/D) | * | ** |
|---|---|---|---|---|

INITIALS: * DESIGNED ** APPROVED

REVISION REGISTER

| No | REFERENCE DRAWINGS NUMBER |
|---|---|

PROFESSIONAL SEAL

REGISTERED PROFESSIONAL ENGINEER
PEGL
CHRISTOPHER M. FUDGE
2013-04-05
DATE
NEWFOUNDLAND & LABRADOR

SNC·LAVALIN
455, René-Lévesque Blvd. West
Montréal (Québec)
Canada H2Z 1Z3

| PREPARATION | APPROVAL |
|---|---|
| DESIGNED<br>C. FUDGE | PROJECT DISCIPLINE ENGINEER<br>N. GILLIS |
| DRAWN<br>T.YOUNG | CLIENT |
| CHECKED<br>C.FUDGE | DATE<br>2013/03/22 |
| SCALE<br>AS NOTED | |

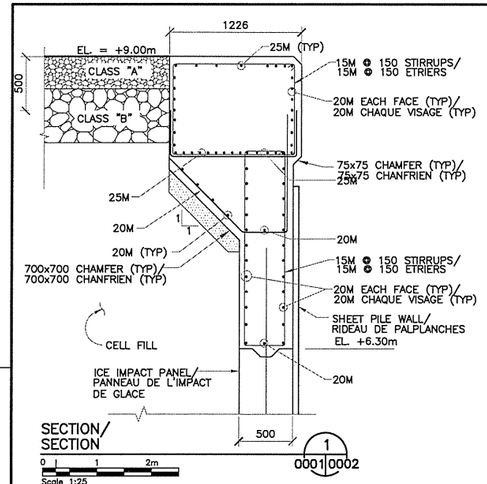
CLIENT
CANADIAN ROYALTIES INC.

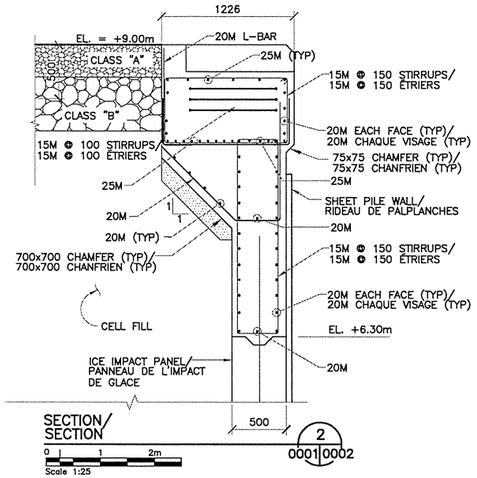
PROJECT
NUNAVIK NICKEL
DECEPTION BAY PORT

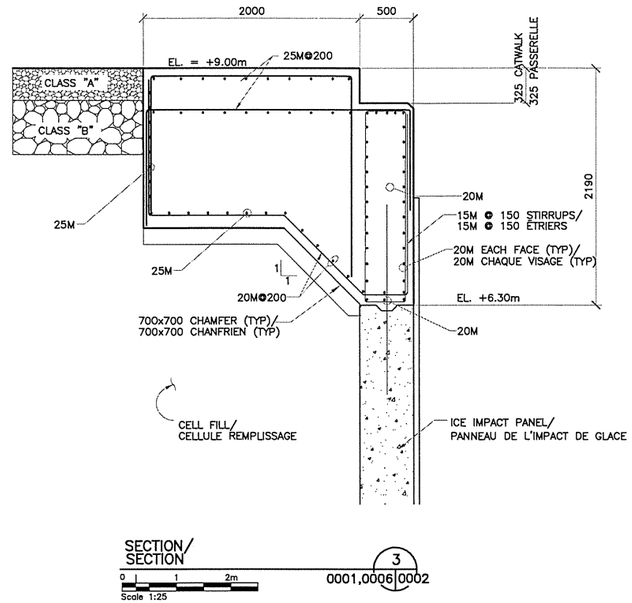
TITLE
SSP CELLS
CONCRETE CAP REINFORCEMENT
SSP CELLULES
CAP À BÉTON RENFORT

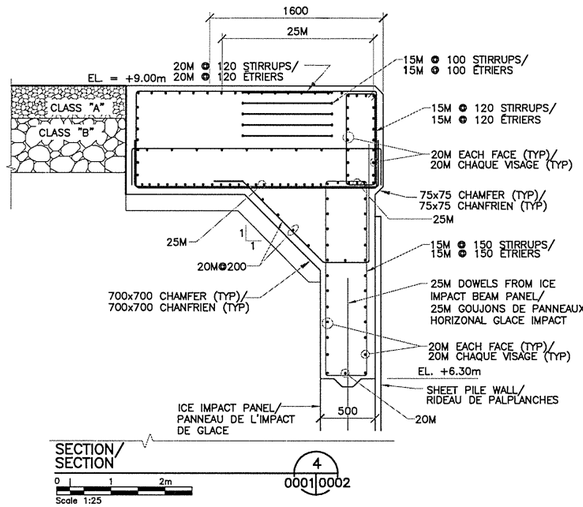
| PROJECT No | SUBDIVISION | SUBJECT | SERIAL | REV. |
|---|---|---|---|---|
| 506117 | 8000 | 42 \ D1 | 0001 | P1 |

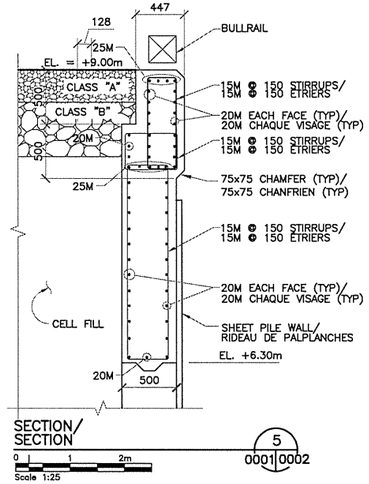
0208784THEN – FRAME A1 HORIZONTAL ENGLISH




FOR PERMIT
NOT FOR CONSTRUCTION

POUR PERMIS
PAS POUR CONSTRUCTION

| ISSUE No | REV. | DATE (Y/M/D) | PURPOSE OF ISSUE | TRANSMISSION LETTER No |
|---|---|---|---|---|

ISSUE REGISTER

| ISSUE No | REV. | DATE (Y/M/D) | PURPOSE OF ISSUE | TRANSMISSION LETTER No |
|---|---|---|---|---|

ISSUE REGISTER

| No | REVISION DESCRIPTION | DATE (Y/M/D) | * | ** |
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INITIALS: * DESIGNED ** APPROVED

REVISION REGISTER

| No | REVISION DESCRIPTION | DATE (Y/M/D) | * | ** |
|---|---|---|---|---|

INITIALS: * DESIGNED ** APPROVED

REVISION REGISTER

| No | REFERENCE DRAWINGS NUMBER |
|---|---|

PROFESSIONAL SEAL

REGISTERED PROFESSIONAL ENGINEER
PROVINCE OF NEWFOUNDLAND & LABRADOR
PEGNL
CHRISTOPHER M. FUDGE
Fudge
2013-04-05
DATE

SNC·LAVALIN
455, René-Lévesque Blvd. West
Montréal (Québec)
Canada H2Z 1Z3

| PREPARATION | APPROVAL |
|---|---|
| DESIGNED<br>C. FUDGE | PROJECT DISCIPLINE ENGINEER<br>N. GILLIS |
| DRAWN<br>T.YOUNG | CLIENT |
| CHECKED<br>C. FUDGE | DATE<br>2013/03/22 |
| SCALE<br>AS NOTED | |

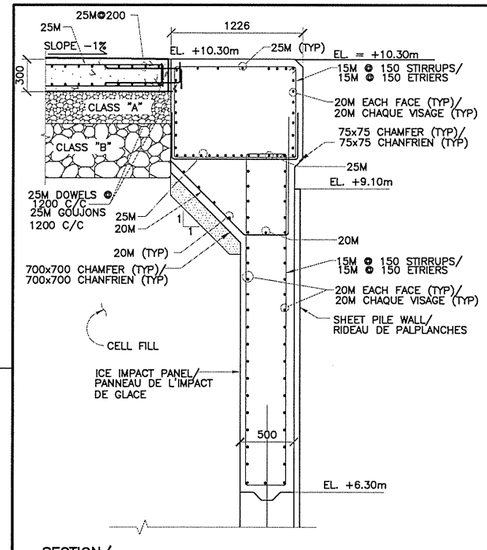
CLIENT
CANADIAN ROYALTIES INC.

PROJECT
NUNAVIK NICKEL
DECEPTION BAY PORT

TITLE
CONCRETE CAP REINFORCING DETAILS – NORTH CELL
CAP À BÉTON COORDONNÉES – CELLULE DU NORD

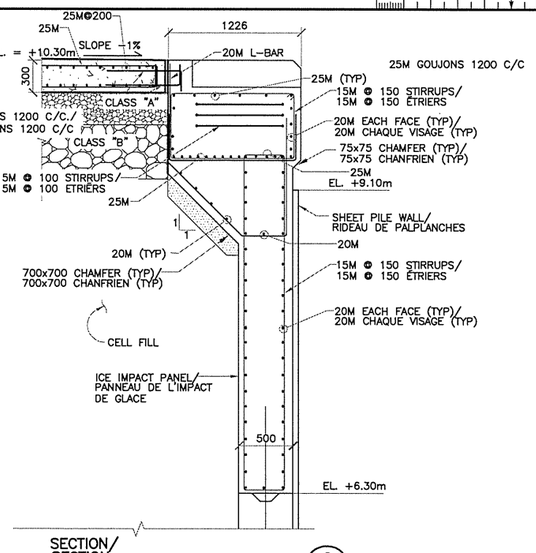
| PROJECT No | SUBDMISION | SUBJECT | SERIAL | REV. |
|---|---|---|---|---|
| 506117 | 8000 | 42 \| D1 | 0002 | P1 |

0206784 1HEN – FRAME A1 HORIZONTAL ENGLISH



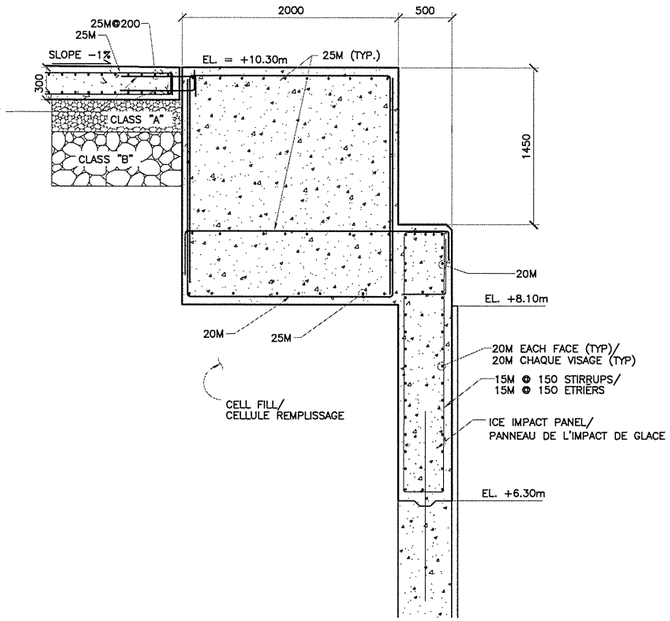

SECTION/
SECTION 1 0001|0002

Scale 1:25



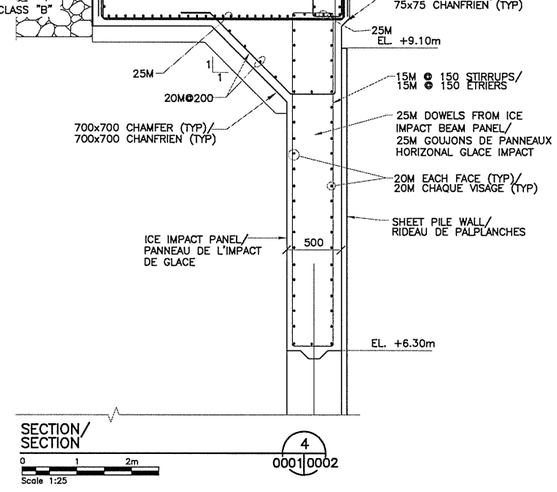

SECTION/
SECTION 2 0001|0002

Scale 1:25



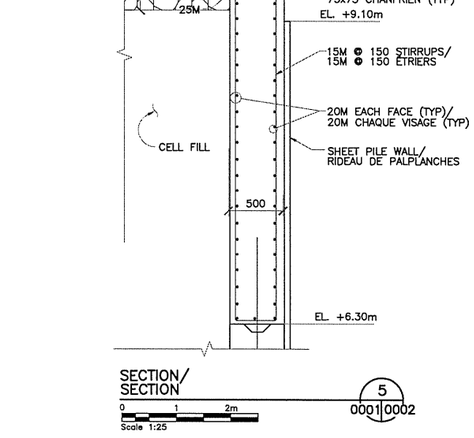

SECTION/
SECTION 3 0001,0006|0002

Scale 1:25




SECTION/
SECTION 4 0001|0002

Scale 1:25




SECTION/
SECTION 5 0001|0002

Scale 1:25

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NOT FOR CONSTRUCTION

POUR PERMIS
PAS POUR CONSTRUCTION

| ISSUE No | REV. | DATE (Y/M/D) | PURPOSE OF ISSUE | TRANSMISSION LETTER No |
|---|---|---|---|---|

ISSUE REGISTER

| ISSUE No | REV. | DATE (Y/M/D) | PURPOSE OF ISSUE | TRANSMISSION LETTER No |
|---|---|---|---|---|

ISSUE REGISTER

| No | REVISION DESCRIPTION | DATE (Y/M/D) | * | ** |
|---|---|---|---|---|
| P1 | ISSUED FOR PERMIT<br>EMIS POUR PERMIS | 2013/04/05 | | |

INITIALS: * DESIGNED ** APPROVED

REVISION REGISTER

| No | REVISION DESCRIPTION | DATE (Y/M/D) | * | ** |
|---|---|---|---|---|

INITIALS: * DESIGNED ** APPROVED

REVISION REGISTER

| No | REFERENCE DRAWINGS NUMBER |
|---|---|

PROFESSIONAL SEAL

REGISTERED PROFESSIONAL ENGINEER
PEGL
PROFESSIONAL ENGINEERS GOVERNMENT REGULATED
CHRISTOPHER M. FUDGE
LICENCE
2013-04-05
DATE
NEWFOUNDLAND & LABRADOR

SNC·LAVALIN
455, René-Lévesque Blvd. West
Montréal (Québec)
Canada H2Z 1Z3

| PREPARATION | APPROVAL |
|---|---|
| DESIGNED: C. FUDGE | PROJECT DISCIPLINE ENGINEER: N. GILLIS |
| DRAWN: T.YOUNG | CLIENT: |
| CHECKED: C. FUDGE | DATE: 2013/03/22 |
| SCALE: AS NOTED | |

CLIENT
CANADIAN ROYALTIES INC.

PROJECT
NUNAVIK NICKEL
DECEPTION BAY PORT

TITLE
CONCRETE CAP REINFORCING
DETAILS – SOUTH CELL
CAP À BÉTON COORDONNÉES
– CELLULE DU SUD

| PROJECT No | SUBDIVISION | SUBJECT | SERIAL | REV. |
|---|---|---|---|---|
| 506117 | 8000 | 42 \| D1 | 0003 | P1 |

020878A1HEN – FRAME A1 HORIZONTAL ENGLISH

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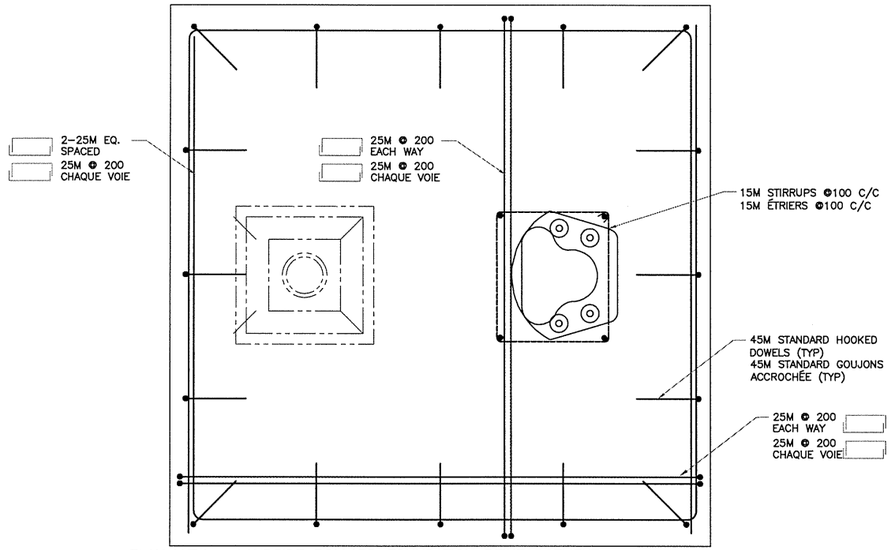
PAS POUR CONSTRUCTION

NOTE: REINFORCEMENT DETAILS SHOWN FOR MOORING STRUCTURE 1. REINFORCEMENT DETAILS FOR MOORING STRUCTURE 2, 3, & 4 SIMILAR

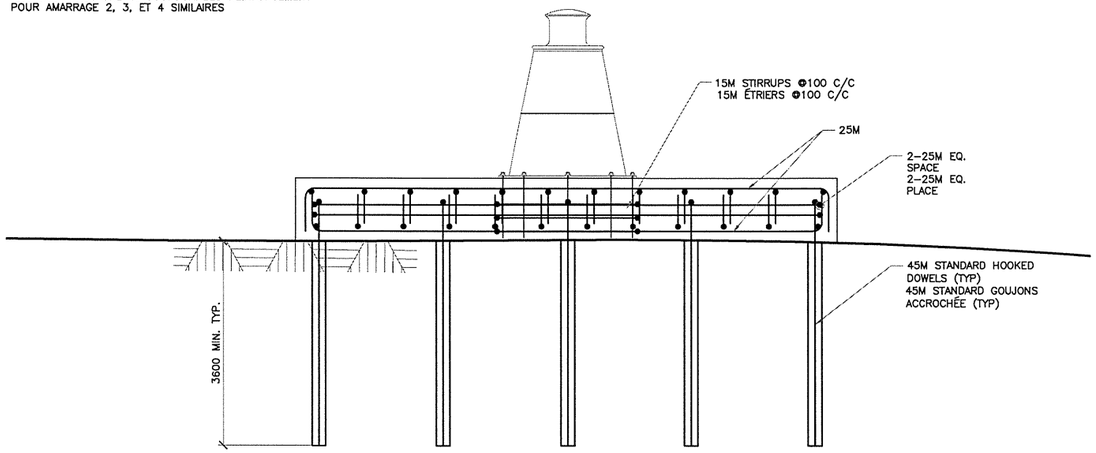
INDICATION: DÉTAILS DE RENFORCÉMENT DE MOUILLAGE ILLUSTRE STRUCTURE 1. COORDONNEES REINFORCÉMENT POUR AMARRAGE 2, 3, ET 4 SIMILAIRES




PLAN VIEW – LANDSIDE BOLLARD FOUNDATION REINFORCEMENT/
PLAN VUE – COTÉ VILLE BOLLARD FOUNDATION DE REINFORCEMENT

1
0003|0003

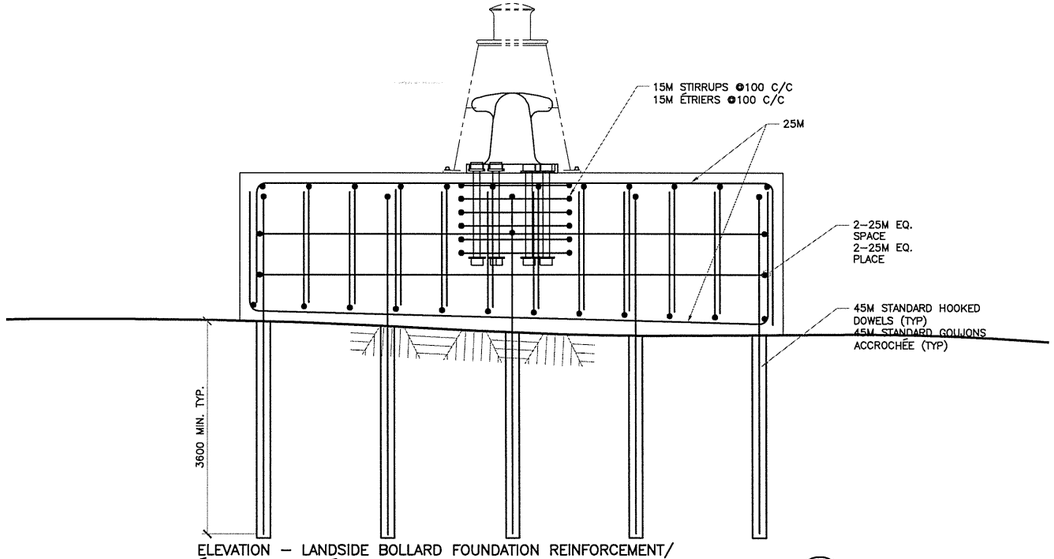
0 1 2m
Scale 1:50




ELEVATION – LANDSIDE BOLLARD FOUNDATION REINFORCEMENT/
ÉLEVATION – COTÉ VILLE BOLLARD FOUNDATION DE REINFORCEMENT

2
0003|0003

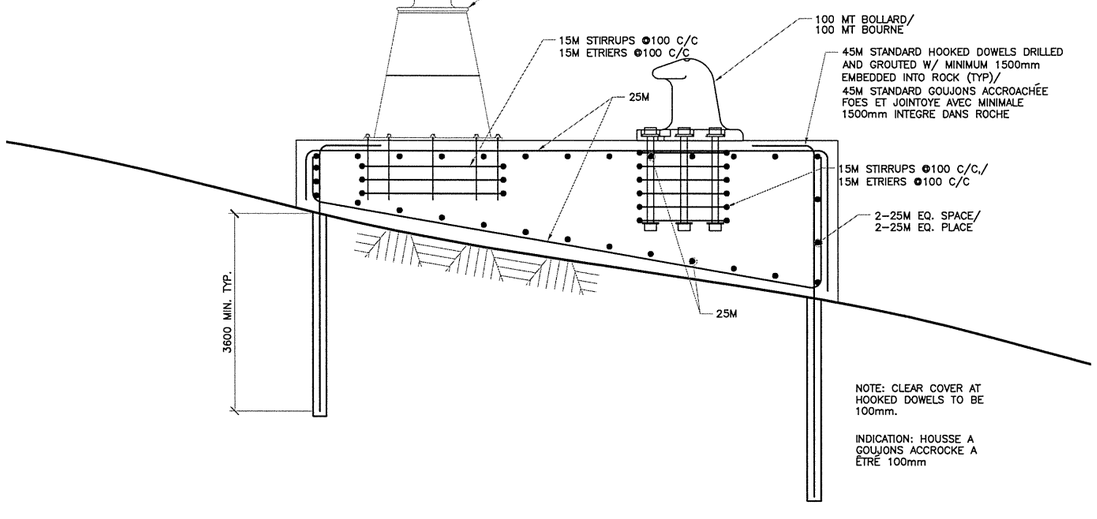
0 1 2m
Scale 1:50




ELEVATION – LANDSIDE BOLLARD FOUNDATION REINFORCEMENT/
ÉLEVATION – COTÉ VILLE BOURNE FOUNDATION DE REINFORCEMENT

3
0003|0003

0 1 2m
Scale 1:50




NOTE: CLEAR COVER AT HOOKED DOWELS TO BE 100mm.

INDICATION: HOUSSE A GOUJONS ACCROCKE A ÉTRÉ 100mm

ELEVATION – LANDSIDE BOLLARD FOUNDATION REINFORCEMENT/
ÉLEVATION – COTÉ VILLE BOLLARD FOUNDATION DE REINFORCEMENT

4
0003|0003

0 1 2m
Scale 1:50

| ISSUE No | REV. | DATE (Y/M/D) | PURPOSE OF ISSUE | TRANSMISSION LETTER No |
|---|---|---|---|---|

ISSUE REGISTER

| ISSUE No | REV. | DATE (Y/M/D) | PURPOSE OF ISSUE | TRANSMISSION LETTER No |
|---|---|---|---|---|

ISSUE REGISTER

| No | REVISION DESCRIPTION | DATE (Y/M/D) | * | ** |
|---|---|---|---|---|
| P1 | ISSUED FOR PERMIT<br>EMIS POUR PERMIS | 2013/04/05 | | |

INITIALS: * DESIGNED ** APPROVED

REVISION REGISTER

| No | REVISION DESCRIPTION | DATE (Y/M/D) | * | ** |
|---|---|---|---|---|

INITIALS: * DESIGNED ** APPROVED

REVISION REGISTER

| No | REFERENCE DRAWINGS NUMBER |
|---|---|

PROFESSIONAL SEAL

REGISTERED PROFESSIONAL ENGINEER
PEGL
CHRISTOPHER M. FUDGE
2013-04-05
DATE
NEWFOUNDLAND & LABRADOR

SNC·LAVALIN
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| PREPARATION | APPROVAL |
|---|---|
| DESIGNED<br>C. FUDGE | PROJECT DISCIPLINE ENGINEER<br>N. GILLIS |
| DRAWN<br>T. YOUNG | CLIENT |
| CHECKED<br>C. FUDGE | DATE<br>2013/03/22 |
| SCALE<br>AS NOTED | |

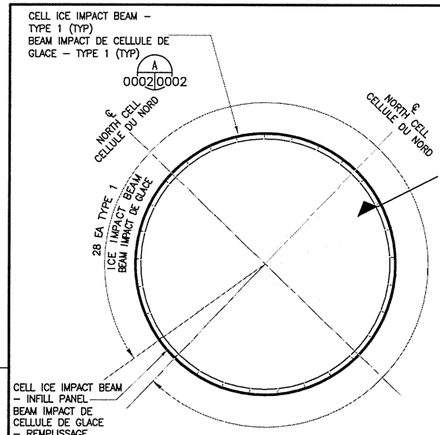
CLIENT
CANADIAN ROYALTIES INC.

PROJECT
NUNAVIK NICKEL
DECEPTION BAY PORT

TITLE
SITE 2– MOORINGS CONCRETE REINFORCING DETAILS (TYP)
SITE 2 – AMARRES BÉTON COORDONNÉES DE RENFORT

| PROJECT No | SUBDMISION | SUBJECT | SERIAL | REV. |
|---|---|---|---|---|
| 506117 | 8000 | 42 \| D1 | 0004 | P1 |

0205784THEN – FRAME A1 HORIZONTAL ENGLISH




PLAN – ICE IMPACT BEAMS/
PLAN – POUTRES D'IMPACT DE GLACE 1 0004 0004

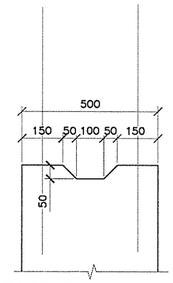
0 5 10m
Scale 1:250

## NOTES:

1. CHAMFER ALL EDGES 50mm.
2. AFTER PLACEMENT OF ICE IMPACT BEAMS AND FILLING OF CELLS, CONTRACTOR TO GROUT VOID BETWEEN SHEET PILES AND ICE IMPACT BEAMS. PREVENT BONDING OF GROUT TO SHEET PILES.

## INDICATIONS:

1. TOUS BORDS CHANFRIEN 50mm.
2. APRES LE PLACEMENT DE POUTRES D'IMPACT DE GLACE ET DE REMPLISSAGE DES CELLULES, ENTREPRENEUR AU COULIS CIDE ENTRE LES PALPLANCHES ET POUTRELLES DE LA CIE. ÉVITIER DE COLLAGE DE COULIS DE PALPLANCHES.




SHEAR KEY DETAIL/
DÉTAIL – CLE DE CISALLEMENT B 0004 0004

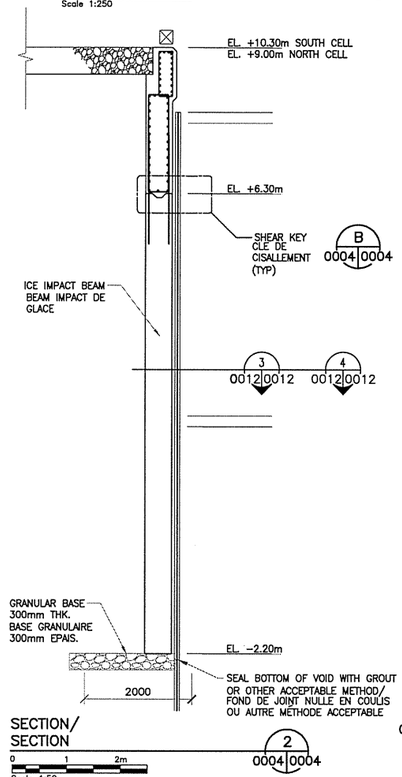
0 100 300 500mm
Scale 1:10

NOTE:

1) TYPE 1 PANELS ARE SUPPLIED BY THE OWNER. CONTRACTOR IS RESPONSIBLE FOR FABRICATION OF INFILL PANELS. CONTRACTOR IS RESPONSIBLE FOR INSTALLATION OF ALL PANELS.

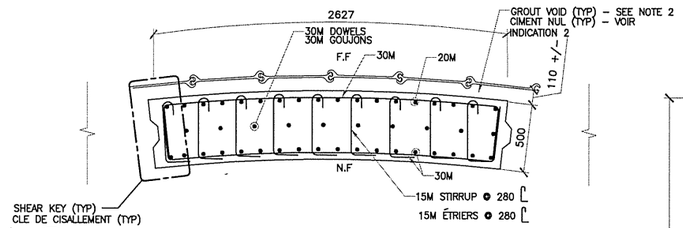
INDICATION:

1) TYPE 1 PANNEAUX SONT FOURNIS PAR LE PROPIETAIRE ENTREPRENEUR EST RESPONABLE DE FABRICATION DE PANNEAUX DE REMPLISSAGE ENTRÉPRENEUR EST RESPONSABLE DE L'INSTALLATION DE TOUS LES PANNEAUX



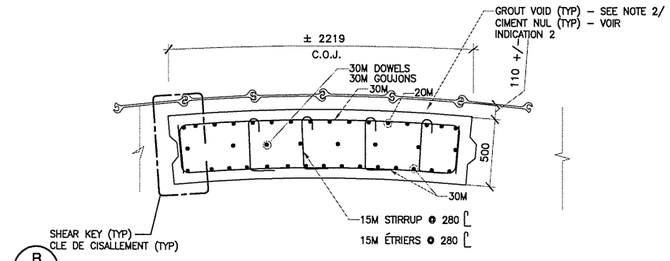

SECTION/
SECTION 2 0004 0004

0 1 2m
Scale 1:50




SECTION – TYPE 1 PANEL/
SECTION – TYPE 1 PANNEAU 3 0004 0004

0 0.5 1.0m
Scale 1:20

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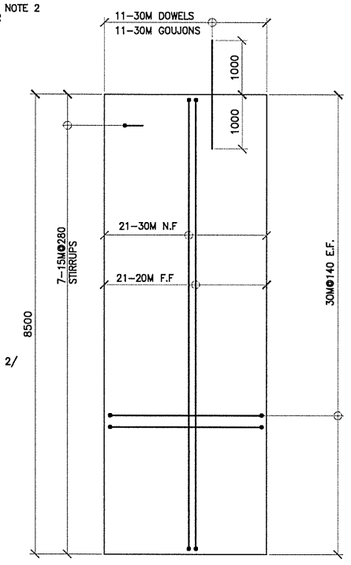


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TYPE 1 PANNEAU A 0004 0004

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| ISSUE No | REV. | DATE (Y/M/D) | PURPOSE OF ISSUE | TRANSMISSION LETTER No |
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PROFESSIONAL SEAL

NEWFOUNDLAND & LABRADOR ASSOCIATION OF PROFESSIONAL ENGINEERS
PEGL
CHRISTOPHER M. FUDGE
2013-04-05

SNC·LAVALIN
455, René-Lévesque Blvd. West
Montréal (Québec)
Canada H2Z 1Z3

| PREPARATION | APPROVAL |
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| DESIGNED<br>C. FUDGE | PROJECT DISCIPLINE ENGINEER<br>N. GILLIS |
| DRAWN<br>T.YOUNG | CLIENT |
| CHECKED<br>C.FUDGE | DATE<br>2013/03/22 |
| SCALE<br>AS NOTED | |

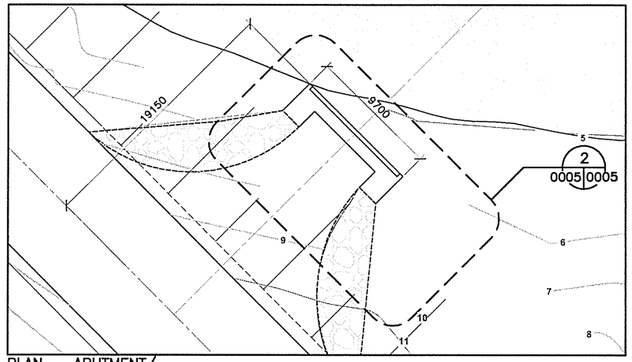
CLIENT
CANADIAN ROYALTIES INC.

PROJECT
NUNAVIK NICKEL
DECEPTION BAY PORT

TITLE
SSP CELLS– ICE IMAPCT BEAMS
SSP CELLULES –
POUTRES D'IMPACT DES GLACE

| PROJECT No | SUBDIVISION | SUBJECT | SERIAL | REV. |
|---|---|---|---|---|
| 506117 | 8000 | 42 | D1 0005 | P1 |

020878A1HEN -- FRAME A1 HORIZONTAL ENGLISH

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PLAN – CULÉE

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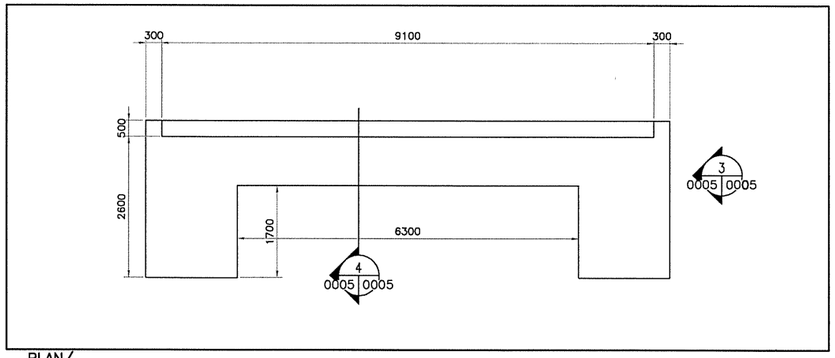


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PLAN

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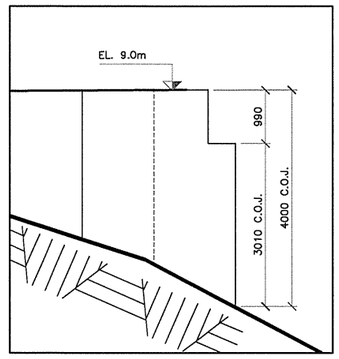


ELEVATION/
ÉLÉVATION

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0005 0005

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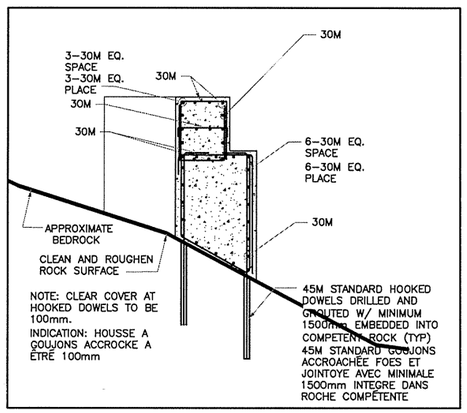


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DÉTAIL–SECTION DU REBAR

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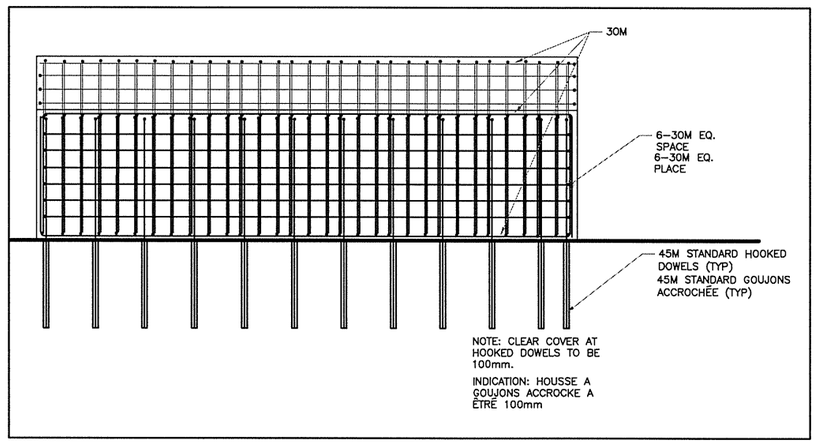


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DÉTAIL–REBAR CULÉE

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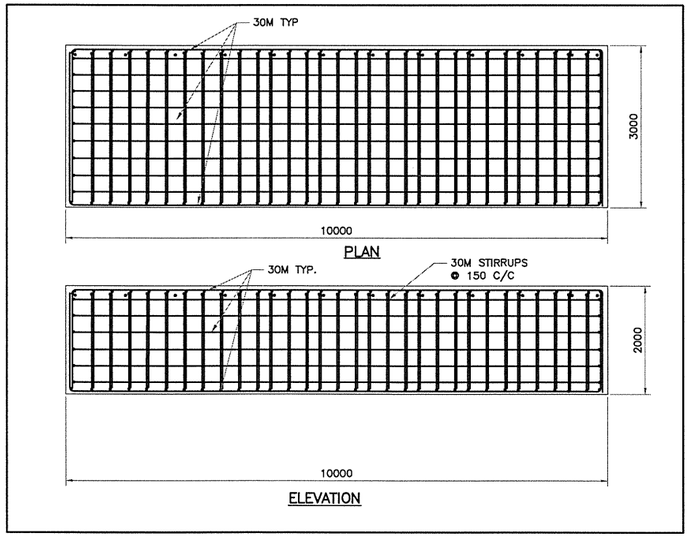


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CAP INTERMÉDAIRE PONT EN BÉTON

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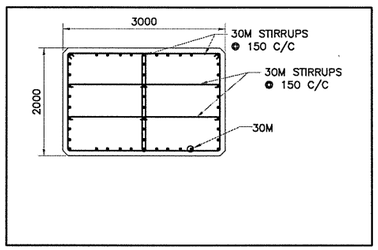


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DÉTAIL–SECTION DU REBAR–
CAP INTERMÉDAIRE PONT EN BÉTON

7
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PROFESSIONAL SEAL

REGISTERED PROFESSIONAL ENGINEER
PEGNL
Permission to Practice
and Labrador
CHRISTOPHER M. FUDGE
SIGNATURE
2013-04-05
DATE
NEWFOUNDLAND & LABRADOR

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| DRAWN: T.YOUNG | CLIENT: |
| CHECKED: C.FUDGE | DATE: 2013/03/22 |
| SCALE: AS NOTED | |

CLIENT
CANADIAN ROYALTIES INC.

PROJECT
NUNAVIK NICKEL
DECEPTION BAY PORT

TITLE
REINFORCED CONCRETE DETAILS
RENFORCES CULEÉ
EN BÉTON

| PROJECT No | SUBDIVISION | SUBJECT | SERIAL | REV. |
|---|---|---|---|---|
| 506117 | 8000 | 42_D1 | 0006 | P1 |

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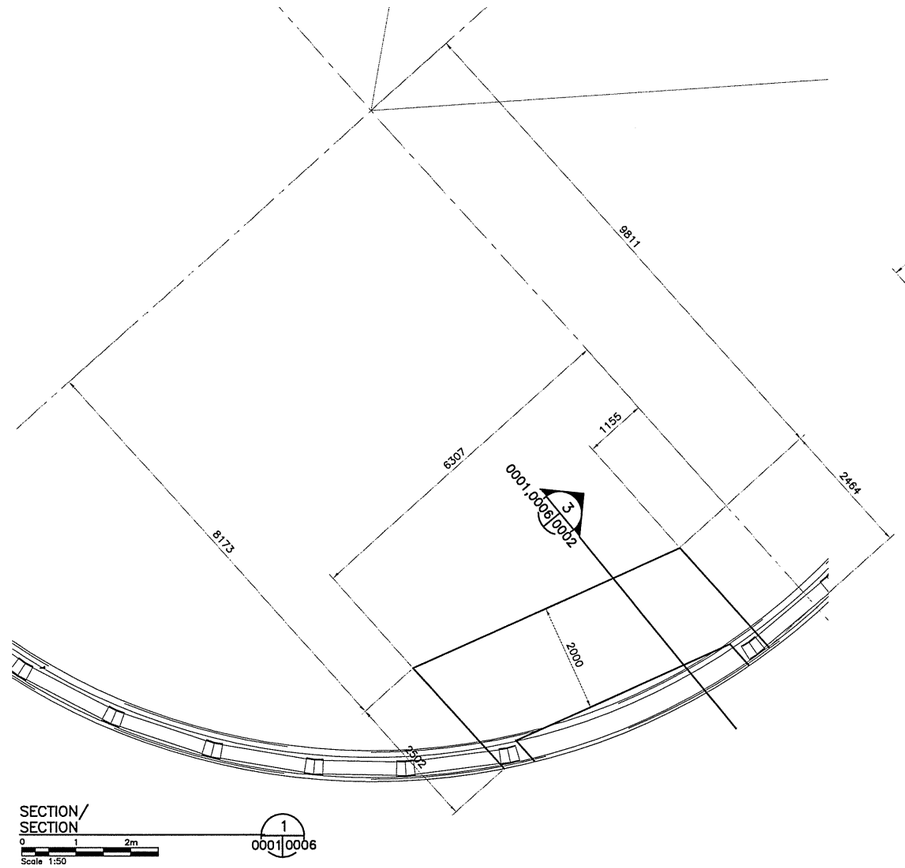


SECTION/
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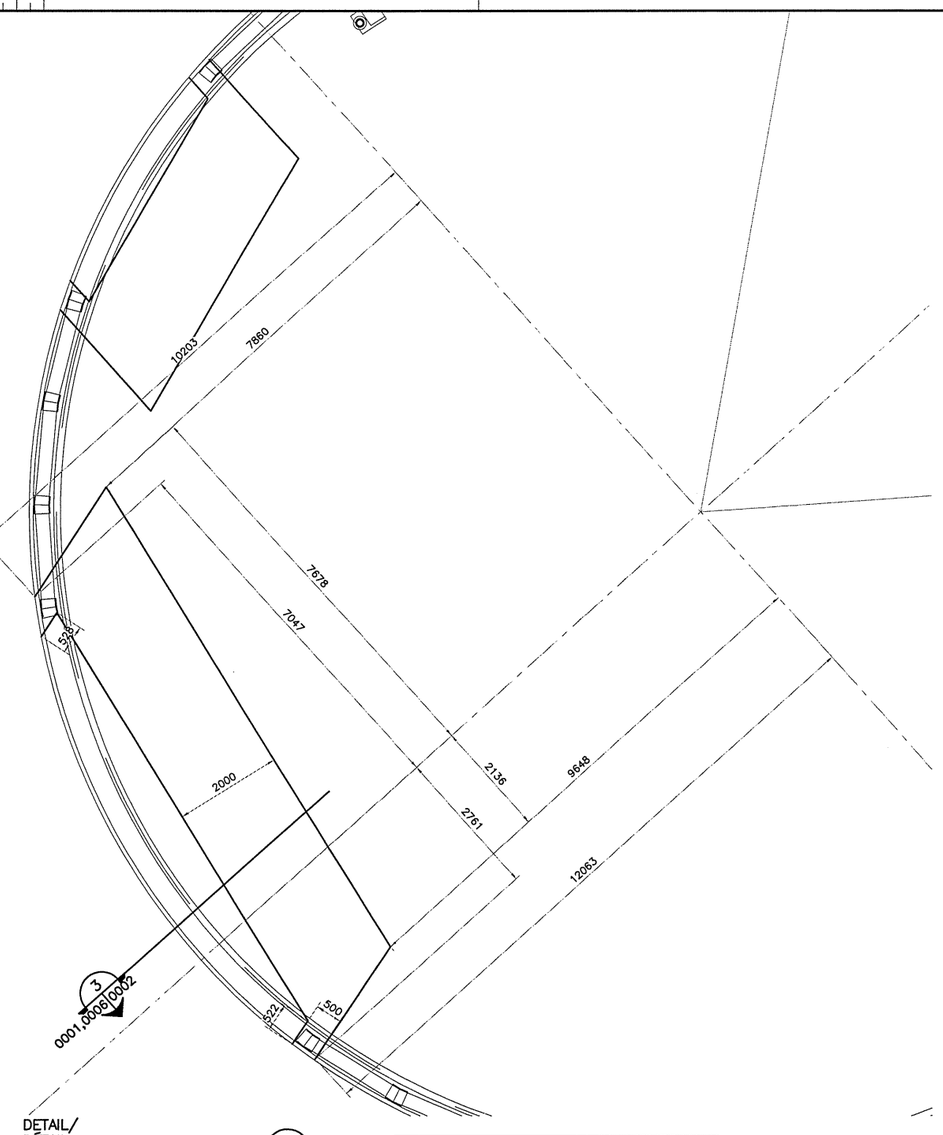


DETAIL/
DÉTAIL 2 0001|0006

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| No | REFERENCE DRAWINGS NUMBER |
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| DRAWN<br>T.YOUNG | CLIENT |
| CHECKED<br>C.FUDGE | DATE<br>2013/03/22 |
| SCALE<br>AS NOTED | |

CLIENT
CANADIAN ROYALTIES INC.

PROJECT
NUNAVIK NICKEL
DECEPTION BAY PORT

TITLE
SSP CELLS
CONCRETE ABUTMENT DETAILS
SSP CELLULES
COORDONNÉES CULÉE EN BÉTON

| PROJECT No | SUBDIVISION | SUBJECT | SERIAL | REV. |
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| 506117 | 8000 | 42 | D1 0007 | P1 |

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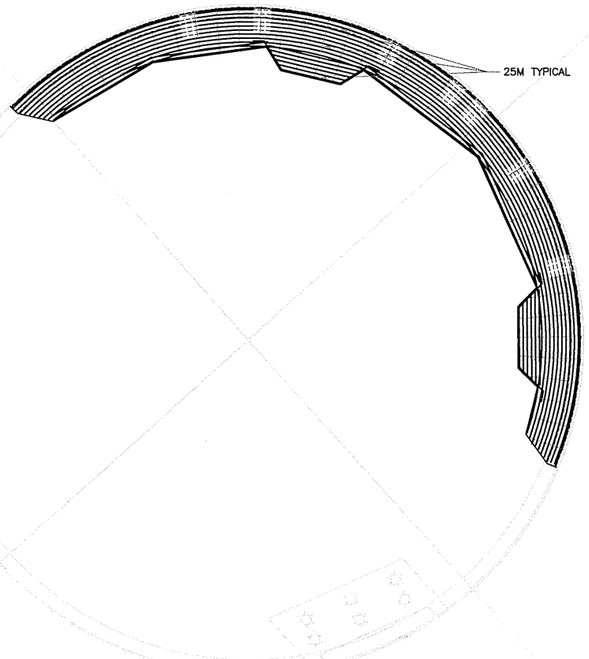


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PLAN – CELLULE DU NORD (1, 0001|0008)
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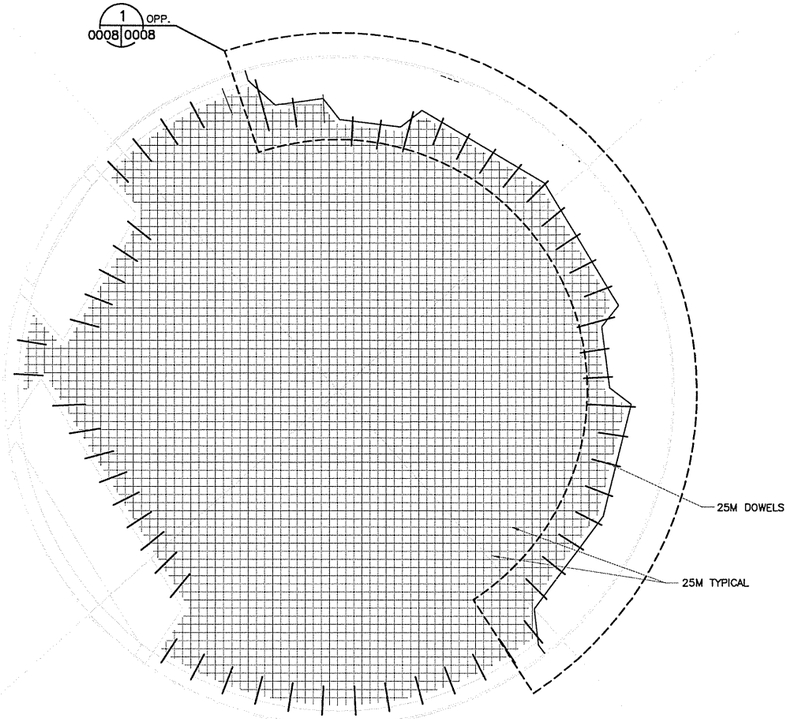


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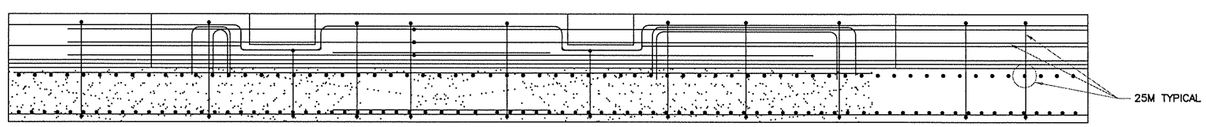


SECTION/
SECTION (3, 0001|0008)
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PAS POUR CONSTRUCTION

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ISSUE REGISTER

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

INITIALS: * DESIGNED ** APPROVED

REVISION REGISTER

| No | REFERENCE DRAWINGS NUMBER |
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PROFESSIONAL SEAL

REGISTERED PROFESSIONAL ENGINEER
PEGL
Newfoundland and Labrador
Provincial Licensing
CHRISTOPHER M. FUDGE
LICENCE
2013-04-05
DATE
NEWFOUNDLAND & LABRADOR

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455, René-Lévesque Blvd. West
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Canada H2Z 1Z3

| PREPARATION | APPROVAL |
|---|---|
| DESIGNED: C.FUDGE | PROJECT DISCIPLINE ENGINEER: N. GILLIS |
| DRAWN: T.YOUNG | CLIENT: |
| CHECKED: C.FUDGE | DATE: 2013/03/22 |
| SCALE: AS NOTED | |

CLIENT
CANADIAN ROYALTIES INC.

PROJECT
NUNAVIK NICKEL
DECEPTION BAY PORT

TITLE
SSP CELLS –
CONCRETE CAP REINFORCING
SSP CELLULES–
RENFORCEMENT COURONNEMENT EN BETON

| PROJECT No | SUBDIVISION | SUBJECT | SERIAL | REV. |
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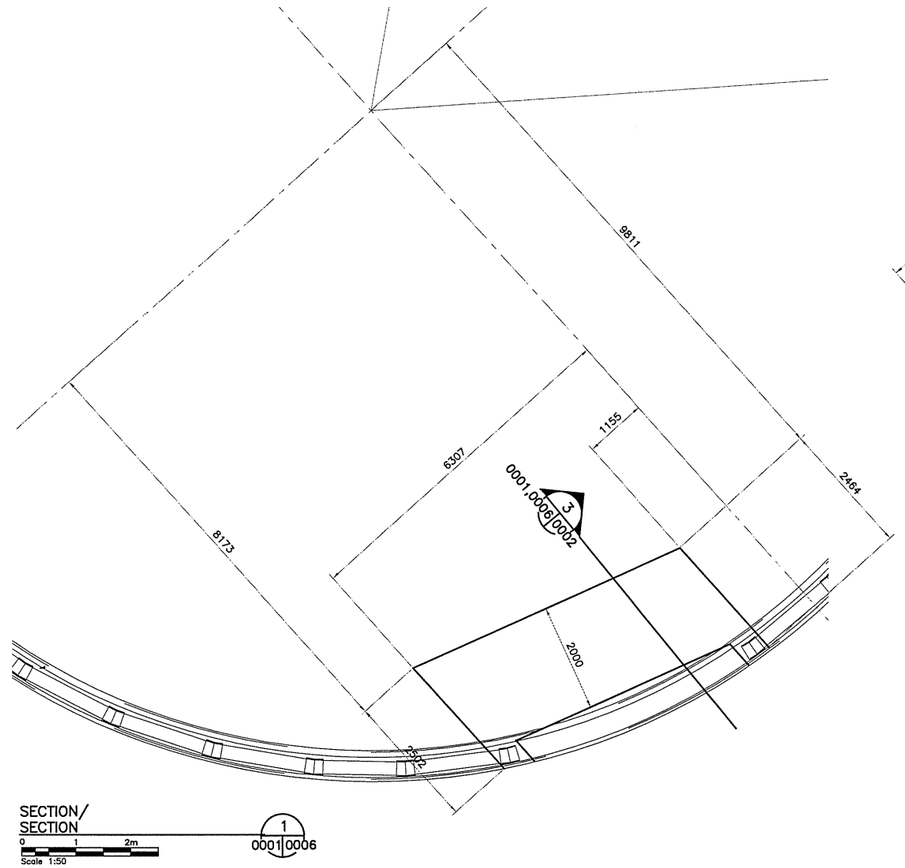
0208784IHEN – FRAME A1 HORIZONTAL ENGLISH




SECTION/
SECTION 1 0001|0006

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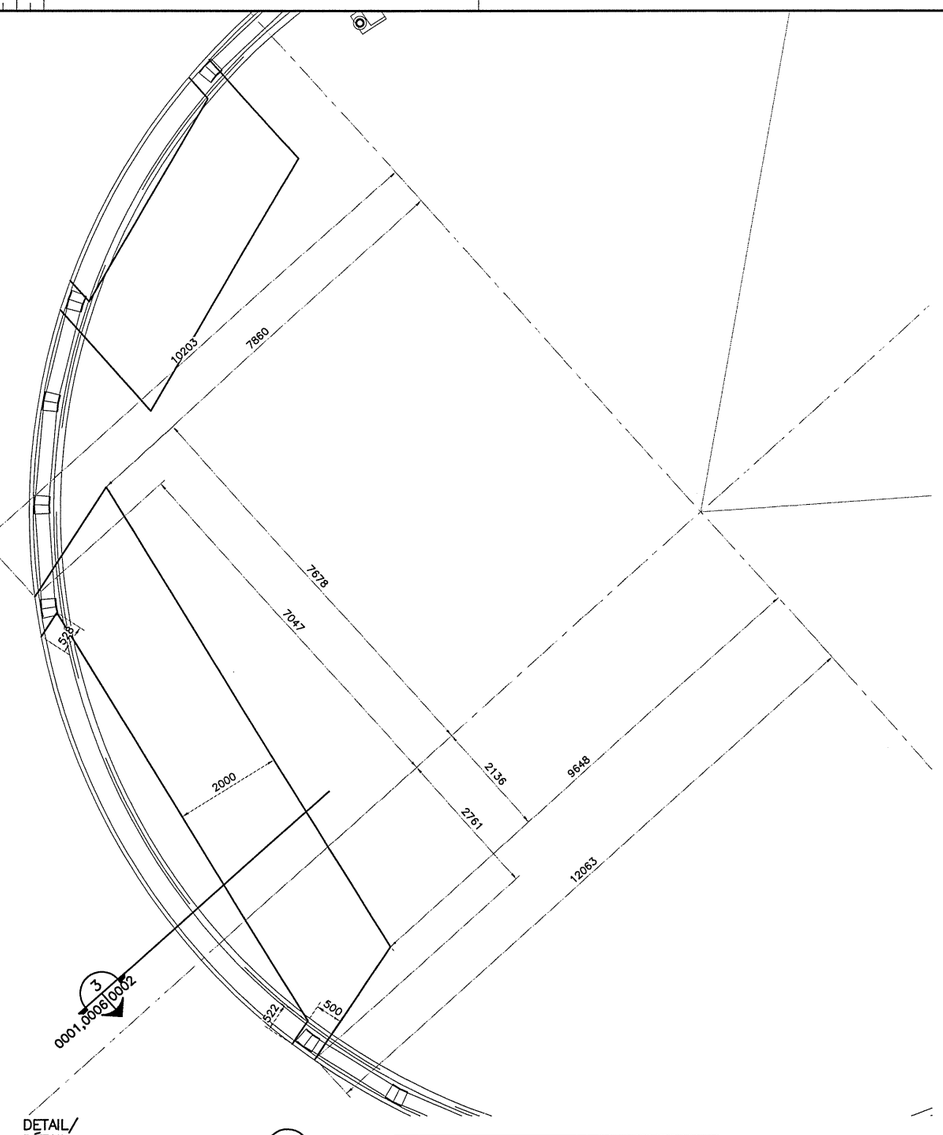


DETAIL/
DÉTAIL 2 0001|0006

0 1 2m
Scale 1:50

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| ISSUE No | REV. | DATE (Y/M/D) | PURPOSE OF ISSUE | TRANSMISSION LETTER No |
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INITIALS: * DESIGNED ** APPROVED

REVISION REGISTER

| No | REFERENCE DRAWINGS NUMBER |
|---|---|

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PROFESSIONAL ENGINEERS PEGL PROFESSIONNELS INGÉNIEURS NEWFOUNDLAND & LABRADOR CHRISTOPHER M. FUDGE 2013-04-05 DATE NEWFOUNDLAND & LABRADOR

SNC·LAVALIN
455, René-Lévesque Blvd. West
Montréal (Québec)
Canada H2Z 1Z3

| PREPARATION | APPROVAL |
|---|---|
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| DRAWN<br>T.YOUNG | CLIENT |
| CHECKED<br>C.FUDGE | DATE<br>2013/03/22 |
| SCALE<br>AS NOTED | |

CLIENT
CANADIAN ROYALTIES INC.

PROJECT
NUNAVIK NICKEL
DECEPTION BAY PORT

TITLE
SSP CELLS
CONCRETE ABUTMENT DETAILS
SSP CELLULES
COORDONNÉES CULÉE EN BÉTON

| PROJECT No | SUBDIVISION | SUBJECT | SERIAL | REV. |
|---|---|---|---|---|
| 506117 | 8000 | 42 | D1 0007 | P1 |

020878A1HEN – FRAME A1 HORIZONTAL ENGLISH

Appendix 2

Stantec Consulting Ltd.: Geotechnical Reports

Stantec Consulting Ltd.
102 – 40 Highfield Park Drive
Dartmouth NS B3A 0A3
Tel: (902) 468-7777
Fax: (902) 468-9009

# FINAL GEOTECHNICAL REPORT
## Proposed Wharf – Site 1
Deception Bay, Quebec

Report Prepared for:
Canadian Royalties Inc.

File: 121613564

Date: April 22, 2013

# Table of Contents



**LIST OF APPENDICES**

# 1.0 Introduction

At the request of Canadian Royalties Inc., Stantec Consulting Ltd. has performed a subsurface investigation for the proposed wharf at port Site 1 for the Nunavik Nickel mine in Deception Bay, Quebec. The investigation consisted of drilling a series of boreholes and air track probes at three different proposed locations and was carried out during the summers of 2011 and 2012.

An interim report containing factual data from the investigation including 49 boreholes, 21 air track probes and selective laboratory testing was submitted September 27 2012. This final report follows an extensive design collaboration with CRI, SNC Lavalin, Ultragen and contractors; it includes all data from the interim report as well as geotechnical design parameters and analysis for the wharf.

This report is specifically and solely for the project described herein and presents all of our findings.

# 2.0 Site Description

The site is located along the southwest coast of Deception Bay in Nunavik region of northern Quebec. Deception Bay is located at approximately latitude 62°08’ N and longitude 74°40’ W. The Hudson Strait is located to the north east of Deception Bay. There is an existing operational wharf structure located to the northwest of the proposed location of this wharf structure.

The general topography of the area surrounding the bay is described as low mountains with numerous bedrock outcrops observed along the northern and southern coasts of the bay.

Based on previous experience in the area and geological mapping, the principal overburden consists of marine sediments comprised of clay and silt overlying a layer of silty sand with gravel. The bedrock at the site beneath the overburden consists of Felsic and Mafic Gneiss.

# 3.0 Investigation Procedures

## 3.1 GENERAL

The field program for the 2011 investigation consisted of 17 boreholes (BH01, BH04 to BH13, BH15, BH16, BH28 to BH30, and BH32) and 13 air track holes (AT21 to AT33), which were drilled during the period of September 3 to October 2, 2011. The field program for the 2012 investigation consisted of 32 boreholes (BH101 to BH117, BH408 to BH420, BH423, and BH424) and 8 air track holes (AT118 to AT121, AT421, AT422, AT425, and AT426), which were

drilled during the period of July 18 to July 31, 2012. All work for the investigation was supervised by Stantec Consulting Ltd. personnel.

The 2011 borehole program at this location varied from the program which was initially proposed due to the identification of poor soil conditions, primarily deep soft clay, at the west side of the proposed wharf location. For this reason, some of the proposed boreholes on the west side of the site were deleted and boreholes were added to the east side.

The borehole locations for the present investigation are shown on Drawing No. 101, in Appendix C.

## 3.2 MARINE BOREHOLES

A total of 49 marine boreholes were drilled at this site. The boreholes were drilled from a spud barge using a CME 55 drill rig mounted on skids. Soil samples were recovered at close intervals using a 50 mm diameter split spoon sampler in conjunction with Standard Penetration Tests and undisturbed samples were obtained in 75 mm thin walled Shelby tubes. Bedrock was cored in HQ and NQ size. In some boreholes it was necessary to core through the overburden in order to advance through cobbles and boulders. Boreholes BH29, BH32, BH106, and BH115 had to be terminated and restarted at locations adjacent to the original location because the barge needed to be moved. A second borehole was drilled adjacent to borehole BH101 to obtain a Shelby tube (undisturbed sample) profile of the clay and silt layer.

The coordinates of the boreholes are provided in the following table:

| BH No. | Easting (m) | Northing (m) |
|---|---|---|
| BH01 | 516502.931 | 6889802.333 |
| BH04 | 516522.453 | 6889763.246 |
| BH05 | 516562.740 | 6889771.230 |
| BH06 | 516552.170 | 6889748.340 |
| BH07 | 516593.919 | 6889757.878 |
| BH08 | 516583.083 | 6889734.967 |
| BH09 | 516625.757 | 6889741.936 |
| BH10 | 516615.078 | 6889719.981 |
| BH11 | 516570.912 | 6889739.891 |
| BH12 | 516569.092 | 6889729.676 |
| BH13 | 516530.422 | 6889739.419 |
| BH15 | 516577.062 | 6889709.750 |
| BH16 | 516552.902 | 6889716.219 |
| BH28 | 516574.998 | 6889744.611 |
| BH29 | 516656.267 | 6889727.330 |
| BH29A | 516655.002 | 6889726.889 |
| BH30 | 516645.131 | 6889705.969 |
| BH32 | 516604.652 | 6889697.788 |
| BH32A | 516605.002 | 6889697.819 |

| BH No. | Easting (m) | Northing (m) |
|---|---|---|
| BH101 | 516548.038 | 6889808.704 |
| BH101A | 516547.860 | 6889808.222 |
| BH102 | 516566.333 | 6889824.013 |
| BH103 | 516561.116 | 6889789.955 |
| BH104 | 516581.530 | 6889803.838 |
| BH105 | 516580.849 | 6889761.790 |
| BH106 | 516600.405 | 6889776.857 |
| BH106A | 516601.129 | 6889776.967 |
| BH107 | 516602.473 | 6889736.048 |
| BH108 | 516619.994 | 6889750.820 |
| BH109 | 516621.983 | 6889707.620 |
| BH110 | 516640.322 | 6889723.788 |
| BH111 | 516634.517 | 6889688.555 |
| BH112 | 516653.630 | 6889703.534 |
| BH113 | 516578.561 | 6889834.470 |
| BH114 | 516594.005 | 6889813.105 |
| BH115 | 516614.063 | 6889787.521 |
| BH115A | 516613.555 | 6889787.821 |
| BH116 | 516634.954 | 6889759.121 |
| BH117 | 516535.982 | 6889791.682 |
| BH408 | 516636.639 | 6889698.715 |
| BH409 | 516665.425 | 6889692.914 |
| BH410 | 516657.671 | 6889683.015 |
| BH411 | 516687.545 | 6889677.662 |
| BH412 | 516679.500 | 6889665.100 |
| BH413 | 516715.654 | 6889655.714 |
| BH414 | 516706.068 | 6889644.016 |
| BH415 | 516737.526 | 6889638.497 |
| BH416 | 516727.217 | 6889627.448 |
| BH417 | 516758.900 | 6889621.370 |
| BH418 | 516749.580 | 6889611.530 |
| BH419 | 516713.466 | 6889621.539 |
| BH420 | 516721.718 | 6889615.140 |
| BH423 | 516649.743 | 6889669.761 |
| BH424 | 516643.474 | 6889675.419 |

## 3.3 LAND-BASED AIRTRACK PROBES

It wasn't possible to navigate the drill barge into the shallow water area and diamond drilling with sampling from the shore was not possible in the intertidal zone. Consequently, a series of air track probes were performed to estimate the elevation of the bedrock surface within the upper tidal zone on the beach. The coordinates of the air track probes are provided in the following table:

| AT No. | Easting (m) | Northing (m) |
|---|---|---|
| AT21 | 516544.940 | 6889630.340 |
| AT22 | 516575.960 | 6889650.720 |
| AT23 | 516571.940 | 6889639.750 |
| AT24 | 516562.700 | 6889622.100 |
| AT25 | 516602.100 | 6889648.330 |
| AT26 | 516589.960 | 6889631.820 |
| AT27 | 516581.980 | 6889613.740 |
| AT28 | 516635.790 | 6889633.820 |
| AT29 | 516625.910 | 6889614.600 |
| AT30 | 516619.190 | 6889597.890 |
| AT31 | 516659.140 | 6889618.640 |
| AT32 | 516650.110 | 6889607.020 |
| AT33 | 516638.210 | 6889586.540 |
| AT118 | 516677.241 | 6889603.174 |
| AT119 | 516685.623 | 6889596.160 |
| AT120 | 516665.587 | 6889593.611 |
| AT121 | 516672.814 | 6889585.955 |
| AT421 | 516686.048 | 6889584.598 |
| AT422 | 516693.464 | 6889578.811 |
| AT425 | 516614.848 | 6889638.956 |
| AT426 | 516623.128 | 6889633.086 |

## 3.4 SURVEYING

The borehole locations and elevations were surveyed by EBC personnel using a Global Positioning System (GPS). We understand from EBC that elevations are referenced to LNT (Chart) Datum and locations are referenced to Universal Transverse Mercator (UTM) (Zone 18) projection.

## 3.5 LABORATORY TESTING

All soil samples were placed in moisture-proof containers and taken to our Dartmouth laboratory for final visual assessment and laboratory classification testing. Laboratory testing included moisture content determinations, Atterberg limits, hydrometers, mini-vanes, grain size analyses and unconfined compressive strength tests on samples of the bedrock. The results of the lab testing performed are provided on the attached Borehole Records and in Appendix B.

# 4.0 Subsurface Conditions

The subsurface conditions encountered in the boreholes are described on the appended Borehole Records. A summary of the various soil strata encountered in the investigation are provided in the following paragraphs, and are outlined in the following table:

| BH No. | Ground Surface Elevation (m) | Thickness of Organic Silt to Silty SAND (m) | Thickness of Sand with Gravel (m) | Thickness of CLAY to Clayey SILT (m) | Thickness of Silty SAND with Gravel to Silty SAND (Elevation of Surface) (m) | Depth to Bedrock (Elevation) (m) |
|---|---|---|---|---|---|---|
| BH01 | -6.9 | 2.0 | - | ~17.6 | ~1.4 (-26.5) | 21.0 (-27.9) |
| BH04 | -9.0 | - | 1.3 | 10.9 | 2.8 (-21.2) | 15.0 (-24.1) |
| BH05 | -12.0 | - | 2.4 | 4.5 | 5.3 (-18.9) | 12.1 (-24.1) |
| BH06 | -9.0 | - | 2.5 | 9.5 | 1.8 (-21.0) | 13.8 (-22.8) |
| BH07 | -11.9 | 1.2 | - | 3.7 | 5.4 (-16.7) | 10.3 (-22.2) |
| BH08 | -9.7 | ~1.3 | - | 3.4 | 3.6 (-14.5) | 8.3 (-18.1) |
| BH09 | -11.6 | ~0.9 | - | ~4.7 | ~0.8 (-17.2) | 6.4 (-18.0) |
| BH10 | -7.6 | 1.4 | - | ~2.9 | ~3.9 (-12.0) | 8.2 (-15.9) |
| BH11 | -10.7 | 3.0 | - | ~2.6 | 2.4 (-16.3) | 8.0 (-18.7) |
| BH12 | -6.2 | 3.4 | - | 5.0 | 3.6 (-14.6) | 12.0 (-18.2) |
| BH13 | -6.8 | - | 4.1 | 9.2 | 1.2 (-20.1) | 14.0 (-20.8) |
| BH15 | -4.5 | 1.9 | - | 2.8 | 5.1 (-11.1) | 11.8 (-16.3) |
| BH16 | -5.3 | 1.2 | - | 8.1 | 5.1 (-14.6) | 14.4 (-19.7) |
| BH28 | -10.4 | ~1.2 | - | 3.4 | 4.0 (-15.1) | 8.7 (-19.1) |
| BH29 | -15.4 | 1.1 | - | 4.8 | >0.4 (-21.3) | - |
| BH29A | -14.7 | - | - | - | >1.4 | 6.0 (-20.7) |
| BH30 | -9.0 | 1.2 | - | 0.8 | 4.7 (-11.0) | 6.7 (-15.7) |
| BH32 | -4.5 | 1.5 | - | >2.8 | - | - |
| BH32A | -4.5 | - | - | >1.3 | 2.5 (-10.1) | 8.1 (-12.6) |
| BH101 | -12.0 | 1.5 | - | 7.3 | 5.9 (-20.8) | 14.7 (-26.7) |
| BH101A | -12.2 | 2.2 | - | 6.7 | >0.36 (-21.1) | - |
| BH102 | -17.0 | 0.2 | - | 6.1 | 4.0 (-23.3) | 10.3 (-27.3) |
| BH103 | -13.2 | 1.8 | - | 6.3 | 3.1 (-21.2) | 11.2 (-24.4) |
| BH104 | -15.1 | 3.3 | - | 4.0 | 4.3 (-22.4) | 11.6 (--26.7) |
| BH105 | -9.6 | 1.5 | - | 8.1 | 2.8 (-19.2) | 12.4 (-22.0) |
| BH106 | -13.5 | 2.4 | - | >1.9 | - | - |
| BH106A | -13.9 | - | - | - | 5.4 (-18.6) | 10.1 (-24.0) |
| BH107 | -11.9 | 0.1 | - | 1.4 | 4.2 (-13.5) | 5.7 (-17.6) |
| BH108 | -14.1 | - | - | 3.8 | 1.1 (-19.7) | 6.8 (-20.8) |
| BH109 | -6.2 | 1.7 | - | 2.6 | 4.7 (-10.4) | 8.9 (-15.1) |
| BH110 | -11.2 | 1.4 | - | 1.3 | 2.8 (-13.8) | 5.5 (-16.7) |
| BH111 | -4.6 | 2.5 | - | 0.6 | 3.6 (-7.8) | 6.7 (-11.3) |
| BH112 | -9.7 | 0.9 | - | 0.8 | 2.3 (-11.3) | 4.0 (-13.7) |

| BH No. | Ground Surface Elevation (m) | Thickness of Organic Silt to Silty SAND (m) | Thickness of Sand with Gravel (m) | Thickness of CLAY to Clayey SILT (m) | Thickness of Silty SAND with Gravel to Silty SAND (Elevation of Surface) (m) | Depth to Bedrock (Elevation) (m) |
|---|---|---|---|---|---|---|
| BH113 | -19.9 | - | - | 6.5 | 2.0 (-26.4) | 8.5 (-28.4) |
| BH114 | -19.3 | 0.9 | - | 5.3 | 4.6 (-25.6) | 10.9 (-30.1) |
| BH115 | -17.7 | 1.8 | - | 4.8 | >2.7 (-24.3) | - |
| BH115A | -17.9 | - | - | - | >2.0 | 11.0 (-28.9) |
| BH116 | -16.8 | 2.3 | - | 2.2 | 4.1 (-21.4) | 8.7 (-25.5) |
| BH117 | -9.6 | 4.2 | - | 8.2 | 4.9 (-22.0) | 17.3 (-27.0) |
| BH408 | -6.2 | 1.6 | - | 1.2 | 4.0 (-8.9) | 6.7 (-12.9) |
| BH409 | -10.2 | 1.2 | - | 1.5 | - | 2.7 (-12.9) |
| BH410 | -6.2 | 1.2 | - | 0.9 | 1.3 (-8.3) | 3.4 (-9.6) |
| BH411 | -14.3 | 1.2 | - | 4.0 | - | 5.2 (-19.5) |
| BH412 | -8.2 | 0.9 | - | - | 0.8 (-9.1) | 1.7 (-9.9) |
| BH413 | -14.6 | 4.5 | - | 7.7 | 2.1 (-26.8) | 14.3 (-28.9) |
| BH414 | -11.0 | 2.7 | - | 8.9 | - | 11.6 (-22.6) |
| BH415 | -14.4 | 0.9 | - | 11.3 | 2.1 (-26.6) | 14.3 (-28.7) |
| BH416 | -11.9 | 4.3 | - | 4.7 | 1.9 (-20.9) | 10.9 (-22.8) |
| BH417 | -13.9 | 3.0 | - | 8.4 | 1.7 (-25.3) | 13.2 (-27.0) |
| BH418 | -12.1 | 4.9 | - | 6.0 | 0.6*(-23.0) | 11.5 (-23.6) |
| BH419 | -6.7 | 7.5 | - | 4.7 | 1.0 (-18.9) | 13.2 (-19.9) |
| BH420 | -7.6 | 6.1 | - | 5.0 | 0.6 (-18.7) | 11.7 (-19.3) |
| BH423 | -3.6 | 4.1 | - | 0.2 | 0.6 (-7.9) | 5.0 (-8.5) |
| BH424 | -3.4 | 3.1 | - | 1.7 | 1.1 (-8.2) | 5.9 (-9.3) |

*Silty SAND with Gravel to Silty SAND layer inferred. Split spoon sheared off while driving.

The inferred bedrock elevations from the air track probes are summarized in the following table:

| AT # | Ground Surface Elevation (m) | Depth to Inferred Bedrock (m) | Inferred Bedrock Elevation (m) |
|---|---|---|---|
| AT22 | 2.8 | 13.9 | -11.1 |
| AT23 | 3.1 | 12.8 | -9.7 |
| AT24 | 3.7 | 7.3 | -3.6 |
| AT25 | 2.4 | 12.2 | -9.8 |
| AT26 | 3.8 | 12.8 | -9.0 |
| AT27 | 4.4 | 8.7 | -4.3 |
| AT28 | 3.2 | 10.0 | -6.8 |
| AT29 | 3.4 | 6.7 | -3.3 |
| AT30 | 5.1 | 8.1 | -3.0 |
| AT31 | 3.2 | 10.5 | -7.3 |
| AT32 | 3.9 | 6.8 | -3.0 |
| AT33 | 5.8 | 5.8 | 0.0 |
| AT118 | 3.0 | 10.5 | -7.5 |
| AT119 | 2.4 | 10.4 | -8.0 |
| AT120 | 3.6 | 11.2 | -7.6 |

| AT # | Ground Surface Elevation (m) | Depth to Inferred Bedrock (m) | Inferred Bedrock Elevation (m) |
|---|---|---|---|
| AT121 | 3.4 | 10.4 | -7.0 |
| AT421 | 2.8 | >4.3 | - |
| AT422 | 2.7 | 10.2 | -7.5 |
| AT425 | 3.3 | 11.9 | -8.6 |
| AT426 | 3.4 | 11.6 | -8.2 |

## 4.1 ORGANIC SILT TO SILTY SAND

A surficial layer, consisting predominantly of organic silt to silty sand, was encountered in the majority of the boreholes drilled for this investigation. Trace amounts of sand, gravel and shells were encountered in this layer; occasional cobbles and boulders were also encountered in some of the boreholes. The thickness of the surficial organic silt to silty sand layer ranged between 0.1 and 7.9 metres.

In boreholes BH11 and BH12 the material encountered at the seabed consisted of silty sand to sand. It should be noted that dredging operations had occurred in this area prior to the commencement of the geotechnical investigation.

In borehole BH15 a layer of sandy clay with gravel to sand with silt was encountered beneath the organic silt layer. A grain size analysis performed on a sample of this material yielded 18% gravel, 29% sand, and 53% silt and clay sized particles. The moisture content of the sample of this material was determined to be 20%.

## 4.2 SAND WITH GRAVEL

A layer of cobbles and boulders with a sand and gravel matrix was encountered in boreholes BH04, BH05, BH06, and BH13 at ground surface. Trace amounts of silt were encountered at some of the locations where samples of this material could be obtained.

## 4.3 CLAY TO CLAYEY SILT

A predominantly very soft layer of grey clay to clayey silt was encountered in all of the boreholes drilled for this investigation with the exception of borehole BH412. In some of the boreholes a firmer crust of clay was encountered at the top of the layer. Occasional sand seams were encountered at the bottom of the layer in some of the boreholes. The thickness of the clay ranged between 0.2 and 17.6 metres over the site.

Grain size analyses performed on samples of the clay layer yielded 0% gravel, 2 to 3% sand, and 97 to 98% clay and silt sized particles. Atterberg limits performed on samples of this material yielded plastic limits of 19 and 20, liquid limits of 32 and 39, resulting in plasticity indexes of 13 and 19. The average moisture content of the samples tested was determined to be 35%. The undrained shear strength of the clay was determined using pocket penetrometers

in the field and miniature lab vanes on the Shelby tube samples. The results of these tests are provided on the borehole records in Appendix A.

### 4.4 SILTY SAND WITH GRAVEL TO SILTY SAND

A layer of silty sand with gravel to silty sand was encountered below the soft clay in all of the boreholes drilled for this investigation, with the exception of boreholes BH409, BH411, and BH414. Occasional cobbles and boulders were encountered. The relative density was described as loose to dense based on the N-values obtained as part of the standard penetration testing. The thickness of this layer ranged between 0.6 and 5.9 metres.

Grain size analyses performed on samples of the silty sand with gravel to silty sand layer yielded 11 to 32% gravel, 38 to 52% sand, and 30 to 48% silt and clay sized particles. The average moisture content of the samples tested was determined to be 9%.

### 4.5 GNEISS BEDROCK

Grey Felsic Gneiss bedrock was encountered in all of the boreholes with the exception of boreholes BH415 and BH417, where grey Mafic Gneiss was encountered. Seams of Mafic Gneiss were encountered within the Felsic Gneiss in boreholes BH114, BH419, and BH420. The rock mass quality generally ranged between fractured and very sound, however there were some locations where very severely fractured bedrock was encountered. An unconfined compressive strength test performed on a sample of this bedrock yielded a strength of 129 MPa.

## 5.0 Discussion

Design of the proposed wharf for the Nunavik Nickel Mine has many geotechnical challenges including restrictions on dredging in deep soft sediments, sloping bedrock surface contributing to poor sliding stability, and high ice forces.

The overburden for the site consists of relatively thick deposits of soft organic silt and clay deposits over compact to dense silty sand with gravel. Bedrock consists of Gneiss bedrock assumed to have a relatively smooth surface based on observation of outcrops on shore.

Several design concepts have been put forth by the civil engineering designers in consultation with CRI to address the challenges at a feasible cost. The final design is comprised of two free standing circular gravity structures, connected by a bridge. Initially the wharf structures were to be concrete caissons, however; following cost estimating (by others) CRI favoured steel sheet pile cellular structures to comprise the wharf. The shore access consists of two bridge spans supported in the centre by drilled socketed piles. The proposed SSP cell locations shown on Drawing 101 have been optimized considering soil/bedrock conditions as well as navigational

constraints. The following discussion details results of geotechnical analysis for both concrete cribs and Steel Sheet Pile cells.

Values of the geotechnical parameters, used for the purposes of the analyses presented in the following sections, are presented in the following table. The values were estimated based on field and laboratory testing and engineering judgment, guided in some cases by published literature.

**Summary of Geotechnical Parameter Values Used in Analyses**

| | |
|---|---|
| **Organic Silt to Silty Sand** | |
| undrained shear strength, $C_u$ (kPa) | lumped with clay to silty clay |
| unit weight (kN/m$^3$) | lumped with clay to silty clay |
| **Clay to Silty Clay** | |
| undrained shear strength, $C_u$ (kPa) | 10 |
| unit weight (kN/m$^3$) | 18 |
| **Silty Sand with Gravel to Silty Sand** | |
| angle of internal friction (degrees) | 30 |
| unit weight (kN/m$^3$) | 19 |
| **Gneiss Bedrock** | |
| unconfined compressive strength (MPa) | 100 |
| unit weight (kN/m$^3$) | 26 |
| **Rockfill** | |
| angle of internal friction (degrees) | 40 |
| unit weight (kN/m$^3$) | 20 |

## 5.1 CONCRETE CAISSONS

For analyses, the caissons were assumed to be circular, 25 m in diameter with a top deck elevation of 9 m LNT. Subsurface profiles, based on borehole data, are attached in Appendix D, Figures 1, 2 and 3. It was assumed that the soft silt/clay stratum would be dredged down to the silty sand and gravel, and that the caissons would be founded on a crushed rock mattress.

Bearing capacity analyses were performed for the caissons using a spreadsheet developed for the purpose. The results of the bearing capacity analyses are summarized in the following table.

**Summary of Bearing Capacity Analyses Results – Concrete Caissons**

| Condition | FoS |
|---|---|
| **North Caisson** | |
| foundation at -14.5m<br>fill and scour protection at -12.5m<br>no ice loading | 2.73 |
| foundation at -14.5m<br>fill and scour protection at -12.5m<br>impact ice load = 15,000kN | 1.78 |
| foundation at -14.5m<br>fill and scour protection at -12.5m<br>thermal ice load = 7,000kN | 2.30 |

| Condition | FoS | |
|---|---|---|
| foundation at -15.0m<br>fill and scour protection at -12.5m<br>no ice loading | 3.11 | |
| foundation at -15.0m<br>fill and scour protection at -12.5m<br>impact ice load = 15,000kN | 2.20 | |
| foundation at -15.0m<br>fill and scour protection at -12.5m<br>thermal ice load = 7,000kN | 2.39 | |
| **South Caisson** | | |
| | **loader and surcharge not included** | **loader and surcharge included** |
| foundation at -14.5m<br>fill and scour protection at -12.5m<br>no ice loading | 3.67 | 3.68 |
| foundation at -14.5m<br>fill and scour protection at -12.5m<br>impact ice load = 15,000kN | 16.70 | 16.56 |
| foundation at -14.5m<br>fill and scour protection at -12.5m<br>thermal ice load = 7,000kN | 3.30 | 2.80 |
| foundation at -14.5m<br>scour protection at -12.5m<br>fill at 0m<br>no ice loading | 3.06 | |
| foundation at -14.5m<br>fill and scour protection at -12.5m<br>impact ice load = 15,000kN | >100 | |
| foundation at -14.5m<br>fill at 0m<br>scour protection at -12.5m<br>thermal ice load = 7,000kN | 2.44 | |

As can be seen from the table, adequate factors of safety were obtained for all cases, using a target value of 3.0 under dead loading, and 1.5 under live (ice) loading. In all cases, it was assumed that there will be no fill placed behind (on the landward side of) the caissons above the -12.5m scour protection elevation. For the north caisson, it was necessary to use a founding elevation of el. -15.0 m to obtain the desired factors of safety, whereas for the south caisson a founding elevation of el. -14.5m proved to be adequate.

The global slope/sliding stability of the north caisson was also checked, using Slope/W. Examples of typical caisson geometry and loading configurations are shown in Figures 1, 2 and 3 of Appendix D. Under all loading cases (thermal ice load, impact ice load, dead loads only), a factor of safety of greater than 1.5 was obtained. This being the case, it was deemed unnecessary to explicitly check the global stability of the south caisson.

## 5.2 STEEL SHEET PILE CELLS

The SSP cells would be at the same locations selected for the caissons, and were taken to be 25m diameter. The top deck of the north cell is assumed to be elevation 9 m LNT. At the designers request the deck of the south cell is to be el. 10.4 metres. Slope/W was used to check

the global stability of the cells. Examples of typical geometry and loading used in the analyses are shown in Figures 4, 5, and 6 in Appendix D. The factors of safety obtained are summarized in the following table. In all cases, the factors of safety obtained from the analyses are greater than 2.0.

**Summary of Global Slope/Sliding Stability Analyses Results – SSP Cells**

| Condition | FoS |
|---|---|
| **North SSP Cell** | |
| SSP sheets driven to -19.0m<br>scour protection at -12.5m<br>no ice loading | 2.63 |
| SSP sheets driven to -19.0m<br>scour protection at -12.5m<br>impact ice load = 15,000kN | 2.96 (sliding offshore) |
| | 6.50 (sliding toward shore) |
| SSP sheets driven to -19.0m<br>scour protection at -12.5m<br>thermal ice load = 7,000kN | 2.26 |
| **South SSP Cell** | |
| SSP sheets driven to -14.0m<br>scour protection at -12.5m<br>no ice loading | 3.05 |
| SSP sheets driven to -14.0m<br>scour protection at -12.5m<br>impact ice load = 15,000kN | 4.87 (sliding offshore) |
| | 9.34 (sliding toward shore) |
| SSP sheets driven to -14.0m<br>scour protection at -12.5m<br>thermal ice load = 7,000kN | 2.27 |

It was deemed to be unnecessary to check bearing capacity of the north cell, in that the geometric conditions and loading are the same as for the caisson option, with the exception that the founding depth is greater in the case of SSP cells which increases the factor of safety against bearing capacity failure. However, since the proposed height of the south cell was increased to 10.4 metres bearing capacity was checked. The results showed that the minimum recommended factor of safety could be achieved if the sheet piles are driven at least to elevation -14.5 metres. Therefore it is recommended that the sheet piles for the south cell should be driven to this depth. Sheet piles for the north cell should be driven to elevation -19 or lower.

## 5.3 PILES AND ROCK ANCHORS

### 5.3.1 Concrete to Rock Compression Bond Stress

The unconfined compressive strength data from previous geotechnical investigations at this site (LEQ and Golder, total of 5 tests) average $q_u$ = 116 MPa. We have assumed an unconfined compressive strength of concrete in the socket to be 35 MPa. Based on this the recommended ultimate bond stress on the walls of the socket would be 2.6 MPa. We recommend a geotechnical resistance factor of 0.4. We also recommend to add approximately 1 metre to the length of the socket to allow for possible weathered and or fractured surface material.

### 5.3.2 Tensile Capacity Socketed Piles or Rock Anchors

It is sometimes more practical to lengthen the pile rock socket to attain the tensile requirements than to drill a separate small diameter anchor. For tension within the rock socket we recommend an ultimate bond stress of 2.0 MPa; a resistance factor of 0.4 should be applied and as previously noted 1 metre of socket should be added to account for the possibility of poor quality rock. In addition to bond, piles in tension must be checked for uplift resistance from the weight of rock and soil. For this we recommend that the weight of rock within a 60 degree cone from the tip of the pile plus the vertical soil column above the rock cone should be included. The design submerged unit weight of rock and soil are recommended to be 16 kN/$m^3$ and 9 kN/$m^3$ respectively.

Allowable bond stress for anchors should be 1/30 times the unconfined compressive strength of the grout and should not to exceed 1.3 MPa.

### 5.3.3 Steel Piles Driven to Bedrock

We recommend using a design value for the unconfined compressive strength of rock not exceeding 100 MPa for the purposes of pile design. The ultimate contact stress for the rock may be taken as 500 MPa. We recommend a geotechnical resistance factor of no more than 0.4. Piles should be driven with a hammer delivering an energy of about 400 J/sq. cm. and should be provided with a cast driving shoe intended for use on rock.

For the purposes of structural design of the piles, we recommend that steel stresses be limited to 0.3 $f_y$. Structural design of the piles will likely govern.

## 6.0 Closure

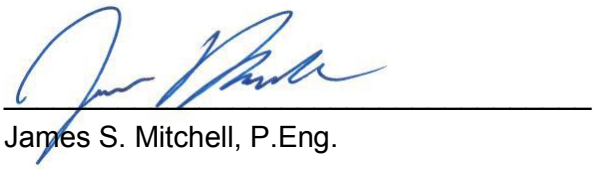
Use of this report is subject to the Statement of General Conditions provided in Appendix A. It is the responsibility of Canadian Royalties Inc., who is identified as “the Client” within the Statement of General Conditions, and its agents to review the conditions and to notify Stantec Consulting Ltd. should any of these not be satisfied. The Statement of General Conditions addresses the following:

- Use of the report
- Basis of the report
- Standard of care
- Interpretation of site conditions
- Varying or unexpected site conditions
- Planning, design or construction

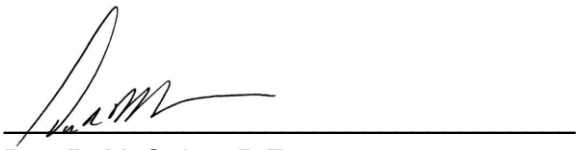
This report was prepared by James S. Mitchell, P.Eng. and Dan R. McQuinn, P.Eng. and reviewed by Brian B. Taylor, Ph.D., P.Eng. We trust that the information contained in it is adequate for your present purposes. If you have any questions about the contents of the report or if we can be of any other assistance please contact us at your convenience.

Yours very truly,

**STANTEC CONSULTING LTD.**



James S. Mitchell, P.Eng.



Dan R. McQuinn, P.Eng.

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# APPENDIX A
# Statement of General Conditions
# Symbols and Terms Used on Borehole and Test Pit Records
# Borehole Records

*STATEMENT OF GENERAL CONDITIONS*

*USE OF THIS REPORT*: This report has been prepared for the sole benefit of the Client or its agent and may not be used by any third party without the express written consent of Stantec Consulting Ltd. and the Client. Any use which a third party makes of this report is the responsibility of such third party.

*BASIS OF THE REPORT*: The information, opinions, and/or recommendations made in this report are in accordance with Stantec Consulting Ltd's present understanding of the site specific project as described by the Client. The applicability of these is restricted to the site conditions encountered at the time of the investigation or study. If the proposed site specific project differs or is modified from what is described in this report or if the site conditions are altered, this report is no longer valid unless Stantec Consulting Ltd. is requested by the Client to review and revise the report to reflect the differing or modified project specifics and/or the altered site conditions.

*STANDARD OF CARE*: Preparation of this report, and all associated work, was carried out in accordance with the normally accepted standard of care in the state or province of execution for the specific professional service provided to the Client. No other warranty is made.

*INTERPRETATION OF SITE CONDITIONS*: Soil, rock, or other material descriptions, and statements regarding their condition, made in this report are based on site conditions encountered by Stantec Consulting Ltd. at the time of the work and at the specific testing and/or sampling locations. Classifications and statements of condition have been made in accordance with normally accepted practices which are judgmental in nature; no specific description should be considered exact, but rather reflective of the anticipated material behavior. Extrapolation of in situ conditions can only be made to some limited. extent beyond the sampling or test points. The extent depends on variability of the soil, rock and groundwater conditions as influenced by geological processes, construction activity, and site use.

*VARYING OR UNEXPECTED CONDITIONS*: Should any site or subsurface conditions be encountered that are different from those described in this report or encountered at the test locations, Stantec Consulting Ltd. must be notified immediately to assess if the varying or unexpected conditions are substantial and if reassessments of the report conclusions or recommendations are required. Stantec Consulting Ltd. will not be responsible to any party for damages incurred as a result of failing to notify Stantec Consulting Ltd. that differing site or sub-surface conditions are present upon becoming aware of such conditions.

*PLANNING, DESIGN, OR CONSTRUCTION*: Development or design plans and specifications should be reviewed by Stantec Consulting Ltd., sufficiently ahead of initiating the next project stage (property acquisition, tender, construction, etc), to confirm that this report completely addresses the elaborated project specifics and that the contents of this report have been properly interpreted. Specialty quality assurance services (field observations and testing) during construction are a necessary part of the evaluation of sub-subsurface conditions and site preparation works. Site work relating to the recommendations included in this report should only be carried out in the presence of a qualified geotechnical engineer; Stantec Consulting Ltd. cannot be responsible for site work carried out without being present.

# SYMBOLS AND TERMS USED ON BOREHOLE AND TEST PIT RECORDS

## SOIL DESCRIPTION

**Terminology describing common soil genesis:**

| | |
|---|---|
| *Topsoil* | - mixture of soil and humus capable of supporting vegetative growth |
| *Peat* | - mixture of visible and invisible fragments of decayed organic matter |
| *Till* | - unstratified glacial deposit which may range from clay to boulders |
| *Fill* | - material below the surface identified as placed by humans (excluding buried services) |

**Terminology describing soil structure:**

| | |
|---|---|
| *Desiccated* | - having visible signs of weathering by oxidization of clay minerals, shrinkage cracks, etc. |
| *Fissured* | - having cracks, and hence a blocky structure |
| *Varved* | - composed of regular alternating layers of silt and clay |
| *Stratified* | - composed of alternating successions of different soil types, e.g. silt and sand |
| *Layer* | - > 75 mm in thickness |
| *Seam* | - 2 mm to 75 mm in thickness |
| *Parting* | - < 2 mm in thickness |

**Terminology describing soil types**:
The classification of soil types are made on the basis of grain size and plasticity in accordance with the Unified Soil Classification System (USCS) (ASTM D 2487 or D 2488). The classification excludes particles larger than 76 mm (3 inches). The USCS provides a group symbol (e.g. SM) and group name (e.g. silty sand) for identification.

**Terminology describing cobbles, boulders, and non-matrix materials (organic matter or debris):**
Terminology describing materials outside the USCS, (e.g. particles larger than 76 mm, visible organic matter, construction debris) is based upon the proportion of these materials present:

| | |
|---|---|
| *Trace, or occasional* | Less than 10% |
| *Some* | 10-20% |
| *Frequent* | > 20% |

**Terminology describing compactness of cohesionless soils:**
The standard terminology to describe cohesionless soils includes compactness (formerly "relative density"), as determined by the Standard Penetration Test N-Value (also known as N-Index). A relationship between compactness condition and N-Value is shown in the following table.

| Compactness Condition | SPT N-Value |
|---|---|
| *Very Loose* | <4 |
| *Loose* | 4-10 |
| *Compact* | 10-30 |
| *Dense* | 30-50 |
| *Very Dense* | >50 |

**Terminology describing consistency of cohesive soils:**
The standard terminology to describe cohesive soils includes the consistency, which is based on undrained shear strength as measured by *in situ* vane tests, penetrometer tests, or unconfined compression tests.

| Consistency | Undrained Shear Strength | |
|---|---|---|
| | kips/sq.ft. | kPa |
| *Very Soft* | <0.25 | <12.5 |
| *Soft* | 0.25 - 0.5 | 12.5 - 25 |
| *Firm* | 0.5 - 1.0 | 25 - 50 |
| *Stiff* | 1.0 - 2.0 | 50 – 100 |
| *Very Stiff* | 2.0 - 4.0 | 100 - 200 |
| *Hard* | >4.0 | >200 |

## ROCK DESCRIPTION

**Terminology describing rock quality:**

| RQD | Rock Mass Quality |
|---|---|
| 0-25 | *Very Poor, Crushed, Very Severely Fractured* |
| 25-50 | *Poor, Shattered and Very Seamy or Blocky, Severely Fractured* |
| 50-75 | *Fair, Blocky and Seamy, Fractured* |
| 75-90 | *Good, Massive, Moderately Jointed or Sound* |
| 90-100 | *Excellent, Intact, Very Sound* |

Rock quality classification is based on a modified core recovery percentage (RQD) in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be due to close shearing, jointing, faulting, or weathering in the rock mass and are not counted. RQD was originally intended to be done on NW core; however, it can be used on different core sizes if the bulk of the fractures caused by drilling stresses are easily distinguishable from *in situ* fractures. The terminology describing rock mass quality based on RQD is subjective and is underlain by the presumption that sound strong rock is of higher engineering value than fractured weak rock.

**Terminology describing rock mass:**

| Spacing (mm) | Joint Classification | Bedding, Laminations, Bands |
|---|---|---|
| > 6000 | *Extremely Wide* | - |
| 2000-6000 | *Very Wide* | *Very Thick* |
| 600-2000 | *Wide* | *Thick* |
| 200-600 | *Moderate* | *Medium* |
| 60-200 | *Close* | *Thin* |
| 20-60 | *Very Close* | *Very Thin* |
| <20 | *Extremely Close* | *Laminated* |
| <6 | - | *Thinly Laminated* |

**Terminology describing rock strength:**

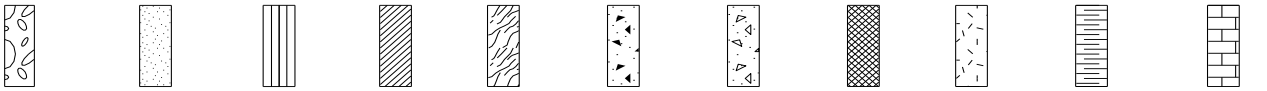
| Strength Classification | Unconfined Compressive Strength (MPa) |
|---|---|
| *Extremely Weak* | < 1 |
| *Very Weak* | 1 – 5 |
| *Weak* | 5 – 25 |
| *Medium Strong* | 25 – 50 |
| *Strong* | 50 – 100 |
| *Very Strong* | 100 – 250 |
| *Extremely Strong* | > 250 |

**Terminology describing rock weathering:**

| Term | Description |
|---|---|
| *Fresh* | No visible signs of rock weathering. Slight discolouration along major discontinuities |
| *Slightly Weathered* | Discolouration indicates weathering of rock on discontinuity surfaces. All the rock material may be discoloured. |
| *Moderately Weathered* | Less than half the rock is decomposed and/or disintegrated into soil. |
| *Highly Weathered* | More than half the rock is decomposed and/or disintegrated into soil. |
| *Completely Weathered* | All the rock material is decomposed and/or disintegrated into soil. The original mass structure is still largely intact. |

## STRATA PLOT

Strata plots symbolize the soil or bedrock description. They are combinations of the following basic symbols. The dimensions within the strata symbols are not indicative of the particle size, layer thickness, etc.



Boulders Cobbles Gravel | Sand | Silt | Clay | Organics | Asphalt | Concrete | Fill | Igneous Bedrock | Meta-morphic Bedrock | Sedi-mentary Bedrock

## SAMPLE TYPE

| | |
|---|---|
| *SS* | Split spoon sample (obtained by performing the Standard Penetration Test) |
| *ST* | Shelby tube or thin wall tube |
| *DP* | Direct-Push sample (small diameter tube sampler hydraulically advanced) |
| *PS* | Piston sample |
| *BS* | Bulk sample |
| *WS* | Wash sample |
| *HQ, NQ, BQ, etc.* | Rock core samples obtained with the use of standard size diamond coring bits. |

## WATER LEVEL MEASUREMENT

measured in standpipe, piezometer, or well

inferred

## RECOVERY

For soil samples, the recovery is recorded as the length of the soil sample recovered. For rock core, recovery is defined as the total cumulative length of all core recovered in the core barrel divided by the length drilled and is recorded as a percentage on a per run basis.

## N-VALUE

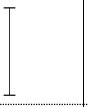
Numbers in this column are the field results of the Standard Penetration Test: the number of blows of a 140 pound (64 kg) hammer falling 30 inches (760 mm), required to drive a 2 inch (50.8 mm) O.D. split spoon sampler one foot (305 mm) into the soil. For split spoon samples where insufficient penetration was achieved and N-values cannot be presented, the number of blows are reported over sampler penetration in millimetres (e.g. 50/75). Some design methods make use of N value corrected for various factors such as overburden pressure, energy ratio, borehole diameter, etc. No corrections have been applied to the N-values presented on the log.

## DYNAMIC CONE PENETRATION TEST (DCPT)

Dynamic cone penetration tests are performed using a standard 60 degree apex cone connected to A size drill rods with the same standard fall height and weight as the Standard Penetration Test. The DCPT value is the number of blows of the hammer required to drive the cone one foot (305 mm) into the soil. The DCPT is used as a probe to assess soil variability.

## OTHER TESTS

| | |
|---|---|
| *S* | Sieve analysis |
| *H* | Hydrometer analysis |
| *k* | Laboratory permeability |
| $\gamma$ | Unit weight |
| $G_s$ | Specific gravity of soil particles |
| *CD* | Consolidated drained triaxial |
| *CU* | Consolidated undrained triaxial with pore pressure measurements |
| *UU* | Unconsolidated undrained triaxial |
| *DS* | Direct Shear |
| *C* | Consolidation |
| $Q_u$ | Unconfined compression |
| $I_p$ | Point Load Index ($I_p$ on Borehole Record equals $I_p(50)$ in which the index is corrected to a reference diameter of 50 mm) |

| | |
|---|---|
|  | Single packer permeability test; test interval from depth shown to bottom of borehole |
|  | Double packer permeability test; test interval as indicated |
|  | Falling head permeability test using casing |
|  | Falling head permeability test using well point or piezometer |

Stantec

# BOREHOLE RECORD

**BH01**

CLIENT **CANADIAN ROYALTIES INC.** PROJECT No. **121613564**

LOCATION **PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC** BH SIZE **HW**

DATES: BORING **2011/09/03 to 2011/09/04** WATER LEVEL _____ DATUM **CHART**

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | mm | | |
| 0 | -6.92 | Loose to compact black ORGANIC SILT with gravel - cobbles throughout | | | SS | 1 | 200 | 8 | |
| 1 | | | | | SS | 2 | 200 | 13 | |
| 2 | -8.90 | Very soft grey CLAY | | | SS | 3 | 600 | Wght. of Rods | |
| 3 | | | | | ST | 4 | 600 | Wght. of Rods | |
| 4 | | | | | | | | | |
| 5 | | | | | VANE | | | | |
| 6 | | | | | | | | | |
| 7 | | | | | ST | 5 | 600 | Wght. of Rods | |
| 8 | | | | | | | | | |
| 9 | | | | | SS | 6 | 600 | Wght. of Rods | |
| 10 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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MBH 9/28/12

Stantec

# BOREHOLE RECORD

BH01

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2011/09/03 to 2011/09/04

WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY mm | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| 10 | | CLAY, cont'd. | | | | | | | |
| 11 | | | | | SS | 7 | 600 | Wght. of Rods | |
| 12 | | | | | | | | | |
| 13 | | | | | ST | 8 | 650 | PUSH | |
| 14 | | | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | -increasing silt content | | | SS | 9 | 600 | Wght. of Rods | |
| 17 | | | | | | | | | |
| 18 | | | | | ST | 10 | 0 | PUSH | |
| | | | | | SS | 11 | 75 | 17 | |
| 19 | | | | | SS | 12 | 300 | 12 | |
| | -26.50 | | | | | | | | |
| 20 | | Compact grey silty SAND to silty SAND with gravel | | | SS | 13 | 50 | 18 | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH01

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2011/09/03 to 2011/09/04

WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | mm | | |
| 20 | | Silty SAND to silty SAND with gravel, cont'd. | | | | | | | |
| 21 | -27.92 | Very sound grey FELSIC GNEISS:BEDROCK<br>-150 mm Quartz seam at depth of 24.4 metres | | | NQ | 14 | 83% | RQD 83% | |
| 22 | | | | | | | | | |
| 23 | | | | | NQ | 15 | 76% | 61% | |
| | -30.42 | End of Borehole | | | | | | | |
| 24 | | | | | | | | | |
| 25 | | | | | | | | | |
| 26 | | | | | | | | | |
| 27 | | | | | | | | | |
| 28 | | | | | | | | | |
| 29 | | | | | | | | | |
| 30 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH04

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2011/09/04 WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | mm | | |
| 0 | -9.04 | COBBLES | | | | | | | |
| | | | | | SS | 1 | 50 | 8 | |
| 1 | -10.36 | | | | | | | | |
| | | Very soft grey CLAY | | | SS | 2 | 125 | 1/300mm | |
| 2 | | | | | | | | | |
| | | | | | SS | 3 | 300 | Wght. of Rods | |
| 3 | | | | | | | | | |
| | | | | | ST | 4 | 525 | Wght. of Rods | |
| 4 | | | | | | | | | |
| | | | | | SS | 5 | 600 | Wght. of Rods | |
| 5 | | | | | | | | | |
| | | | | | ST | 6 | 600 | PUSH | S |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |
| | | | | | SS | 7 | 600 | Wght. of Rods | |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |
| | | | | | ST | 8 | 600 | PUSH | |
| 10 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH04

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2011/09/04

WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | mm | | |
| 10 | | CLAY, cont'd. | | | | | | | |
| 11 | | - increasing silt content | | | | | | | |
| 12 | -21.23 | | | | SS | 9 | 450 | 14 | |
| | | Compact grey silty SAND to silty SAND with gravel | | | | | | | |
| 13 | | | | | | | | | |
| 14 | | | | | SS | 10 | 175 | 13 | |
| | -24.05 | | | | SS | 11 | 200 | 72/275mm | S |
| 15 | | Very sound grey FELSIC GNEISS:BEDROCK | | | | | | | |
| | | | | | NQ | 12 | 100% | RQD | |
| 16 | | | | | NQ | 13 | 0% | 85% 0% | |
| 17 | | | | | NQ | 14 | 100% | 65% | |
| 18 | -27.07 | | | | NQ | 15 | 100% | 54% | |
| | | End of Borehole | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH05

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2011/09/09

WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | -12.01 | | | | | | mm | | |
| 0 | | Very loose COBBLES and BOULDERS | | | | | | | |
| 1 | | | | | | | | | |
| 2 | -14.40 | | | | | | | | |
| | | Very soft grey CLAY | | | SS | 1 | 0 | Wght. of Rods | |
| 3 | | | | | | | | | |
| 4 | | | | | ST | 2 | 600 | PUSH | |
| | | | | | SS | 3 | 600 | Wght. of Rods | |
| 5 | | | | | | | | | |
| | | | | | SS | 4 | 600 | Wght. of Rods | |
| 6 | | | | | SS | 5 | 600 | Wght. of Rods | |
| | -18.87 | | | | | | | | |
| 7 | | Very loose to loose grey silty SAND to silty SAND with gravel<br>- occasional cobbles and boulders | | | SS | 6 | 275 | 37 | |
| | | | | | SS | 7 | 375 | 11 | |
| 8 | | | | | | | | | |
| | | | | | SS | 8 | 250 | 3 | |
| 9 | | | | | SS | 9 | 200 | Wght. of Rods | |
| | | | | | | | | | |
| 10 | | | | | SS | 10 | 200 | Wght. | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH05

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2011/09/09

WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY mm | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| 10 | | | | | | | | of Rods | |
| | | Silty SAND to silty SAND with gravel, cont'd. | | | SS | 11 | 200 | 8 | |
| 11 | | | | | NQ | 12 | 600 | - | |
| 12 | -24.13 | | | | NQ | 13 | 100 | - | |
| | | Severely fractured to fractured grey FELSIC GNEISS:BEDROCK | | | NQ | 14 | 94% | RQD 44% | |
| 13 | | | | | | | | | |
| 14 | -26.46 | | | | NQ | 15 | 100% | 59% | |
| | | End of Borehole | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |
| 17 | | | | | | | | | |
| 18 | | | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

App'd Sep 28 2012 8:31:18

MBH 9/28/12

Stantec

# BOREHOLE RECORD

BH06

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2011/09/12 WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY mm | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| 0 | -8.99 | BOULDERS and COBBLES -intermixed with sand and gravel | | | | | | | |
| 2 | -11.50 | Very soft grey CLAY | | | SS | 1 | 600 | Wght. of Hammer | |
| 3 | | | | | SS | 2 | 600 | Wght. of Rods | |
| 4 | | | | | ST | 3 | 600 | Wght. of Rods | |
| 5 | | | | | SS | 4 | 600 | Wght. of Rods | |
| 6 | | | | | ST | 5 | 600 | PUSH | |
| 7 | | | | | SS | 6 | 600 | Wght. of Hammer | |
| 8 | | -sand seams and increasing gravel content starting at depth of 7.9 metres | | | SS | 7 | 600 | Wght. of Hammer | |
| 9 | | | | | SS | 8 | 600 | Wght. of Hammer | |
| 10 | | | | | SS | 9 | 600 | Wght. of Hammer | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

App'd Sep 28 2012 8:31:19

MBH 9/28/12

Stantec

# BOREHOLE RECORD

BH06

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2011/09/12 WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY mm | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| 10 | | | | | | | | | |
| | | CLAY, cont'd. | | | SS | 10 | 600 | 16 | |
| | | | | | SS | 11 | 600 | 14 | |
| 11 | | | | | SS | 12 | 600 | 15 | |
| | -21.00 | | | | ST | 13 | 50 | PUSH | |
| 12 | | Compact grey silty SAND to silty SAND with gravel -occasional cobbles and boulders | | | SS | 14 | 100 | 14 | |
| | | | | | SS | 15 | 25 | 19 | |
| 13 | -22.81 | | | | SS | 16 | 150 | 53/200mm | |
| | | Severely fractured to sound grey FELSIC GNEISS:BEDROCK | | | HQ | 17 | 80% | RQD 40% | |
| 14 | | | | | HQ | 18 | 100% | 29% | |
| | | | | | HQ | 19 | 100% | 91% | |
| 15 | | | | | | | | | |
| | | | | | HQ | 20 | 100% | 86% | |
| 16 | -25.83 | | | | | | | | |
| | | End of Borehole | | | | | | | |
| 17 | | | | | | | | | |
| 18 | | | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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Stantec

# BOREHOLE RECORD

BH07

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

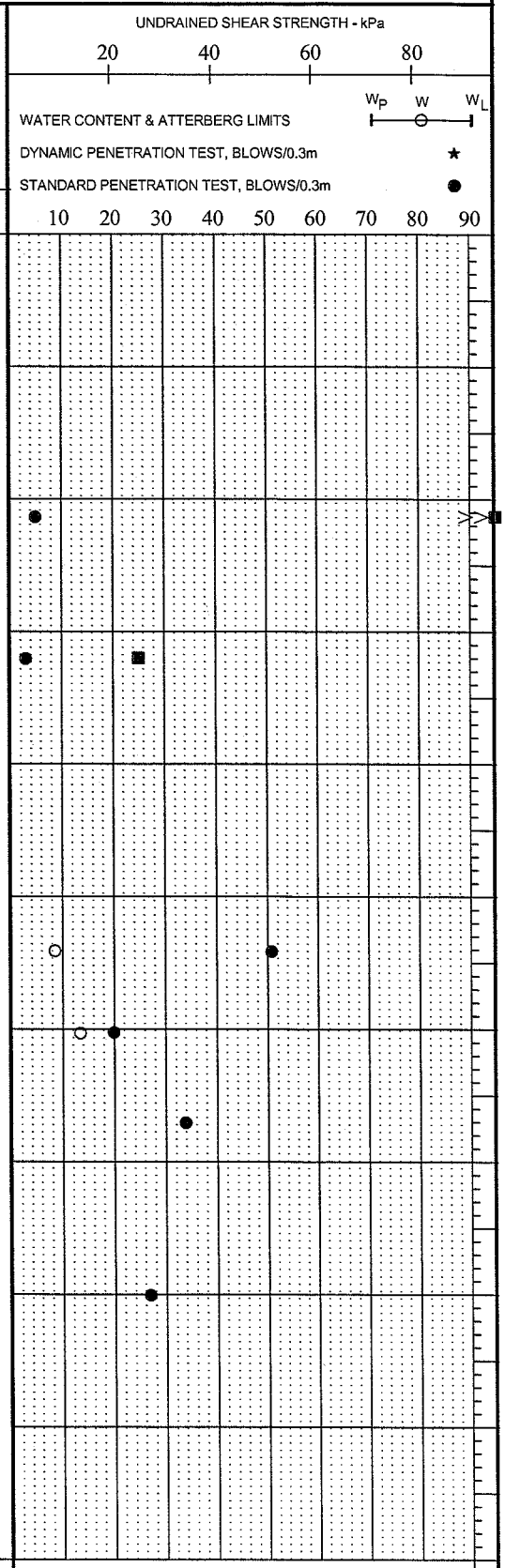
BH SIZE HW

DATES: BORING 2011/09/06

WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | -11.87 | | | | | | mm | | |
| 0 | | Very loose black ORGANIC SILT with sand<br>- shells throughout | | | SS | 1 | 250 | Wght. of Hammer | |
| 1 | -13.09 | Soft to stiff grey CLAY | | | | | | | |
| 2 | | | | | SS | 2 | 250 | 5 | |
| 3 | | | | | SS | 3 | 450 | 3 | |
| 4 | | | | | ST | 4 | 150 | PUSH | |
| | -16.75 | | | | | | | | |
| 5 | | Compact to dense grey silty SAND to silty SAND with gravel<br>- occasional cobbles and boulders | | | ST | 5 | 150 | PUSH | |
| | | | | | SS | 6 | 300 | 51 | S |
| 6 | | | | | SS | 7 | 400 | 20 | S |
| | | | | | SS | 8 | 250 | 34 | |
| 7 | | | | | HQ | 9 | 325 | - | |
| 8 | | | | | SS | 10 | 325 | 27 | |
| 9 | | | | | | | | | |
| | | | | | HQ | 11 | 175 | | |
| 10 | | | | | | | | | |

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# BOREHOLE RECORD

BH07

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2011/09/06

WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | mm | | |
| 10 | -22.16 | Silty SAND to silty SAND with gravel, cont'd. | | | HQ | 12 | 0 | - | |
| | | Fractured to sound grey FELSIC GNEISS:BEDROCK | | | NQ | 13 | 90% | RQD 65% | |
| 12 | | | | | NQ | 14 | 100% | 68% | |
| 13 | -24.90 | | | | NQ | 15 | 77% | 77% | |
| | | End of Borehole | | | | | | | |
| 14 | | | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |
| 17 | | | | | | | | | |
| 18 | | | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH08

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2011/09/07 WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | mm | | |
| 0 | -9.73 | | | | | | | | |
| | | Very loose ORGANIC SILT - shells encountered | | | SS | 1 | 50 | Wght. of Rods | |
| 1 | -11.05 | | | | | | | | |
| | | Very soft to very stiff grey CLAY | | | ST | 2 | 475 | Wght. of Rods | |
| 2 | | | | | SS | 3 | 575 | Wght. of Rods | |
| 3 | | | | | ST | 4 | 600 | Wght. of Rods | S |
| 4 | | - 50 mm sand seam encountered | | | SS | 5 | 600 | Wght. of Rods | |
| | -14.45 | | | | | | | | |
| 5 | | Compact to dense grey silty SAND to silty SAND with gravel | | | ST | 6 | 250 | PUSH | |
| | | | | | SS | 7 | 250 | 13 | |
| 6 | | | | | SS | 8 | 0 | 16 | |
| 7 | | | | | SS | 9 | 150 | 64/175mm | |
| 8 | -18.06 | | | | | | | | |
| | | Very severely fractured to severely fractured grey FELSIC GNEISS:BEDROCK | | | NQ | 10 | 97% | RQD 41% | |
| 9 | | | | | NQ | 11 | 79% | 0% | |
| 10 | | | | | NQ | 12 | 90% | 33% | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH08

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2011/09/07 WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | mm | | |
| 10 | | FELSIC GNEISS:BEDROCK, cont'd. | | | | | | | |
| 11 | | | | | NQ | 13 | 95% | 0% | |
| | -21.01 | End of Borehole | | | | | | | |
| 12 | | | | | | | | | |
| 13 | | | | | | | | | |
| 14 | | | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |
| 17 | | | | | | | | | |
| 18 | | | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH09

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2011/09/05 WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | -11.58 | | | | | | mm | | |
| 0 | | Very loose grey ORGANIC SILT<br>- trace shells | | | SS | 1 | 475 | Wght of Rods | |
| | -12.49 | | | | | | | | |
| 1 | | Very soft grey CLAY | | | | | | | |
| 2 | | | | | | | | | |
| 3 | | | | | | | | | |
| 4 | | - gravel encountered at top of Shelby Tube sample | | | ST | 2 | 300 | PUSH | |
| 5 | | | | | | | | | |
| | -17.19 | | | | | | | | |
| 6 | | Loose grey silty SAND to silty SAND with gravel | | | SS | 3 | 25 | Wght of Rods | |
| | -18.01 | | | | | | | | |
| 7 | | Fractured to sound grey FELSIC GNEISS:BEDROCK | | | HQ | 4 | 100% | RQD 62% | |
| 8 | | | | | HQ | 5 | 100% | 89% | |
| 9 | | | | | HQ | 6 | 81% | 56% | |
| | -21.26 | | | | | | | | |
| 10 | | End of Borehole | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH10

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2011/09/07 WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | -7.64 | | | | | | mm | | |
| 0 | | Loose grey ORGANIC SILT with sand<br>- shells encountered throughout<br>- occasional cobbles and boulders | | | SS | 1 | 325 | 5 | |
| 1 | -9.09 | | | | SS | 2 | 375 | 7 | |
| | | Very soft grey CLAY | | | SS | 3 | 50 | 3 | |
| 2 | | | | | | | | | |
| 3 | | | | | ST | 4 | 600 | Wgt. of Rods | |
| 4 | -11.98 | | | | ~~ST~~ | ~~5~~ | ~~0~~ | ~~PUSH~~ | |
| | | Loose to compact grey silty SAND to silty SAND with gravel | | | SS | 6 | 100 | 8 | |
| 5 | | | | | SS | 7 | 250 | 9 | |
| | | | | | SS | 8 | 125 | 50/125mm | |
| 6 | | | | | HQ | 9 | 925 | | |
| 7 | | | | | HQ | 10 | 0 | | |
| | | | | | SS | 11 | 150 | 18 | |
| 8 | -15.87 | | | | SS | 12 | 75 | 50/75mm | |
| | | Sound to very sound grey FELSIC GNEISS:BEDROCK | | | HQ | 13 | 100% | RQD 75% | |
| 9 | | | | | | | | | |
| 10 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH10

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2011/09/07 WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | mm | | |
| 10 | | FELSIC GNEISS:BEDROCK,cont'd. | | | HQ | 14 | 100% | 91% | |
| 11 | -18.84 | End of Borehole | | | | | | | |
| 12 | | | | | | | | | |
| 13 | | | | | | | | | |
| 14 | | | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |
| 17 | | | | | | | | | |
| 18 | | | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH11

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2011/09/05

WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | mm | | |
| 0 | -10.74 | Very loose grey silty SAND | | | | | | | |
| 1 | | | | | SS | 1 | 425 | Wght. of Rods | |
| 2 | | | | | ST | 2 | 0 | PUSH | |
| 3 | -13.74 | Soft to firm grey CLAY | | | SS | 3 | 325 | 2 | |
| 4 | | | | | | | | | |
| 5 | | | | | ST | 4 | 375 | PUSH | |
| 6 | -16.30 | Loose grey silty SAND to silty SAND with gravel<br>- 75 mm cobble encountered | | | NQ | 5 | 75 | | |
| 7 | | | | | | | | | |
| 8 | -18.69 | Fractured to very sound grey FELSIC GNEISS:BEDROCK<br>- 200 mm seam of soil at depth of 9.17 m | | | SS | 6 | 0 | 9 | |
| 9 | | | | | NQ | 7 | 98% | RQD 96% | |
| 10 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH11

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2011/09/05

WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | mm | | |
| 10 | | FELSIC GNEISS:BEDROCK, cont'd. | | | NQ | 8 | 100% | 65% | |
| | -21.59 | End of Borehole | | | | | | | |
| 11 | | | | | | | | | |
| 12 | | | | | | | | | |
| 13 | | | | | | | | | |
| 14 | | | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |
| 17 | | | | | | | | | |
| 18 | | | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH12

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2011/09/05 WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | -6.19 | | | | | | mm | | |
| 0 | | Very loose to compact black SAND<br>- trace organic silt<br>- shells throughout | | | SS | 1 | 150 | Wght. of Rods | |
| 1 | | | | | SS | 2 | 200 | 13 | |
| 2 | -8.50 | | | | SS | 3 | 250 | 5 | |
| | | Soft to stiff grey CLAY | | | | | | | |
| 3 | | | | | SS | 4 | 225 | 2 | |
| 4 | | | | | | | | | |
| | | | | | ST | 5 | 525 | Wght. of Rods | |
| 5 | | | | | | | | | |
| | | | | | SS | 6 | 600 | Wght. of Rods | |
| 6 | | | | | | | | | |
| 7 | | | | | ST | 7 | 525 | PUSH | |
| | | | | | SS | 8 | 600 | Wght. of Rods | |
| 8 | -14.57 | | | | | | | | |
| | | Compact grey silty SAND to silty SAND with gravel<br>- cobbles and boulders throughout | | | ~~ST~~ SS | ~~9~~ 10 | ~~0~~ 250 | ~~PUSH~~ 54 | |
| 9 | | | | | SS | 11 | 250 | 15 | |
| | | | | | ~~SS~~ | ~~12~~ | ~~50~~ | ~~50/50mm~~ | |
| 10 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH12

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2011/09/05

WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | mm | | |
| 10 | | Silty SAND to silty SAND with gravel, cont'd. | | | NQ | 13 | 575 | - | |
| 11 | | | | | NQ | 14 | 0 | - | |
| 12 | -18.15 | Severely fractured to very sound grey FELSIC GNEISS:BEDROCK | | | HQ | 15 | 100% | RQD 93% | |
| 13 | | | | | | | | | |
| 14 | -20.97 | | | | HQ | 16 | 100% | 34% | |
| 15 | | End of Borehole | | | | | | | |
| 16 | | | | | | | | | |
| 17 | | | | | | | | | |
| 18 | | | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH13

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

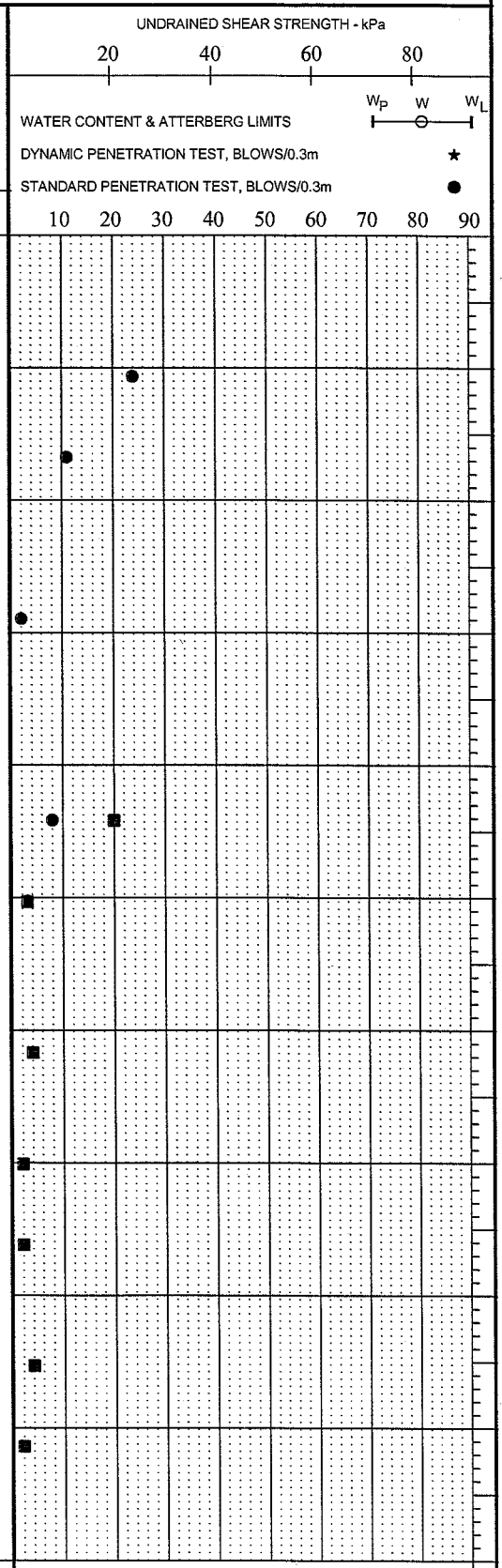
BH SIZE HW

DATES: BORING 2011/09/09 to 2011/09/10

WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | mm | | |
| 0 | -6.81 | Loose to compact grey SAND and GRAVEL<br>-boulders and cobbles throughout<br>-trace silt | | | SS | 1 | 50 | Wght. of Rods | |
| 1 | | | | | SS | 2 | 75 | 24 | |
| 2 | | | | | SS | 3 | 150 | 11 | |
| | | | | | SS | 4 | 0 | Wght. of Hammer | |
| 3 | | | | | SS | 5 | 50 | 2 | |
| | | - 900 mm boulder at depth of 3.2 metres | | | | | | | |
| 4 | -10.92 | Very soft grey CLAY | | | SS | 6 | 600 | 8 | |
| 5 | | | | | SS | 7 | 350 | 3 | |
| 6 | | | | | SS | 8 | 275 | PUSH | |
| 7 | | | | | ST | 9 | 600 | PUSH | |
| | | | | | SS | 10 | 600 | Wght. of Rods | |
| 8 | | | | | SS | 11 | 600 | Wght. of Hammer | |
| 9 | | | | | SS | 12 | 600 | Wght. of Hammer | |
| 10 | | | | | | | | | |

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# BOREHOLE RECORD

BH13

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2011/09/09 to 2011/09/10 WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | mm | | |
| 10 | | CLAY, cont'd. | | | SS | 13 | 600 | Wght. of Hammer | |
| 11 | | | | | SS | 14 | 600 | Wght. of Hammer | |
| 12 | | | | | SS | 15 | 600 | Wght. of Hammer | |
| 13 | | | | | SS | 16 | 600 | Wght. of Hammer | |
| | -20.07 | Compact grey silty SAND to silty SAND with gravel | | | SS | 17 | 175 | 12 | |
| 14 | -20.86 | | | | SS | 18 | 125 | 50/25mm | |
| | | Very severely fractured to sound grey FELSIC GNEISS:BEDROCK | | | HQ | 19 | 43% | RQD 0% | |
| 15 | | | | | HQ | 20 | 100% | 72% | |
| 16 | | | | | HQ | 21 | 57% | 57% | |
| 17 | -24.06 | | | | | | | | |
| | | End of Borehole | | | | | | | |
| 18 | | | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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MBH 9/28/12

Stantec

# BOREHOLE RECORD

BH15

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

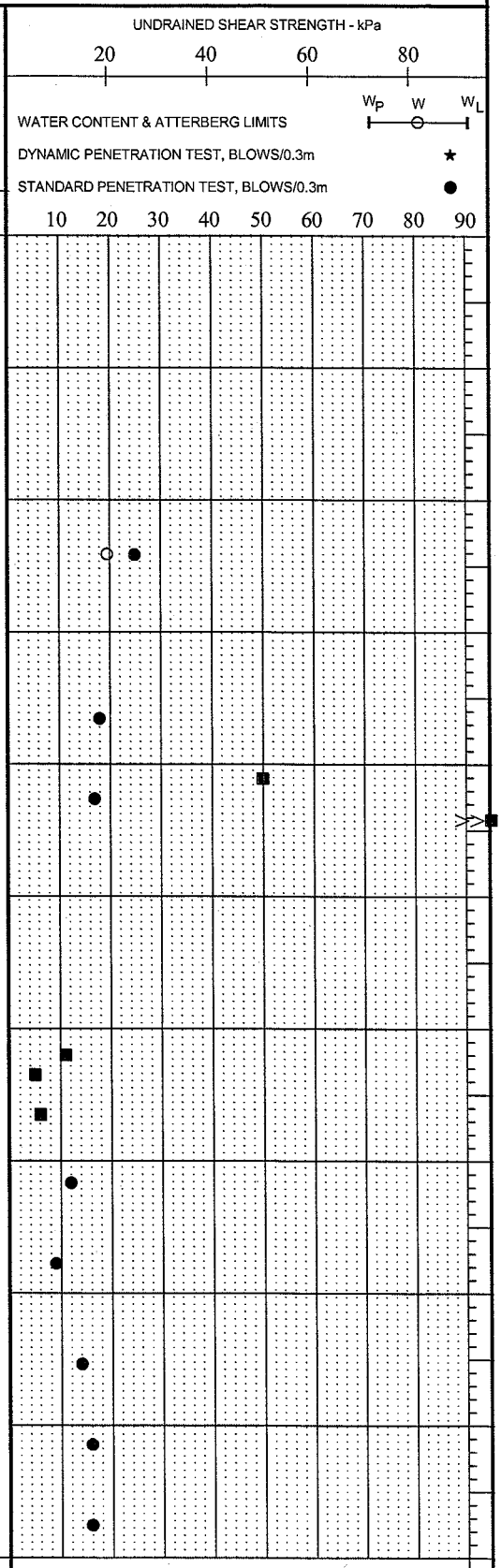
BH SIZE HW

DATES: BORING 2011/09/08

WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY mm | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| 0 | -4.50 | Very loose black ORGANIC SILT | | | SS | 1 | 25 | 1/300mm | |
| 1 | | | | | SS | 2 | 25 | Wght. of Hammer | |
| 2 | -6.41 | Compact grey sandy CLAY with gravel - shells throughout | | | SS | 3 | 225 | Wght. of Rods | |
| 3 | | | | | SS | 4 | 450 | 25 | S |
| 4 | -8.31 | Very soft grey CLAY | | | SS | 5 | 350 | 50/125mm | |
| 5 | | | | | SS | 6 | 400 | 18 | |
| 6 | -11.15 | | | | SS | 7 | 300 | 17 | |
| 7 | | Very loose to compact grey silty SAND to silty SAND with gravel - occasional cobbles and boulders | | | SS | 8 | 150 | Wght. of Rods | |
| 8 | | | | | ST | 9 | 500 | PUSH | |
| 9 | | | | | SS | 10 | 600 | Wght. of Rods | |
| 10 | | | | | SS | 11 | 300 | 12 | |
| | | | | | SS | 12 | 300 | 9 | |
| | | | | | SS | 13 | 150 | 14 | |
| | | | | | SS | 14 | 175 | 16 | |
| | | | | | SS | 15 | 200 | 16 | |

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# BOREHOLE RECORD

BH15

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2011/09/08

WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | mm | | |
| 10 | | Silty SAND to silty SAND with gravel, cont'd. | | | SS | 16 | 100 | Wght. of Rods | |
| | | | | | NQ | 17 | 150 | - | |
| 11 | | | | | SS | 18 | 150 | 19 | |
| | -16.29 | | | | SS | 19 | 200 | 50/50mm | |
| 12 | | Severely fractured to sound grey FELSIC GNEISS:BEDROCK | | | NQ | 20 | 80% | RQD 29% | |
| 13 | | | | | NQ | 21 | 90% | 73% | |
| 14 | | | | | NQ | 22 | 100% | 69% | |
| 15 | -19.69 | | | | | | | | |
| | | End of Borehole | | | | | | | |
| 16 | | | | | | | | | |
| 17 | | | | | | | | | |
| 18 | | | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH16

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2011/09/14 WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY mm | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| 0 | -5.31 | Very loose ORGANIC SILT<br>- trace sand and gravel<br>- shells throughout | | | SS | 1 | 50 | Wght. of Rods | |
| 1 | -6.48 | | | | SS | 2 | 300 | Wght. of Rods | |
| | | Firm grey CLAY | | | SS | 3 | 500 | 6 | |
| 2 | -7.62 | | | | SS | 4 | 575 | 3 | |
| | | Very soft grey CLAY<br>- sand and trace gravel seams throughout | | | SS | 5 | 600 | Wght. of Rods | |
| 3 | | | | | SS | 6 | 600 | Wght. of Hammer | |
| 4 | | | | | SS | 7 | 600 | Wght. of Rods | |
| | | | | | SS | 8 | 325 | Wght. of Hammer | |
| 5 | | | | | | | | | |
| 6 | | | | | SS | 9 | 600 | Wght. of Hammer | |
| | | | | | SS | 10 | 600 | Wght. of Hammer | |
| 7 | | | | | | | | | |
| 8 | | | | | SS | 11 | 600 | Wght. of Rods | |
| | | | | | SS | 12 | 550 | Wght. of Hammer | |
| 9 | -14.56 | | | | ~~SS~~ | ~~13~~ | ~~50~~ | ~~50/50mm~~ | |
| | | Very dense silty SAND to silty SAND with gravel<br>- numerous cobbles and | | | | | | | |
| 10 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH16

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2011/09/14 WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY mm | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| 10 | | boulders throughout<br>Silty SAND to silty SAND with gravel, cont'd.<br>- numerous cobbles and boulders spaced approximately 150 mm apart | | | HQ | 14 | 1150 | | |
| 11 | | | | | | | | | |
| 12 | | | | | | | | | |
| 13 | | | | | HQ | 15 | 925 | | |
| 14 | -19.69 | | | | | | | | |
| 15 | | Fractured moderately weathered grey FELSIC GNEISS:BEDROCK<br>- iron staining throughout | | | HQ | 16 | 92% | RQD 53% | |
| 16 | -21.87 | | | | | | | | |
| 17 | | End of Borehole | | | | | | | |
| 18 | | | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH28

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2011/09/08 WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | mm | | |
| 0 | -10.41 | Very loose grey to brown ORGANIC SILT | | | | | | | |
| 1 | -11.63 | Very soft to stiff grey CLAY | | | SS | 1 | 300 | 14 | |
| 2 | | | | | ST | 2 | 325 | PUSH | |
| 3 | | | | | SS | 3 | 300 | 8 | |
| 4 | -15.06 | | | | SS | 4 | 425 | 6 | |
| 5 | | Very loose to compact grey silty SAND to silty SAND with gravel | | | SS | 5 | 600 | 4 | |
| 6 | | | | | ST | 6 | 600 | PUSH | |
| 7 | | | | | SS | 7 | 200 | 22 | |
| 8 | -18.79 | | | | SS | 8 | 100 | 3 | |
| 9 | | Very severely fractured to sound, moderately weathered FELSIC GNEISS:BEDROCK - iron staining observed throughout | | | SS | 9 | 400 | 3 | |
| 10 | | | | | SS | 10 | 100 | 50/125mm | |
| | | | | | HQ | 11 | 95% | RQD 66% | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH28

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2011/09/08 WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | mm | | |
| 10 | | FELSIC GNEISS:BEDROCK, cont'd. | | | HQ | 12 | 100% | 0% | |
| | -21.36 | | | | | | | | |
| 11 | | End of Borehole | | | | | | | |
| 12 | | | | | | | | | |
| 13 | | | | | | | | | |
| 14 | | | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |
| 17 | | | | | | | | | |
| 18 | | | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH29

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2011/09/13 WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | -15.44 | | | | | | mm | | |
| 0 | | Very loose grey to black ORGANIC SILT<br>- trace sand<br>- shells throughout | | | | | | | |
| 1 | -16.53 | | | | SS | 1 | 450 | Wght. of Hammer | |
| | | Very soft grey CLAY | | | SS | 2 | 150 | Wght. of Hammer | |
| 2 | | | | | | | | | |
| | | | | | ST | 3 | 575 | Wght. of Rods | |
| 3 | | | | | SS | 4 | 600 | Wght. of Rods | |
| 4 | | | | | | | | | |
| | | | | | SS | 5 | 600 | Wght. of Rods | |
| 5 | | | | | SS | 6 | 600 | Wght. of Rods | |
| | -21.33 | | | | ST | 7 | 200 | PUSH | |
| 6 | -21.69 | Compact grey GRAVEL with sand | | | SS | 8 | 75 | 60/200mm | |
| | | End of Borehole<br>- hole terminated because barge needed to be moved | | | | | | | |
| 7 | | | | | | | | | |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |
| 10 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH29A

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2011/09/13 WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | -14.66 | | | | | | mm | | |
| 0 | | Advanced casing to start Borehole again | | | | | | | |
| 1 | | | | | | | | | |
| 2 | | | | | | | | | |
| 3 | | | | | | | | | |
| 4 | -19.33 | | | | | | | | |
| 5 | | COBBLES and BOULDERS - silty sand matrix | | | HQ | 1 | 550 | - | |
| 6 | -20.68 | | | | HQ | 2 | 100% | RQD 84% | |
| 7 | | Severely fractured to sound moderately weathered grey FELSIC GNEISS:BEDROCK - iron staining throughout | | | HQ | 3 | 100% | 42% | |
| 8 | -23.19 | | | | | | | | |
| 9 | | End of Borehole | | | | | | | |
| 10 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

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Stantec

# BOREHOLE RECORD

BH30

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2011/09/13

WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | -8.97 | | | | | | mm | | |
| 0 | | Very loose black ORGANIC SILT<br>- shells throughout | | | SS | 1 | 300 | 1 | |
| 1 | -10.21 | | | | SS | 2 | 325 | 2 | |
| | | Very soft grey CLAY | | | ST | 3 | 250 | PUSH | |
| 2 | -10.98 | | | | | | | | |
| | | Loose to compact grey silty SAND to silty SAND with gravel | | | SS | 4 | 250 | 11 | |
| 3 | | | | | SS | 5 | 150 | 12 | |
| | | | | | SS | 6 | 300 | 21 | |
| 4 | | | | | SS | 7 | 75 | 15 | |
| 5 | | | | | SS | 8 | 375 | 11 | |
| | | | | | SS | 9 | 125 | 8 | |
| 6 | | | | | SS | 10 | 400 | 8 | |
| | -15.68 | | | | | | | | |
| 7 | | Very severely fractured to very sound grey FELSIC GNEISS:BEDROCK | | | HQ | 11 | 97% | RQD 0% | |
| 8 | | | | | HQ | 12 | 100% | 80% | |
| 9 | | | | | HQ | 13 | 100% | 100% | |
| | -18.93 | End of Borehole | | | | | | | |
| 10 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

App'd Sep 28 2012 8:31:28

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Stantec

# BOREHOLE RECORD

BH32

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2011/09/14 WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | -4.47 | | | | | | mm | | |
| 0 | | Loose black ORGANIC SILT<br>- trace shells and wood | | | SS | 1 | 325 | 7 | |
| 1 | | | | | SS | 2 | 550 | 6 | |
| | -5.92 | | | | | | | | |
| | | Firm grey CLAY<br>- trace gravel<br>- trace shells | | | ~~ST~~ | ~~3~~ | ~~0~~ | ~~PUSH~~ | |
| 2 | | | | | SS | 4 | 0 | Wght. of Rods | |
| | | - 300 mm boulder encountered at depth of 2.6 metres | | | | | | | |
| 3 | | | | | SS | 5 | 250 | 7 | |
| | -8.51 | | | | | | | | |
| 4 | | | | | SS | 6 | 600 | 3 | |
| | -8.74 | Very soft grey CLAY | | | | | | | |
| | | End of Borehole<br>- barge needed to be moved as low tide was approaching | | | | | | | |
| 5 | | | | | | | | | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |
| 10 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH32A

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2011/09/14 WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | mm | | |
| 0 | -4.47 | Advanced casing to start borehole again | | | | | | | |
| 4 | -8.79 | | | | | | | | |
| 5 | | Very soft grey CLAY<br>- sand seams encountered | | | SS | 1 | 25 | Wght. of Hammer | |
| | | | | | SS | 2 | 600 | Wght. of Hammer | |
| 6 | -10.08 | Compact grey silty SAND to silty SAND with gravel<br>- trace clay<br>- occasional cobbles and boulders<br>- shells in top 100 mm of layer | | | SS | 3 | 450 | 11 | |
| | | | | | SS | 4 | 325 | 20 | |
| 7 | | | | | SS | 5 | 50 | 19 | |
| | | | | | SS | 6 | 275 | 50/125mm | |
| 8 | -12.57 | | | | HQ | 7 | 500 | | |
| 9 | | Severely fractured to fractured grey FELSIC GNEISS:BEDROCK | | | HQ | 8 | 100% | RQD 23% | |
| 10 | | | | | HQ | 9 | 100% | 72% | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH32A

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2011/09/14 WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY mm | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| 10 | -14.83 | FELSIC GNEISS:BEDROCK, cont'd. | | | | | | | |
| | | End of Borehole | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

App'd Sep 28 2012 8:31:29

MBH 9/28/12

Stantec

# BOREHOLE RECORD

BH101

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/21

WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | -12.01 | | | | | | mm | | |
| 0 | | Very loose grey to dark grey ORGANIC SILT with sand | | | SS | 1 | 275 | Wght. of Rods | |
| 1 | | | | | SS | 2 | 150 | Wght. of Rods | |
| | -13.53 | | | | | | | | |
| 2 | | Very soft grey CLAY | | | SS | 3 | 500 | Wght. of Rods | |
| 3 | | | | | SS | 4 | 600 | Wght. of Rods | |
| 4 | | | | | ST | 5 | 600 | Wght. of Rods | |
| 5 | | | | | SS | 6 | 350 | Wght. of Rods | |
| 6 | | | | | SS | 7 | 600 | Wght. of Rods | |
| 7 | | | | | SS | 8 | 600 | Wght. of Rods | |
| 8 | | | | | SS | 9 | 600 | Wght. of Rods | |
| | -20.80 | | | | | | | | |
| 9 | | Loose to compact grey SAND with silt to silty SAND with gravel -occasional cobbles and boulders | | | SS | 10 | 100 | 10 | |
| 10 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH101

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/21

WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | mm | | |
| 10 | | SAND with silt to silty SAND with gravel, cont'd. | | | SS | 11 | 250 | 8 | |
| 11 | | | | | SS | 12 | 475 | 14 | |
| 12 | | | | | SS | 13 | 0 | 14 | |
| 13 | | | | | SS | 14 | 0 | 14 | |
| 14 | | | | | SS | 15 | 125 | 12 | |
| | -26.72 | | | | SS | 16 | 300 | 60/100mm | |
| 15 | | Very severely fractured to severely fractured slightly weathered grey FELSIC GNEISS:BEDROCK | | | NQ | 17 | 100% | RQD 17% | |
| 16 | | | | | NQ | 18 | 89% | 30% | |
| 17 | -29.10 | | | | | | | | |
| | | End of Borehole | | | | | | | |
| 18 | | | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

**BH101A**

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/31 WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY mm | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| 0 | -12.20 | Very loose dark grey ORGANIC SILT with sand -shells throughout | | | SS | 1 | 200 | Wght. of Rods | |
| 2 | -14.41 | Very soft grey CLAY | | | SS | 2 | 600 | Wght. of Rods | |
| 3 | | | | | ST | 3 | 600 | Wght. of Rods | |
| 4 | | | | | ST | 4 | 600 | Wght. of Rods | |
| 5 | | | | | ST | 5 | 600 | Wght. of Rods | |
| 6 | | | | | ST | 6 | 600 | Wght. of Rods | |
| 7 | | | | | ST | 7 | 600 | Wght. of Rods | |
| 8 | | | | | ST | 8 | 600 | Wght. of Rods | |
| 9 | -21.09 | | | | ST | 9 | 150 | PUSH | |
| | -21.45 | Grey silty SAND with gravel | | | | | | | |
| 10 | | End of Borehole | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH102

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

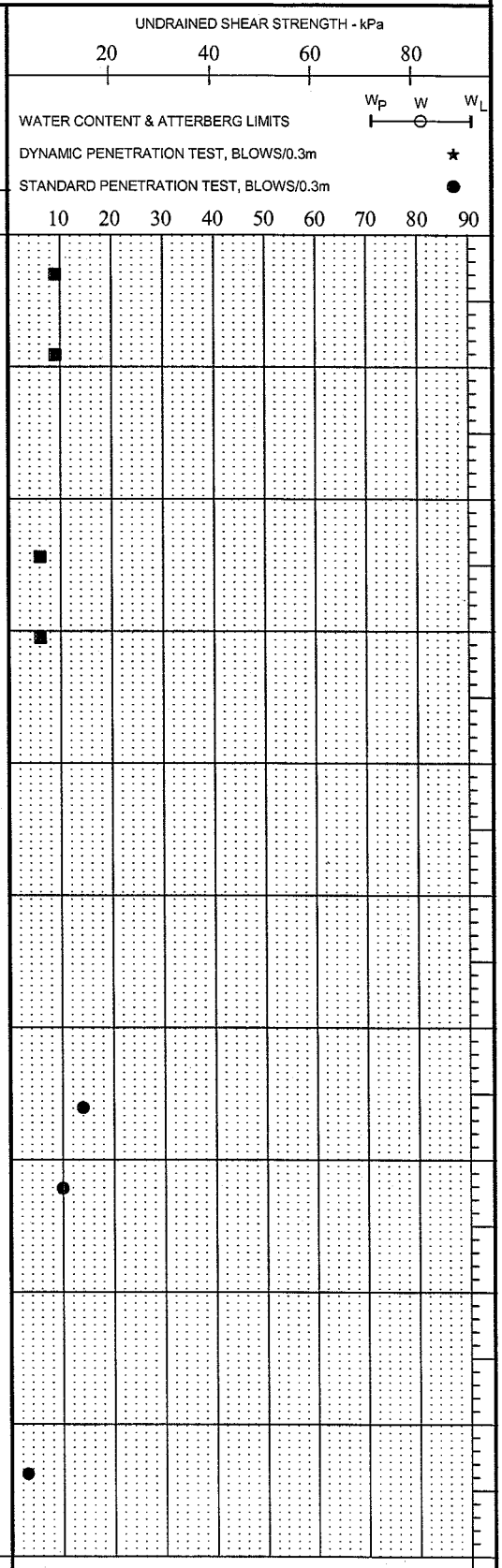
BH SIZE HW

DATES: BORING 2012/07/29

WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | mm | | |
| 0 | -17.04 | | | | | | | | |
| | -17.22 | Very loose grey ORGANIC SILT | | | SS | 1 | 500 | Wght. of Rods | |
| | | Very soft grey CLAY | | | SS | 2 | 600 | Wght. of Rods | |
| 1 | | | | | | | | | |
| 2 | | | | | SS | 3 | 600 | Wght. of Rods | |
| | | | | | SS | 4 | 600 | Wght. of Rods | |
| 3 | | | | | | | | | |
| | | | | | SS | 5 | 0 | Wght. of Rods | |
| 4 | | | | | SS | 6 | 150 | Wght. of Rods | |
| | | | | | SS | 7 | 450 | Wght. of Hammer | |
| 5 | | | | | | | | | |
| 6 | -23.34 | | | | | | | | |
| | | Very loose to compact grey silty SAND with gravel to SAND with silt<br>-occasional cobbles and boulders | | | SS | 8 | 275 | 14 | |
| 7 | | | | | SS | 9 | 150 | 10 | |
| | | | | | | | | | |
| 8 | | | | | | | | | |
| | | | | | SS | 10 | 0 | 1/600mm | |
| 9 | | | | | SS | 11 | 100 | 3 | |
| | | | | | | | | | |
| 10 | | | | | | | | | |




■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH102

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/29

WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | mm | | |
| 10 | -27.33 | Silty SAND with gravel to SAND with silt, cont'd. | | | SS | 12 | 75 | 50/75mm | |
| | | Severely fractured to fractured slightly weathered grey FELSIC GNEISS:BEDROCK | | | NQ | 13 | 100% | RQD 45% | |
| 11 | | | | | | | | | |
| 12 | | | | | NQ | 14 | 95% | 76% | |
| | -29.56 | End of Borehole | | | | | | | |
| 13 | | | | | | | | | |
| 14 | | | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |
| 17 | | | | | | | | | |
| 18 | | | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH103

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/20 WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY mm | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| 0 | -13.16 | | | | | | | | |
| | | Very loose dark grey ORGANIC SILT with sand | | | SS | 1 | 350 | Wght. of Rods | |
| 1 | | | | | SS | 2 | 550 | Wght. of Rods | |
| | -14.99 | | | | | | | | |
| 2 | | Very soft to soft grey CLAY | | | SS | 3 | 350 | Wght. of Rods | |
| | | | | | SS | 4 | 500 | Wght. of Rods | |
| 3 | | | | | | | | | |
| | | | | | ST | 5 | 650 | Wght. of Rods | |
| 4 | | | | | SS | 6 | 425 | Wght. of Rods | |
| 5 | | | | | | | | | |
| | | | | | SS | 7 | 400 | Wght. of Rods | |
| 6 | | | | | SS | 8 | 600 | 1 | |
| | | | | | ST | 9 | 250 | Wght. of Rods | |
| 7 | | | | | SS | 10 | 600 | Wght. of Hammer | |
| 8 | -21.24 | | | | | | | | |
| | | Compact grey SAND with silt to silty SAND with gravel | | | SS | 11 | 125 | 17 | |
| 9 | | | | | SS | 12 | 275 | 22 | |
| 10 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH103

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/20

WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | mm | | |
| 10 | | SAND with silt to silty SAND with gravel, cont'd. | | | SS | 13 | 0 | 35 | |
| | | | | | SS | 14 | 350 | 35 | |
| 11 | -24.39 | | | | | | | | |
| | | Very severely fractured to sound slightly weathered grey FELSIC GNEISS:BEDROCK | | | NQ | 15 | 44% | RQD 0% | |
| 12 | | | | | NQ | 16 | 63% | 53% | |
| 13 | | | | | | | | | |
| 14 | -27.56 | | | | NQ | 17 | 100% | 81% | |
| | | End of Borehole | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |
| 17 | | | | | | | | | |
| 18 | | | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH104

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/29

WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | -15.07 | | | | | | mm | | |
| 0 | | Compact black ORGANIC SILT with sand to SAND with organic silt | | | SS | 1 | 250 | 11 | |
| | -15.81 | | | | | | | | |
| 1 | | Loose to compact dark grey to grey silty SAND<br>-trace gravel<br>-occasional cobbles and boulders<br>-300 mm boulder at depth of 1.2 metres | | | SS | 2 | 350 | 80/225mm | |
| | | | | | NQ | 3 | 350 | - | |
| 2 | | | | | SS | 4 | 0 | 9 | |
| 3 | | | | | SS | 5 | 0 | 14 | |
| | -18.37 | | | | | | | | |
| 4 | | Intermixed layers of very soft grey CLAY and grey SILT<br>-sand seams encountered below depth of 6 metres | | | SS | 6 | 200 | Wght. of Hammer | |
| | | | | | SS | 7 | 400 | Wght. of Hammer | |
| 5 | | | | | ST | 8 | 0 | PUSH | |
| 6 | | | | | SS | 9 | 600 | Wght. of Rods | |
| | | | | | SS | 10 | 475 | Wght. of Rods | |
| 7 | | | | | SS | 11 | 600 | 3 | |
| | -22.39 | | | | | | | | |
| | | Very loose to compact grey SAND with silt to silty SAND with gravel<br>-occasional cobbles | | | SS | 12 | 200 | 12 | |
| 8 | | | | | SS | 13 | 225 | 2 | |
| 9 | | | | | SS | 14 | 150 | Wght. of Hammer | |
| | | | | | SS | 15 | 525 | 12 | |
| 10 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH104

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/29 WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | mm | | |
| 10 | | SAND with silt to silty SAND with gravel, cont'd. | | | SS | 16 | 25 | 6 | |
| 11 | | | | | SS | 17 | 250 | 12 | |
| | -26.68 | | | | SS | 18 | 75 | 50/75mm | |
| 12 | | Very sound slightly weathered grey FELSIC GNEISS:BEDROCK | | | NQ | 19 | 96% | RQD 96% | |
| 13 | | | | | NQ | 20 | 100% | 98% | |
| 14 | -29.19 | | | | | | | | |
| | | End of Borehole | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |
| 17 | | | | | | | | | |
| 18 | | | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH105

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/20 WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY mm | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| 0 | -9.60 | | | | | | | | |
| 0 | | Black to dark grey ORGANIC SILT with sand<br>-shells throughout | | | SS | 1 | 400 | Wght. of Rods | |
| 1 | -11.12 | | | | | | | | |
| 2 | | Very soft grey CLAY<br>-occasional sand seams | | | SS | 2 | 250 | 2 | |
| 3 | | | | | SS | 3 | 550 | 1 | |
| 4 | | | | | ST | 4 | 650 | Wght. of Rods | |
| 5 | | | | | SS | 5 | 600 | Wght. of Rods | |
| 6 | | | | | ST | 6 | 650 | Wght. of Rods | |
| 7 | | | | | SS | 7 | 600 | Wght. of Rods | |
| 8 | | | | | | | | | |
| 9 | | | | | SS | 8 | 200 | Wght. of Hammer | |
| | -19.18 | | | | SS | 9 | 250 | 3 | |
| 10 | | Very loose grey SAND with silt<br>-occasional cobbles and | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH105

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/20 WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY mm | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| 10 | | boulders<br>SAND with silt, cont'd. | | | SS | 10 | 100 | Wght. of Rods | |
| 11 | | | | | SS | 11 | 175 | 2 | |
| 12 | -21.97 | | | | SS | 12 | 150 | 50/75mm | |
| 13 | | Severely fractured to very sound grey FELSIC GNEISS:BEDROCK | | | NQ | 13 | 74% | RQD 39% | |
| 14 | -24.13 | | | | NQ | 14 | 100% | 100% | |
| 15 | | End of Borehole | | | | | | | |
| 16 | | | | | | | | | |
| 17 | | | | | | | | | |
| 18 | | | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

App'd Sep 28 2012 8:28:28

MBH 9/28/12

Stantec

# BOREHOLE RECORD

BH106

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/30 WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY mm | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| 0 | -13.50 | Very loose grey ORGANIC SILT with sand<br>-trace gravel<br>-occasional cobbles and boulders<br>-600mm boulder at depth of 0.3 metres | | | SS | 1 | 150 | 50/25mm | |
| 1 | | | | | | | | | |
| 2 | | | | | SS | 2 | 200 | Wght. of Hammer | |
| | -15.94 | | | | SS | 3 | 425 | Wght. of Hammer | |
| 3 | | Very soft grey clayey SILT | | | | | | | |
| 4 | | | | | SS | 4 | 600 | Wght. of Rods | |
| | -17.69 | | | | SS | 5 | 600 | Wght. of Rods | |
| | -17.84 | Very soft grey CLAY<br>End of Borehole<br><br>-needed to restart borehole as casing wasn't straight | | | | | | | |
| 5 | | | | | | | | | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |
| 10 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

App'd Sep 28 2012 8:28:29

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Stantec

# BOREHOLE RECORD

BH106A

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/30

WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | mm | | |
| 0 | -13.92 | Advance casing to where BH106 was terminated | | | | | | | |
| 4 | -18.57 | Very loose to compact grey silty SAND with gravel to SAND with silt<br>-occasional cobbles and boulders<br>-325 mm boulder encountered at depth of 5.2 metres | | | SS | 6 | 150 | 70/225mm | |
| 5 | | | | | NQ | 7 | 375 | - | |
| 7 | | | | | SS | 8 | 175 | 3 | |
| 8 | | | | | SS | 9 | 200 | 6 | |
| 9 | | | | | SS | 10 | 125 | 17 | |
| 10 | | | | | SS | 11 | 350 | 65/225mm | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

App'd Sep 28 2012 8:28:29

MBH 9/28/12

Stantec

# BOREHOLE RECORD

BH106A

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/30 WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | mm | | |
| 10 | -23.98 | Silty SAND with gravel to SAND with silt, cont'd. | | | NQ | 12 | 100% | RQD 44% | |
| | | Fractured to sound slightly weathered grey FELSIC GNEISS:BEDROCK | | | NQ | 13 | 100% | 79% | |
| 11 | -25.63 | End of Borehole | | | | | | | |
| 12 | | | | | | | | | |
| 13 | | | | | | | | | |
| 14 | | | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |
| 17 | | | | | | | | | |
| 18 | | | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

App'd Sep 28 2012 8:28:29

MBH 9/28/12

Stantec

# BOREHOLE RECORD

BH107

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/21 WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | -11.95 | | | | | | mm | | |
| 0 | -12.00 | Very loose dark grey ORGANIC SILT | | | SS | 1 | 150 | Wght. of Rods | |
| | | Very soft grey CLAY | | | | | | | |
| 1 | | | | | SS | 2 | 275 | Wght. of Rods | |
| | -13.45 | | | | | | | | |
| 2 | | Very loose to compact grey SAND with silt to silty SAND with gravel -occasional cobbles | | | SS | 3 | 225 | 24 | |
| | | | | | SS | 4 | 350 | 28 | |
| 3 | | | | | SS | 5 | 0 | 10 | |
| | | | | | SS | 6 | 150 | 5 | |
| 4 | | | | | SS | 7 | 75 | 5 | |
| | | | | | SS | 8 | 325 | 2 | |
| 5 | | | | | ~~SS~~ | ~~9~~ | ~~0~~ | ~~50/75mm~~ | |
| | -17.64 | | | | | | | | |
| 6 | | Sound to very sound slightly weathered grey FELSIC GNEISS:BEDROCK | | | NQ | 10 | 100% | RQD 83% | |
| | | | | | NQ | 20 | 100% | 93% | |
| 7 | -19.47 | | | | | | | | |
| | | End of Borehole | | | | | | | |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |
| 10 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

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Stantec

# BOREHOLE RECORD

BH108

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/20

WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | -14.05 | | | | | | mm | | |
| 0 | | Very soft grey CLAY | | | | | | | |
| 1 | | | | | | | | | |
| 2 | | | | | SS | 1 | 450 | Wght. of Rods | |
| 3 | | | | | SS | 2 | 550 | | |
| | -17.86 | | | | | | | | |
| 4 | | Very loose grey clayey SAND<br>-trace gravel<br>-occasional cobbles | | | SS | 3 | 300 | 13 | |
| 5 | | | | | SS | 4 | 325 | 3 | |
| | -19.71 | | | | | | | | |
| 6 | | Compact to dense SAND with gravel and silt to silty SAND | | | SS | 5 | 175 | 31 | |
| | | | | | SS | 6 | 150 | 50/75mm | |
| | -20.83 | | | | | | | | |
| 7 | | Severely fractured to fractured grey FELSIC GNEISS:BEDROCK | | | NQ | 7 | 78% | RQD 38% | |
| 8 | | | | | NQ | 8 | 77% | 57% | |
| | -23.17 | | | | | | | | |
| 9 | | End of Borehole | | | | | | | |
| 10 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

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# BOREHOLE RECORD

BH109

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/19 to 2012/07/20

WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | -6.15 | | | | | | mm | | |
| 0 | | Black to dark grey ORGANIC SILT with sand<br>-trace shells | | | SS | 1 | 150 | 2 | |
| 1 | | | | | SS | 2 | 375 | 2 | |
| | -7.83 | | | | | | | | |
| 2 | | Very soft grey CLAY | | | SS | 3 | 0 | 3 | |
| | | | | | SS | 4 | 350 | 1 | |
| 3 | | | | | ST | 5 | 450 | Wght. of Rods | |
| 4 | -10.42 | | | | ST | 6 | 525 | Wght. of Rods | |
| | | Very loose to very dense grey silty SAND to silty SAND with gravel<br>-trace clay<br>-occasional cobbles and boulders | | | SS | 7 | 250 | 17 | |
| 5 | | | | | SS | 8 | 125 | 9 | |
| 6 | | | | | SS | 9 | 275 | 7 | |
| | | | | | SS | 10 | 75 | 13 | |
| 7 | | | | | SS | 11 | 0 | 4 | |
| 8 | | | | | SS | 12 | 0 | 8 | |
| | | | | | SS | 13 | 400 | 64 | |
| | -15.09 | | | | | | | | |
| 9 | | Fractured to very sound grey FELSIC GNEISS:BEDROCK | | | NQ | 14 | 80% | RQD 53% | |
| 10 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH109

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/19 to 2012/07/20

WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | mm | | |
| 10 | | FELSIC GNEISS:BEDROCK, cont'd. | | | | | | | |
| 11 | | | | | NQ | 15 | 100% | 92% | |
| | -17.58 | End of Borehole | | | | | | | |
| 12 | | | | | | | | | |
| 13 | | | | | | | | | |
| 14 | | | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |
| 17 | | | | | | | | | |
| 18 | | | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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Stantec

# BOREHOLE RECORD

**BH110**

CLIENT **CANADIAN ROYALTIES INC.** PROJECT No. **121613564**

LOCATION **PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC** BH SIZE **HW**

DATES: BORING **2012/07/22** WATER LEVEL _____ DATUM **CHART**

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | NUMBER | RECOVERY | N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | -11.16 | | | | | | mm | | |
| 0 | | Very loose dark grey to black ORGANIC SILT with sand -shells throughout | | | SS | 1 | 175 | Wght. of Rods | |
| 1 | -12.53 | | | | SS | 2 | 75 | Wght. of Hammer | |
| | | Very soft grey CLAY | | | | | | | |
| 2 | -13.83 | | | | SS | 3 | 475 | Wght. of Rods | |
| | | Compact grey SAND with silt to silty SAND -trace clay -occasional cobbles and boulders | | | SS | 4 | 550 | 13 | |
| 3 | | | | | | | | | |
| 4 | | | | | SS | 5 | 0 | 12 | |
| 5 | | | | | SS | 6 | 275 | 14 | |
| | -16.67 | | | | | | | | |
| | | Very severely fractured to severely fractured slightly weathered grey FELSIC GNEISS:BEDROCK | | | NQ | 7 | 100% | RQD 57% | |
| 6 | | | | | NQ | 8 | 65% | 41% | |
| 7 | | | | | | | | | |
| 8 | | | | | NQ | 9 | 55% | 5% | |
| | -19.95 | | | | | | | | |
| 9 | | End of Borehole | | | | | | | |
| 10 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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Stantec

# BOREHOLE RECORD

BH111

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/22 WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | -4.62 | | | | | | mm | | |
| 0 | | Loose to compact dark grey ORGANIC SILT with sand<br>-trace gravel<br>-shells throughout | | | SS | 1 | 225 | 6 | |
| 1 | | | | | SS | 2 | 450 | 24 | |
| 2 | | | | | SS | 3 | 250 | 31 | |
| | -7.16 | | | | | | | | |
| | | Stiff grey CLAY | | | SS | 4 | 425 | 14 | |
| 3 | -7.77 | | | | | | | | |
| | | Loose to compact SAND with silt to silty SAND with gravel<br>-occasional cobbles | | | SS | 5 | 150 | 23 | |
| 4 | | | | | SS | 6 | 50 | 20 | |
| 5 | | | | | SS | 7 | 275 | 6 | |
| | | | | | SS | 8 | 200 | 32 | |
| 6 | | | | | SS | 9 | 100 | 50/100mm | |
| | -11.33 | | | | | | | | |
| 7 | | Fractured to very sound grey FELSIC GNEISS:BEDROCK | | | NQ | 10 | 100% | RQD 100% | |
| 8 | | | | | NQ | 11 | 100% | 67% | |
| 9 | -13.76 | | | | | | | | |
| | | End of Borehole | | | | | | | |
| 10 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

App'd Sep 28 2012 8:28:32

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Stantec

# BOREHOLE RECORD

BH112

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/18 to 2012/07/19

WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | -9.66 | | | | | | mm | | |
| 0 | | Compact grey to dark grey ORGANIC SILT -trace shells | | | SS | 1 | 600 | 11 | |
| | -10.57 | | | | | | | | |
| 1 | | Very soft grey CLAY | | | SS | 2 | 500 | 2 | |
| | -11.34 | | | | | | | | |
| 2 | | Compact grey to dark grey silty SAND to silty SAND with gravel -occasional cobbles | | | SS | 3 | 175 | 22 | |
| | | | | | SS | 4 | 350 | 13 | |
| 3 | | | | | SS | 5 | 200 | 15 | |
| | -13.65 | | | | ~~SS~~ | ~~6~~ | ~~25~~ | ~~50/25mm~~ | |
| 4 | | Severely fractured to very sound grey FELSIC GNEISS:BEDROCK - sands seams and quartz seams encountered | | | NQ | 7 | 100% | RQD 100% | |
| 5 | | | | | NQ | 8 | 91% | 91% | |
| 6 | | | | | NQ | 9 | 82% | 34% | |
| | -16.19 | | | | | | | | |
| | | End of Borehole | | | | | | | |
| 7 | | | | | | | | | |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |
| 10 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

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# BOREHOLE RECORD

BH113

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/28 to 2012/07/29 WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | -19.89 | | | | | | mm | | |
| 0 | | Very soft grey CLAY | | | SS | 1 | 200 | Wght. of Rods | |
| 1 | | | | | SS | 2 | 600 | Wght. of Rods | |
| 2 | | | | | SS | 3 | 600 | Wght. of Rods | |
| | | | | | SS | 4 | 600 | Wght. of Rods | |
| 3 | | | | | ST | 5 | 600 | Wght. of Rods | |
| 4 | | | | | | | | | |
| | | | | | SS | 6 | 600 | Wght. of Rods | |
| 5 | | | | | SS | 7 | 600 | Wght. of Rods | |
| 6 | | | | | | | | | |
| | -26.42 | | | | SS | 8 | 600 | Wght. of Rods | |
| 7 | | Loose to compact grey silty SAND with gravel -occasional cobbles | | | SS | 9 | 325 | 7 | |
| | | | | | | | | | |
| 8 | | | | | SS | 10 | 200 | 9 | |
| | -28.42 | | | | SS | 11 | 50 | 50/50mm | |
| | | Sound grey FELSIC GNEISS:BEDROCK | | | | | | | |
| 9 | | | | | NQ | 12 | 85% | RQD 79% | |
| 10 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

**BH113**

CLIENT **CANADIAN ROYALTIES INC.** PROJECT No. **121613564**

LOCATION **PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC** BH SIZE **HW**

DATES: BORING **2012/07/28 to 2012/07/29** WATER LEVEL _____ DATUM **CHART**

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | mm | | |
| 10 | | FELSIC GNEISS:BEDROCK, cont'd. | | | NQ | 13 | 96% | 87% | |
| 11 | -30.91 | End of Borehole | | | | | | | |
| 12 | | | | | | | | | |
| 13 | | | | | | | | | |
| 14 | | | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |
| 17 | | | | | | | | | |
| 18 | | | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH114

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/29

WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY mm | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| 0 | -19.30 | | | | | | | | |
| | | Very loose grey sandy SILT with gravel to silty SAND with gravel | | | SS | 1 | 50 | Wght. of Rods | |
| | -20.21 | | | | SS | 2 | 100 | Wght. of Hammer | |
| 1 | | Very soft grey clayey SILT | | | SS | 3 | 425 | Wght. of Rods | |
| 2 | | | | | SS | 4 | 450 | Wght. of Rods | |
| | -21.74 | | | | | | | | |
| | | Very soft grey CLAY | | | SS | 5 | 600 | Wght. of Rods | |
| 3 | | | | | SS | 6 | 600 | Wght. of Rods | |
| 4 | | | | | | | | | |
| | | | | | ST | 7 | 600 | Wght. of Rods | |
| 5 | | | | | | | | | |
| | | | | | SS | 8 | 600 | Wght. of Hammer | |
| 6 | -25.55 | | | | | | | | |
| | | Loose to compact grey silty SAND with gravel to SAND with silt | | | SS | 9 | 300 | 6 | |
| 7 | | | | | | | | | |
| | | | | | SS | 10 | 150 | 5 | |
| 8 | | | | | SS | 11 | 75 | 6 | |
| | | | | | | | | | |
| 9 | | | | | SS | 12 | 225 | 15 | |
| | | | | | SS | 13 | 325 | 6 | |
| 10 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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MBH 9/28/12

Stantec

# BOREHOLE RECORD

BH114

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/29

WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | mm | | |
| 10 | | Silty SAND with gravel to SAND with silt, cont'd. | | | ~~SS~~ | ~~14~~ | ~~0~~ | ~~50/25mm~~ | |
| | -30.15 | | | | | | | | |
| 11 | | Fractured to sound slightly weathered grey FELSIC GNEISS:BEDROCK | | | NQ | 15 | 175 100% | - RQD 77% | |
| 12 | | -275 mm zone of dark grey MAFIC GNEISS encountered at depth of 11.8 metres | | | NQ | 16 | 97% | 38% | |
| 13 | -32.33 | End of Borehole | | | | | | | |
| 14 | | | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |
| 17 | | | | | | | | | |
| 18 | | | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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MBH 9/28/12

Stantec

# BOREHOLE RECORD

BH115

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/30

WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | -17.69 | | | | | | mm | | |
| 0 | | Very loose dark grey to black ORGANIC SILT with sand -shells throughout | | | ST | 1 | 450 | PUSH | |
| 1 | | | | | ST | 2 | 425 | PUSH | |
| | -19.52 | | | | ST | 3 | 600 | PUSH | |
| 2 | | Very soft grey clayey SILT -shells throughout | | | | | | | |
| | | | | | SS | 4 | 550 | Wght. of Rods | |
| 3 | -20.87 | | | | SS | 5 | 600 | Wght. of Rods | |
| | | Very soft grey CLAY | | | | | | | |
| 4 | | | | | SS | 6 | 575 | Wght. of Rods | |
| | | | | | SS | 7 | 600 | Wght. of Rods | |
| 5 | | | | | | | | | |
| | | | | | ST | 8 | 550 | Wght. of Rods | |
| 6 | | | | | SS | 9 | 400 | 3 | |
| | -24.29 | | | | | | | | |
| | | Very loose to compact grey SAND with silt to silty SAND with gravel -occasional cobbles and boulders | | | | | | | |
| 7 | | | | | SS | 10 | 225 | 12 | |
| | | | | | SS | 11 | 325 | 12 | |
| 8 | | | | | | | | | |
| | | | | | SS | 12 | 50 | 2 | |
| 9 | -26.96 | | | | SS | 13 | 300 | 50/75mm | |
| | | End of Borehole -barge needed to be moved for an onshore blast | | | | | | | |
| 10 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

**BH115A**

CLIENT **CANADIAN ROYALTIES INC.** PROJECT No. **121613564**

LOCATION **PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC** BH SIZE **HW**

DATES: BORING **2012/07/30 to 2012/07/31** WATER LEVEL _____ DATUM **CHART**

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | -17.91 | | | | | | mm | | |
| 0 | | Advanced casing to where BH115 was terminated | | | | | | | |
| 1 | | | | | | | | | |
| 2 | | | | | | | | | |
| 3 | | | | | | | | | |
| 4 | | | | | | | | | |
| 5 | | | | | | | | | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |
| 8 | | | | | | | | | |
| 9 | -26.90 | Grey SAND with silt to silty SAND with gravel -cobbles and boulders throughout | | | | | | | |
| 10 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

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# BOREHOLE RECORD

**BH115A**

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/30 to 2012/07/31

WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | mm | | |
| 10 | | SAND with silt to silty SAND with gravel, cont'd. | | | NQ | 14 | 850 | - | |
| | -28.88 | | | | | | | | |
| 11 | | Very severely fractured slightly to moderately weathered grey FELSIC GNEISS:BEDROCK | | | NQ | 15 | 71% | RQD 14% | |
| 12 | | | | | | | | | |
| 13 | | | | | NQ | 16 | 97% | 17% | |
| | -31.60 | | | | | | | | |
| 14 | | End of Borehole | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |
| 17 | | | | | | | | | |
| 18 | | | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

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# BOREHOLE RECORD

BH116

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/31 WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | mm | | |
| 0 | -16.79 | Very soft grey clayey SILT | | | SS | 1 | 150 | Wght. of Rods | |
| 1 | -17.93 | Dark grey to grey ORGANIC SILT with sand to silty SAND -frequent shell fragments | | | SS | 2 | 200 | Wght. of Rods | |
| 2 | -19.13 | Very soft grey clayey SILT | | | SS | 3 | 600 | Wght. of Hammer | |
| 3 | -20.40 | Very soft grey CLAY | | | SS | 4 | 600 | Wght. of Rods | |
| 4 | -21.36 | Very loose to compact grey SAND with silt to silty SAND with gravel -occasional cobbles | | | SS | 5 | 600 | Wght. of Rods | |
| 5 | | | | | SS | 6 | 600 | Wght. of Rods | |
| 6 | | | | | SS | 7 | 75 | 4 | |
| 7 | | | | | SS | 8 | 50 | 8 | |
| 8 | -25.45 | Severely fractured to fractured slightly to moderately weathered grey FELSIC GNEISS:BEDROCK -occasional sand seams | | | SS | 9 | 100 | 9 | |
| 9 | | | | | SS | 10 | 325 | 6 | |
| 10 | | | | | SS | 11 | 25 | 10 | |
| | | | | | SS | 12 | 400 | 4 | |
| | | | | | NQ | 13 | 100% | RQD 31% | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH116

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/31

WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | mm | | |
| 10 | | FELSIC GNEISS:BEDROCK, cont'd. | | | NQ | 14 | 74% | 37% | |
| 11 | | | | | NQ | 15 | 100% | 39% | |
| 12 | | | | | NQ | 16 | 100% | 50% | |
| | -29.59 | | | | | | | | |
| 13 | | End of Borehole | | | | | | | |
| 14 | | | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |
| 17 | | | | | | | | | |
| 18 | | | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH117

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/21

WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY mm | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| 0 | -9.58 | Very loose black to dark grey ORGANIC SILT with sand -shells throughout | | | SS | 1 | 250 | Wght. of Rods | |
| 1 | | | | | | | | | |
| 2 | -11.76 | | | | SS | 2 | 150 | Wght. of Hammer | |
| | | Very loose to compact grey silty SAND -trace clay -shells throughout | | | SS | 3 | 425 | Wght. of Hammer | |
| 3 | | | | | SS | 4 | 150 | 16 | |
| 4 | -13.75 | | | | SS | 5 | 275 | 2 | |
| | | Very soft grey CLAY -sand seams encountered below depth of 10.2 metres | | | SS | 6 | 0 | Wght. of Rods | |
| 5 | | | | | SS | 7 | 475 | Wght. of Rods | |
| 6 | | | | | ST | 8 | 675 | Wght. of Rods | |
| 7 | | | | | SS | 9 | 600 | Wght. of Rods | |
| 8 | | | | | | | | | |
| 9 | | | | | SS | 10 | 600 | Wght. of Rods | |
| | | | | | SS | 11 | 600 | Wght. of Rods | |
| 10 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH117

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/21 WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY mm | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| 10 | | | | | | | | | |
| | | CLAY, cont'd. | | | SS | 12 | 400 | Wght. of Rods | |
| 11 | | | | | SS | 13 | 600 | Wght. of Rods | |
| 12 | -21.98 | | | | | | | | |
| | | Very loose to compact grey SAND with silt to silty SAND with gravel -occasional cobbles and boulders | | | ST | 14 | 0 | PUSH | |
| 13 | | | | | SS | 15 | 225 | 1 | |
| | | | | | SS | 16 | 150 | Wght. of Hammer | |
| 14 | | | | | | | | | |
| | | | | | SS | 17 | 250 | 8 | |
| 15 | | | | | SS | 18 | 400 | 80/225mm | |
| | -25.56 | | | | | | | | |
| 16 | | COBBLES and BOULDERS | | | NQ | 19 | 250 | - | |
| | | | | | NQ | 20 | 100% | 50% | |
| 17 | -26.90 | | | | | | | | |
| | | Very severely fractured slightly weathered grey FELSIC GNEISS:BEDROCK | | | | | | | |
| 18 | -27.61 | | | | | | | | |
| | | End of Borehole | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH408

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/22 WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | -6.17 | | | | | | mm | | |
| 0 | | Loose grey to dark grey silty SAND to sandy SILT<br>-trace organics<br>-trace gravel<br>-trace shells | | | SS | 1 | 100 | 6 | |
| 1 | | | | | SS | 2 | 450 | 13 | |
| | -7.74 | | | | SS | 3 | 600 | 3 | |
| | | Very soft grey CLAY | | | | | | | |
| 2 | | | | | SS | 4 | 300 | 3 | |
| | -8.91 | | | | | | | | |
| 3 | | Compact grey SAND with silt to silty SAND with gravel<br>-occasional cobbles and boulders | | | SS | 5 | 50 | 15 | |
| 4 | | | | | SS | 6 | 275 | 14 | |
| | | - 325 mm boulder | | | | | | | |
| 5 | | | | | SS | 7 | 50 | 50/75mm | |
| 6 | | - 300 mm boulder | | | SS | 8 | 100 | 56/175mm | |
| | -12.88 | | | | | | | | |
| 7 | | Sound to very sound slightly weathered grey FELSIC GNEISS:BEDROCK | | | NQ | 9 | 98% | RQD 87% | |
| 8 | | | | | NQ | 10 | 85% | 74% | |
| | -15.21 | | | | | | | | |
| 9 | | End of Borehole | | | | | | | |
| 10 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH409

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/22 WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | -10.19 | | | | | | mm | | |
| 0 | | Very loose dark grey ORGANIC SILT with sand -shells throughout | | | SS | 1 | 100 | Wght. of Rods | |
| 1 | -11.41 | | | | SS | 2 | 0 | | |
| | | Soft grey CLAY -trace gravel | | | | | | | |
| 2 | | | | | SS | 3 | 25 | 1/900mm | |
| | -12.93 | | | | | | | | |
| 3 | | Severely fractured to sound slightly weathered grey FELSIC GNEISS:BEDROCK | | | SS | 4 | 50 | 50/75mm | |
| | | | | | NQ | 5 | 100% | RQD 50% | |
| 4 | | | | | NQ | 6 | 93% | 78% | |
| | -15.12 | | | | | | | | |
| 5 | | End of Borehole | | | | | | | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |
| 10 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

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# BOREHOLE RECORD

**BH410**

CLIENT **CANADIAN ROYALTIES INC.** PROJECT No. **121613564**

LOCATION **PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC** BH SIZE **HW**

DATES: BORING **2012/07/22 to 2012/07/23** WATER LEVEL _____ DATUM **CHART**

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | -6.22 | | | | | | mm | | |
| 0 | | Very loose grey sandy SILT | | | SS | 1 | 0 | Wght. of Rods | |
| 1 | | | | | SS | 2 | 350 | Wght. of Rods | |
| | -7.44 | Very soft grey CLAY | | | SS | 3 | 600 | Wght. of Hammer | |
| 2 | -8.30 | Compact grey SAND with silt to silty SAND -trace gravel | | | SS | 4 | 400 | 8 | |
| 3 | | | | | SS | 5 | 225 | 14 | |
| | -9.57 | | | | SS | 6 | 125 | 50/125mm | |
| 4 | | Very sound grey FELSIC GNEISS:BEDROCK | | | NQ | 7 | 98% | RQD 92% | |
| 5 | | | | | NQ | 8 | 100% | 100% | |
| | -11.81 | | | | | | | | |
| 6 | | End of Borehole | | | | | | | |
| 7 | | | | | | | | | |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |
| 10 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH411

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/23 WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | -14.30 | | | | | | mm | | |
| 0 | | Very loose grey to dark grey ORGANIC SILT | | | SS | 1 | 325 | Wght. of Rods | |
| | -15.21 | | | | | | | | |
| 1 | -15.52 | Very loose grey sandy SILT to silty SAND<br>-trace gravel<br>-occasional shells | | | SS | 2 | 600 | Wght. of Rods | |
| 2 | | Very soft grey CLAY | | | SS | 3 | 600 | Wght. of Hammer | |
| 3 | | | | | | | | | |
| | | | | | ST | 4 | 600 | Wght. of Rods | |
| 4 | | | | | SS | 5 | 600 | Wght. of Rods | |
| | | | | | SS | 6 | 600 | Wght. of Rods | |
| 5 | -19.48 | | | | | | | | |
| | | Severely fractured moderately weathered grey FELSIC GNEISS:BEDROCK | | | NQ | 7 | 90% | RQD 43% | |
| 6 | | | | | | | | | |
| 7 | | | | | NQ | 8 | 81% | 46% | |
| 8 | -22.45 | | | | | | | | |
| | | End of Borehole | | | | | | | |
| 9 | | | | | | | | | |
| 10 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

App'd Sep 28 2012 8:28:37

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Stantec

# BOREHOLE RECORD

BH412

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/23 WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | -8.22 | | | | | | mm | | |
| 0 | | Very loose black to dark grey ORGANIC SILT with sand -shells throughout | | | SS | 1 | 350 | Wght. of Rods | |
| | -9.06 | | | | | | | | |
| 1 | | Loose to compact grey silty SAND -shells throughout | | | SS | 2 | 100 | 8 | |
| | -9.87 | | | | SS | 3 | 200 | 37 | |
| | | Sound to very sound grey FELSIC GNEISS:BEDROCK | | | NQ | 4 | 100% | RQD 100% | |
| 2 | | | | | NQ | 5 | 100% | 71% | |
| 3 | | | | | NQ | 6 | 94% | 86% | |
| 4 | -12.54 | | | | | | | | |
| | | End of Borehole | | | | | | | |
| 5 | | | | | | | | | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |
| 10 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

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# BOREHOLE RECORD

BH413

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/23 to 2012/07/24

WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY mm | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| 0 | -14.60 | Very loose dark grey to black ORGANIC SILT with sand<br>-strong organic odour | | | SS | 1 | 200 | Wght. of Hammer | |
| 1 | -15.97 | | | | SS | 2 | 450 | Wght. of Rods | |
| 2 | | Very loose black SAND with organic silt<br>-strong organic odour | | | SS | 3 | 600 | 1 | |
| 3 | -17.34 | Compact dark grey silty SAND with gravel to SAND with silt<br>-organic odour<br>-shells throughout | | | SS | 4 | 600 | 12 | |
| 4 | -19.10 | -375 mm boulder | | | | | | | |
| 5 | | Very soft grey CLAY | | | SS | 5 | 600 | Wght. of Rods | |
| 6 | | | | | SS | 6 | 300 | Wght. of Rods | |
| 7 | | | | | ST | 7 | 0 | Wght. of Rods | |
| 8 | | | | | SS | 8 | 600 | Wght. of Rods | |
| 9 | | | | | ST | 9 | 600 | PUSH | |
| 10 | | | | | SS | 10 | 600 | Wght. of Rods | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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Stantec

# BOREHOLE RECORD

BH413

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/23 to 2012/07/24 WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | mm | | |
| 10 | | CLAY, cont'd. | | | | | | | |
| 11 | | | | | | | | | |
| 12 | -26.79 | | | | SS | 11 | 450 | Wght. of Rods | |
| | | Compact grey silty SAND with gravel to SAND with silt -occasional cobbles and boulders | | | SS | 12 | 150 | 11 | |
| 13 | | | | | SS | 13 | 0 | 50/25mm | |
| 14 | -28.93 | | | | | | | | |
| | | Fractured to sound slightly weathered grey FELSIC GNEISS:BEDROCK | | | NQ | 14 | 82% | RQD 59% | |
| 15 | | | | | | | | | |
| 16 | -31.06 | | | | NQ | 15 | 88% | 88% | |
| | | End of Borehole | | | | | | | |
| 17 | | | | | | | | | |
| 18 | | | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH414

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2102/07/23

WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY mm | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| 0 | -11.02 | | | | | | | | |
| | | Very loose dark grey ORGANIC SILT with sand | | | SS | 1 | 200 | Wght. of Rods | |
| | -11.48 | Very loose dark grey to black SAND with organic silt<br>-shells throughout<br>-strong organic odour | | | SS | 2 | 250 | 3 | |
| 1 | | | | | | | | | |
| 2 | | | | | SS | 3 | 25 | Wght. of Hammer | |
| | -13.66 | | | | SS | 4 | 425 | 1 | |
| 3 | | Intermixed layers of very soft grey CLAY and grey SILT<br>-sand seams encountered below depth of 10 metres | | | SS | 5 | 450 | Wght. of Rods | |
| 4 | | | | | SS | 6 | 450 | 7 | |
| | | | | | SS | 7 | 600 | Wght. of Rods | |
| 5 | | | | | SS | 8 | 600 | Wght. of Rods | |
| 6 | | | | | SS | 9 | 300 | Wght. of Rods | |
| | | | | | SS | 10 | 600 | Wght. of Rods | |
| 7 | | | | | SS | 11 | 600 | Wght. of Rods | |
| 8 | | | | | SS | 12 | 600 | Wght. of Rods | |
| | | | | | ST | 13 | 600 | Wght. of Rods | |
| 9 | | | | | SS | 14 | 600 | Wght. of Rods | |
| 10 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH414

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2102/07/23 WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | mm | | |
| 10 | | CLAY and SILT, cont'd. | | | SS | 15 | 450 | Wght. of Rods | |
| 11 | | | | | SS | 16 | 425 | Wght. of Rods | |
| | -22.58 | | | | | | | | |
| 12 | | Severely fractured to fractured slightly to moderately weathered grey FELSIC GNEISS:BEDROCK -quartz mineralization throughout | | | NQ | 17 | 100% | RQD 38% | |
| 13 | | | | | NQ | 18 | 100% | 70% | |
| | -25.04 | | | | | | | | |
| 14 | | End of Borehole | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |
| 17 | | | | | | | | | |
| 18 | | | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH415

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

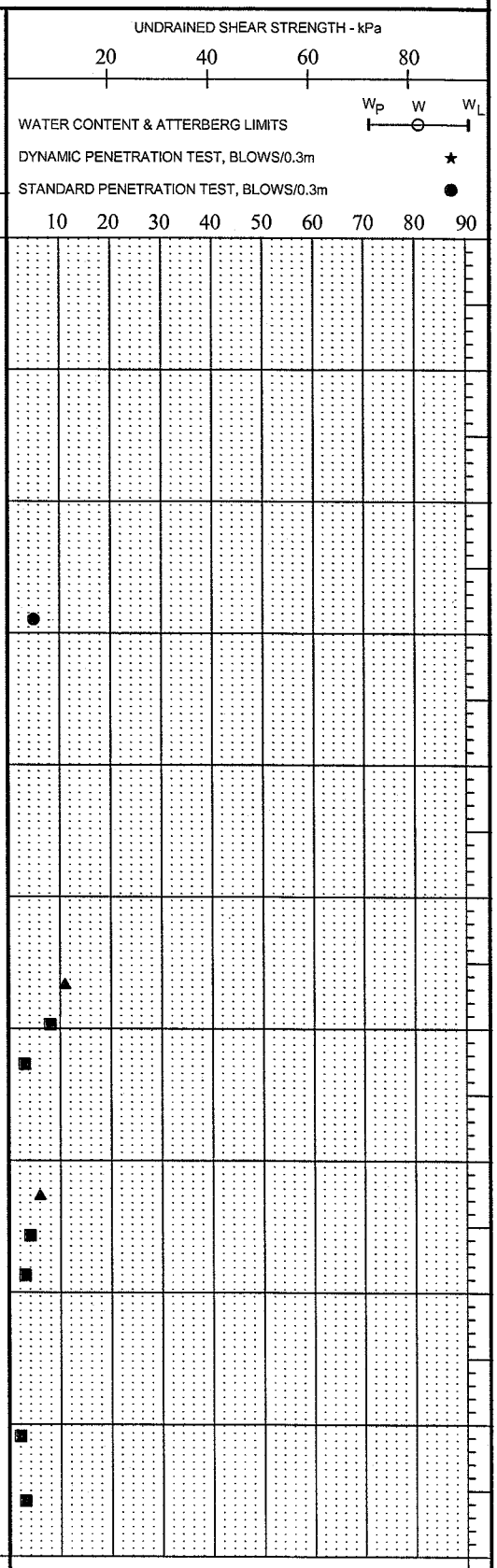
BH SIZE HW

DATES: BORING 2012/07/24

WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | mm | | |
| 0 | -14.41 | | | | | | | | |
| | -14.79 | Very loose grey ORGANIC SILT with sand | | | SS | 1 | 550 | Wght. of Rods | |
| 1 | -15.32 | Very loose grey silty SAND<br>-trace gravel<br>-trace shells | | | SS | 2 | 600 | Wght. of Hammer | |
| | -16.39 | Soft grey CLAY | | | | | | | |
| 2 | | Very loose grey SILT with sand to silty SAND<br>-shells throughout<br>-trace gravel | | | SS | 3 | 600 | Wght. of Rods | |
| 3 | | | | | SS | 4 | 600 | 5 | |
| | -18.19 | | | | | | | | |
| 4 | | Very soft grey CLAY | | | SS | 5 | 600 | Wght. of Hammer | |
| 5 | | | | | | | | | |
| 6 | | | | | ST | 6 | 600 | Wght. of Rods | |
| | | | | | SS | 7 | 600 | Wght. of Rods | |
| 7 | | | | | | | | | |
| | | | | | ST | 8 | 600 | Wght. of Rods | |
| 8 | | | | | SS | 9 | 600 | Wght. of Rods | |
| 9 | | | | | SS | 10 | 600 | Wght. of Rods | |
| | | | | | SS | 11 | 600 | Wght. of Rods | |
| 10 | | | | | | | | | |

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# BOREHOLE RECORD

BH415

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/24 WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | mm | | |
| 10 | | CLAY, cont'd. | | | | | | | |
| 11 | | | | | ST | 12 | 600 | PUSH | |
| 12 | -26.58 | | | | SS | 13 | 400 | Wght. of Rods | |
| | | Compact grey silty SAND with gravel to SAND with silt | | | SS | 14 | 175 | 10 | |
| 13 | -27.87 | | | | SS | 15 | 100 | 85/250mm | |
| | | COBBLES and BOULDERS -possible bedrock at 13.9 metres | | | NQ | 16 | 425 | - | |
| 14 | -28.74 | | | | NQ | 17 | 500mm | - | |
| | | Very severely fractured to sound slightly weathered dark grey MAFIC GNEISS:BEDROCK | | | | | 100% | RQD 0% | |
| 15 | | | | | NQ | 18 | 100% | 66% | |
| 16 | | | | | | | | | |
| 17 | | - 125 mm Quartz seam at depth of 16.9 metres | | | NQ | 19 | 100% | 89% | |
| | -32.04 | | | | | | | | |
| 18 | | End of Borehole | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH416

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/24 WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY mm | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| 0 | -11.93 | | | | | | | | |
| | | Very loose dark grey ORGANIC SILT with sand<br>-trace gravel<br>-shells throughout<br>-strong organic odour | | | SS | 1 | 75 | Wght. of Rods | |
| 1 | | | | | SS | 2 | 575 | Wght. of Hammer | |
| | | | | | SS | 3 | 150 | 2 | |
| 2 | -14.29 | | | | SS | 4 | 525 | 10 | |
| | | Very loose to loose grey silty SAND with gravel to SAND with silt<br>-shells throughout | | | SS | 5 | 600 | Wght. of Hammer | |
| 3 | | | | | SS | 6 | 75 | 4 | |
| 4 | -16.20 | | | | | | | | |
| | | Very soft grey CLAY | | | SS | 7 | 400 | Wght. of Hammer | |
| 5 | | | | | SS | 8 | 600 | Wght. of Rods | |
| | | | | | ST | 9 | 300 | PUSH | |
| 6 | | -300 mm thick layer of sand at depth of 6.2 metres | | | SS | 10 | 175 | 2 | |
| 7 | | | | | SS | 11 | 600 | Wght. of Rods | |
| | | | | | SS | 12 | 600 | Wght. of Rods | |
| 8 | | | | | | | | | |
| 9 | -20.92 | | | | | | | | |
| | | Loose to compact grey silty SAND with gravel to SAND with silt | | | SS | 13 | 250 | 10 | |
| 10 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH416

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/24

WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | mm | | |
| 10 | | Silty SAND with gravel to SAND with silt, cont'd. | | | SS | 14 | 350 | 5 | |
| | -22.83 | | | | SS | 15 | 75 | 56/200mm | |
| 11 | | Fractured to very sound grey FELSIC GNEISS:BEDROCK | | | | | | | |
| 12 | | | | | NQ | 16 | 77% | RQD 70% | |
| 13 | | | | | NQ | 17 | 100% | 100% | |
| | -25.85 | | | | NQ | 18 | 100% | 70% | |
| 14 | | End of Borehole | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |
| 17 | | | | | | | | | |
| 18 | | | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH417

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/25 to 2012/07/26 WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | -13.88 | | | | | | mm | | |
| 0 | | Very loose dark grey ORGANIC SILT | | | SS | 1 | 350 | Wght. of Rods | |
| 1 | | | | | SS | 2 | 600 | Wght. of Rods | |
| | -15.43 | | | | | | | | |
| 2 | | Very loose grey silty SAND with gravel -trace shells | | | SS | 3 | 200 | Wght. of Hammer | |
| | | | | | SS | 4 | 300 | 1 | |
| 3 | -16.93 | | | | | | | | |
| | | Very soft grey CLAY | | | | | | | |
| 4 | | | | | SS | 5 | 600 | Wght. of Rods | |
| | | | | | SS | 6 | 600 | Wght. of Rods | |
| 5 | | | | | SS | 7 | 600 | Wght. of Rods | |
| 6 | | | | | | | | | |
| | | | | | SS | 8 | 350 | Wght. of Rods | |
| 7 | | | | | | | | | |
| 8 | | | | | SS | 9 | 600 | Wght. of Rods | |
| 9 | | | | | SS | 10 | 600 | Wght. of Rods | |
| 10 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH417

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/25 to 2012/07/26 WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | mm | | |
| 10 | | CLAY, cont'd. | | | SS | 11 | 600 | Wght. of Rods | |
| 11 | -25.31 | | | | ST | 12 | 600 | Wght. of Rods | |
| 12 | | Loose grey silty SAND with gravel | | | SS | 13 | 300 | Wght. of Rods | |
| 13 | -27.04 | | | | | | | | |
| 14 | | Fractured to sound dark grey MAFIC GNEISS:BEDROCK | | | NQ | 14 | 89% | RQD 78% | |
| 15 | | | | | NQ | 15 | 100% | 73% | |
| 16 | -29.98 | -quartz seam from depth of 15.72 metres to bottom of core | | | NQ | 16 | 100% | 67% | |
| | | End of Borehole | | | | | | | |
| 17 | | | | | | | | | |
| 18 | | | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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Stantec

# BOREHOLE RECORD

BH418

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/25

WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY mm | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| 0 | -12.13 | | | | | | | | |
| | | Very loose dark grey ORGANIC SILT with sand -occasional cobbles -shells throughout | | | SS | 1 | 350 | Wght. of Rods | |
| 1 | | | | | SS | 2 | 600 | Wght. of Rods | |
| 2 | | | | | SS | 3 | 50 | 7 | |
| | -14.64 | | | | SS | 4 | 600 | 3 | |
| | | Very loose grey SILT with sand to sandy SILT -shells throughout | | | | | | | |
| 3 | | | | | SS | 5 | 400 | Wght of Hammer | |
| 4 | | | | | SS | 6 | 600 | Wght of Hammer | |
| | -17.01 | | | | ST | 7 | 0 | PUSH | |
| 5 | | Very soft grey CLAY | | | SS | 8 | 600 | Wght. of Rods | |
| 6 | | | | | | | | | |
| | | | | | SS | 9 | 600 | Wght. of Rods | |
| 7 | | | | | | | | | |
| 8 | | | | | ST | 10 | 600 | Wght. of Rods | |
| 9 | | | | | | | | | |
| 10 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH418

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/25 WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | mm | | |
| 10 | | CLAY. cont'd. | | | SS | 11 | 600 | Wght. of Rods | |
| | -23.00 | | | | | | | | |
| 11 | | Inferred to be silty SAND with gravel | | | SS | 12 | - | 27 | |
| | -23.61 | -spoon broke off in borehole | | | | | | | |
| | | Fractured moderately weathered grey FELSIC GNEISS:BEDROCK | | | NQ | 13 | 100% | RQD 53% | |
| 12 | | | | | | | | | |
| | | | | | NQ | 14 | 93% | 67% | |
| 13 | | | | | | | | | |
| | -26.02 | | | | NQ | 15 | 100% | 61% | |
| 14 | | End of Borehole | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |
| 17 | | | | | | | | | |
| 18 | | | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH419

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/24 WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY mm | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| 0 | -6.74 | | | | | | | | |
| | | Very loose to loose dark grey to black ORGANIC SILT with sand | | | SS | 1 | 0 | Wght. of Rods | |
| 1 | -7.76 | | | | SS | 2 | 200 | Wght. of Rods | |
| | | Very loose to loose black SAND with organic silt<br>-strong organic odour<br>-shells throughout | | | | | | | |
| 2 | | | | | SS | 3 | 25 | Wght. of Hammer | |
| | | | | | SS | 4 | 225 | 6 | |
| 3 | | | | | | | | | |
| | | | | | SS | 5 | 0 | Wght. of Hammer | |
| 4 | | | | | SS | 6 | 300 | 1 | |
| | -11.06 | | | | | | | | |
| | | Very loose to loose dark grey SAND with organic silt to ORGANIC SILT with sand<br>-strong organic odour<br>-shells throughout | | | SS | 7 | 375 | Wght. of Hammer | |
| 5 | | | | | SS | 8 | 400 | 5 | |
| | -12.28 | | | | | | | | |
| | | Very loose to loose grey silty SAND to SAND with silt<br>-shells throughout<br>-trace gravel | | | SS | 9 | 0 | 8 | |
| 6 | | | | | SS | 10 | 200 | 7 | |
| | | | | | SS | 11 | 0 | 1 | |
| 7 | -14.26 | | | | | | | | |
| | | Very soft grey SILT | | | SS | 12 | 600 | Wght. of Hammer | |
| 8 | | | | | | | | | |
| | -15.53 | | | | SS | 13 | 200 | Wght. of Hammer | |
| | | Very soft grey CLAY | | | SS | 14 | 600 | Wght. of Rods | |
| 9 | | | | | | | | | |
| 10 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH419

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/24

WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | mm | | |
| 10 | | CLAY, cont'd. | | | SS | 15 | 550 | Wght. of Rods | |
| | | | | | SS | 16 | 600 | Wght. of Rods | |
| 11 | | -sand seams at depth of 10.8 metres | | | | | | | |
| 12 | -18.93 | | | | SS | 17 | 600 | Wght. of Rods | |
| | | Loose grey silty SAND with gravel to SAND with silt -occasional cobbles | | | SS | 18 | 325 | 8 | |
| 13 | -19.90 | | | | NQ | 19 | 75mm 100% | - RQD 10% | |
| 14 | | Very severely fractured to fractured slightly to moderately weathered grey FELSIC GNEISS:BEDROCK -two seams of MAFIC GNEISS encountered | | | | | | | |
| 15 | | | | | NQ | 20 | 95% | 19% | |
| 16 | | | | | NQ | 21 | 91% | 65% | |
| 17 | -23.71 | | | | | | | | |
| | | End of Borehole | | | | | | | |
| 18 | | | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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Stantec

# BOREHOLE RECORD

BH420

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/25 WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY mm | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| 0 | -7.61 | Very loose to loose black ORGANIC SILT with sand -shells throughout | | | SS | 1 | 50 | Wght. of Rods | |
| 1 | | | | | SS | 2 | 400 | Wght. of Rods | |
| 2 | -9.13 | Very loose to loose SAND with organic silt -shells throughout -occasional cobbles -strong organic odour | | | SS | 3 | 25 | 6 | |
| 3 | | | | | SS | 4 | 400 | 3 | |
| 4 | -11.50 | Black ORGANIC SILT -trace gravel -occasional cobbles | | | SS | 5 | 225 | 9 | |
| 5 | -12.11 | Very loose to loose dark grey silty SAND with gravel -shells throughout | | | SS | 6 | 600 | 4 | |
| 6 | -13.71 | Very soft grey SILT | | | SS | 7 | 350 | 6 | |
| 7 | -14.26 | Very soft grey CLAY -sand seam at depth of 9.24 metres | | | SS | 8 | 600 | Wght. of Rods | |
| 8 | | | | | SS | 9 | 600 | Wght. of Rods | |
| 9 | | | | | SS | 10 | 600 | Wght. of Rods | |
| 10 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH420

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/25 WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | mm | | |
| 10 | | CLAY, cont'd. | | | SS | 11 | 600 | Wght. of Rods | |
| 11 | -18.68 | | | | SS | 12 | 600 | Wght. of Rods | |
| | -19.29 | Loose grey silty SAND with gravel | | | SS | 13 | 50 | 50/50mm | |
| 12 | | Very severely fractured to severely fractured grey FELSIC GNEISS:BEDROCK -seam of MAFIC GNEISS encountered | | | NQ | 14 | 44% | RQD 0% | |
| 13 | | | | | NQ | 15 | 97% | 36% | |
| 14 | -21.86 | | | | | | | | |
| | | End of Borehole | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |
| 17 | | | | | | | | | |
| 18 | | | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

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# BOREHOLE RECORD

BH423

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/25

WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | SAMPLES NUMBER | SAMPLES RECOVERY | SAMPLES N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | -3.56 | | | | | | mm | | |
| 0 | | Very loose black ORGANIC SILT | | | SS | 1 | 100 | 1 | |
| | -4.17 | -shells throughout | | | | | | | |
| 1 | | Compact black SAND with organic silt | | | SS | 2 | 350 | 14 | |
| | | -trace gravel | | | | | | | |
| | | -occasional cobbles | | | SS | 3 | 275 | 32 | |
| 2 | | -shells throughout | | | | | | | |
| | | -strong organic odour | | | SS | 4 | 225 | 25 | |
| | -6.02 | | | | | | | | |
| | | Loose grey SILT with sand to silty SAND with gravel | | | | | | | |
| 3 | | -occasional cobbles | | | SS | 5 | 25 | 9 | |
| | | | | | SS | 6 | 450 | 7 | |
| 4 | -7.70 | | | | | | | | |
| | -7.90 | Very soft grey CLAY | | | | | | | |
| | | Dense grey silty SAND with gravel | | | SS | 7 | 175 | 63/250mm | |
| | -8.54 | -occasional cobbles | | | | | | | |
| 5 | | Severely fractured to sound slightly weathered grey FELSIC GNEISS:BEDROCK | | | NQ | 8 | 75mm<br>100% | -<br>RQD<br>77% | |
| 6 | | -iron staining | | | | | | | |
| | | | | | NQ | 9 | 98% | 47% | |
| 7 | -10.98 | | | | | | | | |
| | | End of Borehole | | | | | | | |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |
| 10 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

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# BOREHOLE RECORD

BH424

CLIENT CANADIAN ROYALTIES INC.

PROJECT No. 121613564

LOCATION PROPOSED WHARF - SITE 1, DECEPTION BAY, QUEBEC

BH SIZE HW

DATES: BORING 2012/07/25 WATER LEVEL

DATUM CHART

| DEPTH(m) | ELEVATION(m) | SOIL DESCRIPTION | STRATA PLOT | WATER LEVEL | SAMPLES TYPE | NUMBER | RECOVERY | N-VALUE OR-RQD % | OTHER TESTS |
|---|---|---|---|---|---|---|---|---|---|
| | -3.37 | | | | | | mm | | |
| 0 | | Very loose dark grey ORGANIC SILT with sand -shells throughout | | | SS | 1 | 150 | Wght. of Rods | |
| | -4.06 | Very loose grey SILT to SILT with sand -gravel in top 550 mm -trace shells | | | SS | 2 | 525 | 4 | |
| 1 | | | | | SS | 3 | 425 | 2 | |
| 2 | | | | | SS | 4 | 300 | 1 | |
| 3 | -6.52 | | | | SS | 5 | 475 | Wght. of Hammer | |
| | | Very soft grey CLAY | | | SS | 6 | 600 | Wght. of Hammer | |
| 4 | | | | | SS | 7 | 225 | Wght. of Hammer | |
| | -8.20 | -sand seams below depth of 4.4 metres | | | SS | 8 | 575 | 9 | |
| 5 | | Loose grey silty sand with gravel -occasional cobbles | | | SS | 9 | 25 | 7 | |
| | -9.29 | | | | SS | 10 | 100 | 50/100mm | |
| 6 | | Severely fractured to fractured slightly weathered grey FELSIC GNEISS:BEDROCK | | | NQ | 11 | 100mm-100% | RQD 42% | |
| 7 | | | | | NQ | 12 | 98% | 73% | |
| | -11.07 | | | | | | | | |
| 8 | | End of Borehole | | | | | | | |
| 9 | | | | | | | | | |
| 10 | | | | | | | | | |

UNDRAINED SHEAR STRENGTH - kPa

20 40 60 80

WATER CONTENT & ATTERBERG LIMITS $W_P$ W $W_L$

DYNAMIC PENETRATION TEST, BLOWS/0.3m ★

STANDARD PENETRATION TEST, BLOWS/0.3m ●

10 20 30 40 50 60 70 80 90

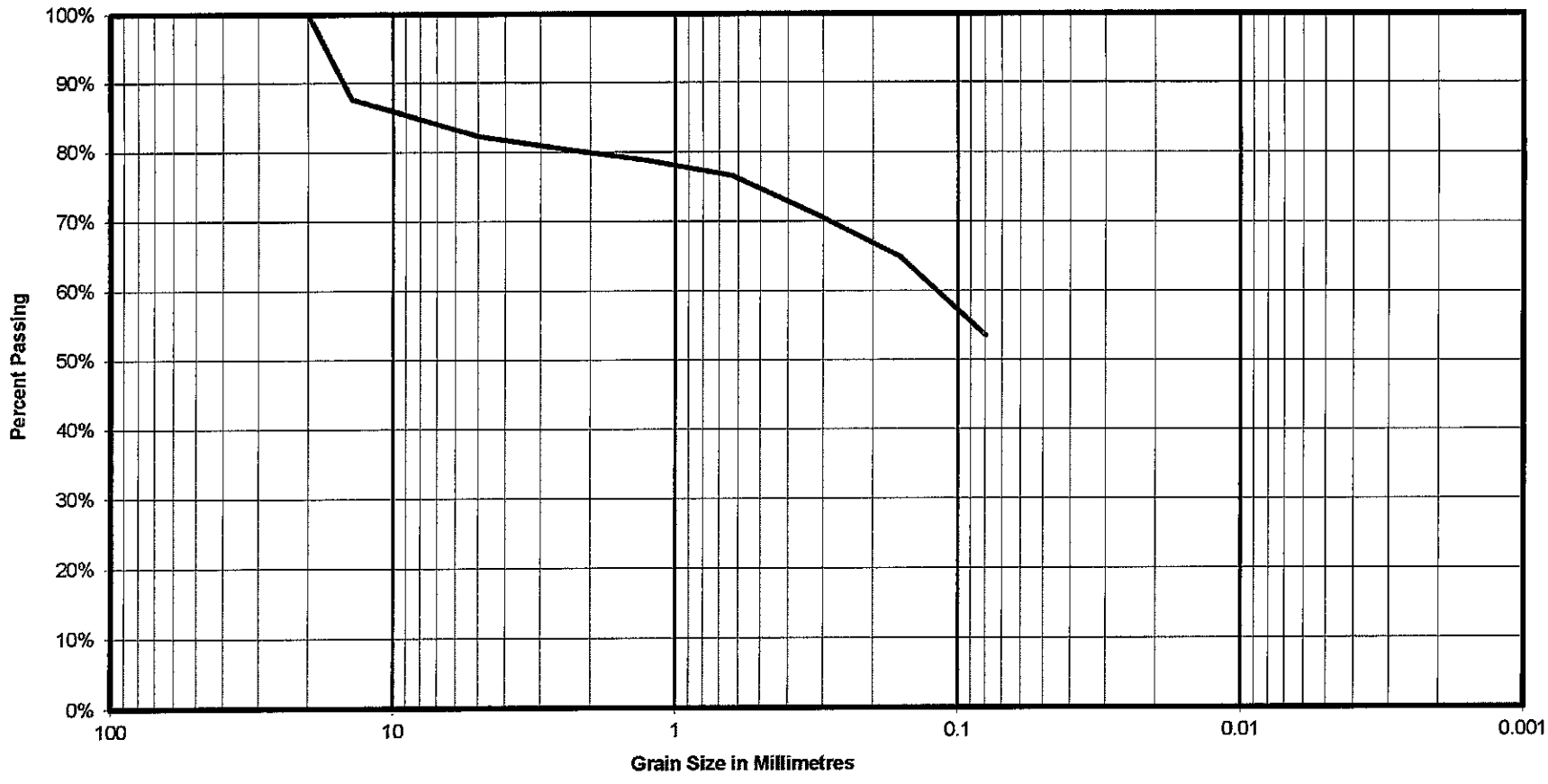
■ PENETROMETER
▲ FIELD VANE TEST
◆ MINIATURE VANE SHEAR TEST
✖ UU TRIAXIAL TEST

App'd Sep 28 2012 8:28:45

MBH 9/28/12

# APPENDIX B
# Grain Size Curves

Approved:




| | Gravel | | Sand | | | Silt and Clay |
|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | |

Unified Soil Classification System ASTM D 2487/2488

| Curve | BOREHOLE/TESTPIT | SAMPLE | DEPTH (m) | Soil Fractions | | | Soil Description |
|---|---|---|---|---|---|---|---|
| | | | | Gravel | Sand | Silt/Clay | |
| ——— | BH 15 | Sa 4 | 2.11 - 2.72 | 18% | 29% | 54% | Sandy CLAY with Gravel |
| | | | | | | | |
| | | | | | | | |

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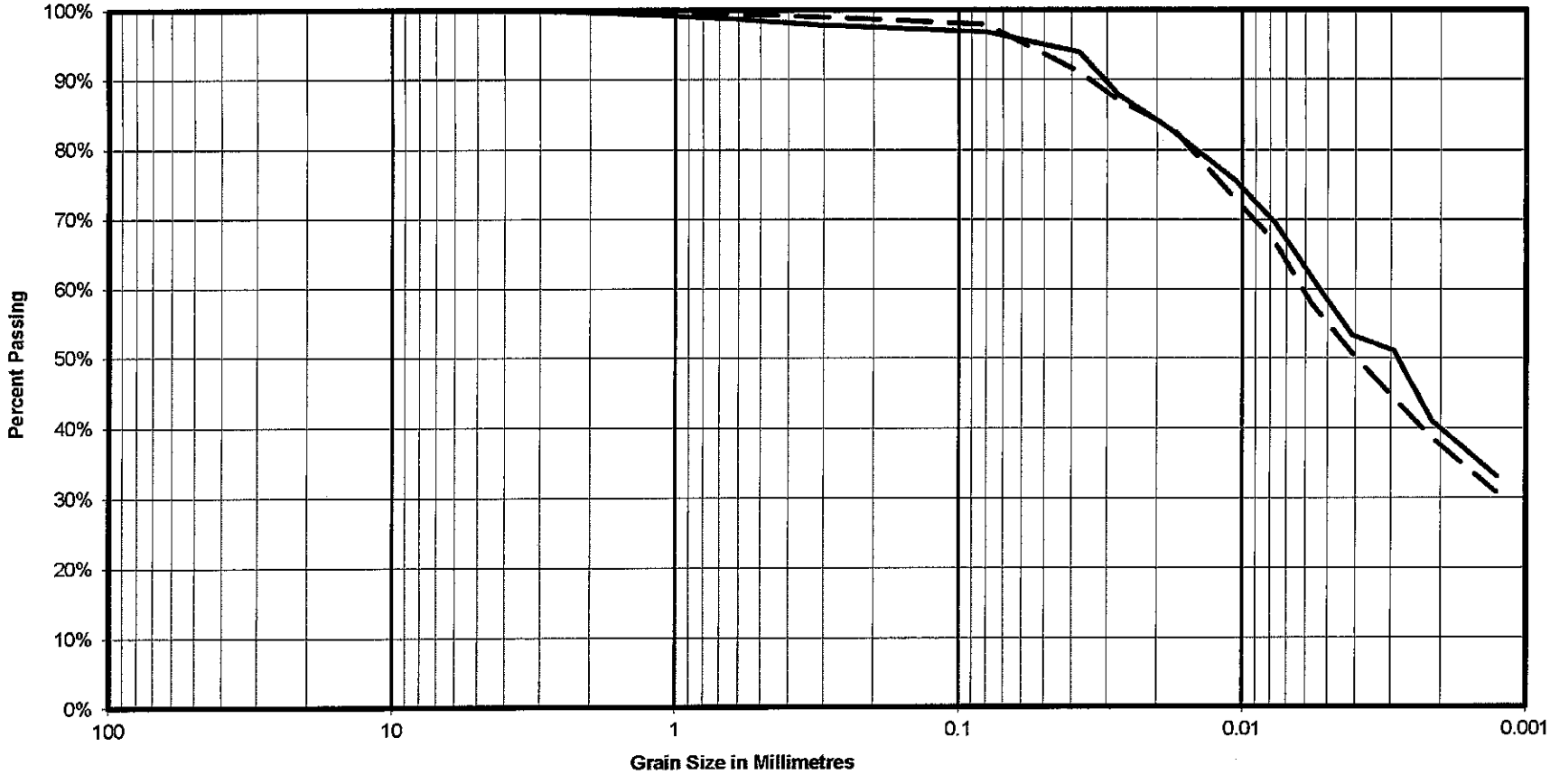
Approved:




| | Gravel | | Sand | | | Silt and Clay |
|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | |

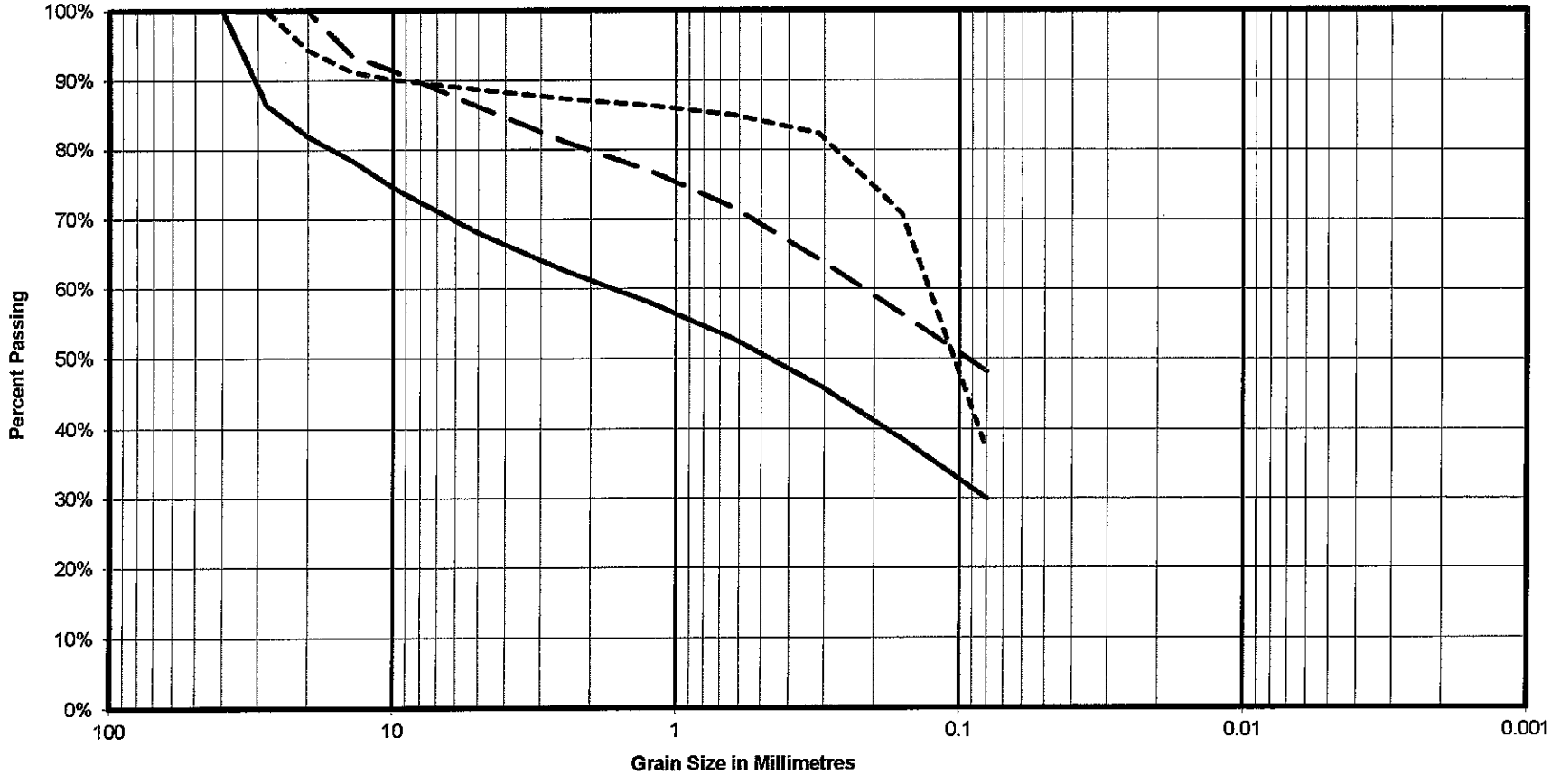
Unified Soil Classification System ASTM D 2487/2488

| Curve | BOREHOLE/TESTPIT | SAMPLE | DEPTH (m) | Soil Fractions | | | Soil Description |
|---|---|---|---|---|---|---|---|
| | | | | Gravel | Sand | Silt/Clay | |
| ——— | BH 4A | Sa 6 | 6.1 | | 3% | 97% | CLAY |
| — — — | BH 8 | Sa 4 | 3.05 - 3.66 | | 2% | 98% | CLAY |
| | | | | | | | |

Stantec

Job No.: 121613564

Approved:




| | Gravel | | Sand | | | Silt and Clay |
|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | |

Unified Soil Classification System ASTM D 2487/2488

| Curve | BOREHOLE/TESTPIT | SAMPLE | DEPTH (m) | Soil Fractions | | | Soil Description |
|---|---|---|---|---|---|---|---|
| | | | | Gravel | Sand | Silt/Clay | |
| ——— | BH 4 | Sa 11 | 14.43 - 15.04 | 32% | 38% | 30% | Silty SAND with Gravel |
| — — - | BH 7 | Sa 6 | 5.11 - 5.71 | 14% | 38% | 48% | Silty SAND |
| - - - - | BH 7 | Sa 7 | 5.71 - 6.32 | 11% | 52% | 37% | Silty SAND |

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Job No.: 121613564

# APPENDIX C
# Drawing No. 101, Borehole Location Plan

## LEGEND

- BOREHOLE LOCATION
- [–XX.X] BOTTOM CLAY ELEVATION (FROM BOREHOLE LOGS)
- (–XX.X) BEDROCK ELEVATION (FROM BOREHOLE LOGS)

516500

516750

6889750

BH113 [–26.4] (–28.4)
BH114 [–25.6] (–30.1)
BH102 [–23.3] (–27.3)
BH104 [–22.4] (–26.7)
BH115 [–24.3] (N/A)
BH115A [N/A] (–28.9)
BH101A [–21.1] (N/A)
BH101 [–20.8] (–26.7)
BH106 [N/A] (N/A)
BH106A [–18.6] (–24.0)
BH116 [–21.4] (–25.5)
BH103 [–21.2] (–24.4)
BH108 [–19.7] (–20.8)
BH117 [–22.0] (–27.0)
BH01 [–26.5] (–27.9)
BH05 [–18.9] (–24.1)
BH105 [–19.2] (–22.0)
BH07 [–16.7] (–22.2)
BH09 [–17.2] (–18.0)
BH29A [N/A] (–20.7)
BH29 [–21.3] (N/A)
BH107 [–13.5] (–17.6)
BH110 [–13.8] (–16.7)
BH28 [–15.1] (–19.1)
BH112 [–11.3] (–13.7)
BH04 [–21.2] (–24.1)
BH06 [–21.0] (–22.8)
BH08 [–14.5] (–18.1)
BH30 [–11.0] (–15.7)
BH409 [N/A] (–12.9)
BH411 [N/A] (–19.5)
BH11 [–16.3] (–18.7)
BH10 [–12.0] (–15.9)
BH109 [–10.4] (–15.1)
BH12 [–14.6] (–18.2)
BH408 [–8.9] (–12.9)
BH410 [–8.3] (–9.6)
BH111 [–7.8] (–11.3)
BH412 [–9.1] (–9.9)
BH413 [–26.8] (–28.9)
BH13 [–20.1] (–20.8)
BH15 [–11.1] (–16.3)
BH32A [–10.1] (–12.6)
BH424 [–8.2] (–9.3)
BH423 [–7.9] (–8.5)
BH414 [N/A] (–22.6)
BH415 [–26.6] (–28.7)
BH417 [–25.3] (–27.0)
BH16 [–14.6] (–19.7)
BH416 [–20.9] (–22.8)
BH418 [–23.0] (–23.6)
BH419 [–18.9] (–19.9)
BH420 [–18.7] (–19.3)

PROPOSED CELL [CENTER COORDINATES E 516595 N 6889756]

PROPOSED CELL [CENTER COORDINATES E 516631 N 6889715]

PROPOSED PIER [CENTER COORDINATES E 516593 N 6889655]

LWL (APPROX)

HWL (APPROX)

AT25 (–9.8)
AT425 (–8.6)
AT426 (–8.2)
AT28 (–6.8)
AT31 (–7.3)
AT118 (–7.5)
AT119 (–8.0)
AT22 (–11.1)
AT32 (–3.0)
AT23 (–9.7)
AT26 (–9.0)
AT29 (–3.3)
AT120 (–7.6)
AT422 (–7.5)
AT121 (–7.0)
AT21 (–4.0)
AT24 (–7.6)
AT27 (–4.3)
AT30 (–3.0)

NOTE: THIS DRAWING ILLUSTRATES SUPPORTING INFORMATION SPECIFIC TO A STANTEC CONSULTING LTD REPORT AND MUST NOT BE USED FOR OTHER PURPOSES.

T:\1216XX\121613564 deception bay\121613564-101.dwg PRINTED: Apr 22, 2013

| | | | | | |
|---|---|---|---|---|---|
| Reference:<br>-CAD FILE "10730_contours.dwg" PROVIDED BY IGLU, 5 JULY 2012<br>-CAD FILE "8063SG-001-BTY-DECPT12-01-0.dwg" PROVIDED BY FUGRO JACQUES GEOSURVEYS INC., 30 AUG, 2011 | Job No.: 121613564<br>Scale: 1:1000<br>Date: 2013/04/16<br>Dwn. By: BSP<br>App'd By: | Client: CANADIAN ROYALTIES INC.<br>Site Address: DECEPTION BAY, QUEBEC | Project: DECEPTION BAY WHARF SITE 1 | Drawing Title: BOREHOLE LOCATION PLAN | Dwg. No.: 101 |

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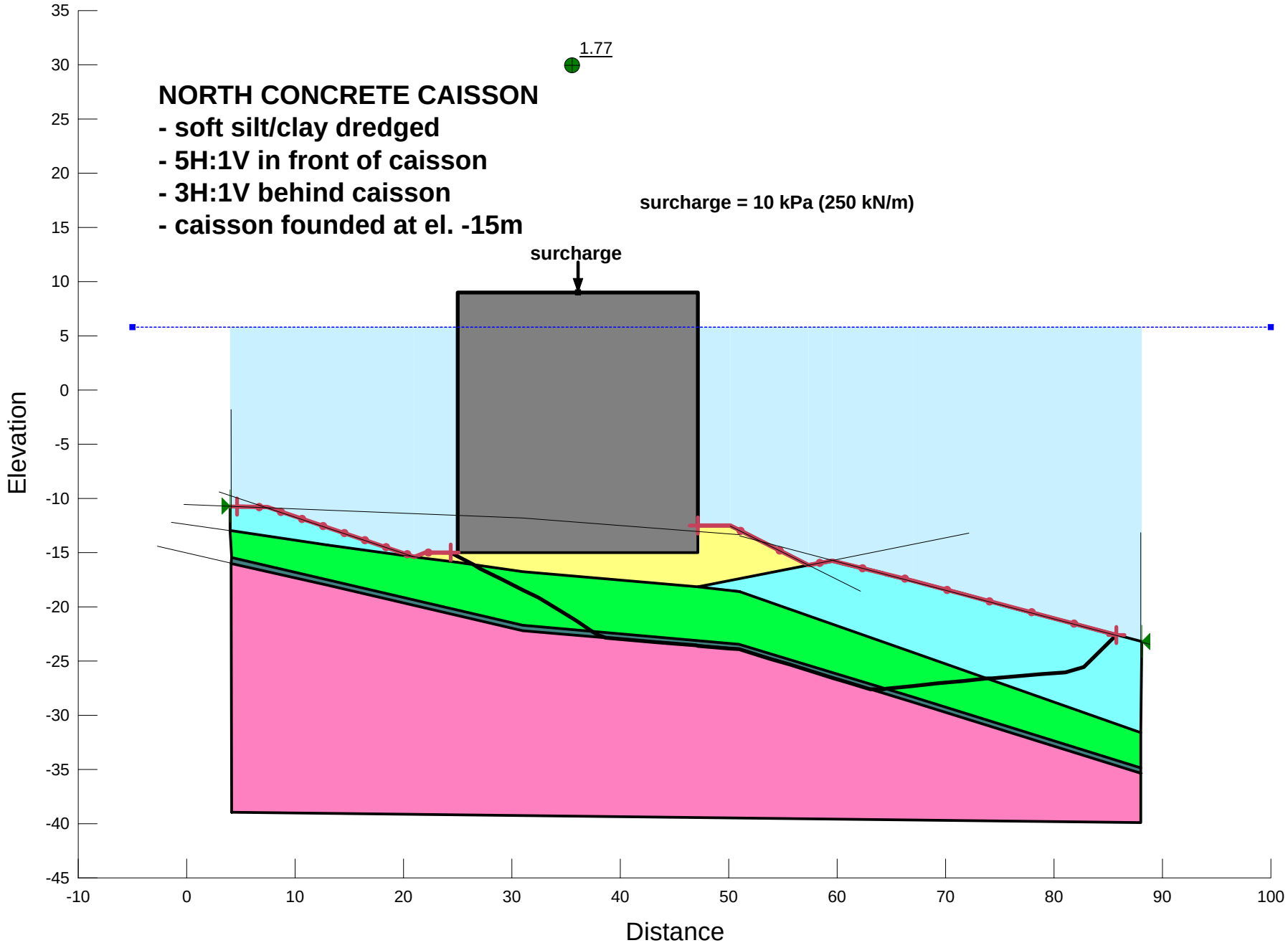
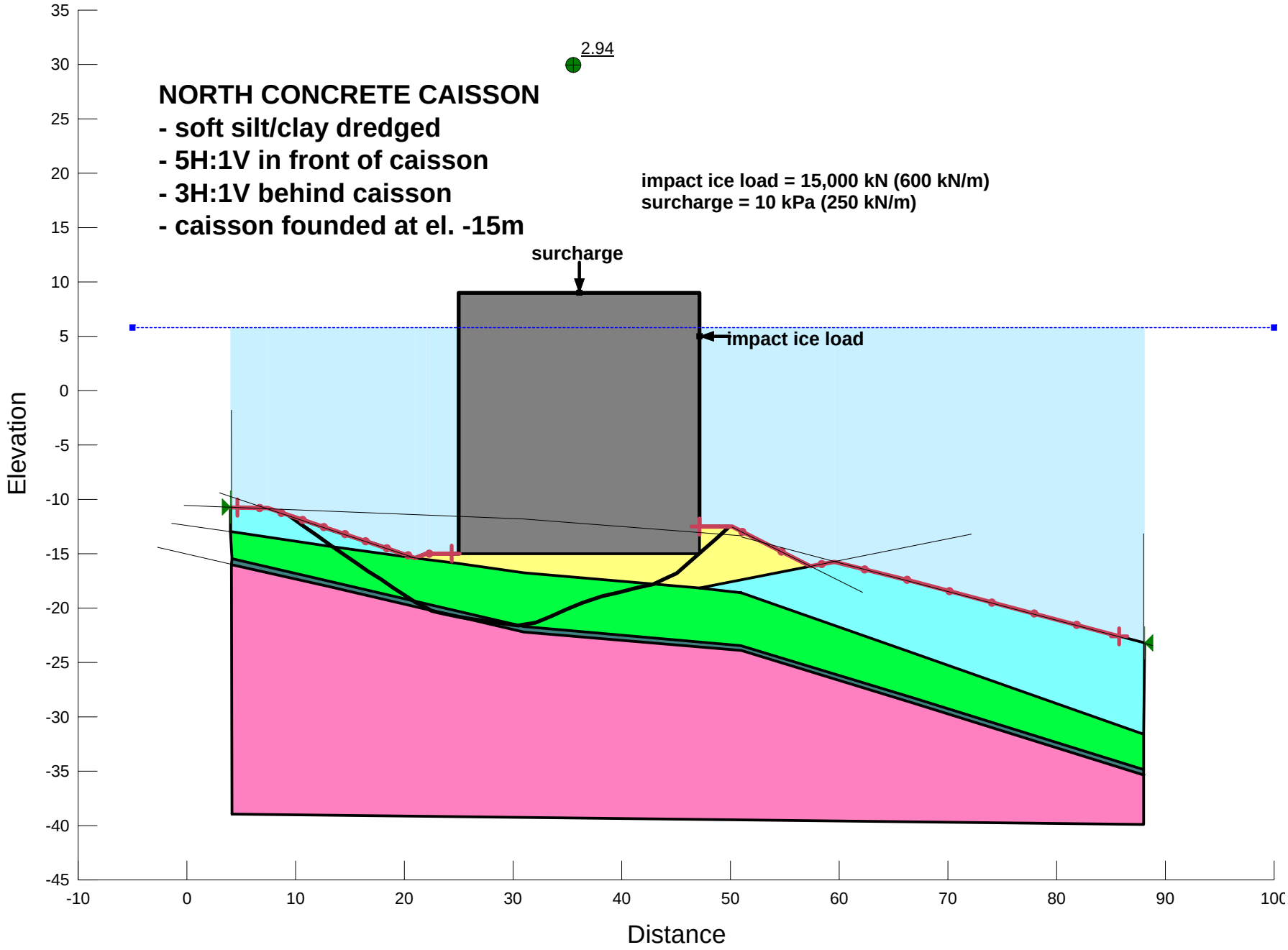
# APPENDIX D
# Figures 1 to 6, Typical Wharf Sections



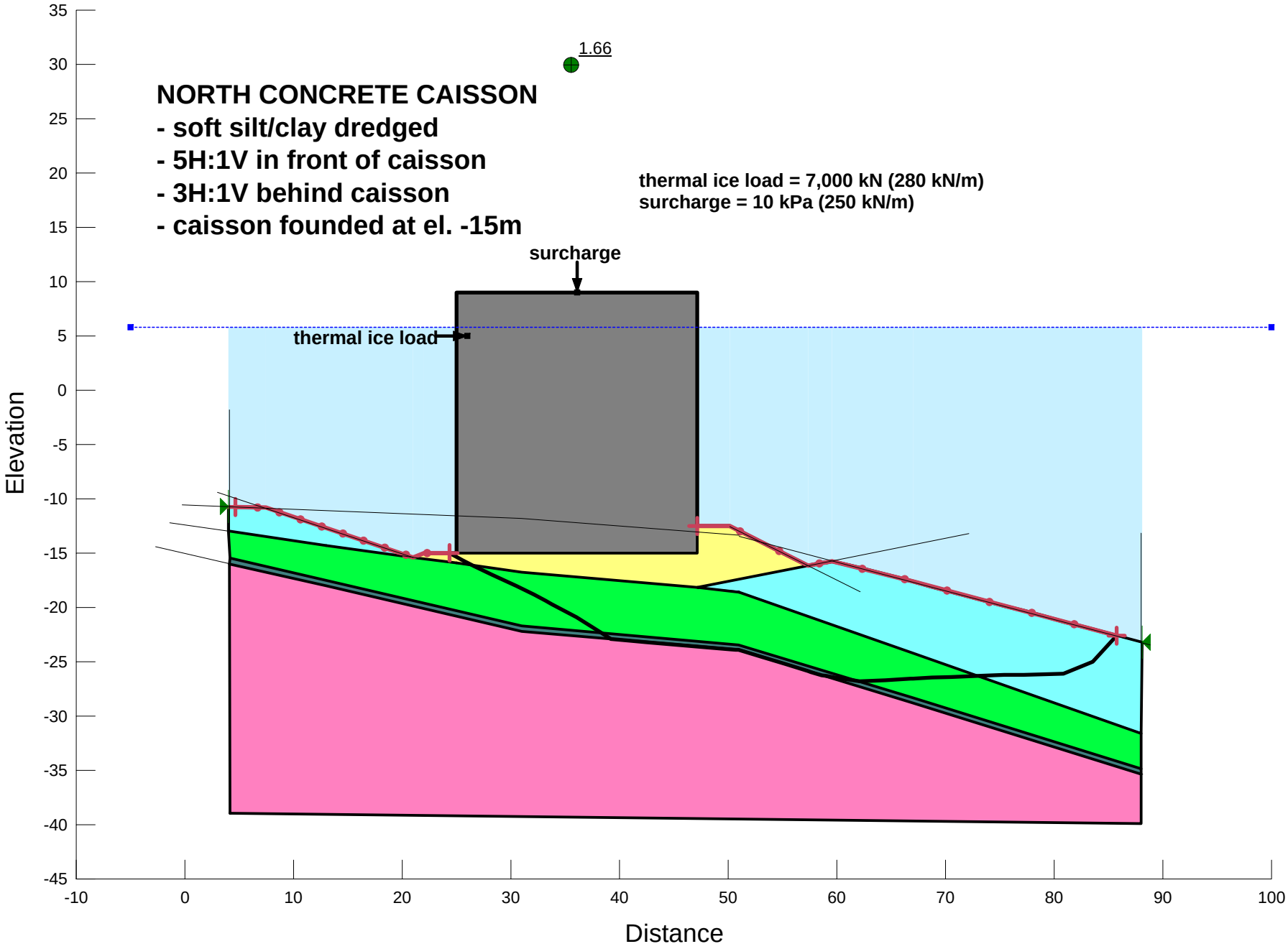

Project No. 121613564

Figure 1



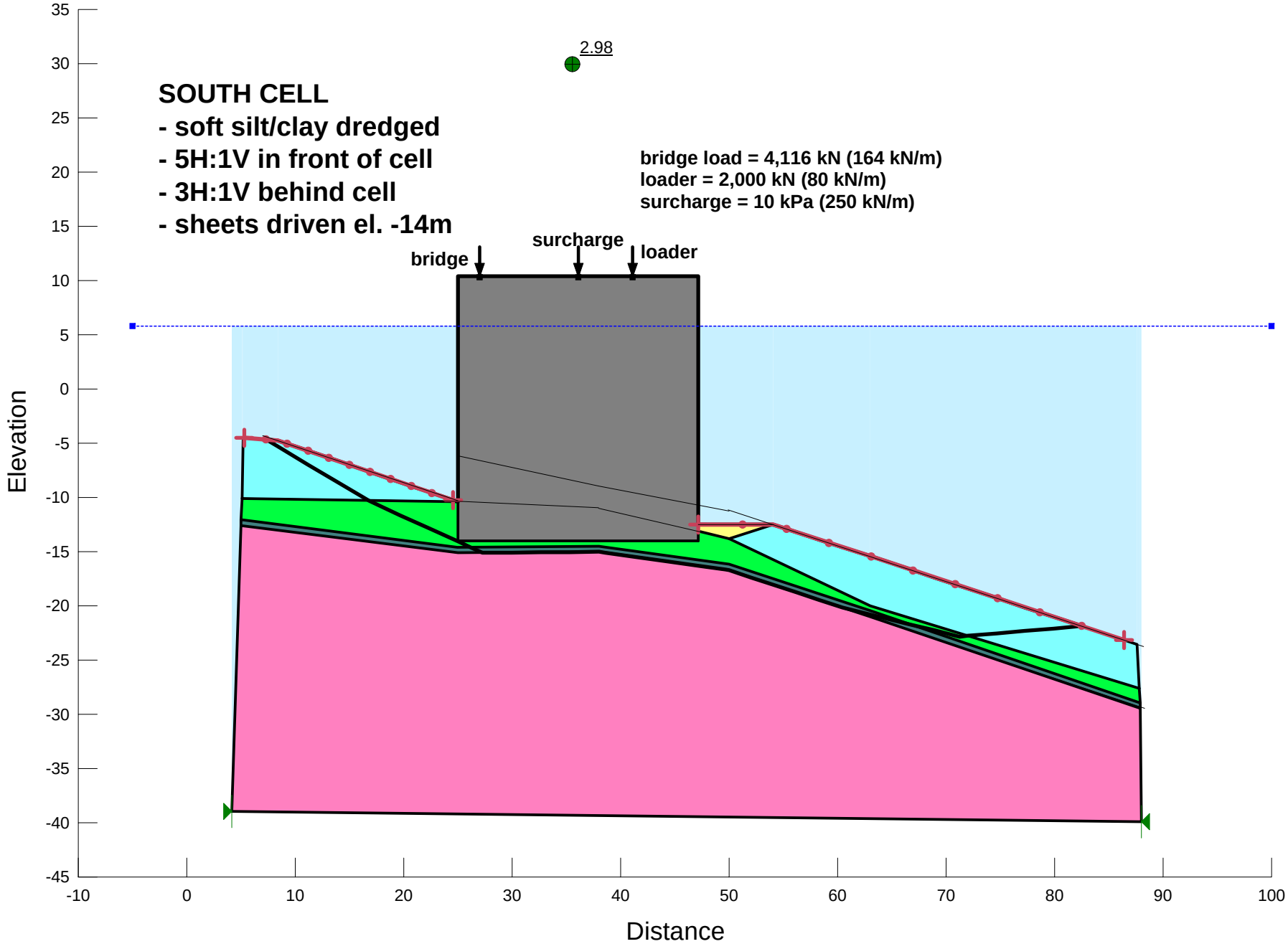

Project No. 121613564

Figure 2



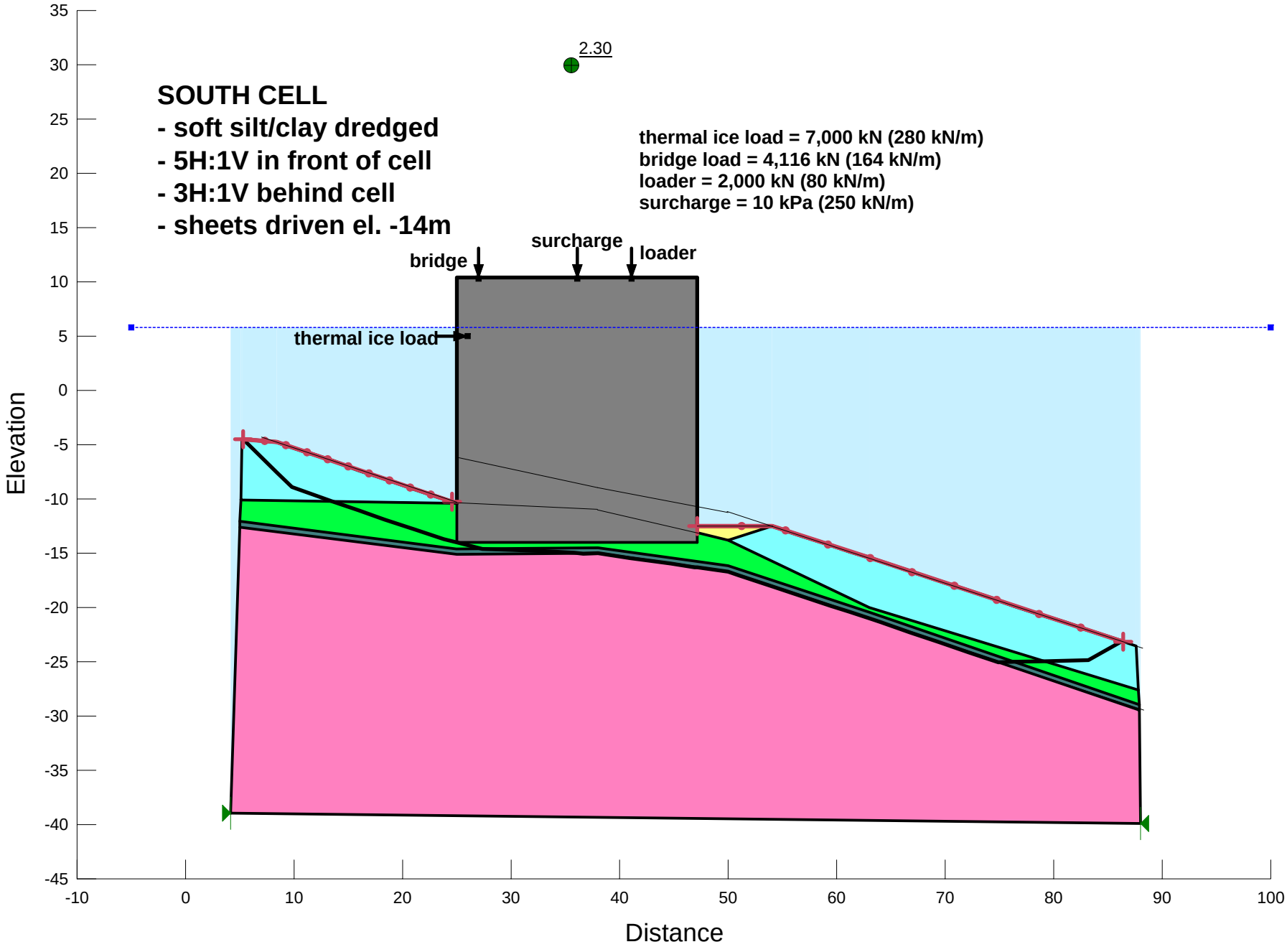

Project No. 121613564

Figure 3



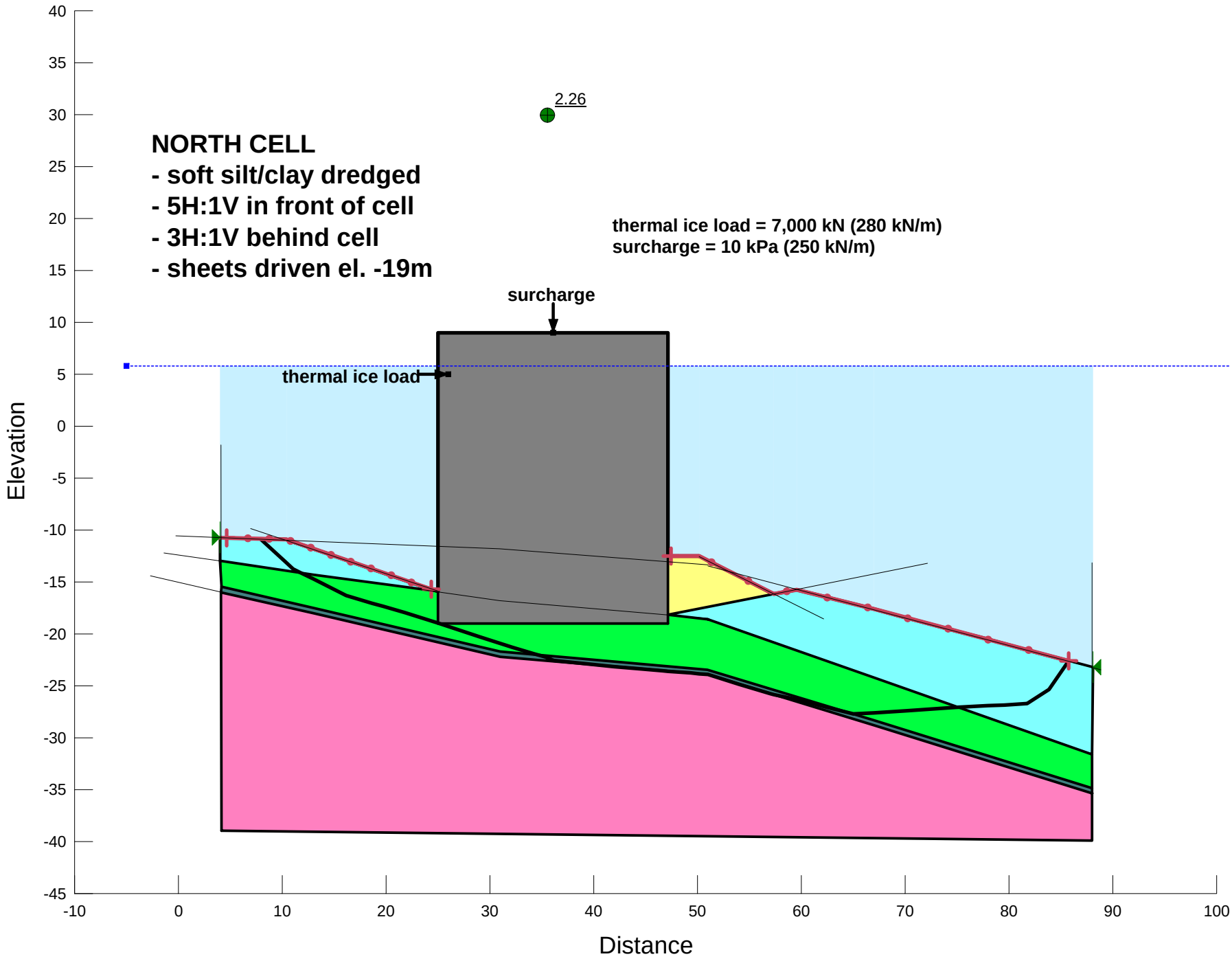

Project No. 121613564

Figure 4




Project No. 121613564

Figure 5




Project No. 121613564

Figure 6

| | |
|---|---|
| **De :** | McQuinn, Dan |
| **A :** | Gail Amyot |
| **Cc :** | Natalie Gagne; Jean Corbeil; Joel Desmeules; briantaylor@accesswave.ca |
| **Objet :** | RE: questions from COFEX |
| **Date :** | 7 mai 2013 14:33:09 |

Gail,

please find attached response to geotechnical questions by the Department of Fisheries and Oceans. Each question is preceded by a bullet and succeeded by our response. If any clarification is need please do not hesitate to contact us.

- How can we be sure of the slopes' stability? Can the clay to silty clay layer support/take up the weight of the riprap? Can you calculate the security factor of the slope (after the excavation and with the riprap)?

We have not specifically calculated the slope stability for each condition within the clay to silty clay surrounding the proposed SSP cells. However, in general the rock fill /riprap will only replace the volume of clay that will be removed. Although the weight of rock fill is assumed to be approximately 10 percent more than the clay that it replaces the rock would form a significant part of the shear plane and would therefore reinforce the slope relative to its original condition. Hence, we expect the final factor of safety against slope failure to be equivalent to or better than the pre-construction condition.

Stability calculations conducted for the riprap fill around the centre bridge pier indicate a need for revision of this detail and we have been in contact with the designers on this matter. Revisions may include reduction of the fill height or, benching of the fill to improve the slope stability or a combination of these. Other solutions could include strengthening the pile bent to reduce the need for armouring or surrounding the pier with a steel sheet pile barrier. The final solution would be submitted as an addendum to the design specifications.

- Can you calculate the global stability in pseudo static condition?

For earthquake loading, we have used a site peak ground acceleration (PGA) of 0.102g. This value was obtained from Natural Resources Canada for Deception Bay using 2%/50 years probability. For pseudostatic slope stability analysis, $k_h$ = 0.051g and $k_v$ = 0g were used. The recommended value of $k_h$ is based on Hynes-Griffin and Franklin (1984) criteria which suggests that for pseudostatic analysis, 50% of the PGA is appropriate.
We have assumed that the earthquake loading does not act simultaneously with the thermal ice loading, in that they are both considered to be extraordinary loads. Our analyses for the north cell yield a factor of safety of 1.63 under earthquake loading, compared to 2.63 under dead loads alone. The Slope/W output for the global stability analysis is attached.

Since the south cell has a higher factor of safety under dead loads than the north cell, we infer that the south cell factor of safety under earthquake loading will be greater than 1.63.

Using similar assumptions, bearing capacity analysis of the South cell (the critical case under static conditions) under a pseudostatic earthquake loading gives a factor of safety against bearing capacity failure of 3.

- Is there settlement anticipated under the riprap?

We would expect consolidation settlement of the clay to silty clay where the future net pressure exceeds the existing in situ pressure. However, settlements would be within tolerable limits.

- What is the bearing capacity of the clay to silty clay layer?

We have assumed the undrained shear strength of the clay to silty clay to be 10 kPa. Based on this the unfactored bearing capacity would be 50 kPa. In some locations this is a conservative value considering that the sediment layer that failed in 2011 was estimated to be supporting in excess of 5 metres of fill, approximately equivalent to 100 kPa. However, the borehole and test pit data indicate that there is variation in the strength of the silty clay layer, although no trends or patterns could be determined. Accordingly, for analysis and design purposes we have adopted the aforementioned value of 10 kPa.

Reference

Hynes-Griffin, M.E., and Franklin, A.G. 1984. "Rationalizing the seismic coefficient method", Miscellaneous Paper GL-84-13, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS

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**From:** Gail Amyot [mailto:gail.amyot@canadianroyalties.com]
**Sent:** Friday, May 03, 2013 1:45 PM
**To:** McQuinn, Dan
**Cc:** Natalie Gagné; Jean Corbeil; Joel Desmeules
**Subject:** questions from COFEX

Hi Dan

We recently got some other questions from DFO related to the port conception and geotecnical stability of the location.

Could you please provide us answers to the followings:

- How can we be sure of the slopes' stability? Can the clay to silty clay layer support/take up the weight of the riprap? Can you calculate the security factor of the slope (after the excavation and with the riprap)
- Can you calculate the global stability in pseudo static condition?
- Is there settlement anticipated under the riprap?
- What is the bearing capacity of the clay to silty clay layer?

As you might know we are in the final stretch of permitting process; so rapid answer will be appreciated.

Best regards

Gail Amyot

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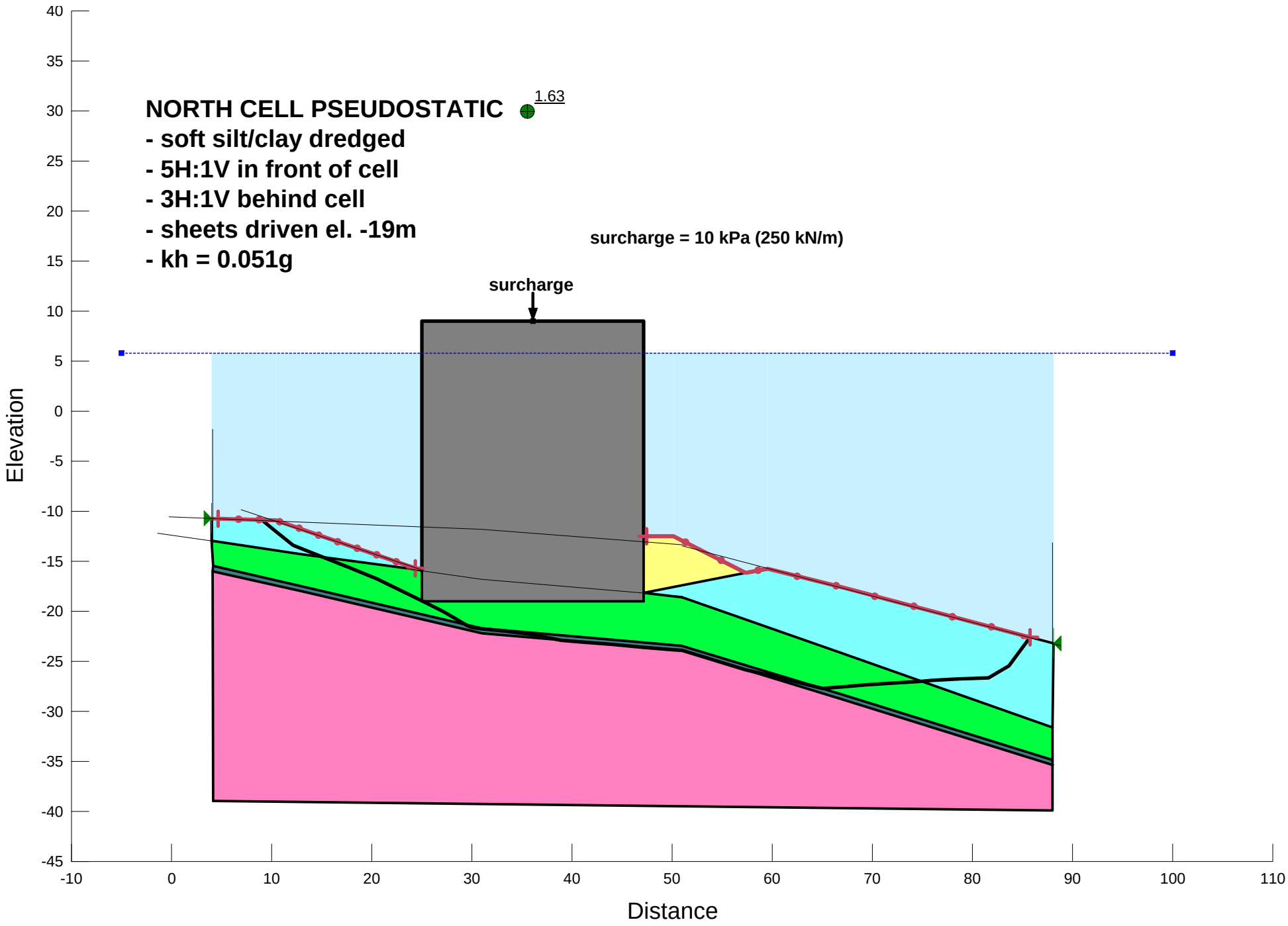
NORTH CELL PSEUDOSTATIC
1.63
- soft silt/clay dredged
- 5H:1V in front of cell
- 3H:1V behind cell
- sheets driven el. -19m
- kh = 0.051g
surcharge = 10 kPa (250 kN/m)
surcharge
Elevation
Distance
40
35
30
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-10
0
10
20
30
40
50
60
70
80
90
100
110

Appendix 3

GENIVAR: Technical Note: Dredging Methods

# TECHNICAL NOTE

**RECIPIENT:** Ms. Gail Amyot, Eng. M.Sc.
**SENDER:** Ms. Natalie Gagné, Eng. M.Sc., GENIVAR
**COPY:** Mr. François Hazel, Biologist
**DATE:** 2013-04-19
**SUBJECT:** **Nunavik Nickel Project, Canadian Royalties Inc. (CRI)**
**Environmental and Social Impact Assessment for the Development of Port Infrastructure and Sediment Management in Deception Bay**
**Dredging Techniques**
**O/Ref.: 101-53046-03_100**

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## 1.0 CONTEXT

Following the submission of the Environmental and Social Impact Assessment (ESIA) for the Development of Port Infrastructure and Sediment Management in Deception Bay, in December 2012, Fisheries and Oceans Canada analysts requested further information regarding the recommended dredging method as well as the measures proposed for sediment containment.

The aim of this technical note is to provide the information on which GENIVAR Inc. (GENIVAR) based its choice of dredging technique. The following sections give an overview and compare the different dredging options, highlighting the solution seeming to be the most appropriate for work required in Deception Bay.

Besides the dredging methods, the control measures proposed in the ESIA for the sediment dispersion plume will also be presented and commented with regard to their effectiveness for Deception Bay.

## 2.0 DREDGING TECHNIQUES

The most common dredges can be divided into three categories: mechanical dredges, hydraulic dredges and specialized dredges (1992; Herbich, 1992; Bray, 2008).

### 2.1 Mechanical Dredges

Mechanical dredges are used both for hard and soft materials. They remove sediment by direct application of mechanical force to the bottom surface. There are three types of mechanical dredges, namely clamshell dredges, dipper dredges and backhoe dredges.

Table 1 presents the main characteristics of each type of dredge, while their main advantages and disadvantages are in Table 2.

**Clamshell dredge:** This dredge is among the most common in the world and is sometimes considered to be an environmentally-friendly dredge (Bray, 2008). Clamshell dredges comprise a floating platform which can be self-propelled or be towed. It is mounted onto a crane which is itself installed on a pontoon stabilized using spuds or an anchor system. The crane can be cable or hydraulic. The pontoon can be equipped with a space to receive the dredged material, but most often, for transportation purposes, the dredged material is placed on scows or barges. Clamshell dredges are compact and relatively precise. In addition, they offer great flexibility in rough waters, as they can move vertically. However, clamshell dredges can lead to resuspension of sediment at several points of the dredging work, for instance at the moment of impact with the bottom surface, or during its penetration of the sediment, the lifting of the material and any spillage of dredged material from barges or scows, as well as during their disposal in open water, if applicable. According to Herbich (1992), it is preferable to use watertight clamshell dredges from an environmental point of view, as they reduce turbidity by 30 to 70% compared to other dredges.

**Dipper dredge:** This dredge is comparable to a power shovel mounted onto a pontoon with three spuds. The two front spuds are used to raise the pontoon alongside its dredging position, while the back spud keeps the dredger in a fixed position. It is most often used to extract soft rock and indurated sedimentary deposits, as well as recovering submerged infrastructure. There is however extensive loss of fine material when raising the bucket.

**Backhoe dredge:** This dredge is similar to excavators used on land except that at sea, it is installed on the reinforced deck of a scow. The dredge's bucket is attached to a mechanical arm and sediment is excavated by dragging the bucket towards the dredge. Dredged material can be dumped into scows, trucks or directly on the shore. This dredging method is very precise, but its main disadvantage is that fine material is easily resuspended. It should be noted that the hopper scows used during the dredging have a draft of around 2.4 m when filled with sediment. Thus, there needs to be an additional depth allowance of 3.7 m for the opening of hoppers when dumping.

Table 1 Characteristics of Main Types of Dredges Used in the St. Lawrence River

| | Mechanical Dredges | | | Hydraulic Dredges | | | Environmental Dredges | |
|---|---|---|---|---|---|---|---|---|
| | Clamshell Dredge | Dipper Dredge | Backhoe Dredge | Plain suction Dredge | Cutter-Suction Dredge | Hopper Dredge | Horizontal Auger Dredge (Mud Cat™) | Suction Bucket Dredge (Amphibex™) |
| Types of dredged materials | Fine, consolidated, gravel and sand sediment | Broken weak rock and dense sediments | All types | Mud, sand, loose, gravel | Mud, sand, gravel, compact material | Sandy, unconsolidated and non-cohesive | Fine sediments | All types |
| Maximum Water Depth | 40 m | 12 m | 12 m | 25 m | 25 m | 20 m | 6.1 m | 6.5 m |
| Precision of Dredging | 35 to 50 cm | 35 to 50 cm | 10 cm (with newer equipment) | 10 to 20 cm | 10 to 20 cm (depending on required production) | Vertical: 15 to 25 cm (with improved equipment, otherwise 0.5 to 1 m) Horizontal: 3 to 10 m | 10 to 20 cm | 5 cm |
| Yield | 30 to 500 $m^3/h$ | 30 to 200 $m^3/h$ | 30 to 200 $m^3/h$ | 50 to 1000 $m^3/h$ | 50 to 1000 $m^3/h$ | 50 to 500 $m^3/h$ | 90 $m^3/h$ | 100 $m^3/h$ |
| Resuspension | Average | Extensive | Average | Low at dredging site | Low at dredging site | Extensive | Extensive | Average |
| Water Content of Dredged Material | Low | Low | Low | Extensive | Extensive | Extensive | Extensive | Average |
| Dredged Material Transportation | Scows, trucks | Scows, trucks | Scows, trucks | Pipeline | Pipeline | Integrated | Pipeline | Scows, trucks, pipeline |

Source: Alliance Environnement (2004).

Table 2 Main Advantages and Disadvantages of Mechanical Dredges Used in the St. Lawrence River

| | Advantages | Disadvantages |
|---|---|---|
| General | • Low disturbance of excavated soil with a high level of solids and a low level of water.<br>• Minimal facilities necessary for transportation, treatment and disposal of material.<br>• Safe work near wharfs and other fixed installations.<br>• Effective for removal of polluted sediment near the shore or in a floodplain.<br>• Flexibility of execution in loose or compacted material and where there are obstacles or debris.<br>• Unit costs generally lower than for hydraulic dredges for dredging small volumes of sediments.<br>• Good dredging precision in shallow water.<br>• Barge discharging in open water generating less turbidity than hydraulic dredging.<br>• Easier to transport dredged material over long distances. | • Relatively low production rate, getting lower as depth increases.<br>• Relatively high sediment resuspension rate in the water column, particularly when working in fine and non-cohesive materials.<br>• Low effectiveness in fluid sediment or where there are debris.<br>• Can make navigation cumbersome.<br>• Additional handling required when open water disposal is impossible.<br>• Worker safety (possibility of direct contact with contaminated materials, if applicable). |
| Clamshell Dredge | • Maneuverability.<br>• Similar water content in material to in-situ sediments.<br>• Dredging possible in very deep water. | • Mixing of sediment layers.<br>• Average to extensive resuspension, especially for very fine and non-cohesive materials. |
| Dipper Dredge | • Stability of pontoon.<br>• Can excavate in very cohesive rock or material. | • Difficult to operate in bad weather.<br>• Low yield.<br>• Extensive resuspension in fine and non-cohesive materials. |
| Backhoe Dredge | • Stability of pontoon.<br>• Avoids mixing of sediment layers.<br>• Dredged sediment maintains own density.<br>• Provides great dredging precision. | • Difficult to operate in bad weather.<br>• Low yield.<br>• Average to extensive resuspension especially for fine and non-cohesive materials. |

Source: Alliance Environnement (2004).

## 2.2 Hydraulic Dredges

Hydraulic dredging is carried out using a machine that breaks up the sediment then sucks it up through a pipe with a strong flow of water. They are generally mounted on barges equipped with centrifugal pumps powered by a diesel or an electric motor. Pumps are connected to 15 to 122-cm diameter pipelines, kept at the surface by floaters. Hydraulic dredges suck up and discharge sediment in the form of liquid mud whose water content hovers around 90% (USACE, 2008). There are three main types of hydraulic dredges: plain suction dredges, cutter-suction dredges and hopper dredges. Some of the characteristics of these dredges are presented in Table 2. The main advantages and disadvantages of the various pieces of hydraulic equipment are contained in Table 3.

**Plain suction dredge:** This dredge uses a centrifugal pump and generally moves using a system of anchor cables.

**Cutter-suction dredge:** This dredge is equipped with a powerful rotating apparatus installed at the end of a suction pipe. The cutting step serves to break up hard and cohesive material into debris which are then sucked up. For optimal yield, the bucket ladder and the cutter must be used at their full capacity, which means that the minimum thickness of sediment must reach between 1 and 3 m (Alliance Environnement, 2004).

**Hopper dredge:** This machine differs from the other two types of hydraulic dredge, as it is installed on self-propelled ships. They transport dredged material on board instead of channelling them to a discharge site via a pipe. Dredged material is sucked up using a suction pipe to be then poured into hopper's space where solids settle. The excess water with low amounts of suspended matter (SM) is discharged into open waters by overflow weirs and solids are kept on board to then be dumped at an authorized aquatic site. As this type of dredging does not use any type of anchoring, the elevation of the dredged area is often very uneven, which requires overdredging to obtain the desired depth throughout.

Table 3 Main Advantages and Disadvantages of Hydraulic Dredges Used in the St. Lawrence River

| | Advantages | Disadvantages |
|---|---|---|
| General | • High rate of production (up to several hundreds of cubic meters per hour)<br>• Lower sediment resuspension rate in water column than with mechanical dredges, at the dredging location<br>• Use not affected by current speed<br>• In polluted sediment, minimizes risks to workers and population due to pipeline transportation<br>• Unit costs are generally lower when excavating large volumes than for mechanical dredges, especially for large-scale capital work | • High percentage of water in excavated material (80 – 90%)<br>• Large surfaces needed for disposal of dredged material and water treatment<br>• Impossible to remove most debris hydraulically<br>• Navigation possibly impeded by the dredge as well as the pipeline<br>• More turbidity generated by open water disposal via pipeline than barge disposal by mechanical dredges<br>• Possible impact of gas in the sediment on the pumps<br>• Long-distance transportation (more than a few kilometres) impossible<br>• Loud noise sometimes generated |
| Plain Suction Dredge | • Significant yield in fine and loose sediment | • Possible mixing of sediment layers |
| Cutter Suction Dredge | • Compatible with a large array of materials<br>• Precision and uniformity of excavation | • Possible extensive resuspension at dredging site if pumping power is not equal to the cutter power |
| Self-supporting Suction Dredge | • Low sensitivity to swells and waves<br>• Does not impede navigation<br>• Makes long-distance transport easier and requires no additional handling when open water disposal is possible<br>• Maximum use of compartments due to overflow | • Type of dredge which can only be used on non-contaminated sand that can be discharged into open waters (generally reserved for excavating large volumes in the St. Lawrence's navigation channel)<br>• Dredging depth limited by the draft of the boat and bucket ladders<br>• Requires overdredging (several passes to obtain an even surface) |

Source: Alliance Environnement (2004).

## 3.0 RECOMMENDED DREDGING TECHNIQUE

There are three (3) dredging methods that can be considered for the dredging work at Deception Bay, namely:

- Mechanical dredging using an environmental clamshell dredge;
- Suction cutter hydraulic dredge; or
- Suction hydraulic dredge.

Given the advantages and disadvantages listed in Tables 2 and 3, mechanical dredging seems to be a better choice than hydraulic dredging. The main disadvantage of using a clamshell is the relatively high rate of sediment resuspension in the water column, especially when fine, non-cohesive materials are present. However, resuspension is greatly reduced by the use of an environmental clamshell, as it becomes leak-free once closed. Furthermore, it also prevents resuspension of dredged materials in the water column when the clamshell is raised or when it crosses the water surface, or when the clamshell is hanging in the air between the dredging point and the dumping point. Sediment resuspension remains an issue at the clamshell's point of contact with the sea bed, but at this depth, there is almost no current. The scow used for transporting the materials to the shore must of course be leak-free.

The environmental clamshell dredge is suitable for land dumping of dredged material. Its advantage is that the water content of the dredged materials is similar to that of the sediment in place. This is a significant advantage as this limits the amount of water to be managed at the dumping site. The amount of excess water depends on the volume of the clamshell and its fill rate. Based on data compiled during dredging work using this method, the clamshell's fill volume varies from 39% to 70%, thus the volume of water varies from 61% to 30%. Another advantage that should not be ignored is that mechanical dredging using a clamshell preserves the integrity of the dredged material, which reduces the settling time of the sediment in the basin, thus making management of excess water easier: limiting the amount of disturbance of the consolidated clay reduces the amount of SM in the overlying water.

Hydraulic dredging could be used; however, the large quantities of water generated by this method have a major impact on the facilities at the disposal site. Values contained in literature suggest that a percentage of solids of around 8% to 12% (USACE, 2008) should be considered, thus the water content would be about 90%.

The materials excavated from Deception Bay consist mainly of consolidated clay, meaning a cutter-suction dredge must be used to render the materials uniform and easy to pump. It should be noted that heterogeneous materials could be encountered; variable-sized rocks could also be observed, which would greatly impede the efficiency of this method. There could also be a great turbidity of the water at the point of contact while using this method if the suction level is inadequate.

Another consideration is that the dredged materials' disintegration could increase significantly during the settlement of solids once transferred to the land-based sediment management site. The increase in water turbidity would oblige CRI to oversize the sedimentation facilities and, given the size of suspended particles (micron-sized), this could make reaching water quality criteria difficult. CRI will only authorize hydraulic dredging if the contractor demonstrates that the hydraulic method used will be combined with other operations that will make it possible to meet water quality criteria: water returned to Deception Bay shall at all times have a SM rate below 30 mg/l.

## 4.0 CONFINEMENT METHOD

Sediment dispersion during dredging can be controlled through one of two (2) approaches:

- Engineered containment methods:
  - Cofferdam, sheet piles
  - Containment curtain: geomembranes, geotextiles, pneumatic (bubbles)
  - Use of geotubes
- Controlling operations

Engineered containment methods consist of erecting physical barriers to isolate the work zone. At first, we can exclude the construction of a rock or sheet pile cofferdam considering the major impacts it would have on the environment.

In the case of Deception Bay, using containment curtains would not be very effective. Indeed, a containment curtain is frequently used in lakes or maritime or port areas that are sheltered from the wind and oceanographic conditions (IADC/CEDA, 1999; Bray, 2008). At Deception Bay, the worksite is not sheltered from the wind and waves. Moreover there are 5 m tides at this location. According to Bray (2008), the site's meteorological and oceanographic conditions could restrict the use of such mitigation measures. Indeed, when climatic conditions are not perfect (waves under 1 m and tides under 3 m), the retention rate of a containment curtain is around 25% to 40% (Bray, 2008). Notwithstanding the method's low effectiveness, in the climatic context of Deception Bay where difficult oceanographic conditions are frequent, deploying a containment curtain would be dangerous for the workers, as the complexity of deployment would require specialized equipment and an experienced contractor (Bray, 2008). Moreover, when such work is conducted at depths of more than 3 to 5 m (20 m in this case), using a curtain requires additional flotation devices. Thus, for technical and safety reasons, the possibility of using a containment curtain for controlling sediment dispersion was rejected.

Using a bubble curtain is one alternative to using a containment curtain with membrane. However, this technique is only effective when conditions are perfect, which is rarely the case in Deception Bay. Further, it requires injecting large quantities of air, and thus consumes a great deal of energy. Noise generated by compressors is also a nuisance factor that cannot be ignored.

As engineered containment methods have low effectiveness in the context of Deception Bay, it was deemed preferable to apply measures aimed at controlling the dredging operations so as to minimize sediment dispersion at the source. These control measures include:

- controlling and limiting the clamshell's speed of ascent;
- using a clamshell with reasonably leak-proof jaws;
- using a leak-proof scow for transporting dredged material to the shore;
- avoiding overfilling the scow containing the dredged material;
- avoiding overdredging;
- developing a staging area for materials on the shore, ensuring that quality criteria are respected for the water sent back to the bay.

These control methods will be included in the specifications provided to bidding contractors.

## 5.0 CONCLUSION

CRI favours mechanical dredging using an environmental clamshell (leak-proof). Hydraulic dredging will only be authorized if it is shown that the method suggested by the contractor maintains the water quality criteria at all times.

Considering climatic and sea conditions, as well as the nature of the dredging in Deception Bay, controlling sediment dispersion through work methods seems to be more effective than using engineered containment methods.

## 6.0 BIBLIOGRAPHICAL REFERENCES


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