

## Memo

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<b>To:</b>	John Roberts	<b>Client:</b>	TMAC Resources Inc.
<b>From:</b>	Lowell Wade	<b>Project No:</b>	1CT022.001.130
<b>Cc:</b>	Maritz Rykaart, SRK	<b>Date:</b>	December 22, 2014
<b>Subject:</b>	Doris North Project: 2014 Annual Roberts Bay Jetty Inspection		

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## 1 Introduction

### 1.1 General

The Doris North Project (Project) is a mining and milling undertaking of TMAC Resources Inc. The site is located in the Kitikmeot Region of Nunavut, about 170 km southwest of Cambridge Bay (with general coordinates of latitude 68°09'N and longitude 106°40'W).

The Project is licensed to conduct mining, milling and associated activities. Construction of the Project, including construction of the jetty in Roberts Bay, started in 2007 and was expected to continue through to 2013, but on January 31, 2012, Newmont Mining Corporation (NMC), the previous owner, announced the Project would be placed under Care and Maintenance. The Project was then purchased by TMAC, in March 2013. In addition to carrying out water management and compliance monitoring activities while remaining in Care and Maintenance, the site was used to support regional exploration.

### 1.2 Monitoring and Inspection Requirements

Site operations are currently conducted under a Type "A" Nunavut Water Board (NWB) License 2AM-DOH1323, dated August 16, 2013, which entitles TMAC (the Licensee) to use water and dispose of waste associated with their operations. In addition, the Project is governed by Project Certificate 003 issued by the Nunavut Impact Review Board (NIRB) on September 15, 2006.

The Project Certificate required ground temperature cables to be installed into the jetty foundation to monitor the effects of the jetty on submarine permafrost, with reporting of the results of this monitoring to the NIRB. Annual reporting of the status of the jetty based on a site inspection by a licenced Geotechnical Engineer is required under NWB Licence 2AM-DOH1323.

In fulfillment of these regulatory obligations TMAC, requested that SRK Consulting (Canada) Inc. conduct the 2014 geotechnical site inspection of the jetty, which includes analysis of the thermistor monitoring data. This memorandum provides a summary of the conditions observed at the jetty during this inspection, and provides the results of the thermistor monitoring in fulfillment of the Project Certificate requirements. This is the sixth annual geotechnical inspection completed for the jetty (SRK 2009a; SRK 2011; SRK 2013; SRK 2014).

## 2 Site Conditions

The Project area trends north to south and is approximately 8 km long and 3 km wide from Roberts Bay in the north to the southern end of Tail Lake in the south. At the north end of the Project area in Roberts Bay adjacent to a shoreline laydown area is the jetty, which is the subject of this technical memorandum. An all-weather road connects the jetty to the Roberts Bay lay down area and fuel storage facilities, and from there to the Doris North mine and camp infrastructure approximately 4km to the south.

The jetty was constructed in the summer of 2007, and was put in use for the first time in August 2007. It was used as a berthing facility from which to offload barges during the annual resupply sealift. This jetty was designed to replace the use of the old barge landing site and beach lay down area along the east shoreline in Roberts Bay for normal resupply operations of the Project.

Site climate, regional geology, permafrost and geotechnical conditions are discussed in SRK (2014b) and will not be repeated here.

## 3 Inspection Conditions

### 3.1 General

Lowell Wade, a Senior Civil Engineer with SRK, conducted the geotechnical inspection from July 15 to 22, 2014. The detailed site inspection was carried out on foot, after conducting a reconnaissance fly-over of the site via helicopter.

Weather conditions during the inspection were clear, sunny with light wind, and no precipitation.

### 3.2 Thermistors

Two thermistor strings (SRK-JT1-09 and SRK-JT2-09) were installed through the jetty into submarine permafrost in 2009 (SRK 2009b). During snow clearing operations in late 2011, the thermistor SRK-JT2-09 was severed. A replacement thermistor string (SRK-JT2-12) was installed in early 2012. In 2013, the jetty was rebuilt after being damaged in a storm. During reconstruction activities, thermistor SRK-JT2-12 was damaged and has not yet been repaired. There are no data loggers connected to these thermistor strings. TMAC's Environmental or Operations staff collect manual readings at monthly intervals. This data is forwarded to SRK, who maintains a database of the relevant information.

The complete dataset for each of the two strings are presented in Attachment 1, and a 2013 as-built drawing showing the location of these strings are included as Attachment 2. This data confirms that the active layer is between 1.4 and 1.6 m below seabed elevation, and there is no indication that the active layer has changed since installation of the strings in 2009. It can therefore be concluded that the approximately 2 m thick engineered fill used to construct the jetty has not altered the submarine permafrost regime. Given the consistency of the data, SRK does not see the need to repair or install the damaged thermistor string.

### 3.3 Sediment Transport and Deposition

In accordance with TMAC's obligations under Section 5 of the Authorization for Works or Undertakings Affecting Fish Habitat granted by the Department of Fisheries and Oceans (DFO) (DFO File No: NU-02-0117) for construction of the jetty, three years of sediment transport and deposition monitoring has been carried out (Golder 2008; Rescan 2009; and Rescan 2010).

Bathymetric surveys were conducted in Roberts Bay in the vicinity of the jetty in 2006, 2008 by Golder Associates Ltd. (Golder 2006; and 2008), and by Rescan Engineers and Scientists in 2009, 2010, 2011, and 2012 (Rescan, 2009, 2010, 2011, and 2012) with the specific aim of identifying sediment transport and deposition changes due to the presence of the jetty. Rescan (2010) reported minor changes in bathymetry, due to sedimentation transport, between pre-construction (2006) and post-construction (2008 onwards) were minor. The largest change in bathymetry was observed immediately following construction (i.e. between 2006 and 2008). Changes in bathymetry for subsequent years are small suggesting that steady state conditions had likely been reached (Rescan 2010).

No bathymetric surveys were conducted around the jetty in 2013 or 2014 as the Project had been placed in Care and Maintenance. As such, DFO approved in 2013 that bathymetric monitoring may be reduced to once every three years for both data collection and reporting of the results until the schedule for the jetty removal can be confirmed (DFO 2013).

### 3.4 Roberts Bay Jetty

Foundation conditions beneath the jetty consist of very weak marine sediments. Submarine permafrost is present for about the first 55 m from shoreline, transitioning to unfrozen soils. The unfrozen soils have very little strength, and as a result the jetty is subject to extensive consolidation settlement (SRK 2004; 2005a, b; and 2006). This settlement was expected, and to facilitate more controlled settlement, the rock fill structure was underlain by a double layer of geogrid placed directly onto the seabed. The jetty was originally designed to extend a total length of 103 m from the shoreline, such that the barges could berth in 5 m deep water; however, during construction, and due to very weak foundation conditions in the deep water, the front section of the jetty slumped. The design was subsequently modified to allow berthing in shallower water (about 2 m deep), which resulted in a slightly shorter overall jetty length. The failure occurred in the unfrozen soils and is not a result of submarine permafrost thaw (SRK 2009c, d).

Extensive settlement monitoring of the berthing face of the jetty was undertaken in 2007, and by the summer of 2008 the jetty was observed to have settled about 0.5 m in accordance with original design expectations (SRK 2005a). Subsequently, the jetty was raised in the summer of 2008 to ready the facility for the 2008 sealift. No further settlement monitoring was undertaken after this, and no further raising of the jetty was required prior to the 2009 sealift. Further levelling and raising of the jetty was done prior to the 2010 sealift; however, no surveys were available to confirm how much settlement had occurred. No further work was done on the jetty prior to the 2011 sealift. In preparation for the 2012 sealift the jetty was raised, extended by a few metres and an earthen ramp constructed to facilitate demobilization activities that were underway during the time of inspection. No surveys or quantities of fill used are available.

In 2013, the jetty was damaged due to a severe storm at the beginning of August. Large waves washed the rock fill at the end of the jetty out into Roberts Bay. PND Engineers Canada Inc. supervised the jetty reconstruction and became the Engineers-of-Record for the jetty. As part of the reconstruction activities two survey monitoring points were installed at the end of the jetty (PND 2013). These two survey monitoring points are shown on drawing JT-1 (Attachment 2). An updated as-built survey of the jetty was completed on June 26, 2014 (Attachment 3). The two survey monitoring points have settled 0.52 m since their installation on September 9, 2013.

During the 2014 geotechnical inspection, the remaining PND (2013) recommended construction items were completed, including the installation of armour rock along the sides of the jetty to prevent erosion. The jetty does not show obvious signs of distress on the structure, and based on these observations, supported by verbal descriptions from site staff, the jetty appears to be functional.

PND (2013) made the following recommendations for monitoring of the completed jetty repairs:

- Inspect the jetty after any significant storm exceeding 25 knots (46.3 km/hr) and make any necessary repairs; and
- Perform surveys of the settlement plates and report results to PND for monitoring of settlement and stability.

## 4 Conclusions

This memorandum provides a performance assessment of the Roberts Bay jetty. The findings are based on a review of the structure history since the design and construction, a site visit and walkover survey between July 15 to 22, 2014, and subsequent consultation with site staff. This is the sixth formal annual geotechnical inspection undertaken for the Project which has included inspection of the jetty.

The followings conclusions are important:

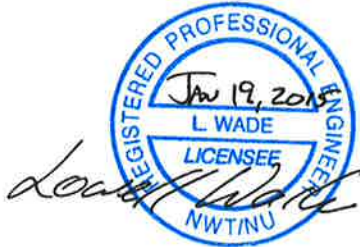
1. Thermal monitoring from the remaining thermistor string, installed through the jetty into the underlying submarine permafrost, suggests that there has been no degradation of permafrost resulting from the construction of the jetty; and
2. In SRK's opinion there is no need to repair or replace thermistor string SRK-JT2-12; however, approval for this has to be sought from the Nunavut Impact Review Board as it was a Project Certificate requirement to have this thermistor string installed.

## 5 Recommendations

To ensure continued functional use of the jetty, SRK recommends that the following actions be undertaken:

1. Continue to collect monthly thermistor string data as a minimum (July to August).
2. Follow the recommendations for settlement monitoring provided in Section 7.0 of PND (2013).
3. Remind operational staff annually about the operational limitations of the jetty as provided in Section 4.0 of PND (2013).

This memo, "2014 Doris North Project: 2014 Annual Roberts Bay Jetty Inspection", was prepared by

A blue circular professional engineer stamp from the Northwest Territories (NWT) and Nunavut (NU) is placed over a handwritten signature. The stamp contains the text "REGISTERED PROFESSIONAL ENGINEER", "JAN 19, 2015", "L. WADE", "LICENSEE", and "NWT/NU".

Lowell Wade, P.Geo., P.Eng.  
Senior Consultant

and reviewed by

A blue circular professional engineer stamp from the Northwest Territories (NWT) and Nunavut (NU) is placed over a handwritten signature. The stamp contains the text "REGISTERED PROFESSIONAL ENGINEER", "19/1/2014", "E.M. RYKAART", "LICENSEE", and "NWT/NU".

Maritz Rykaart, P.Eng., PhD.  
Practice Leader

All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practices.

**Disclaimer**—SRK Consulting (Canada) Inc. has prepared this document for TMAC Resources Inc.. Any use or decisions by which a third party makes of this document are the responsibility of such third parties. In no circumstance does SRK accept any consequential liability arising from commercial decisions or actions resulting from the use of this report by a third party.

The opinions expressed in this report have been based on the information available to SRK at the time of preparation. SRK has exercised all due care in reviewing information supplied by others for use on this project. Whilst SRK has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information, except to the extent that SRK was hired to verify the data.

## 6 References

- Department of Fisheries and Oceans, 2013. Hope Bay Project Jetty Bathymetry Requirements. E-mail correspondence between Katsky Venter ([Katsky.Venter@Newmont.com](mailto:Katsky.Venter@Newmont.com)) and Georgina Williston (Georgina [Williston@dfo-mpo.gc.ca](mailto:Williston@dfo-mpo.gc.ca)). Government of Canada, Fisheries and Oceans Canada. June 6, 2013.
- Golder Associates Ltd. 2006. Bathymetric Surveys, Hope Bay, Nunavut. Report prepared for SRK Consulting (Canada) Inc., Report No. 06-1419-007.
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- PND Engineers Inc., 2013. Construction Report – Rock Jetty Repairs Roberts Bay. Report prepared for Newmont North America and TMAC Resources Inc., September 2013.
- Rescan Engineers & Scientists. 2009. Doris North Gold Mine Project: 2009 Roberts Bay Jetty Fisheries Authorization Monitoring Report. Report prepared for Hope Bay Mining Ltd., Project #1009-002-19, December 2009.
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- SRK Consulting (Canada) Inc. 2005b. Phase II Foundation Investigation, Proposed Roberts Bay Jetty Location, Doris North Project, Hope Bay, Nunavut, Canada. Report prepared for Miramar Hope Bay Limited, Report No. 1CM014.04-0110, May 2005.

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SRK Consulting (Canada) Inc. 2009b. Hope Bay Project: Roberts Bay Jetty Thermistor Installation. Memo prepared for Hope Bay Mining Limited, Project No. 1CH008.015.400, March 30, 2009.

SRK Consulting (Canada) Inc. 2009c. Doris North Project: 2008 SRK Construction Support. Letter Report prepared for Hope Bay Mining Limited, Report No. 1CH008.004, February 12, 2009.

SRK Consulting (Canada) Inc. 2009d. Doris North Project: 2007 SRK Construction Support. Letter Report prepared for Hope Bay Mining Limited, Report No. 1CH008.025, September 29, 2009.

SRK Consulting (Canada) Inc. 2011. Doris North Project: 2011 Annual Roberts Bay Jetty Inspection. Technical Memorandum prepared for Hope Bay Mining Limited, Project No. 1CH008.046, November 2011.

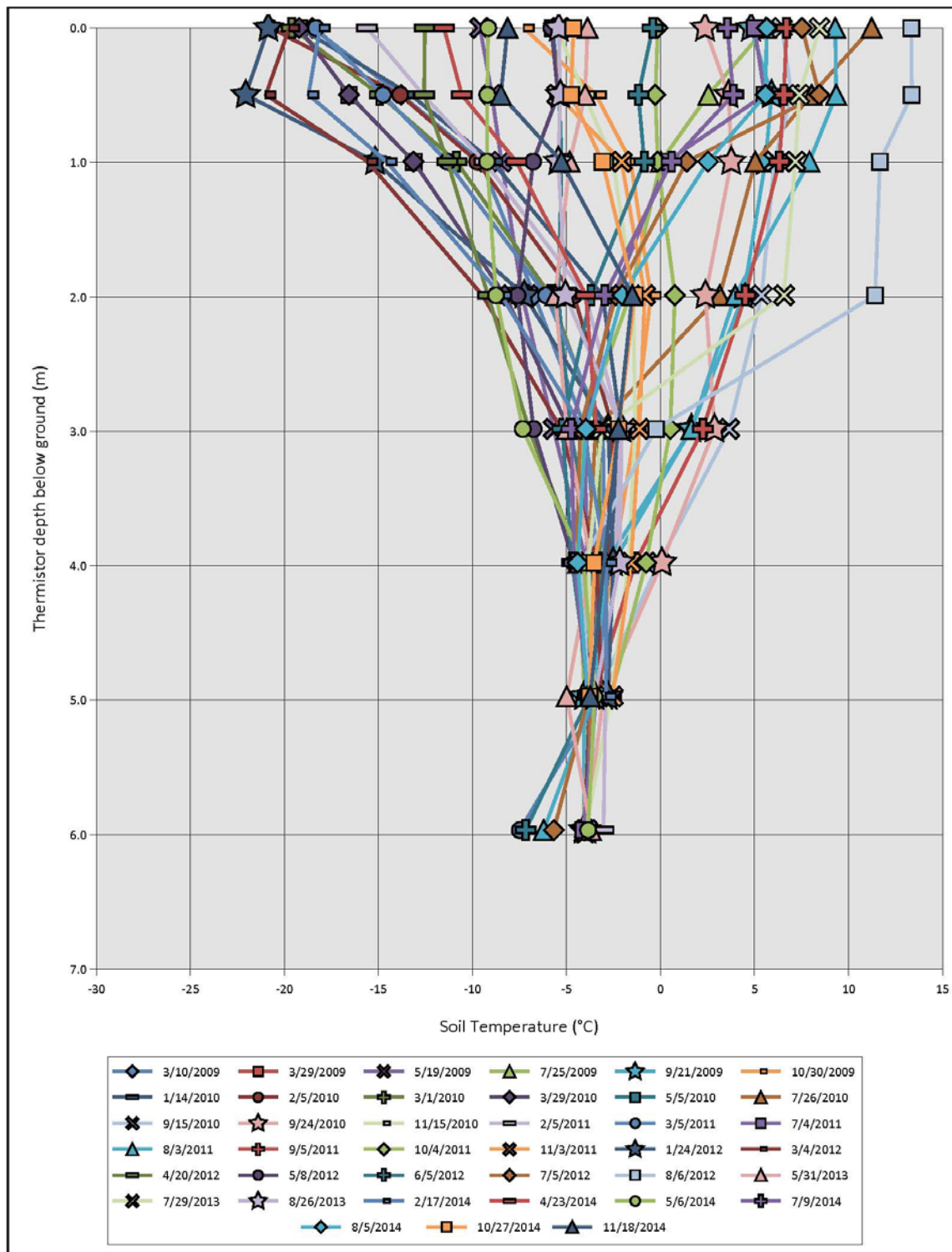
SRK Consulting (Canada) Inc. 2013. Doris North Project: 2012 Annual Roberts Bay Jetty Inspection. Technical Memorandum prepared for Hope Bay Mining Limited, Project No. 1CH008.066, February 2013.

SRK Consulting (Canada) Inc., 2014. Doris North Project: 2013 Annual Roberts Bay Jetty Inspection. Technical Memorandum prepared for TMAC Resources Inc., Project No. 1CT022.000.330, March 2014.

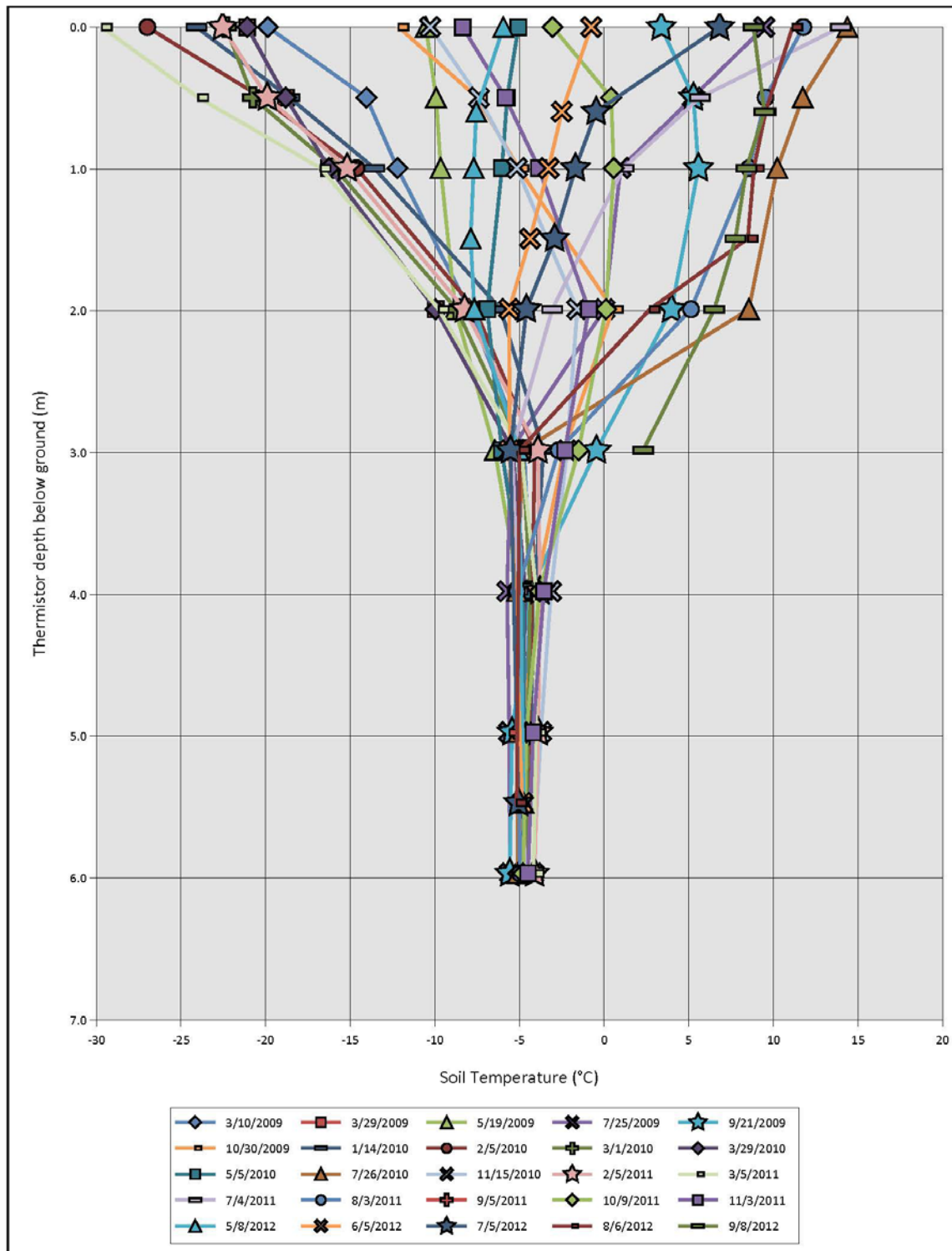
## Attachment 1: Hope Bay Jetty Thermistor Data



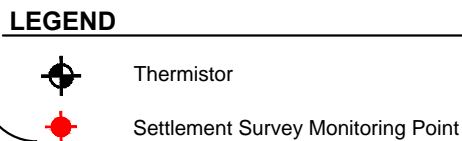
# Thermistor Data (SRK-JT1-09)



### Thermistor Data (SRK-JT2-09/ SRK-JT2-12)



Attachment 2: 2013 Thermistor Installation As-Built Drawings



A horizontal scale bar with a black line and white tick marks. The numbers 0, 5, 10, 15, 20, and 25 are placed above the tick marks. Below the bar, the text 'Scale in Metres' is centered.

Thermistor Asbuilt Locations:		
Thermistor	Easting	Northing
SRK-JT1-09:		
Post	432,531	7,563,297
Drillhole	432,534	7,563,297
SRK-JT2-09 & SRK-JT2-12:		
Post	432,553	7,563,262
Drillhole	432,550	7,563,264


Point #	Easting	Northing	Elevation
1500	432,532.93	7,563,323.58	2.31
1501	432,515.90	7,563,317.32	2.33

1. Jetty as-built outline down to MSL was provided by Sub-Arctic Survey Ltd. Survey was done on September 9th, 2013.
2. Bathymetric data was provided by Golder Associates, from a 2006 survey. Contour intervals are 0.5m.
3. The co-ordinate system is UTM NAD 83, Zone 13.
4. The thermistors should be a RST 2252  $\Omega$  thermistor, 8 beads and 10m in length. The terminal station should have 8 channel switches. Thermistor bead spacing is provided by SRK (SRK, 2008).
5. Thermistors should be installed a minimum 1m in from the crest of the jetty.
6. Currently the thermistors, terminal boxes and mounting posts are to be installed on the west side of the Jetty. These can be move to the east side of the jetty if site personnel deemed it as more convenient for operations, with engineer's approval.
7. The terminal boxes and mounting posts shall be installed above the High Water Level.
8. Backfill will be a minus 1/2" sand and gravel material. A finer material is preferred, if able, to prevent bridging inside hole.
9. Shallow trenches are to be excavated to bury the thermistor cables leading to the termial stations. These trenches can be excavated via hammering action of an airtrack percussion rock drill by overlapping series of shallow drillholes.
10. Thermistor hole and trench backfill shall be placed in a manner to prevent bridging of backfill material.
11. All items shown in red represent as-built information.

1. SRK 2008 - Doris North Jetty Thermistors Technical Memo to Hope Bay Mining Ltd., December 8, 2008.
2. PND Engineers Inc., 2013. Construction Report - Rock Jetty Repairs Roberts Bay. Report prepared for Newmont North America and TMAC Resources Inc., September 2013.

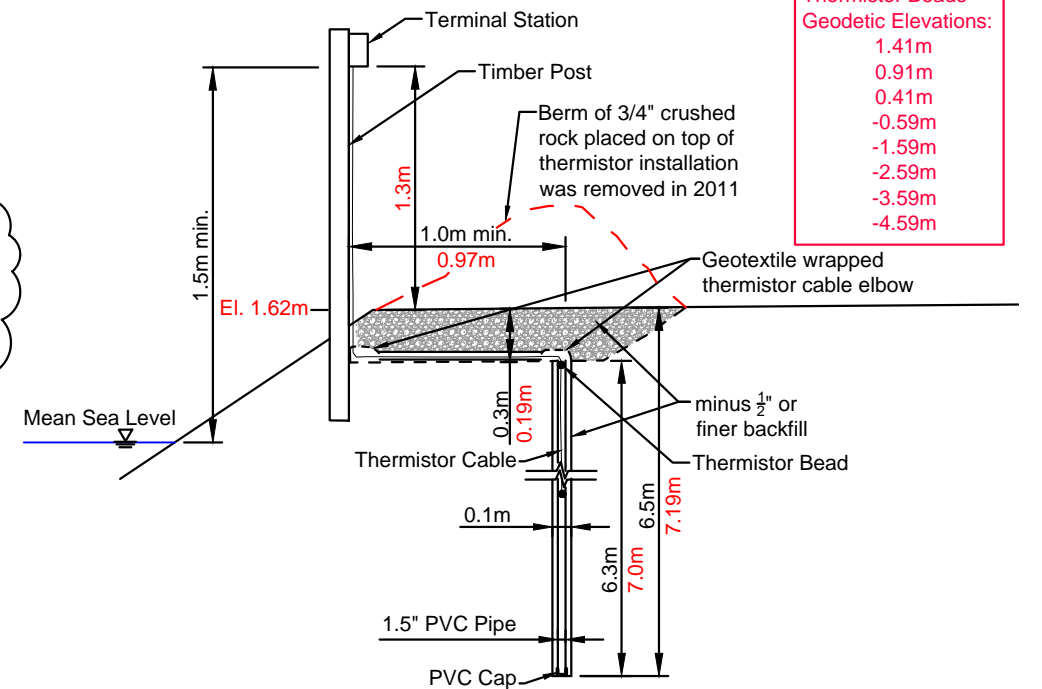
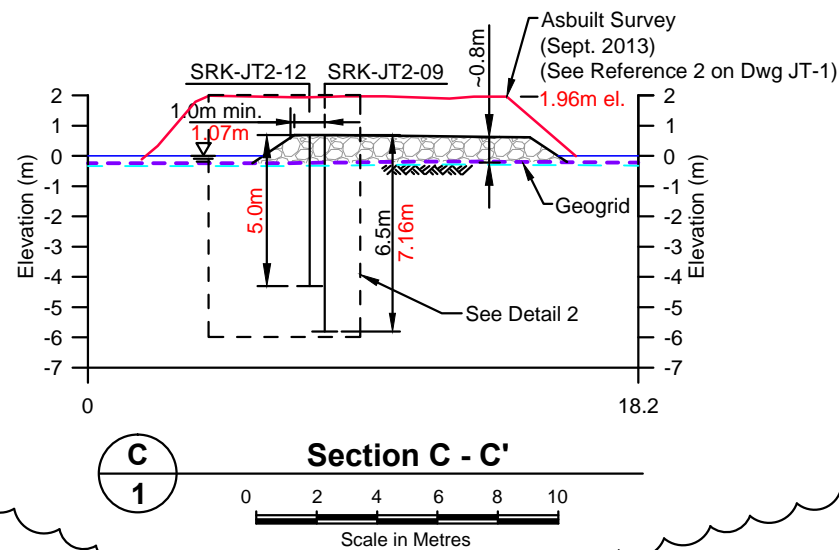
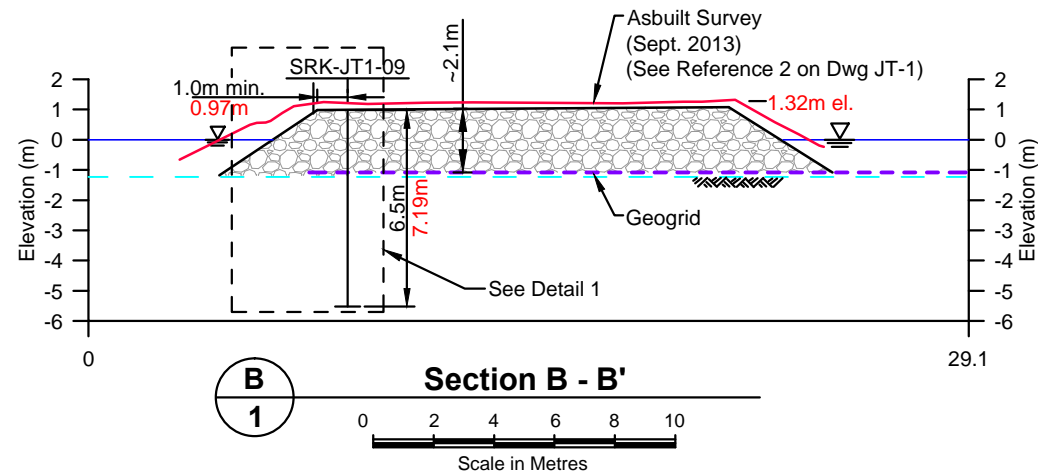
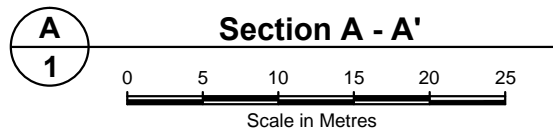
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					B	Asbuilt	LW	EMR	13Mar09
JT-2	Thermistor Installation - Section and Profile	A	Issued for Review	AT	EMR	5Mar09			
DRAWING NO.	DRAWING TITLE	DRAWING NO.	DRAWING TITLE	NO.	DESCRIPTION	(CHK'D)	APP'D	DATE	
REFERENCE DRAWINGS						REVISIONS			

PROFESSIONAL ENGINEERS STAMP

		
DESIGN: MM/AT	DRAWN: NV	REVIEWED: EMR
CHECKED: LW	APPROVED: EMR	DATE: March 2014
FILE NAME: Jetty Asbuil March2014.dwg		

	
	Hope Bay Project
	SRK JOB NO.: 1CT002.001

Jetty Thermistor Installation Program		
DRAWING TITLE:		
Thermistor Installation - Plan View		
DRAWING NO.	SHEET	REVISION NO.
JT-1	1 OF 2	C



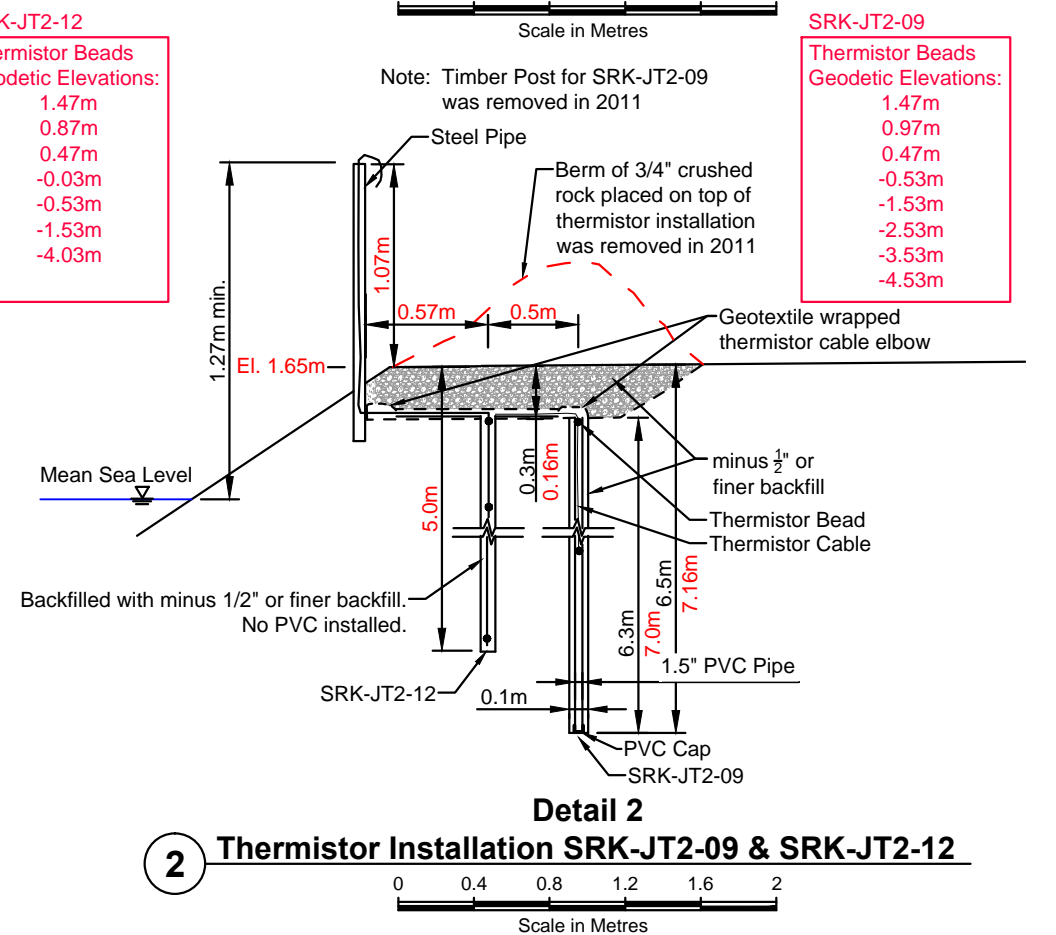
**Detail 1**

**1 Thermistor Installation SRK-JT1-09**

0 0.4 0.8 1.2 1.6 2

Scale in Metres

SRK-J




**2 Thermistor Installation SRK-JT2-09 & SRK-JT2-12**

0 0.4 0.8 1.2 1.6 2

Scale in Metres

					D	Absuilt Survey	LW	EMR	4Mar14
					C	Absuilt-Installed SRK-JT2-12	LW	EMR	29Jan13
					B	Absuilt	LW	EMR	13Mar09
JT-1	Thermistor Installation - Plan View				A	Issued for Review	AT	EMR	5Mar09
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REFERENCE DRAWINGS				REVISIONS					

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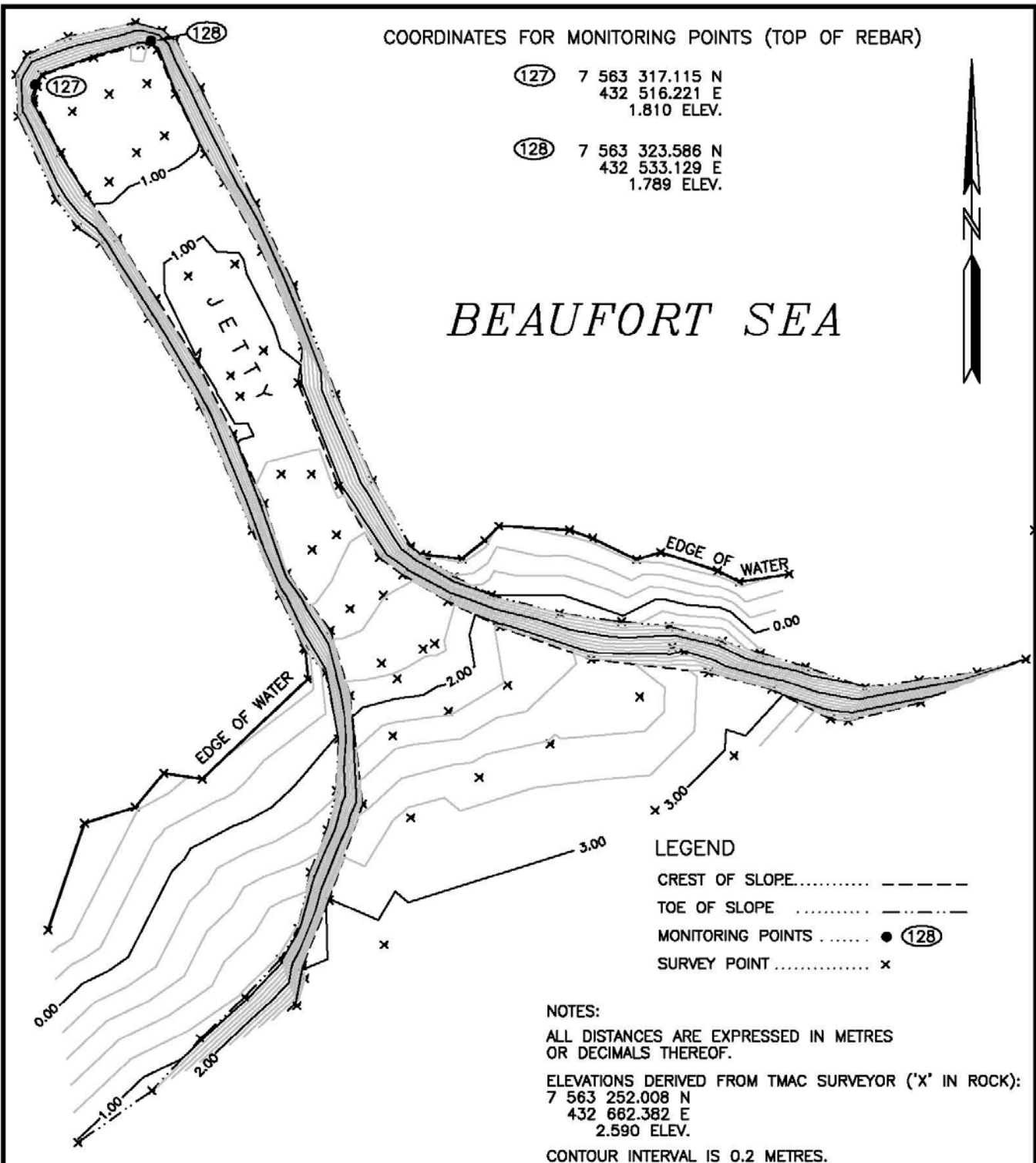
		
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	<p>Hope Bay Project</p>	
SRK JOB NO.:	1CT002.001	

Jetty Thermistor Installation Program		
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Thermistor Installation - Section and Profile		
DRAWING NO.	SHEET	REVISION NO.
JT-2	2 OF 2	D

Attachment 3: 2014 Jetty As-Built Figure





**SUB-ARCTIC SURVEYS LTD.**  
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PROJECT NO.: 14-063-NC  
 FILE NO.: 14-063-NC-JN26 AS-BUILT  
 DATE: JUNE 26, 2014  
 SCALE: 1:750  
 PREPARED BY: PV

**NUNA CONTRACTING LTD.**  
**TOPOGRAPHIC SURVEY OF JETTY**  
**TMAC RESOURCES INC.**  
**HOPE BAT MINE SITE, NU**