Attachment 2

Note:

The Melville et al. (1989) document was previously provided to MVEIRB and DFO on December 21, 2011; available on the MVEIRB registry.

Reference:

Melville et al. 1989. Thor Lake Area (NWT) Environmental Baseline Study. Prepared for Senes on behalf of the Saskatchewan Research Council.

Attachment 3

AVALON RARE METALS INC.
TRANSPORTATION ASSESSMENT

RED SKY ENTERPRISES INC.

September 21, 2011

Table of Contents

1.0 Introduction: This report provides an assessment of the proposed method to transport moist concentrate from the Nechalacho, Thor Lake mine (Thor) across Great Slave Lake to Pine Point where the concentrate will be further processed before onward shipping to southern destinations. Fuel, reagents and other commodities will be shipped to Thor from Hay River, which may or may not be a separate operation.

Information pertaining to quantities, port location/infrastructure, load/offload operations and lay down areas was provided by Avalon Rare Minerals Inc. (Avalon).

Various over water transportation modes have been investigated; however, the current mode described in Developer's Assessment Report (DAR) is predicated upon tug and barge transport. Most criteria pertaining to marine equipment and cost estimates have been provided by the Northern Transportation Company Limited (NTCL).

Three tug and barge options have been considered for the transportation of Moist concentrates from Thor to Pine Point:

- Option 1 – 2 tugs, 6 1500 series barges
- Option 2 – 1 towing tug, 6 1500 series barges & 2 port tugs
- Option 3 – 2 tugs, 6 1000 series barges

Three tug and barge options have been considered for the transportation of fuel, reagents and other commodities from Hay River to Thor:

- Option 1 – 1 tug, 3 1500 series barges
- Option 2 – 1 tug, 3 1000 series barges
- Option 3 – 1 tug, 1 port tug, 6 1000 series barges

Detailed and summary schedules have been developed for all of the above options which are based on current tonnage data for all commodities. Cost estimates according to the above schedules and information received from NTCL are also included.

Two other local marine companies were contacted to ascertain their potential interest in this project. Both companies, which are described below, had positive responses.

Suggested docking arrangements at the Ports of Thor and Pine Point have been altered from what was initially envisaged by Avalon. This new arrangement should decrease load/offload times, but will require further consultation with tug and barge operators.

Transportation by Hovercraft was also investigated. Details of these craft was provided by Dale Wilson and followed by discussions with Paul Schmidt. It should be noted that the writer has had previous experience with 3 separate Hovercraft models, 2 working the Beaufort Sea off Tuktoyaktuk, NT and 1 working as a Pilot Project along the Athabasca River at Fort McMurray, AB. These machines were much smaller than proposed herein; however, it is believed that operational characteristics may be similar.

2.0 **Commodities to be Transported**: Listed below are the recent estimates of annual quantities of the various commodities to be transported by barge.

2.1 ***Moist Concentrates***: 144,540 tonnes – Thor to Pine Point. Concentrates are intended to be loaded in 40 tonne purpose built low rise containers having dimensions of 6.1 x 2.4 x 1.3 m. The containers will be stored at laydown areas located adjacent to the Thor and Pine Point docks.

2.2 ***Diesel Fuel***: 18,136 tonnes (21,800,000 litres) from Hay River to Thor.

2.3 ***Reagents*** : 4,025 tonnes from Hay River or Pine Point to Thor.

2.4 ***Mill Equipment***: Approximately 4280 tonnes from Hay River to Thor. A part of this equipment may be shipped from Pine Point.

2.5 ***Underground Equipment***: Approximately 480 tonnes of which the majority may be brought into Thor by ice road.

2.6 ***Other Commodities***: To be determined.

3.0 **Port Access, Infrastructure, Loading and Offloading:** Initially, seasonal docks comprised of flat deck barges will be used at each site. A mooring arrangement will be developed to adequately secure the dock barges during the open water season. Careful consideration must be given to the configuration of the barge dock to enhance loading/offloading operations. Where practicable, the preferred arrangement for the dock barge is an alongside mooring rather than bow on. These reasons include:

- easier to moor the cargo barge to be loaded;
- less travel for the lift trucks; and
- cargo barge can be loaded from center rather than over the bow or stern, therefore more efficient in keeping the cargo barge in trim.

In cases where the dock barge(s) are moored bow on (Pine Point), preference would be to moor the cargo barge across the stern of the dock barge, again for ease of mooring and cargo operations. If this is not possible, the cargo barge should be moored stern to the dock barge to eliminate the requirement to cross the raised bow of the 1500 series barge. In any event only one cargo barge should be moored to the dock barge during loading/offloading operations. Other barges would be tended by the towing tug. *Note: In the case of a 1 towing tug, 6 cargo barge operation (Option 2) it would be necessary to have a smaller tending tug at each Port.*

Under the current arrangement as described in the DAR, NTCL 1000 series barges are considered for use as dock barges and 1500 series barges for cargo. The moulded depth of each barge series differ by 0.77 metres (2.5 ft.) (Figures 3.0, 3.0.1), therefore ramping will be required, up or down, as the draft of the cargo barge changes. Ramping between barges can be eliminated by either ballasting or a lift truck pass-pass operation. Either method would add time to the load/offload operation.

As well, adverse weather conditions will be a limiting factor throughout operations; floating barge docks may have to be disassembled to avoid damage. During these conditions operations would cease until weather moderates to safely continue.

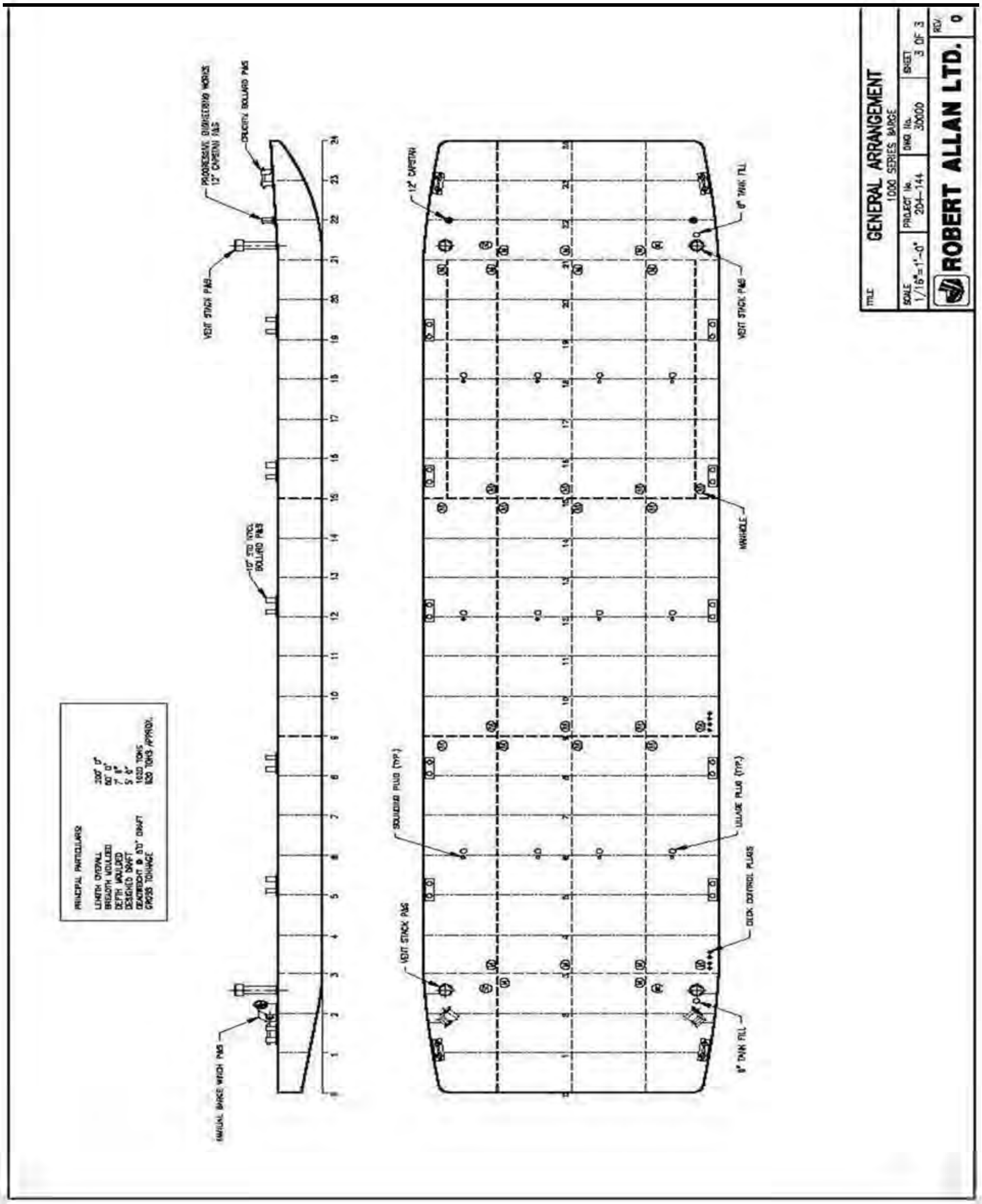

Figure 3.0 – NTCL 1000 Series Barge. Moulded Depth – 2.31 m (7' 6")

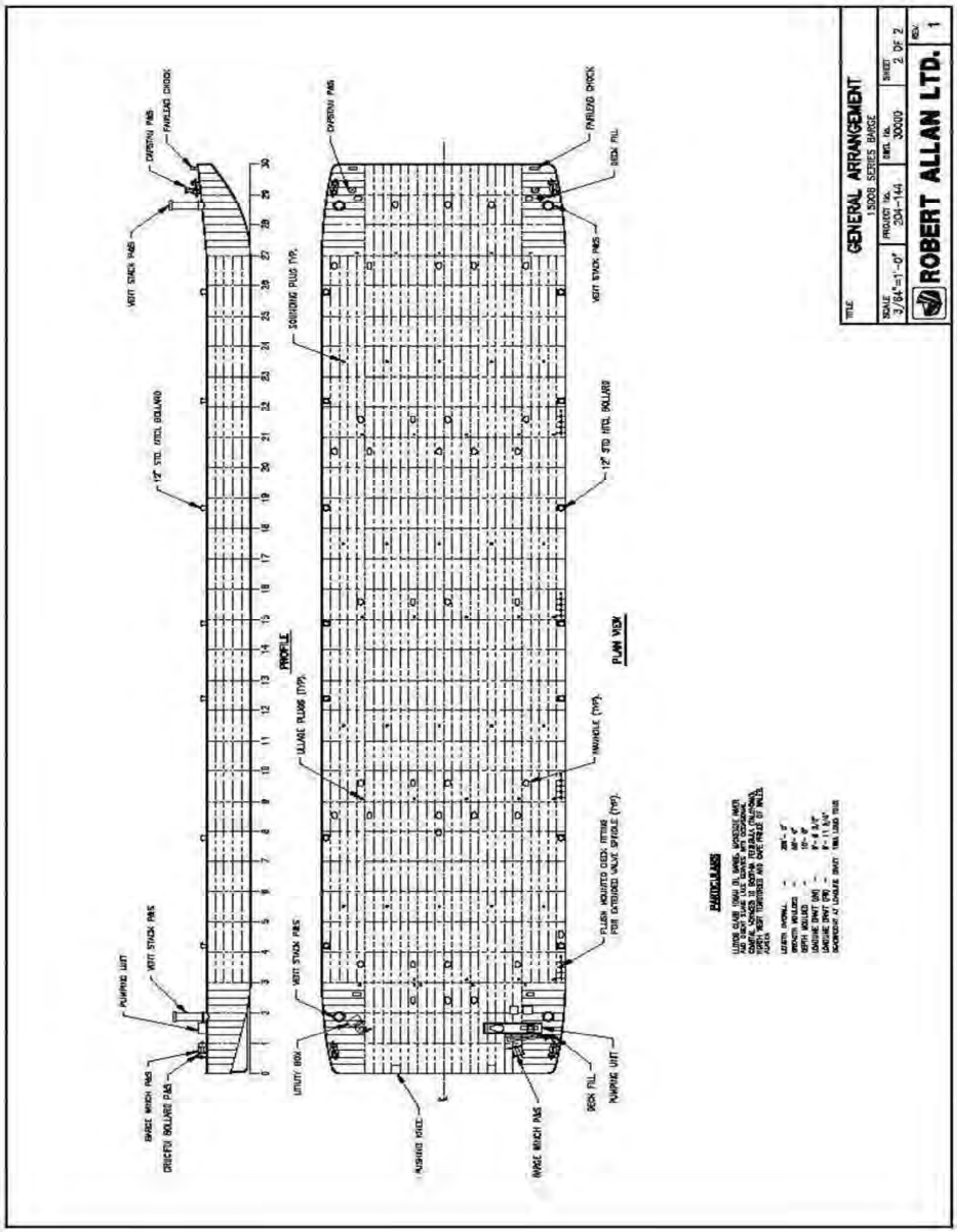

Figure 3.0.1 – NTCL 1500 Series Barge. Moulded Depth – 3.08 m (10’)

3.1 ***Nechalacho, Thor Lake Mine:*** Located along the north shore of Great Slave Lake (Hearne Channel), the port is reasonably protected from adverse winds except those originating from the westerly to south westerly quadrants. Access is believed to be satisfactory for equipment having a draft of not more than 3 metres (near shore). <u>For more certainty a bathymetric survey is recommended. The recommended bathymetric survey was subsequently completed by EBA (2011) and the results are provided as Appendix 1 to this report.</u>

3.1.1 ***Mooring Arrangement:*** Figure 3.1.1 describes the mooring arrangement at the Thor Dock. One 1000 series barge is moored alongside the shore with lines running to 4 dead men (anchor points) ashore. A ramp can be set about amidships of the dock barge. One cargo barge is then moored alongside the dock barge for loading. Other barges in the tow (2) can be anchored nearby or tied to the shore and shuttled into the loading dock when barge 1 is loaded.

A second mooring arrangement for the discharge of fuel should be considered as this is a time-sensitive operation and will interrupt cargo operations. As well, for safety reasons, fuel is not normally discharged in an isolated area. For fuel discharge 1 dock barge may be required; however, subject to near shore water depth, the fuel barge can be nosed into the beach and moored to deadmen ashore. Reagents and other commodities can be offloaded over the primary docking arrangement with little interruption to concentrate operations (Figure 3.1.1 of Avalon's Image shows inserted comment for recommended fuel discharge area).

3.1.2 ***Loading:*** It is anticipated that loading will be performed by 2 Hyster 1050 Series Lift Trucks, each carrying 40 tonne containers from a nearby laydown area. The weight of the lift truck is approximately 61 tonnes, therefore ramps onto the dock barge and/or cargo barge should be certified for a minimum 110 tonne weight. In the stow plan shown in Figure 3.1.2, the lift truck(s) will board the cargo barge at amidships, then place the containers fore and aft to keep the barge in trim. Figure 3.1.3 shows an alternate stow plan which provides more room at the center of the barge for the lift trucks to manoeuvre.

Thirty eight (38) containers, each loaded with 40 tonnes of moist concentrate, are loaded on each cargo barge. Including container weight (estimated at 5 tonnes each) total load will be 1710 tonnes, which translates into a barge draft of 1.93 metres. Lighter containers would reduce the loaded draft of the barge which would be beneficial for docking at Pine Point.

Estimated cycle time to load 1 container is 10 minutes. With 2 machines, a barge can be loaded in 3.2 hours. Unloading empty containers will take about half the time (1.6 hrs) as 2 containers can be moved at one time; therefore 1 barge load equals 4.8 hours. Shuttling time would be about 1 hour per barge times 2 barges equals 2 hours. Total estimated time for each tow load (3 barges) would be approximately 16.4 hours. Tow preparation for departure would take an additional 2 hours for a total sum of approximately 18.4 hours. Stow plans are shown in Figures 3.1.2 and 3.1.3.

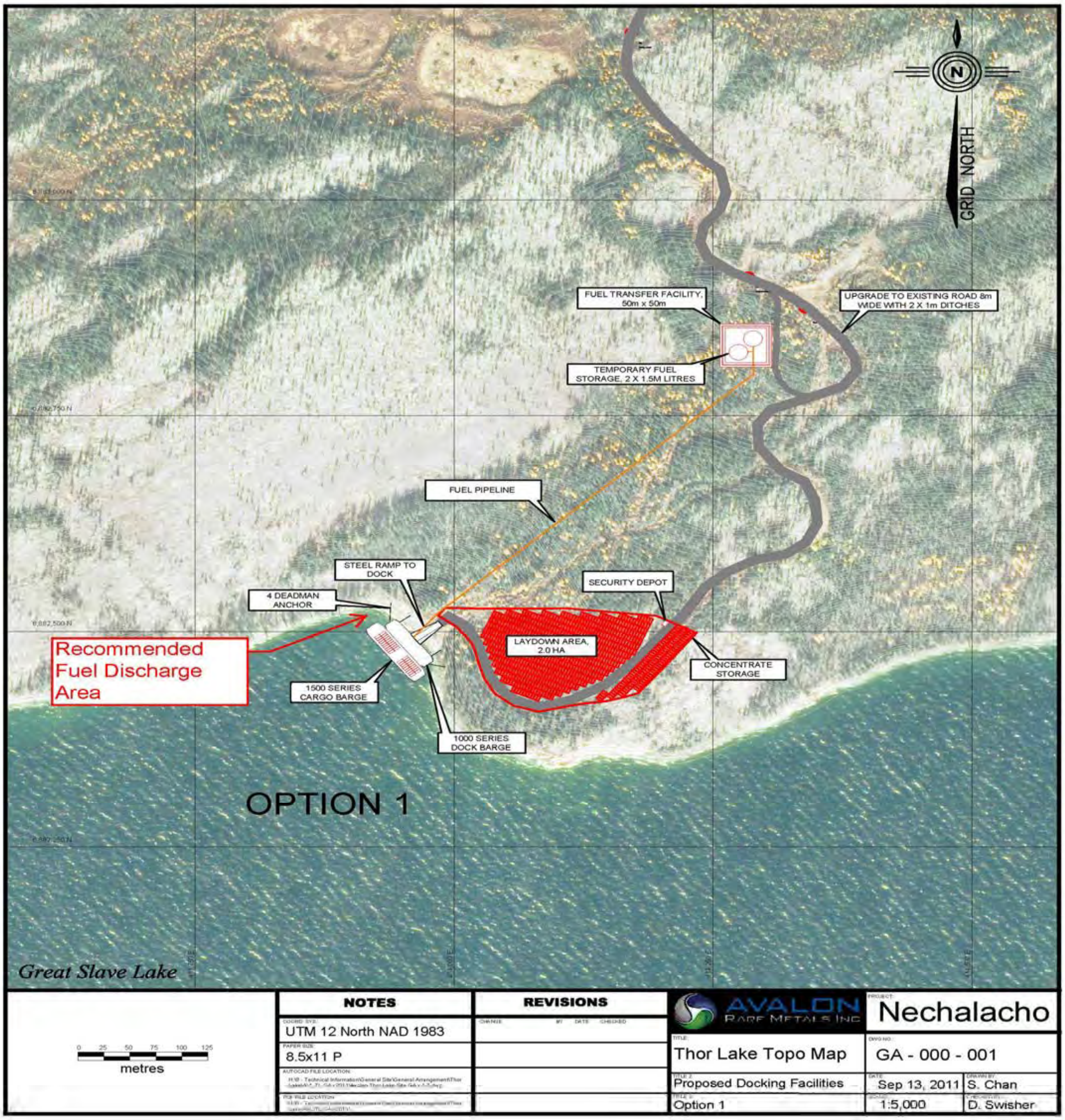

Figure 3.1.1 Avalon image with inserted caption showing recommended fuel discharge area

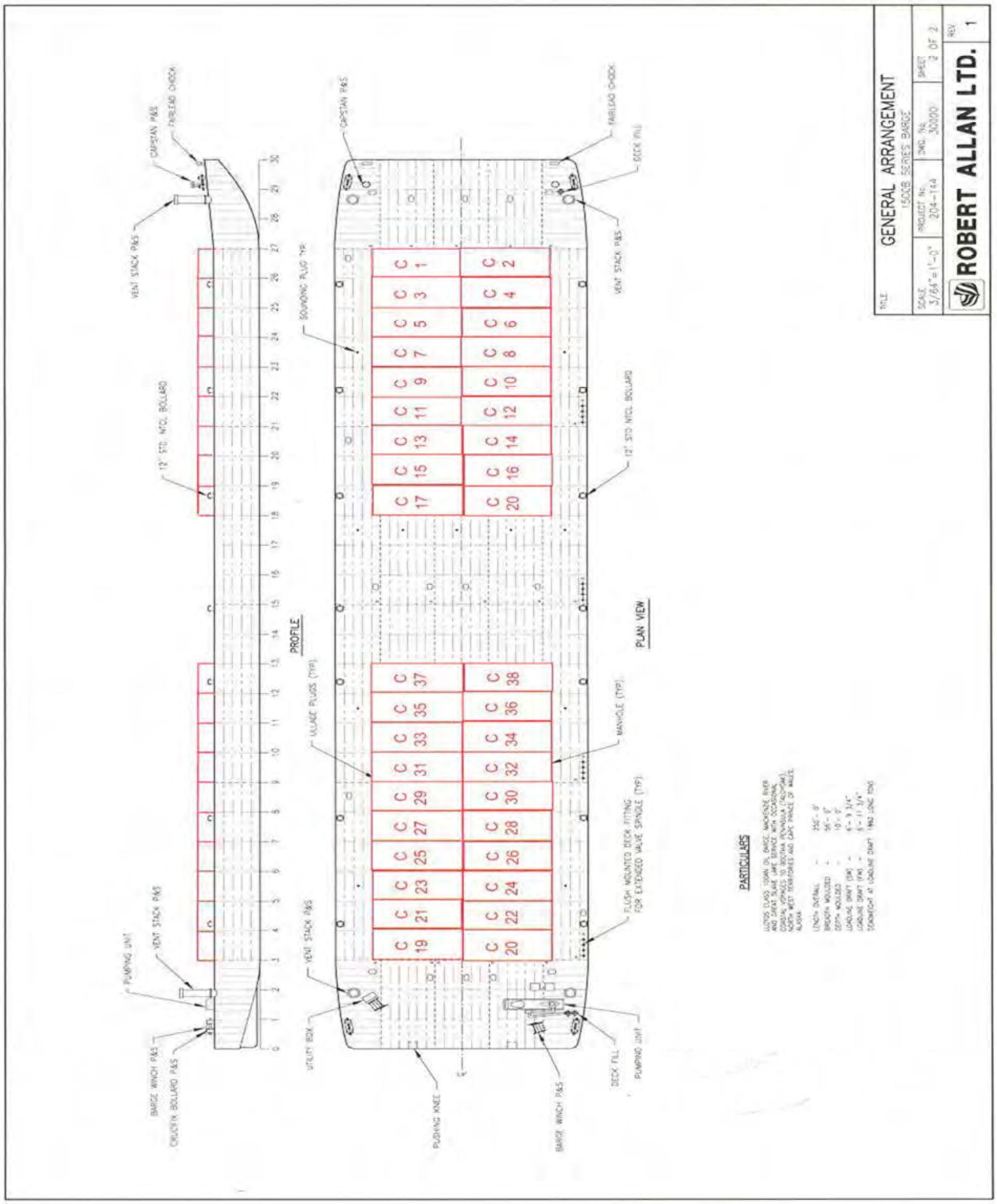

Figure 3.1.2 Primary Stow Plan

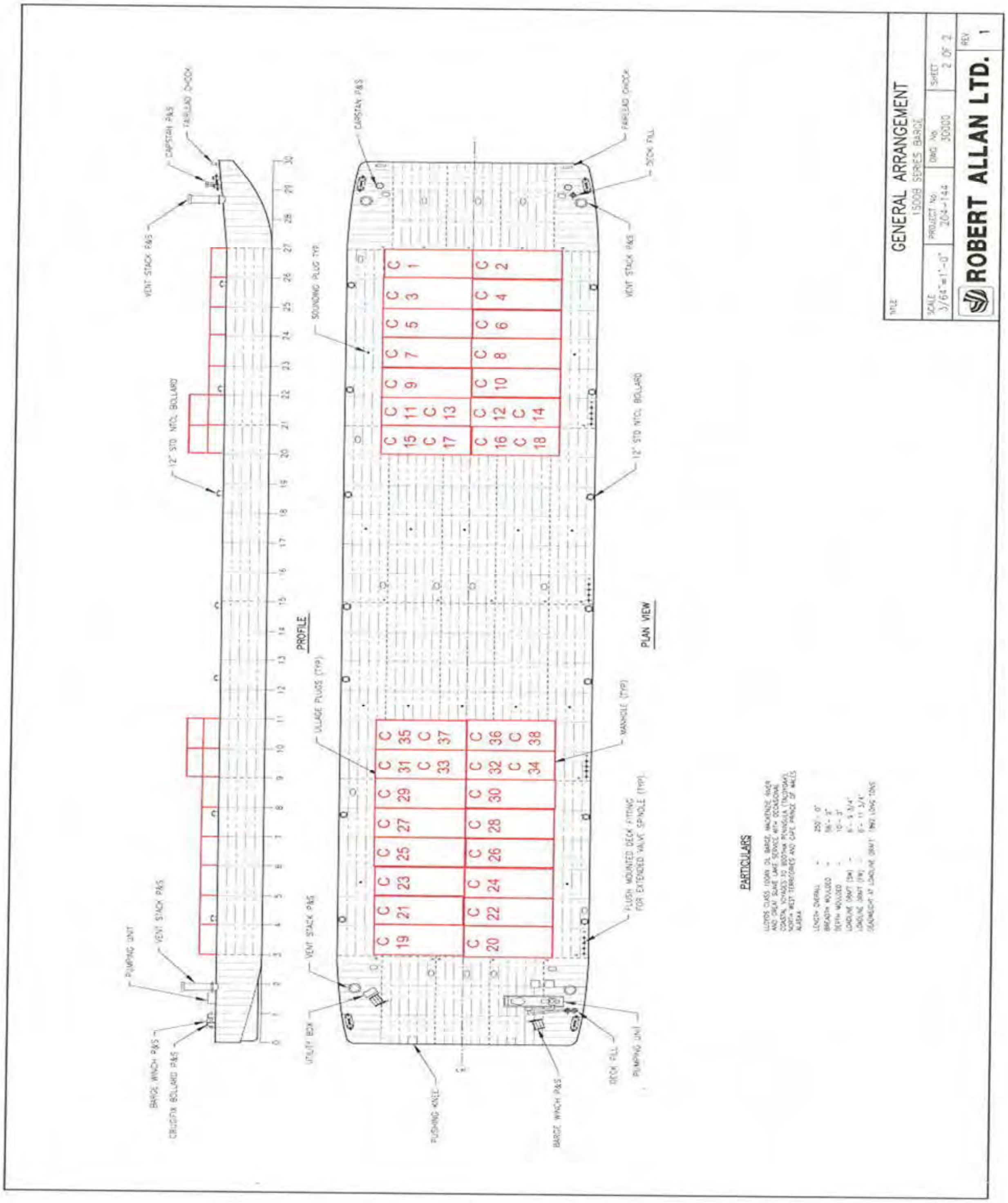

Figure 3.1.3 Alternate Stow Plan

3.2 ***Pine Point****:* Located along the southern shores of Great Slave Lake, the Port is essentially unprotected from adverse winds originating from the south southwest through north to the north northeasterly quadrant (SSW-N-NNE). In other words, most weather conditions may affect offloading operations.

3.3 This area is mostly low lying causing shallow approaches into the Port. A thru-ice bathymetric survey was conducted by EBA Engineering Consultants Ltd. in 2010 to determine the boundary of the 2 meter curve. The result suggested the 2 meter curve was 194 meters (630 ft.) offshore. This becomes problematic for cargo barges having a draft of 1.93 meters. <u>It is recommended that an in water bathymetric survey be conducted of this area plus surrounding areas nearby to ascertain water depth and bottom configuration. The recommended bathymetric survey was subsequently completed by EBA (2011) and the results are provided as Appendix 2 to this report.</u>

Assuming that the existing Pine Point docking area (end of the road) were to be used, 3 1000 series dock barges, secured in line, would be required to moor the cargo barge (see Figure 3.2). A well planned securing arrangement for the dock barges would be required to withstand adverse weather conditions. Grounding the dock barges by ballast water is another possibility but would require further investigation and approval by the barging contractor.

Offloading and reloading empty containers across this arrangement would be time consuming, probably 2 times, or more, longer than the loading operation. As well, weather related delays can be expected, especially later in the barging season.

For future use,Dawson Bay might be considered as an alternative landing site (see Figure 3.2.1, Google and Figure 3.2.2 CHS Chart 6371). As opposed to Pine Point, Dawson Bay provides some protection from adverse winds however updated bathymetry would be required to ascertain its suitability as a landing site. An analysis of the area was conducted and it was determined that it was not economic at this time and also would require further environmental investigations Further studies for use of Dawson Bay as a landing site should be undertaken at a later time.

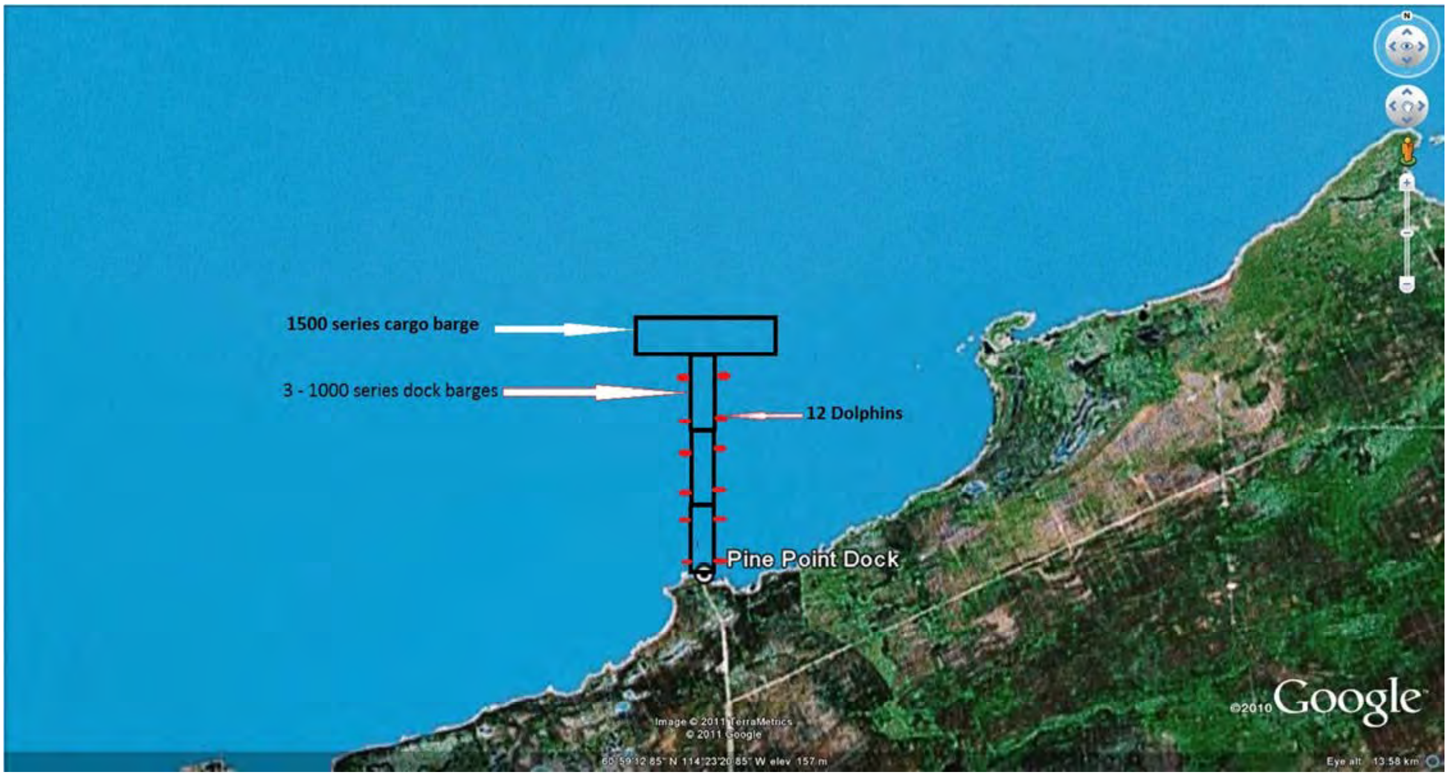

Figure 3.2 – Pine Point Docking Arrangement

Figure 3.2.1 – Dawson Bay

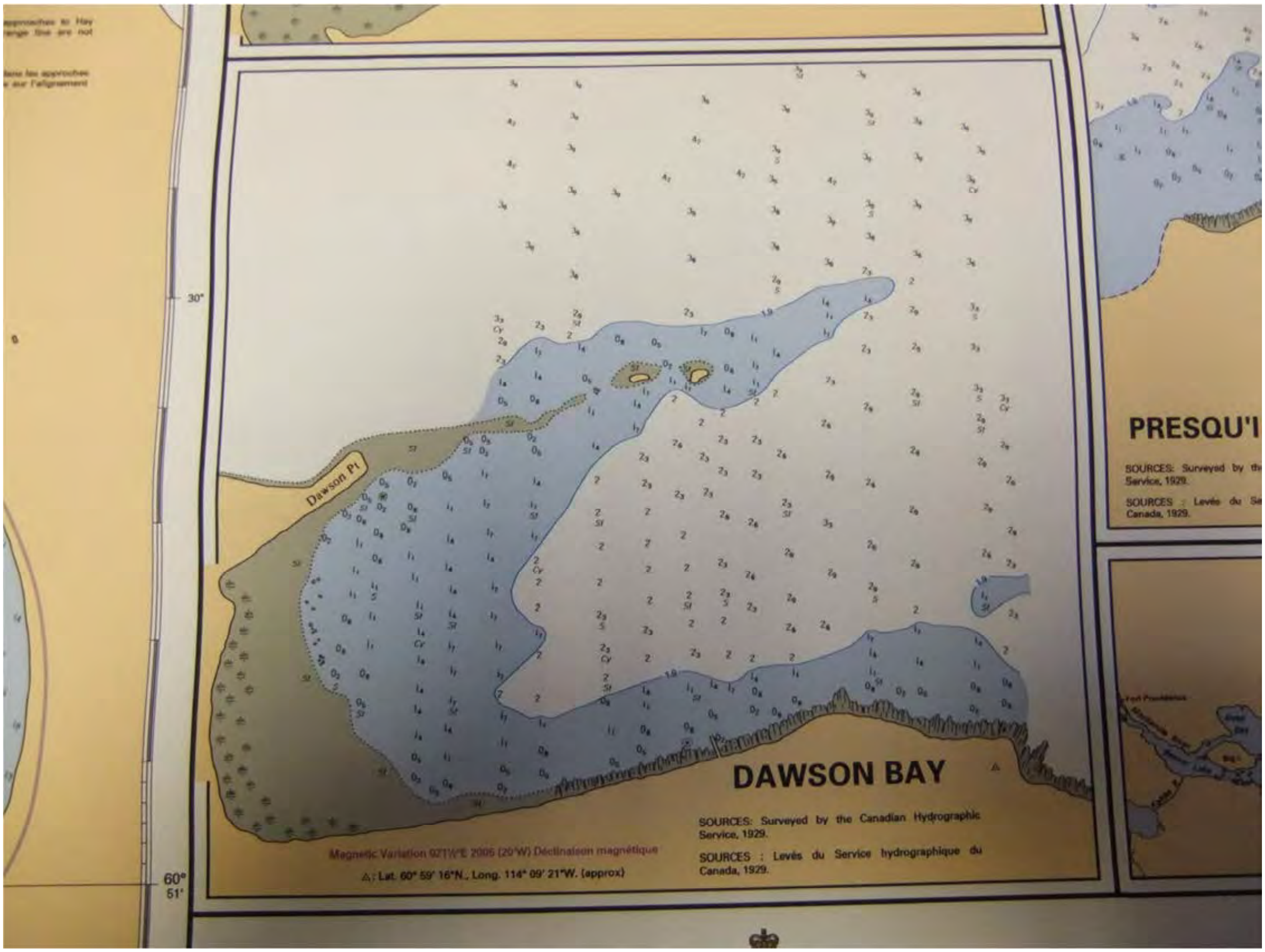

Figure 3.2.2 – Dawson Bay – CHS Chart 6371

4.0 Sea Fastenings: A lashing arrangement for securing concentrate containers must be developed and, preferably, approved by Class or Transport Canada. Several options are available for this task all of which are standard within the industry.

5.0 Routing: Figure 5.0 and 5.0.1 each show 2 routes from Thor to Pine Point and Hay River to Thor. It will be the mariner's decision which route is chosen.

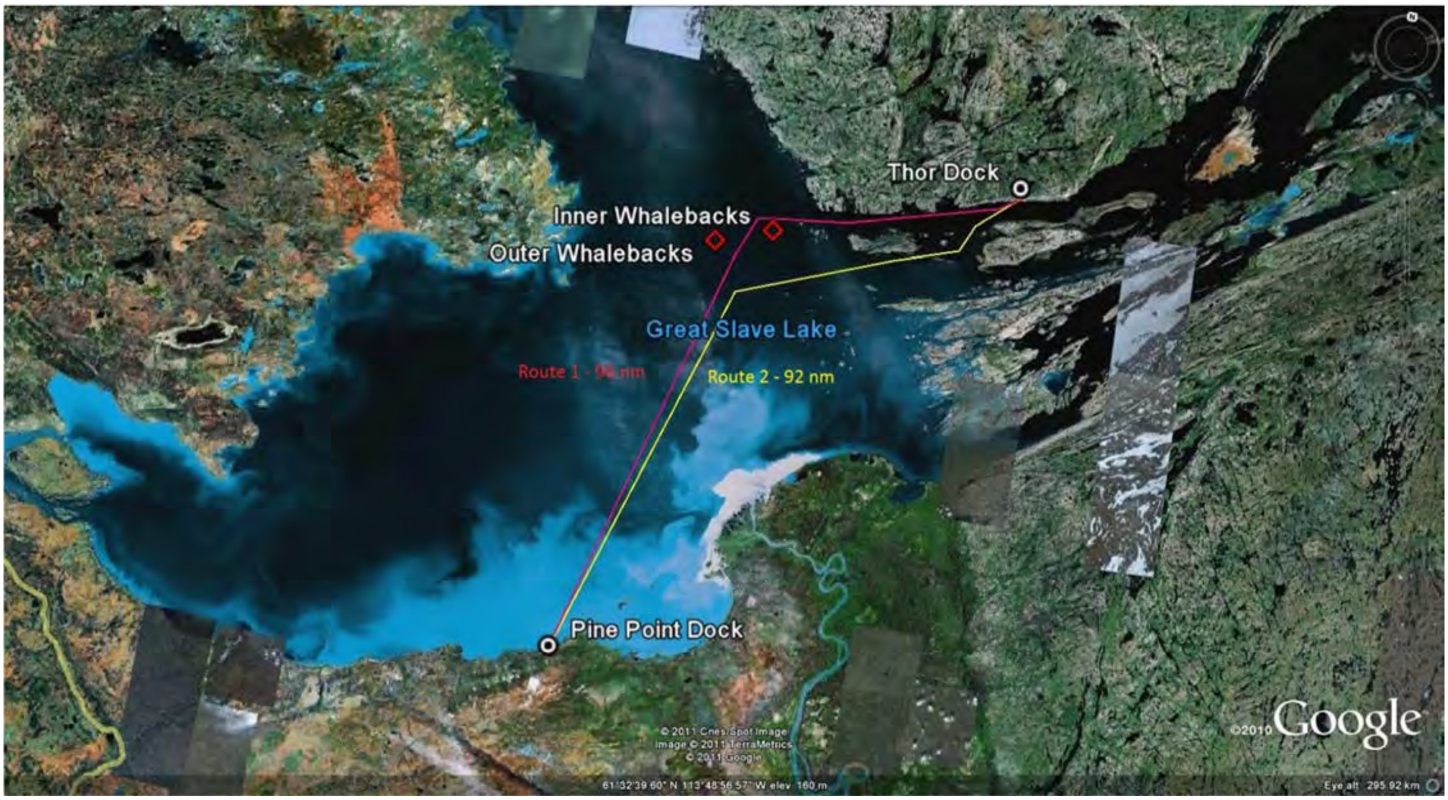

Figure 5.0 – Thor to Pine Point

Figure 5.0.1 Hay River to Thor

6.0 Weather and Wave Data: Random data for wave and wind measurements has been collected from 4 wave buoys on Great Slave Lake (Figure 6.0);

- Wave buoy C45141 – West Great Slave Lake
- Wave buoy C45150 – North Great Slave Lake
- Wave buoy MEDS089 – Hay River (operational 1975 only)
- Wave buoy MEDS326 – Fort Resolution (operational1995 only)

This information, provided on line by Fisheries and Oceans Canada, is randomly selected to ensure best data quality. The MED Stations listed above did not provide wind direction or wind speed.

Figure 6.0 Buoy Stations on Great Slave Lake

Limiting weather conditions for sailing across Great Slave Lake is generally based upon:

- 20 knot wind speed (10.3meters/second) but dependent upon direction
- 0.91 meter (3 foot) sea state

Figures 6.0.1 and 6.0.2 show wind direction speed and wave heights. In all cases strongest winds are from the west through north quadrant. Wave heights tend to increase as the season progresses. Figures 6.0.3 and 6.0.4 show wave heights only which also indicates an increase in heights as the season progresses.

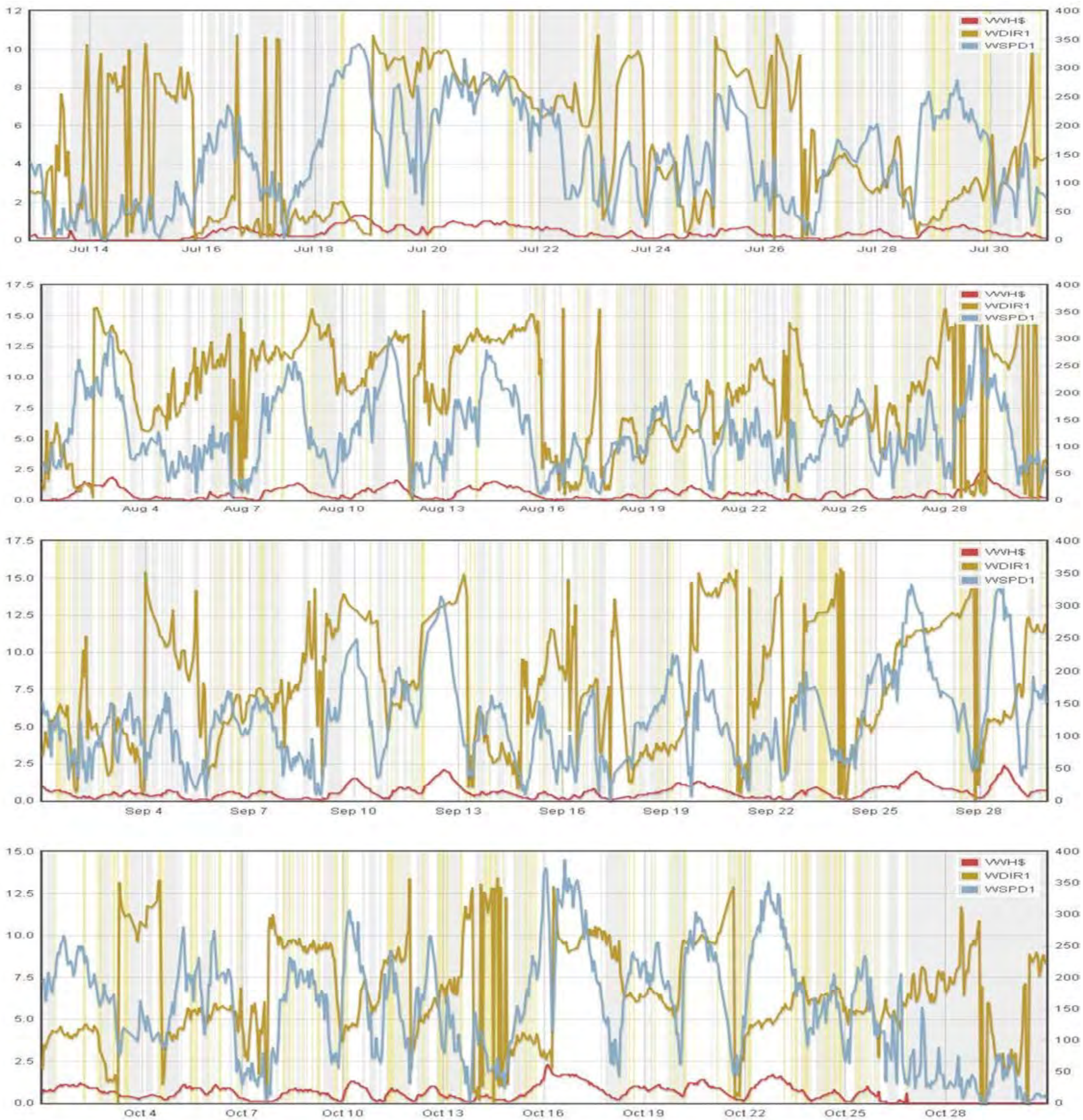

Figure 6.0.1 Buoy C45141 2005

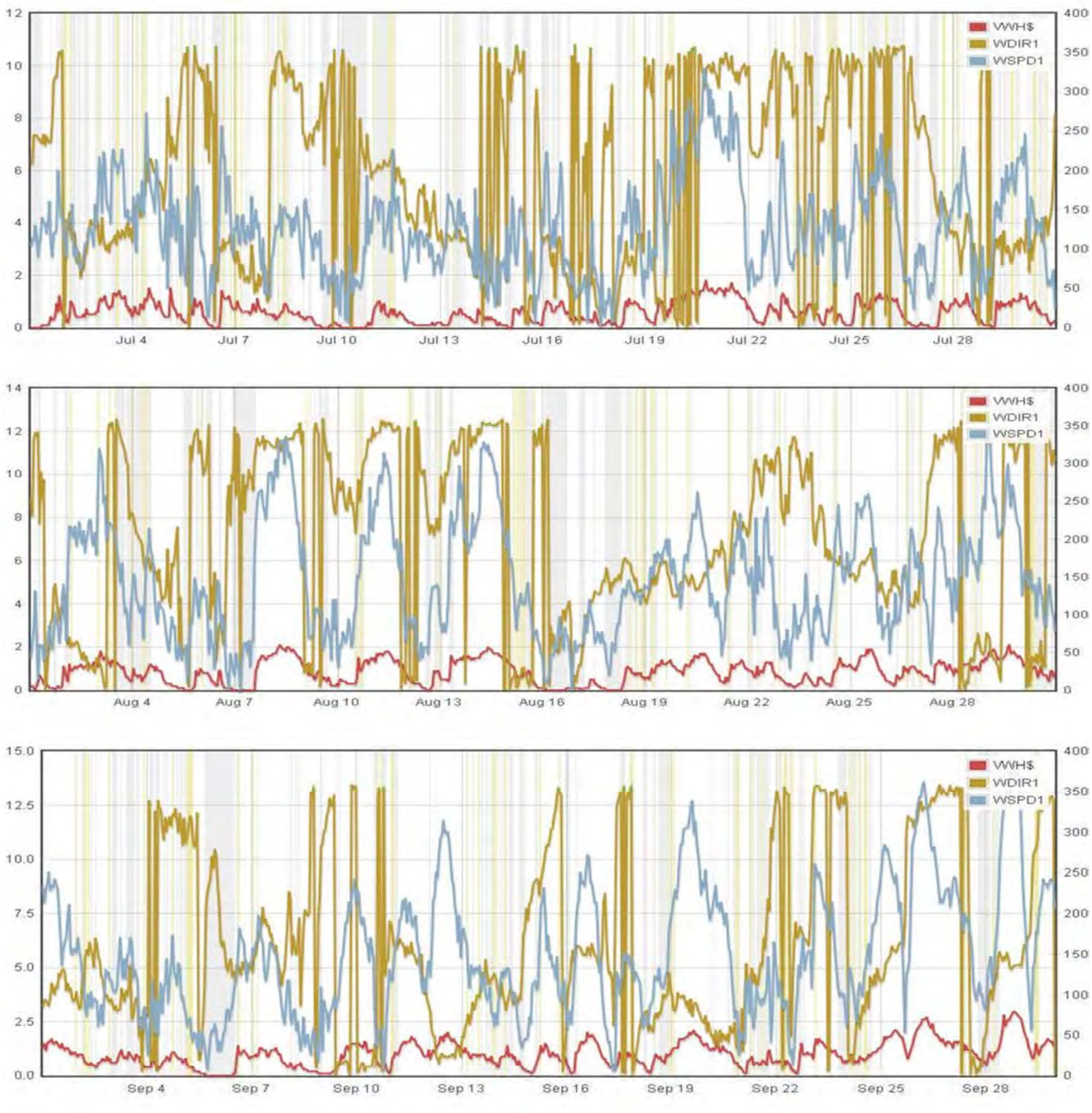

Figure 6.0.2 Buoy C45150 2005

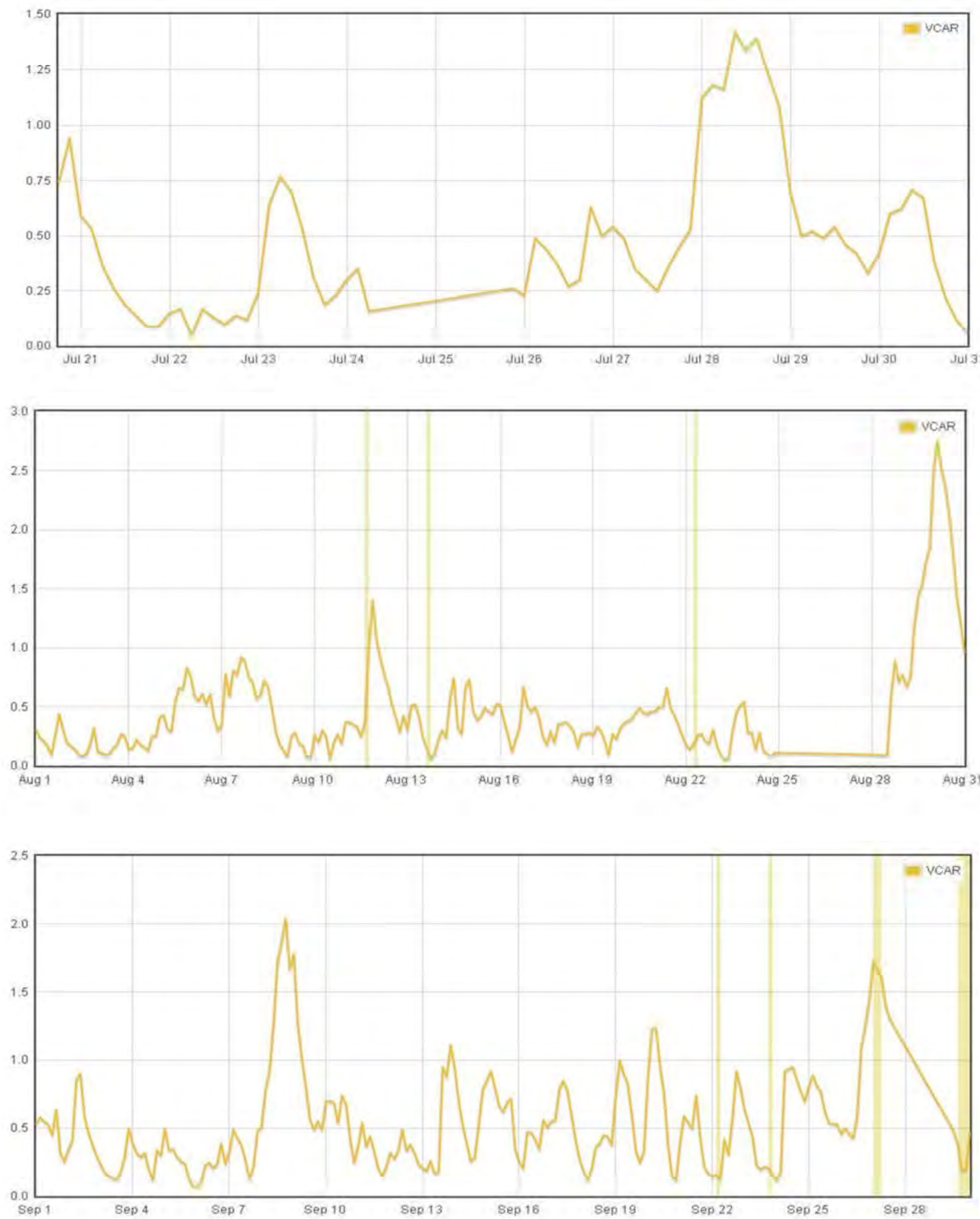

Figure 6.0.3 Buoy MEDS089 – Hay River 1975

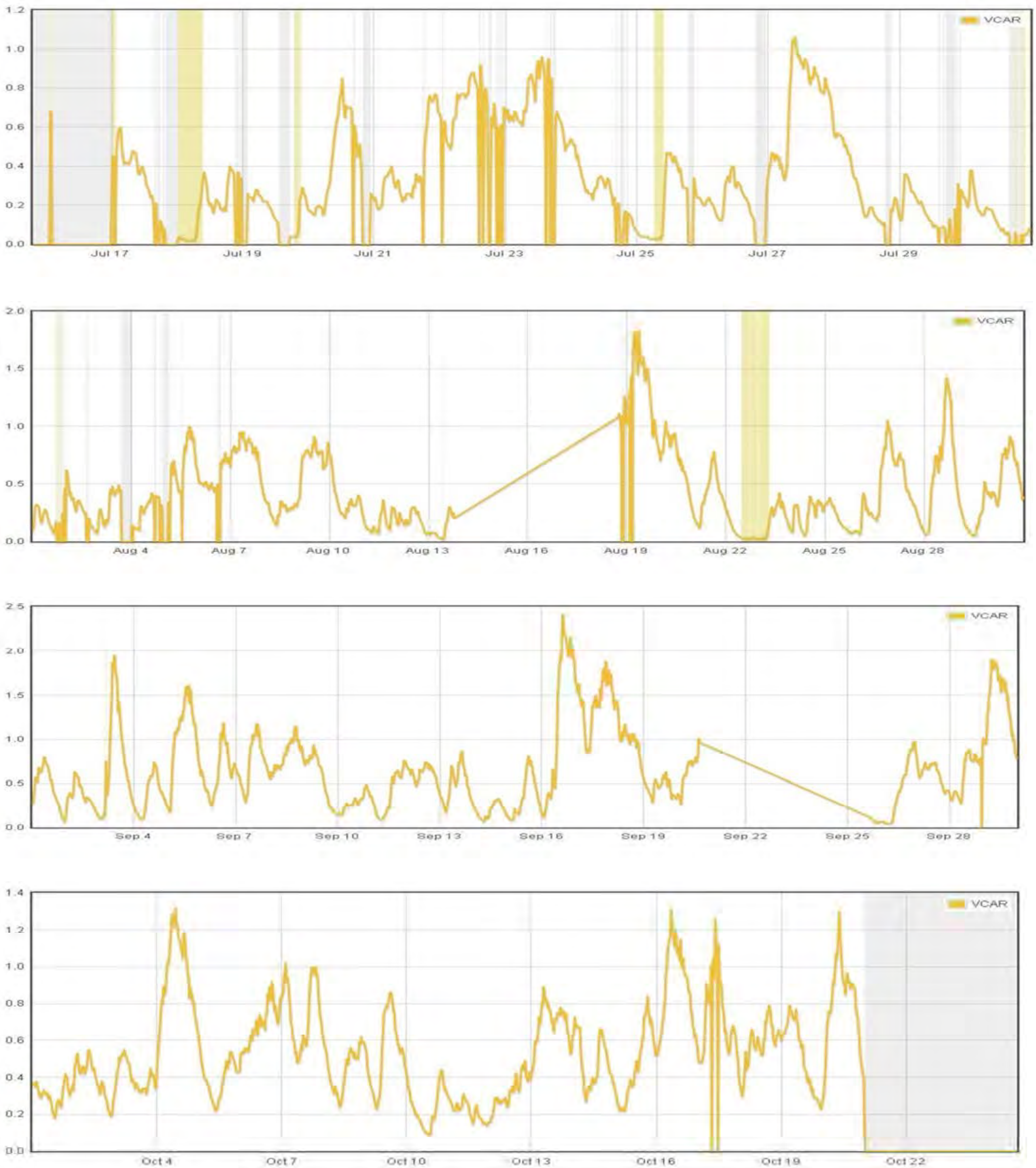

Figure 6.0.4 Buoy MEDS326 – Fort Resolution 1995

7.0 Preliminary Schedules: Detail and summary schedules have been developed to indicate days and timelines to transport by barge all commodities destined for Thor and Pine Point. These schedules, which are based on current tonnage estimates, are indications only and are subject to change. Two separate operations have been scheduled as two operations limit overall time and take advantage of favourable weather conditions on Great Slave Lake. Summary schedules are shown as tables; detail is attached as Appendix 1.

7.1 ***Moist Concentrates:*** 3 options have been considered to transport 144,500 tonnes of concentrate from Thor to Pine Point (Table 1)

Thor Cargo - Metric Tonnes													
		Barge Series	Quantities	Container WT	Container Cargo	Total Wt	No. Of Containers		Barge DW Capacity	Containers per Barge	Product per Barge	Barge Loads	Barge Trips
Concentrate		1500	144,500	5	40	45	3,613		1710	38	1520	96	32
Concentrate		1000	144,500	5	40	45	3,613		900	20	800	181	60

Option 1 - 2 4500 HP Tugs, 6 1500 Series Barges													
	No. Tugs	No. Barges	Voyage Distance (nm)	Speed (nmh)	Voyage Time (hrs.)	Offload Time (hrs.)	Load Time (hrs.)	Lapsed Time (hrs.)	Contin. (%)	Contin. Time (hrs.)	Total Time (hrs.)	Round Trip (hrs.)	Days Required
Concentrate	2	6	92	6.5	14		18.4	33	10%	3.3	35.8		61.24
Empty	2	6	92	6.5	14	36.8		51	10%	5.1	56.0		
												91.86	
Total Days													**61.24**

Option 2 - 1 4500 Hp Tug, 2 Port Tugs, 6 1500 Series Barges													
		No. Barges	Voyage Distance (nm)	Speed (nmh)	Voyage Time (hrs.)	Offload Time (hrs.)	Load Time (hrs.)	Lapsed Time (hrs.)	Contin. (%)	Contin. Time (hrs.)	Total Time (hrs.)	Round Trip (hrs.)	
Concentrate	1	3	92	6.5	14		6	20	10%	2.0	22.2		67.92
Empty	1	3	92	6.5	14	12		26	10%	2.6	28.8		
												50.9	
Total Days													**67.92**

Option 3 - 2 4500 Hp Tugs, 6 1000 Series Barges													
		No. Barges	Voyage Distance (nm)	Speed (nmh)	Voyage Time (hrs.)	Offload Time (hrs.)	Load Time (hrs.)	Lapsed Time (hrs.)	Contin. (%)	Contin. Time (hrs.)	Total Time (hrs.)	Round Trip (hrs.)	
Concentrate	1	3	92	6.5	14		12	26	10%	2.6	28.8		88.91
Empty	1	3	92	6.5	14	24		38	10%	3.8	42.0		
												70.7	
Total Days													**88.91**

Table 1 - Concentrates

7.2 ***Diesel Fuel, Reagents & Mine Supplies:*** These commodities, totalling 26,444 tonnes, have been combined as all are transported from Hay River to Thor (Table 2). 3 options have been considered. Load and offload times for fuel has been provided by NTCL; load offload times for general cargo is based upon 150 tonnes per hour. Option 2 or 3 appears to be the best solution due to significantly less time to load and offload fuel.

Due to the length of time it takes to load and offload fuel (more than 50% of total days) consideration should be given to using more barges and having a port tug at the Thor site to perform offload operations. This port tug would also be useful to assist in concentrate loading operations.

Hay River Cargo - Metric Tonnes								
	Quantities	Conversion	Tonnes	Barge Draft (m)	1500 Series DW Capacity	1000 Series DW Capacity	15000 Series Barge Loads	1000 Series Barge Loads
Fuel (litres)	21,800,000	0.000832	18,138	1.69	1,300	900	13.95	20.15
Reagents			4,026	1.69	1,300	900	3.10	4.47
Mine Supplies			4,280	1.69	1,300	900	3.29	4.76
Totals			26,444				20.34	29.38

Option 1 - 1 4500 HP Tug, 3 1500 Series Barges													
	No. Tugs	No. Barges	Voyage Distance (nm)	Speed (nmh)	Voyage Time (hrs)	Offload Time (hrs)	Load Time (hrs)	Lapsed Time (hrs)	Contingency (%)	Contingency Time (hrs)	Total Time (hrs)	Round Trip (hrs)	Days Required
Fuel	1	3	121	6.5	20	90	54	164	10%	16.4	180.9	203.5	39.43
Reagents	1	3	121	6.5	20	27	27	74	10%	7.4	81.6	104.1	4.48
Supplies	1	3	121	6.5	20	29	29	78	10%	7.8	85.3	107.8	4.93
Empty	1	3	121	6.5	20			20	10%	2.0	22.5		
Total Days													**48.83**

Option 2 - 1 4500 Hp Tug, 3 1000 Series Barges													
	No. Tugs	No. Barges	Voyage Distance (nm)	Speed (nmh)	Voyage Time (hrs)	Offload Time (hrs)	Load Time (hrs)	Lapsed Time (hrs)	Contingency (%)	Contingency Time (hrs)	Total Time (hrs)	Round Trip (hrs)	
Fuel	1	3	121	6.5	20	45	30	95	10%	9.5	105.0	127.6	35.70
Reagents	1	3	121	6.5	20	18	18	56	10%	5.6	62.1	84.7	5.26
Supplies	1	3	121	6.5	20	18	18	56	10%	5.6	62.1	84.7	5.59
Empty	1	3	121	6.5	20			20	10%	2.0	22.5		
Total Days													**46.55**

Option 3 - 1 4500 Hp Tug, 1 Port Tug, 6 1000 Series Barges													
	No. Tugs	No. Barges	Voyage Distance (nm)	Speed (nmh)	Voyage Time (hrs)	Offload Time (hrs)	Load Time (hrs)	Lapsed Time (hrs)	Contingency (%)	Contingency Time (hrs)	Total Time (hrs)	Round Trip (hrs)	
Fuel	1	3	121	6.5	20	4	30	54	10%	5.4	59.9	82.5	23.08
Reagents	1	3	121	6.5	20	4	2	26	10%	2.6	28.6	51.2	3.18
Supplies	1	3	121	6.5	20	4	0	25	10%	2.5	27.4	49.9	3.30
Empty	1	3	121	6.5	20			20	10%	2.0	22.5		
Total Days													**29.55**

Table 2 – Fuel, Reagents & Mine Supplies

8.0 Northern Tug & Barge Companies: Described below are 3 tug and barge companies currently operating in the Northwest Territories.

8.1 ***Northern Transportation Company Limited (NTCL)***: Jointly owned by the Inuvialuit of the Northwest Territories and the Nunasi of Nunavut, NTCL is the largest tug and barge company operating in the area. They have ample equipment to satisfy the needs of this project; however, they have suggested this may not be the case in the future as their equipment may be dedicated to other projects. Fleet details of the company can be viewed on line at www.ntcl.com.

8.2 ***Horizon North Logistics Inc. (HNL)***: HNL is a public company trading on the TSX. They are headquartered in Calgary and have a marine operations base at Inuvik, NT. Except for 2 tugs that could be used as towing or port support tugs, their equipment is not suitable to meet Avalon's project requirements. HNL has shown a keen interest in this project and wish to be included in any tender process that may occur. It would be their intent to partner with a West Coast Company (Seaspan International or Island Tug and Barge) and possibly a First Nations

Group, and then build equipment to satisfy the needs of the project. HNL's web site is www.horizonnorth.ca.

8.3 ***Cooper Barging Service Ltd. (CBSL)**:* CBSL is a private company with headquarters in Fort Nelson, BC and operations base in Ft. Simpson, NT. Except for barges suitable for dock barges and possibly port support tugs, they currently do not have adequate equipment to satisfy the requirement for this project. CBSL web site is www.cooperservices.ca

9.0 **Hovercraft:** Use of a hovercraft to transport concentrates has introduced as an alternative to tug and barge. Craft proposed for this project is the SRN 4 model which previously operated in a car/passenger ferry service across the English Channel. Paul Schmidt has developed the economics of this craft, so the following will be an elaboration based on previous experience by the writer.

- 1973-74 - Bell Voyageur – Mackenzie Delta. A jet propulsion cargo craft chartered to Imperial Oil, primary use was to provide a "hot shot" service on a year round basis from base camp to drill sites. This was essentially a pilot project to evaluate performance in cold climates. Winter operations, coupled with very high maintenance costs, were problematic. In extreme cold (-30+ degrees), skirts became brittle and tore very easily. As well, rough ice very abrasive to fingers. In fairness, skirt material is more advanced today. The pilot project was not considered a success.
- 1985-1989 – Larus – Beaufort Sea. Larus was a Finnish craft constructed by Wartsila in 1981. In 1985, Wartsila Arctic and Arctic Transportation Ltd. formed a joint venture (Arctic Hovertrans), Canadianized the craft and transported her to station in Tuktoyaktuk, NT. The purpose of this venture was to introduce an alternate means of transportation to the offshore industry. The craft was diesel propelled, carried 46 passengers or 25 tonnes of cargo. It was a learning experience in terms of capabilities over ice. Fully loaded, operators could not get the craft on cushion over thin ice. In attempting to do so, fingers and skirts were severely damaged. To avoid this problem, an ice thickness of 17 inches was required. Rough ice and ridging proved to be a problem as well. Rough ice was very abrasive to the skirts and ridges over 0.5 meters had to be avoided due to skirt height. Visibility over ice and determining ice objects well in advance proved to be a challenge. Due to the suspension of activities in the Beaufort (1988 and onwards) the craft was demobilized from the Arctic and transported to Singapore.
- 2008 – 2009 – AP 1-88 – Fort McMurray. The craft was owned by Alaska Hovercraft (Lynden Transport) and chartered by NTCL for a period of 1 year. Canadian duty was paid on the 1/120 basis to bring the craft into Canada. This was a pilot project initiated by Canadian Natural Resources and Petro Canada (chartered from NTCL) to move personnel from Fort McMurray to CNRL's Base Camp 40+ miles north and along the Athabasca River. This was primarily a winter operation, but transit did occur over open water as well. The pilot project proved to be reasonably successful; however, there were issues with the navigation system for night travel. At the end of the term the craft was moved back to Prudhoe Bay, AK.

Transportation of concentrates by Hovercraft can be a viable alternative to tug and barge. From an economic perspective (developed by Paul Schmidt) this appears to be the case. Unfortunately (except

for Russian craft) long term operational history in cold climates is very limited. The SRN4, proposed for this operation, has had a very successful operation as a passenger/car ferry crossing the English Channel. Channel crossings were very short to what is contemplated here. Even with the short runs, maintenance and running costs appear to be on the high side. For cold climate operations some things that must be considered are:

- Skirt flexibility in -40 degree C temperatures;
- High wind conditions for control of the craft;
- Cabin insulation for crew members;
- Navigation equipment to identify ice obstacles, especially during the hours of darkness;
- Skirt height to navigate ice ridging;
- Finger abrasion on rough ice;
- Ice thickness required to achieve “on cushion” with full load; and
- Speed over ice in darkness

There are many other considerations; however, these can be discussed in the next phase of the project.

10.0 Preliminary Transportation Cost:

Note..This section has been removed from this copy of the report for reasons of corporate confidentiality.

11.0 Other Transportation Options

Other Transportation Options: Two other options that should be considered are:

- Transporting concentrates in bulk. This would entail installing conveyor systems but could reduce dock infrastructure.
- Building purpose built power barges having shallow draft and a deadweight capacity of about 6,000 tonnes. This may also reduce dock infrastructure. *Note; A Naval Architectural firm was engaged to evaluate using large shallow draft self-propelled barges to transport moist concentrates from Thor to Pine Point. This proved to be uneconomical due to the large dimensional requirements of the barge and high horsepower required to propel the unit at a reasonable speed. Their recommendation was using a tug/barge system employing a drop/swap operation with 2 shallow draft tugs, each having about 1200 kW horsepower, and 4 1350 tonnes DWT barges. A single barge would be pushed rather than towed using an ATB connecting system Articouple KD type or equal deck-mounted pin connectors. These barges would not be fuel capable therefore only suitable for the transportation of deck cargo.*

12.0 Summary & Recommendations: Several alternatives have been considered to perform Avalon's transportation requirements across Great Slave Lake. tug and barge appears to be the best solution for this task. Weather will be a factor, in particular at Pine Point, where delays in offloading/loading operations can be expected. It is important therefore, to start operations early in the season when ice conditions permit. From a weather point of view, June, July and August are the most favourable months. Beginning in early September, weather conditions begin to deteriorate causing considerably more lost time in operations.

A number of recommendations are suggested:

1. In-water bathymetry surveys should be conducted at Thor and Pine Point to determine bottom conditions as well as water depth*. The recommended bathymetric surveys of both sites were completed by EBA (2011) and the results provided in Appendix 1 to this report.* The possibility of using Dawson Bay as an alternative to Pine Point should be examined. Dawson location would provide more shelter, which would reduce weather down time. This area would also require an in-water bathymetry survey to determine bottom conditions and water depth. *For future study*
2. Contact should be made with Canadian Coast Guard at Hay River to request setting buoys and marking a channel into Pine Point. This contact should occur 1 or 2 years in advance of transportation operations so the Coast Guard can budget accordingly. *Completed. CCG Hay River has advised, subject to confirmation from head office, that they would buoy a channel into Pine Point at the beginning of each season and retrieve the buoys at the end of each season. This would be a user pay operation.*
3. For safety reasons, a port tug will be required at Thor and Pine Point unless line haul tugs stand by during load and offload operations. *After further investigation a port tug may not be required at Thor*
4. For safety reasons, a separate location for offloading fuel should be planned. This will also eliminate interference with concentrate operations. *A separate location for the discharge of fuel at Thor has been identified.*
5. For fuel discharge, consideration should be given to using floater hose to connect the barge discharge line to the shore pipeline *Potential operators have advised that this is not a problem*
6. All barges should be fitted with an anchor and a means to deploy and retrieve*. This is only necessary if mooring buoys are not installed at Pine Point and Thor.*
7. For securing purposes, all barges should be fitted with hand or mechanical winches.
8. Deck strength of all barges must be suitable for heavy lift trucks carrying 45 tonne containers and point loading for containers stacked 2 high. *The RFP will describe this requirement.*
9. All ramps need to be certified for the heaviest load. *Aspen Trailer in Nisku, AB was contacted and they provided a price indication for constructing 110 tonne ramps*
10. Engage a naval architect to do a preliminary design of a shallow draft power barge capable of lifting up to 6,000 tonnes. *Completed. Resolve advised that a power barge for shallow water operations was not cost effective*
11. Submit a competitive tender to interested marine companies for the work to ensure best overall price and guaranteed equipment availability. *An RFP is currently being developed*

APPENDIX I

EBA BATHYMETRY REPORT

A TETRA TECH COMPANY

October 27, 2011

ISSUED FOR USE
EBA FILE: V15101007.011

Avalon Rare Minerals Inc.
330 – 6165 Hwy 17
Delta, BC V4K 5B8

Confidential

Attention: David Swisher

Subject: Thor Lake Mine – Environmental Services
Bathymetry and Side-Scan Study of Proposed Barge Landing Locations
Avalon Rare Minerals Inc.

1.0 INTRODUCTION

EBA, a Tetra Tech Company (EBA) was retained by Avalon Rare Minerals Inc. (Avalon) to perform a bathymetric and side-scan sonar investigation at two proposed barge landing locations on Great Slave Lake, Northwest Territories. The objective of the survey was to provide preliminary maps of the water depth and any underwater obstructions, such as rocks and boulders, which may inhibit the docking and mooring of barges at the two sites. The two proposed barge landing locations are near Pine Point (641073 E, 6762112 N, UTM Zone 11) on the southern shore of Great Slave Lake; and near Thor Lake (413945 E, 6882576 N, UTM Zone 12), on the northern shore of Great Slave Lake at the beginning of the Eastern Arm.

EBA acquired bathymetric and side-scan sonar data, and surveyed complete water-bottom coverage within the proposed barge landing footprint. The surveys were performed on October 15th, 2011 by Mr. James Mickle, M.Sc., P. Geoph. (pending), by floatplane (Arctic Sunwest's DHC-2 Turbo Beaver). Rocky areas were identified at the Pine Point site that will need to be considered with respect to the mooring plan usage and draft of the barges to be used.

2.0 METHODOLOGY: BATHYMETRY AND SIDE-SCAN SONAR

2.1 Bathymetry Data Collection

Bathymetry data at both locations was acquired using a hydrographic grade echosounder. The data collected provides water depths in metres in relation to the surface of the lake water at the time of the survey. It has not been referenced to a geodetic datum as this was beyond the defined work scope authorized. It therefore should be considered suitable for general proof of concept use only. Echosounders measure water depth by emitting a short-duration sound pulse from an acoustic transducer and measuring the elapsed time for the pulse to travel to the water bottom and back to the transducer. The elapsed time is combined with the speed of sound in water to determine the depth to the bottom. The system was calibrated at each site by determining site-specific sound velocity values by measuring true water depth with a weighted rope at a specific calibration location.

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2.2 Side-Scan Sonar Data Collection

Side-scan sonar produces a full-coverage image of the bottom by repetitively illuminating the bottom with a short-duration pulse of sound shaped into a beam that is very wide (typically 60°) in the direction perpendicular to travel, and very narrow (typically 1° to 2°) in the direction parallel to travel. Typically, two channels of data are collected: one beam is directed to port, and one to starboard. The sound pulse reflects off rough features on the bottom and back to the side-scan system (even sand and silt are sufficiently rough to reflect some sound energy back to the sonar transducer). Features that stand proud above the water bottom reflect back relatively more energy than does a flat soft bottom, resulting in higher-amplitude responses. In addition, these features produce 'shadow zones' behind them, as for a limited period of time immediately after these higher-amplitude responses, no sound energy is reflected back. The time duration of these shadow zones can be used to determine the height of the feature above the bottom.

Since the side-scan beam is wide, it insonifies a strip or swath of the sediments on the water bottom either side of the track travelled by the survey boat. These systems can resolve items on the bottom that are a few decimetres in size depending on the frequency used and the distance of the side-scan fish from the bottom. In the case of this survey, the area was surveyed using a nominal line spacing of 25 m, with a nominal side-scan coverage of 50 m to either side of the boat, for greater than 100 percent bottom coverage. The side-scan data and GPS positions were recorded to a laptop computer for post processing and mapping using the commercial software Hypack.

3.0 EQUIPMENT

3.1 Bathymetry Equipment

Bathymetry data was acquired using a SonarLite portable echo sounder, manufactured by Ohmex Instrumentation in the UK. Its specifications are:

- Transducer frequency: 200 kHz Active Transducer
- Beam spread: 8° to 10 °
- Depth range: 0.30 m to 50.00 m (Software limited)
- Accuracy: ±0.025 m (RMS)
- Sound velocity range: 1390 to 1500 m/sec
- Pulse frequency: 1 Hz

The echosounder was mounted 1 m aft of the GPS antenna, 50 cm below the water surface. All positional offsets have been applied to the data presented.

3.2 Side-Scan Sonar Equipment

Side-scan sonar data was acquired using a Starfish 450F system manufactured by Tritech International Ltd. of the UK. Its specifications are:

- Acoustic frequency: 450 kHz
- Range: 1 m to 100 m
- Transmitted power: < 210 db relative to 1 μPa at 1 m
- Vertical beam width: 60°
- Horizontal beam width: 1.7°
- Transducer arrangement: dual fin-mounted transducers, with 30° down-angle

The side-scan towfish was towed off the float plane, 4 m aft of the GPS antenna, approximately 1 m below the water surface. Use of the floatplane as the survey platform precluded operations in very shallow water (less than 2 m) due to safety concerns expressed by the pilot.

3.3 GPS Equipment

Survey track lines were recorded using a Novatel Smart V1 GPS system. The GPS was configured to output NMEA data strings every second. This data stream was split and then merged with the side-scan and echosounder data as the survey data was collected. In addition to the NMEA data strings, the GPS system was also configured to output RINEX positional data that was logged every 5 seconds. This data was used for GPS post processing using Natural Resources Canada's online CSRS service. The post-processed GPS positions are of sub-metre accuracy. Post-processed positions were compared with the NMEA positions, and the differences calculated. These differences, along with the data offset form GPS layback, were applied to the final figures to correct the absolute position of the data in the horizontal plane. GPS data is reported in UTM coordinates. It should be noted that Pine Point and Thor Dock are in different UTM zones. Pine Point is in UTM Zone 11 and Thor Dock is in UTM Zone 12.

4.0 RESULTS

4.1 Pine Point

Figure 01 shows the results of the bathymetry and side-scan sonar data. All data has been corrected for transducer and GPS offsets. The Pine Point survey area is the more shallow of the two survey areas, ranging in depth from 2 to 7 m, with water depths gradually decreasing towards the shoreline. The shoreline was approximately 150 m southeast from the edge of the survey area. It was imprudent to survey closer to the shore due to the increasing possibility of rocks being present that would reduce water depths abruptly to less than 1 metre, the maneuvering required to collect the survey data, and the risk of damage to the floatplane's floats. Bathymetry contour spacing on Figure 01 is 0.2 m.

The side-scan data has been mosaicked using Hypack and laid underneath the bathymetry contours. Ten rocks, generally less than 0.5 m in diameter, have been picked and are shown as red crosses on the figure.

Five areas containing several rocks with rock sizes generally less than 0.5 m in diameter are shown as orange rectangles. A list of specific rock targets and their locations is included in the following Tables section.

As a general comment, the nature of the side-scan data suggests a coarse hard bottom material with some cobbles and rocks. Areas with softer finer grained materials show in the side-scan data as patches or bands of darker colours.

4.2 Thor Dock

Figure 02 shows the results of the bathymetry and side-scan sonar data at Thor Dock. The Thor Dock survey area is very deep, ranging in depth from 3 to over 70 m, with water depths decreasing steeply towards the north shoreline, which has been approximately shown on the figure. The shoreline is also visible in the side-scan mosaic as a dark region of low signal return along the north edge of the side-scan mosaic caused by the side-scan signal being lost between the bottom and the water's surface where the water is shallow. Bathymetry contour spacing on Figure 02 is 1 m..

The side-scan data has been mosaicked using Hypack and laid underneath the bathymetry contours. Two rocks, generally less than 0.5 m in diameter, have been picked and are shown as red crosses on the figure. A list of specific rock targets and their locations is included in the following Tables section.

In general little detail is visible with respect to the character of the bottom at Thor Dock. This is because of the steeply dipping bathymetry and resulting slopes coupled with the distance from the side-scan fish to the bottom over much of the survey area. In order to obtain more detailed data of the character of the bottom material at this site, it would have been necessary to fit a depressor weight to the side-scan fish and repeat the survey varying the cable length so the side-scan fish was kept a constant distance off the bottom. This was beyond the work scope provided for, given the time budgeted at this site, and considering the deeper water depths, it was not considered critical.

5.0 LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of Avalon Rare Minerals Inc. and their agents. EBA, A Tetra Tech Company, does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than Avalon Rare Minerals Inc. or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. EBA's General Conditions are provided in Appendix A of this report.

6.0 CLOSURE

We trust this report meets your present requirements. Should you have any questions or comments, please contact the undersigned at your convenience.

Sincerely,
EBA, A Tetra Tech Company

REGISTERED PROFESSIONAL GEOPHYSICIST
P.I. FINLAY
NWT/NU

October 27, 2011

Patrick Finlay, P.Geoph.
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October 27, 2011

Reviewed by:
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Engineering & Environmental Geophysics
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/ln

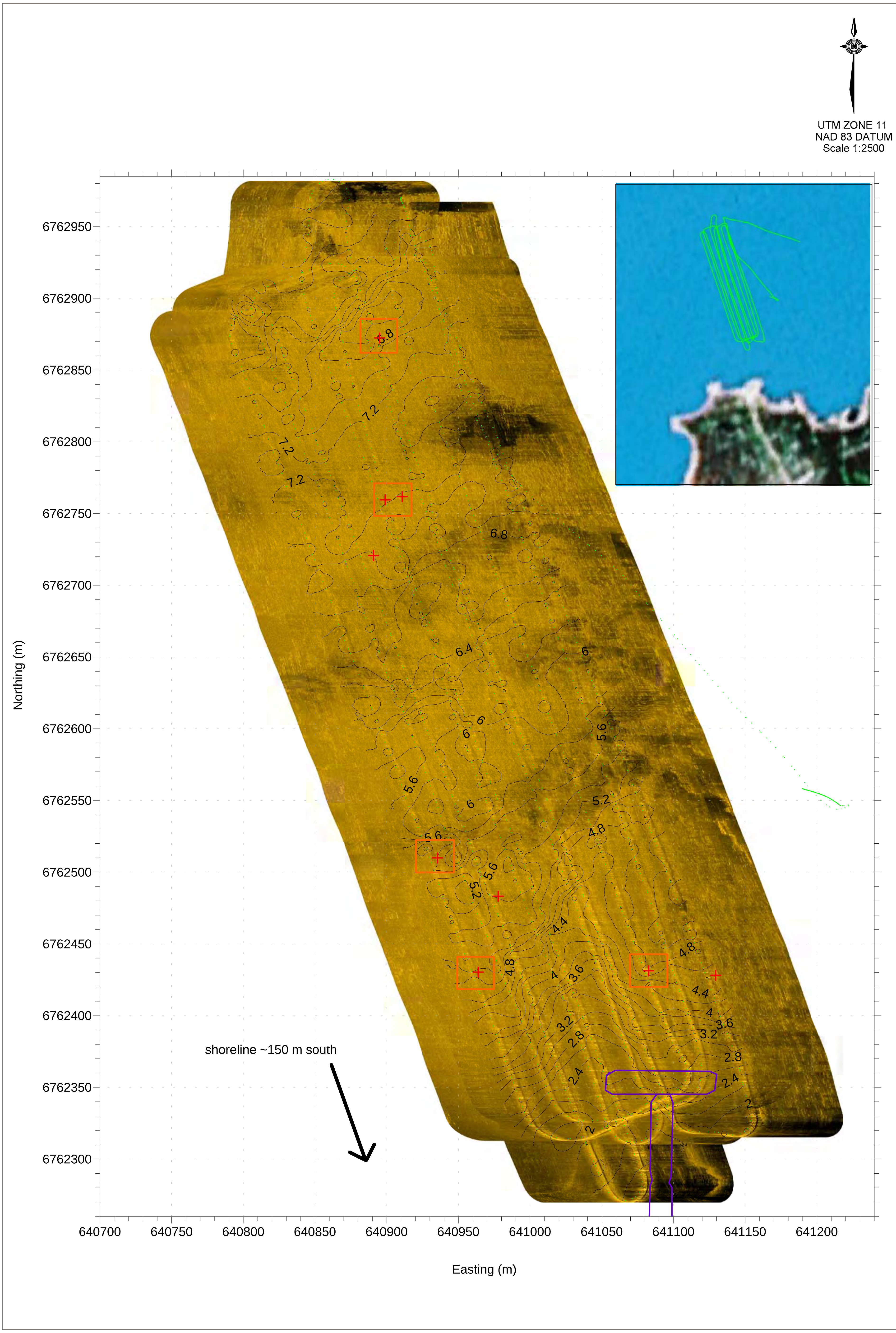
PERMIT TO PRACTICE
EBA ENGINEERING CONSULTANTS LTD.
Signature
Date October 27, 2011
PERMIT NUMBER: P 018
NWT/NU Association of Professional Engineers and Geoscientists

TABLES

Table: Side-Scan Targets

Pine Point (UTM Zone 11)		
Easting (m)	**Northing**	**Comments**
640898.9	6762759.6	Height: 1.8 Length: 2.9 Width: 1.5
640895	6762872.4	Height: 0.5 Length: 1.4 Width: 1.5
641129.4	6762428.2	Height: 0.7 Length: 1.8 Width: 1.5
641082.5	6762431.3	Height: 0.6 Length: 1.4 Width: 4.5 rocky area
640963.8	6762430.4	Height: 0.7 Length: 5.8 Width: 12.2 rocky area
640935.5	6762510	Height: 2.6 Length: 3.5 Width: 3.0 big shadow
640890.8	6762720.7	Height: 0.9 Length: 1.4 Width: 2.9
640977.7	6762483.3	Height: 1.0 Length: 0.6 Width: 0.6 Rocky Area
640910.8	6762761.8	Height: 0.6 Length: 4.6 Width: 3.8 Rocky area
Thor Dock (UTM Zone 12)		
Easting (m)	**Northing**	**Comments**
413939.4	6882501	Height: 0.4 Length: 0.5 Width: 1.2
413878.2	6882387.2	Height: 1.5 Length: 3.4 Width: 3.0

FIGURES



LEGEND

- Rocky Areas
- Rocks
- Bathymetry Contours
- GPS Trackline
- Proposed Dock Infrastructure

CLIENT

AVALON

eba
A TETRA TECH COMPANY

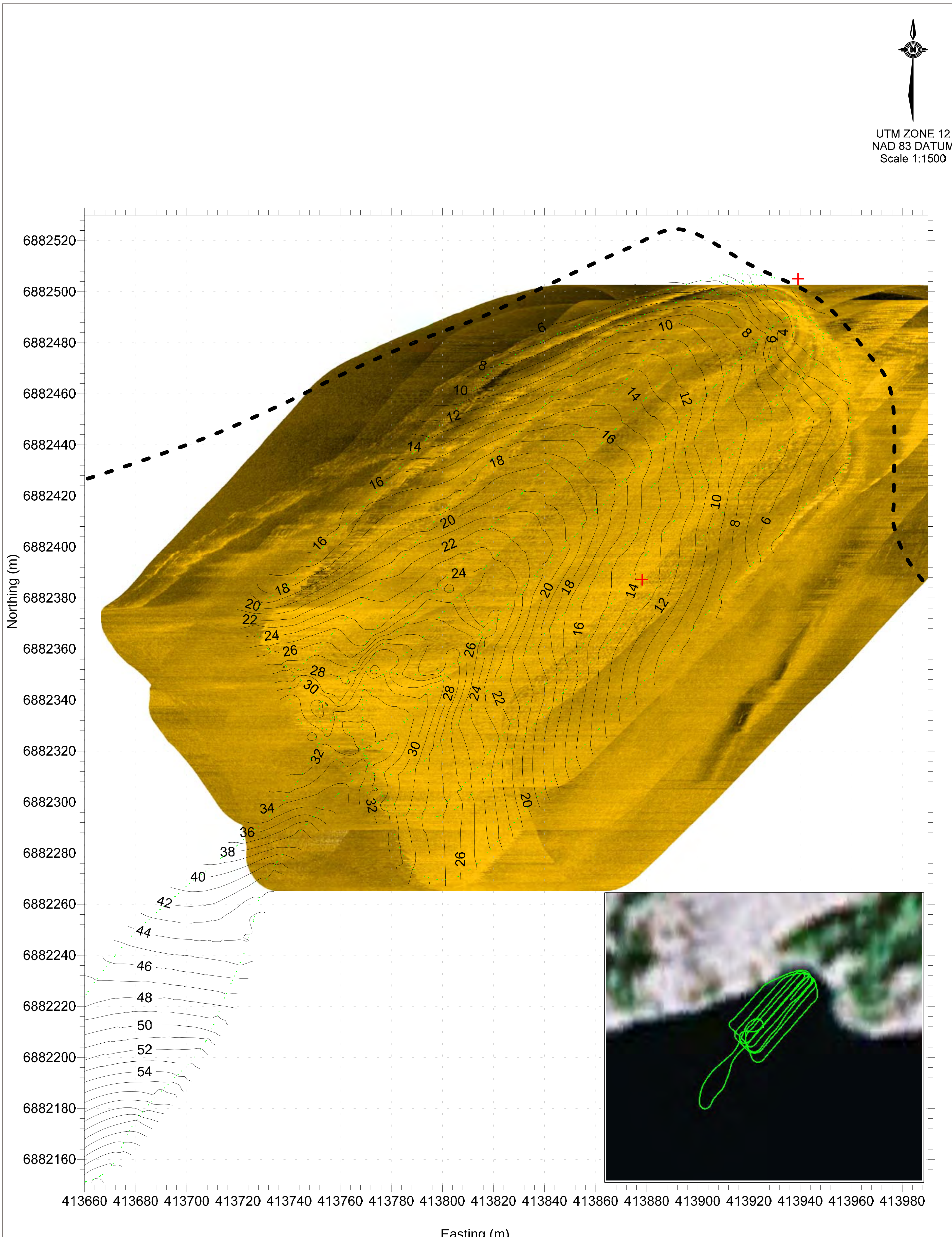
Thor Lake Project
Northwest Territories

Pine Point Barge Area
Bathymetry and Side-scan Sonar

PROJECT NO.	DWN	CKD	APVD	REV
V15101007.011	PIF	RJM	NSP	000

OFFICE	DATE
EBA-OTT	October 27, 2011

Figure 01



LEGEND

- Rocks
- Bathymetry Contours
- Approximate Shoreline
- GPS Trackline

CLIENT

AVALON

eba A TETRA TECH COMPANY

Thor Lake Project
Northwest Territories

Thor Dock Barge Area
Bathymetry and Side-scan Sonar Results

PROJECT NO.	DWN	CKD	APVD	REV
V15101007.011	PIF	RJM	NSP	000

OFFICE	DATE
EBA-OTT	October 27, 2011

Figure 02

APPENDIX A

APPENDIX A EBA'S GENERAL CONDITIONS

GENERAL CONDITIONS

GEOPHYSICAL REPORT

This report incorporates and is subject to these "General Conditions".

1.0 USE OF REPORT

This geophysical report pertains to a specific site, a specific development, and a specific scope of work. It is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the site or proposed development would necessitate a supplementary investigation and assessment.

This report and the assessments and recommendations contained in it are intended for the sole use of EBA's client. EBA does not accept any responsibility for the accuracy of any of the data, the analysis or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than EBA's client unless otherwise authorized in writing by EBA. Any unauthorized use of the report is at the sole risk of the user.

This report contains figures, maps, drawings and sketches that represent processed geophysical data collected at a specific site. This processed data will have inherent interpretation assumptions and accuracies that are discussed in the report. Consequently, the report can only be considered in its entirety and individual figures, maps, drawings and sketches shall not be distributed without the text of the report unless authorized in writing by EBA.

This report is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of EBA. Additional copies of the report, if required, may be obtained upon request.

2.0 ALTERNATE REPORT FORMAT

Where EBA submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed EBA's instruments of professional service), the Client agrees that only the signed and/or sealed versions shall be considered final and legally binding. The original signed and/or sealed version archived by EBA shall be deemed to be the original for the project.

Both electronic file and hard copy versions of EBA's instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except EBA. EBA's instruments of professional service will be used only and exactly as submitted by EBA.

Electronic files submitted by EBA have been prepared and submitted using specific software and hardware systems. EBA makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

3.0 ENVIRONMENTAL AND REGULATORY ISSUES

Unless stipulated in the report, EBA has not been retained to investigate, address, or consider and has not investigated, addressed, or considered any environmental or regulatory issues associated with the development of the site.

4.0 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems and methods employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from the system or method prevail, they are specifically mentioned.

Classification and identification of geological units are judgemental in nature as to both type and condition. EBA does not warrant conditions represented herein as exact, but infers accuracy only to the extent that is common in practice.

Where subsurface conditions encountered during development are different from those described in this report, qualified geotechnical personnel should revisit the site and review recommendations in light of the actual conditions encountered.

5.0 LOGS OF TESTHOLES

The testhole logs are a compilation of conditions and classification of soils and rocks as obtained from field observations and laboratory testing of selected samples. Soil and rock zones have been interpreted. Change from one geological zone to the other, indicated on the logs as a distinct line, can be, in fact, transitional. The extent of transition is interpretive. Any circumstance which requires precise definition of soil or rock zone transition elevations may require further investigation and review.

6.0 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

The stratigraphic and geological information indicated on drawings contained in this report are inferred from logs of test holes and/or soil/rock exposures. Stratigraphy is known only at the locations of the test hole or exposure. Actual geology and stratigraphy between test holes and/or exposures may vary from that shown on these drawings. Natural variations in geological conditions are inherent and are a function of the historic environment. EBA does not represent the conditions illustrated as exact but recognizes that variations will exist. Where knowledge of more precise locations of geological units is necessary, additional investigation and review may be necessary.

7.0 SURFACE WATER AND GROUNDWATER CONDITIONS

Surface and groundwater conditions mentioned in this report are those observed at the times recorded in the report. These conditions vary with geological detail between observation sites; annual, seasonal and special meteorological conditions; and with development activity. Interpretation of water conditions from observations and records is judgmental and constitutes an evaluation of circumstances as influenced by geology, meteorology and development activity. Deviations from these observations may occur during the course of development activities.

8.0 INFORMATION PROVIDED TO EBA BY OTHERS

During the performance of the work and the preparation of the report, EBA may rely on information provided by persons other than the Client. While EBA endeavours to verify the accuracy of such information when instructed to do so by the Client, EBA accepts no responsibility for the accuracy or the reliability of such information which may affect the report.

Attachment 4

Avalon Rare Metals Inc.

CONCEPTUAL EROSION AND SEDIMENT CONTROL PLAN

Prepared for:

AVALON RARE METALS INC.

Prepared by:

EBA, A TETRA TECH COMPANY

JANUARY 2012

ISSUED FOR USE

FILE: V15101007.004

TABLE OF CONTENTS

FIGURES

1.0 INTRODUCTION

Avalon Rare Metals Inc. ('Avalon') is a publicly traded company involved in the exploration and development of rare metal deposits in Canada. Avalon's 100% owned Thor Lake Property is located at Thor Lake in the Mackenzie Mining District of the Northwest Territories, about 5 km north of the Hearne Channel of Great Slave Lake and about 100 km southeast of Yellowknife.

Avalon proposes to mine, mill, and produce rare earth carbonate and oxides, zirconium, niobium and tantalum oxides from the Nechalacho deposit, located on its Thor Lake Property. The proposed development is referred to as the Thor Lake Project (TLP) or "the Project".

The proposed TLP has two main site components: an underground mine and flotation plant (Nechalacho Mine and Flotation Plant site), to be located at the Thor Lake Property, and a hydrometallurgical plant (Hydrometallurgical Plant site) to be located at the existing brownfields site of the former Pine Point Mine, 85 km east of Hay River, NT on the south shore of Great Slave Lake.

Approximately 14.5 million tonnes of mineral reserves will be mined from the Nechalacho deposit over a period of 20 years of operations. Construction will begin 16-18 months before the start of operations. At the end of mine life, the majority of reclamation activities will begin and will continue for a period of about three years. Progressive reclamation will be carried out throughout all stages of the Project, wherever possible.

1.1 Corporate Overview and Governance

Avalon has adopted the Principles and Guidelines for Responsible Exploration being developed by the Prospectors and Developers Association of Canada, as a policy of the Company and made Corporate Social Responsibility (CSR) a Company priority. Avalon applies these principles throughout its operations, particularly with respect to its environmental and community engagement practices for the Thor Lake Project. Avalon is also a member of the Mining Association of Canada (MAC) and has committed to following the principles of socially responsible mining through MAC (2004) "*Toward Sustainable Mining*" initiatives.

1.1.1 Environmental, Health, and Safety Policy

Avalon Rare Metals Inc. (the 'Corporation') recognizes that maintenance of environmental quality is vital to the Corporation's existence, progress, and continued development. The Corporation will maintain high environmental standards limited only by technical and economic feasibility. The Corporation will take positive action to protect the safety of its workers, conserve natural resources, and minimize the effects of its activities on the environment through diligent application of appropriate technology and responsible conduct at all stages of exploration, mine development, mining, mineral processing, decommissioning, and reclamation.

The purpose of Avalon Rare Metals Inc.'s Environmental, Health, and Safety Policy is to provide a measurable framework for the performance of the Corporation's activities in an environmentally responsible manner, achieving compliance by the Corporation and its employees with all applicable environmental regulations and commitments.

1.1.2 Environmental Responsibility

Prior to Avalon acquiring the Thor Lake property, Highwood Resources Ltd. (Highwood) held a land use permit that allowed for clean-up, maintenance and exploration on the property. The permit expired on October 26, 2002.

Past exploration on the Thor Lake property included underground bulk sampling, drilling, and trenching. Accordingly, there is little surface disturbance from exploration activities. Apart from a trailer camp, miscellaneous buildings, a 60,000 gallon six tank farm, a tent camp, and a core storage area located on the property, there are no other environmental liabilities left by past exploration activities. The diesel fuel remaining in the tank farm has been consumed during Avalon's recent exploration activities and the tanks will be re-purposed for future operations. Parts of the trailer camp have been removed, while others have been refurbished and utilized for current camp and office facilities. A recent reclamation campaign removed over 6,000 cubic metres of historic waste piles for use in Avalon's completed airstrip.

The company has undertaken extensive general clean-up of material left from previous exploration utilizing First Nations labour. Access to the underground workings has been barricaded and the mine workings allowed to flood. Warning fencing has also been installed around the ramp entrance.

1.1.3 Regulatory Environment

Several statutes apply to erosion and sediment control planning in the Northwest Territories. These include:

- *Fisheries Act* and Regulations
- *Arctic Waters Pollution Prevention Act* and Regulations
- *Northwest Territories Waters Act* and Regulations
- *Mackenzie Valley Resource Management Act* and Regulations
- *Canadian Environmental Assessment Act* and Regulations
- *Canadian Environmental Protection Act* and Regulations
- *Territorial Lands Act* and Regulations

2.0 BACKGROUND

Surface erosion is the process of physical and chemical weathering of rock and soil, and the transport of the resulting particulates by water, wind, gravity, and thermal processes (Claridge and Mirza 1981). Although erosion occurs naturally, it can be exacerbated by human activities that result in soil exposure, or increases or changes in water transport patterns. The deposition of both inorganic and organic particulates in water bodies can result in adverse impacts to aquatic biota and their habitats. In most cases, however, the extent, duration, and consequences of erosion can be avoided or mitigated through proper planning, the application of suitable designs, effective monitoring, and timely maintenance.

The Developer's Assessment Report (DAR) for the Thor Lake Project (Avalon 2011) indicates that erosion and sediment control will be guided by the DFO "Land Development Guidelines for the Protection of Aquatic Habitat" (DFO 1993). Although these guidelines were developed for conditions in British Columbia, they are generally applicable for northern areas, although it is understood that subarctic climatic, vegetation, and particularly, permafrost conditions may require the modification of designs and procedures to effectively manage erosion and sedimentation.

This Conceptual Erosion and Sediment Control Plan identifies, on a preliminary basis, the general methods that may be applicable to the Thor Lake Project to avoid or minimize sedimentation of water bodies caused by site development. However, specific designs, methods, and technologies will be dependent on a thorough reconnaissance of development areas to determine site specific characteristics and appropriate erosion control options. This plan will be updated as necessary as the Thor Lake Project progresses through the detailed design and eventual construction and operations phases.

3.0 SITE DEVELOPMENTS AND CHARACTERISTICS

Land disturbance or modification at the Thor Lake property will generally be limited to:

- Upgrading of the existing road leading from the Flotation Plant Site to the seasonal barge landing site on Great Slave Lake;
- Extension of the existing air strip;
- Upgrade of the existing road and pipeline corridor from the Flotation Plant Site to the Tailings Management Facility; and
- Construction and operation of the flotation plant site.

Figure 1 identifies the locations of these proposed infrastructure developments, as well as existing roads within the Project footprint.

Surface disturbances in permafrost areas can be problematic by promoting ground warming, which can lead to the progressive thaw and possibly the loss of permafrost in localized areas. Thawed soil particles are then susceptible to mobilization by flowing water and subsequent downslope deposition (Claridge and Mirza 1981). In northern latitudes, runoff volumes tend to be very high due to limited subsurface water storage potential (Kane and Yang 2004). As such, summer storms can result in substantial overland flow, potentially leading to high rates of erosion.

Within the Thor Lake Project area, most of the new developments will be situated in areas comprised mainly of bedrock or over thin organics over bedrock (Avalon 2011). This is apparent in soil mapping of much of the Project footprint (Figure 2), which shows a preponderance of bedrock and coarse materials in areas proposed for infrastructure development.

4.0 EROSION AND SEDIMENT CONTROL MEASURES

4.1 General Guidelines

The "Land Development Guidelines for the Protection of Aquatic Resources" (DFO 1993) provides general guidance to avoid or minimize erosion. Many of the erosion control guidelines outlined in that document are applicable to conditions in northern latitudes. The following principles from that document will be applied as part of design and construction for the Thor Lake Project, with adaptation to suit site conditions:

Plan the development to the existing terrain and site conditions. A critical component of the erosion and sediment control plan is the avoidance, where possible, of permafrost areas, and the minimization of permafrost thawing where avoidance is not practical or possible. Mine planning and design has avoided permafrost areas wherever possible, with most structures being situated on bedrock or ecosystem types with thin organics over bedrock. Where permafrost cannot be avoided, development plans will require stripping of overlying materials to bedrock prior to construction or will incorporate the use of features such as Arctic foundations to ensure any heat generated does not transfer into the subsurface, thereby compromising the integrity of the permafrost.

Schedule development to minimize risk of potential erosion. Winter is the optimal time for carrying out land clearance in areas of fine-grained, highly silty ice-rick soils (Claridge and Mirza 1981). This will permit operation of heavy equipment with only limited damage to the organic surface, where such exists. Every effort will be made to carry out construction in these areas during the winter. Where surface preparation cannot be carried out in winter, exposed surfaces will be immediately stabilized with coarse, granular materials.

Retain existing vegetation where possible. Construction boundaries will be carefully demarcated to restrict vegetation removal and soil disturbance to active development sites. No vegetation will be removed and no machinery will be permitted outside of these locations.

Re-vegetate/protect denuded areas and bare soils. Wherever possible, re-vegetation will be carried out using native seed or cuttings. Claridge and Mirza (1981) recommend that where practical, material from the surface organic layer should be removed, stored, and then later utilized to re vegetate disturbed areas. This procedure will be followed, if possible, where sites must be disturbed but will not be ultimately covered by road or building structures.

Divert runoff away from denuded areas. Runoff from the site cleared for the Flotation Plant, and runoff from impervious surfaces created as part of the flotation plant, will be collected by runoff collection ditches that will lead to the Plant Site Collection Sump (Figure 1). This system will be designed to handle runoff associated with normal precipitation as well as the 1 in 20 year storm event. Water from the sump will be pumped to the process plant for use as process water, and then to the TMF.

Minimize the length and steepness of slopes where possible. Road/pipeline and TMF embankments will have slopes between 2:1 and 3:1, and will consist of clean rock fill and riprap. Where possible, a minimum 15 m buffer of natural vegetation or undisturbed land will be maintained between embankments and natural water bodies.

Minimize runoff velocities and erosive energy. Runoff from embankment slopes is anticipated to be clean due to the use of crushed rock and riprap in side slope construction. However, the potential exists during spring freshet and following summer storms for large amounts of water to drain from the embankments, which can result in soil erosion. Two types of drainage can occur along the transportation corridors: cross drainage and longitudinal drainage. Longitudinal drainage will be minimized to prevent water acceleration and gullying, which can occur when water flows unimpeded downslope. Where necessary, longitudinal drainage will be provided by ditches set several metres from the toe of the embankment slope (to prevent ponding and undercutting of the embankment). However, ditches will not be constructed in fine-grained frozen soils (Claridge and Mirza 1981) unless alternative methods are not available to transport drainage. Examples of methods to reduce the erosion potential along longitudinal ditches include:

- Provision of cross drainage through the embankment at appropriate intervals, preferably at natural topographic depressions;
- Inclusion of ditch checks made of clean, crushed rock, to prevent flow acceleration and to provide small settling basins. Ditch checks will be designed to prevent excessive water backup and overtopping of the ditch, and must be routinely maintained to remove accumulated sediment;
- Lining of ditches with such materials as coarse gravel or cobble to prevent the exposure of sediment particles to flowing water; and, diversion dykes to deflect; and
- Diversion of ditches at regular intervals away from road or pipeline embankments into vegetated areas or sedimentation ponds (INAC 2010).

Retain eroded sediments onsite with erosion and sediment control structures. Construction areas will be separated from undisturbed terrain using silt fences as necessary. Temporary ditches will be lined with plastic and channeled to small, temporary sediment ponds, which will be regularly maintained. Temporary ponds and ditches will be backfilled with clean gravel once they are no longer necessary. Stockpiled materials, especially those including excavated overburden containing ice, will preferably be deposited in low lying areas to limit overland drainage, and will be contained by means of appropriate ditching. Where necessary, temporary stockpiles will be covered with waterproof tarps to prevent storm water erosion.

Control erosion and sedimentation at stream crossings. A 29 m long culvert within the north access road at the outlet of Fred Lake will be the main new stream crossing proposed as part of the Thor Lake Project (Figure 1). This culvert will be an open bottom arch structure, which will support the access road, water recycle pipeline, and tailings delivery pipeline. The road surface will also be fitted with containment berms designed to prevent spills of tailings to the stream in the most unlikely event of a pipeline failure. These containment berms will also prevent the washing of sediment into the stream as a result of road surface runoff. The inlet and outlet of the culvert will include retaining walls consisting of rock filled gabion baskets for erosion protection. The culvert will be installed at low water to limit stream bottom disruption, which will be minimal since bed excavation will not be required.

5.0 EROSION AND SEDIMENT CONTROL PROCEDURES

The following design and implementation procedures will be followed to ensure appropriate erosion and sediment control at the Thor Lake project:

- Conceptual erosion and sediment control measures will be incorporated into infrastructure and facility designs, and as part of construction methods and scheduling;
- A reconnaissance site visit will be held to identify potentially erodible soils and permafrost areas that could be impacted by construction and operational activities. Detailed mapping will be produced to assist in appropriate design and construction planning;
- An environmental management plan (EMP) will be prepared and will include a more detailed, site specific Erosion and Sediment Control Plan to update this conceptual plan. The plan will include the identification of individuals responsible for implementation of the EMP including environmental monitors who will be engaged to oversee all construction activities;
- The EMP will include drainage water quality criteria, such as suspended solids or turbidity limits, to ensure protection of receiving water bodies;
- Environmental monitors will be given the authority to stop work and to require the implementation of remedial measures in the event of potential or ongoing erosion resulting from construction activities;
- The construction contractor(s) will be responsible for preparing detailed environmental protection plans (EPP), which will include site specific implementation plans for erosion and sediment control measures, including re-vegetation plans, where required; and
- All erosion and sediment control structures will be regularly monitored and maintained to ensure proper functioning. Maintenance will include watering of road surfaces during dry summer periods to reduce dust formation, examination of the integrity of ditches and sediment control structures, and removal of excessive accumulations of sediment from traps and sediment ponds.

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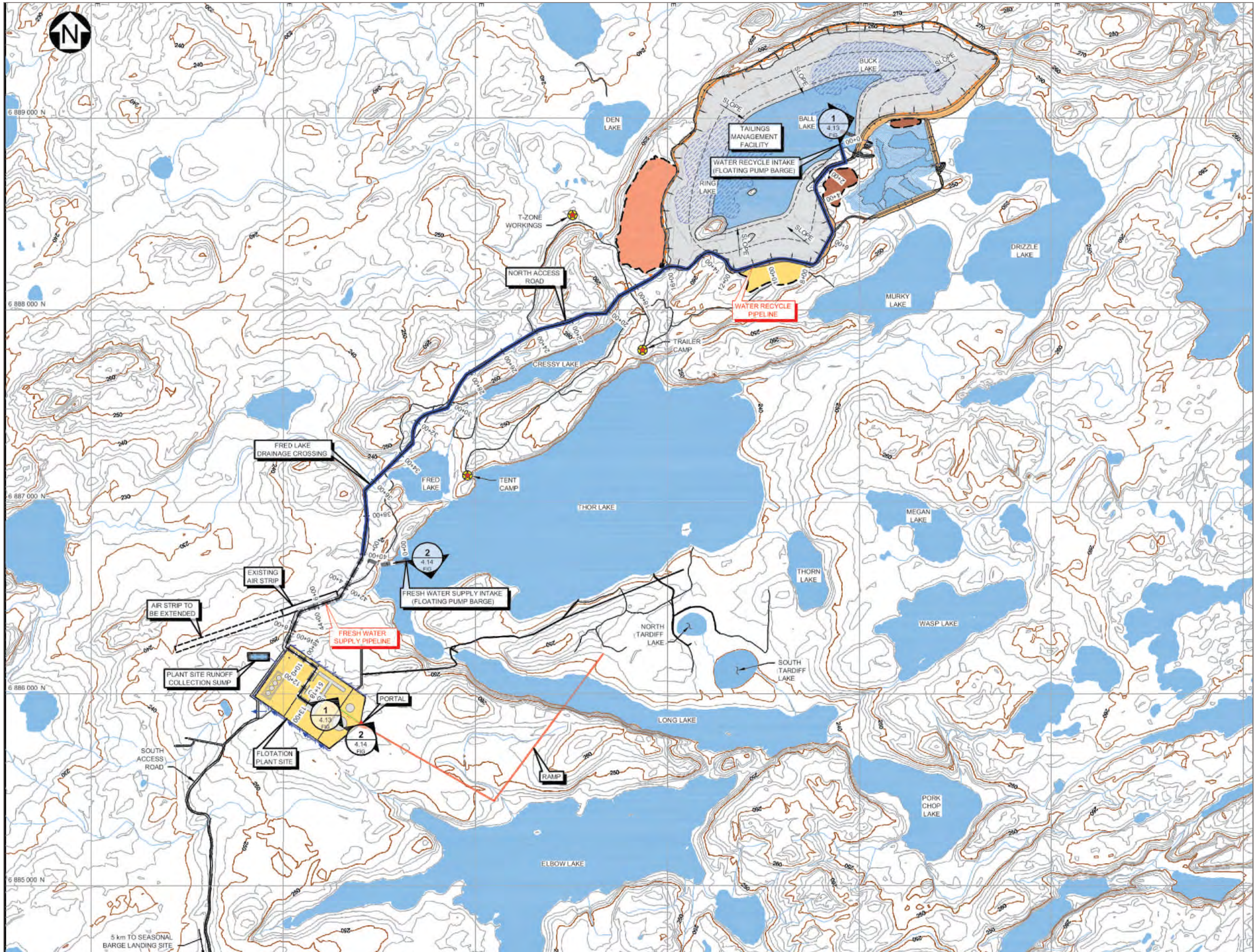
FIGURES



REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	16JUN11	ISSUED WITH REPORT	UBM	SIR	KEH	KDE

LEGEND

- WATER
- TAILINGS
- ORIGINAL LAKE LIMITS
- EMBANKMENT FILL
- FLOTATION PLANT SITE
- POTENTIAL QUARRY
- POTENTIAL ORGANICS STOCKPILE AREA
- AREA TO BE RE-GRADED WITH EXCAVATED ICE RICH OVERBURDEN
- ALLOWABLE MAXIMUM WATER LEVEL
- EXISTING ACCESS ROAD
- PROPOSED ACCESS ROAD
- RAMP
- TAILINGS DELIVERY PIPELINE
- TAILINGS DEPOSITION POINT
- WATER RECYCLE PIPELINE
- FRESH WATER PIPELINE
- RUNOFF COLLECTION DITCH
- FRESH WATER INTERCEPT DITCH

NOTES:

1. COORDINATE GRID IS UTM (NAD83) ZONE 12N AND IS IN METRES.
2. PLAN BASED ON INFORMATION PROVIDED BY AVALON RARE METALS INC.
3. CONTOURS ARE IN METRES. CONTOUR INTERVAL IS 2 METRES.
4. TAILINGS MANAGEMENT FACILITY FINAL LAYOUT (YEAR 20) DETERMINED FROM WATER/SOLIDS BALANCE ANALYSIS AND TAILINGS/WATER MODELLING.
5. FIGURE SOURCE: KNIGHT PIESOLD CONSULTING (JUNE 2011)

SCALE A 200 100 0 200 400 600 800 1000 m

STATUS
ISSUED FOR USE

THOR LAKE PROJECT

Site Layout

CLIENT
AVALON RARE METALS INC.

eba A TETRA TECH COMPANY

FILE NO.
V15101007_004_Figure01cdr

PROJECT NO.	DWN	CKD	APVD	REV
V15101007.004	MEZ	DM	DM	0

OFFICE
EBA-VANC

DATE
January 10, 2012

Figure 1

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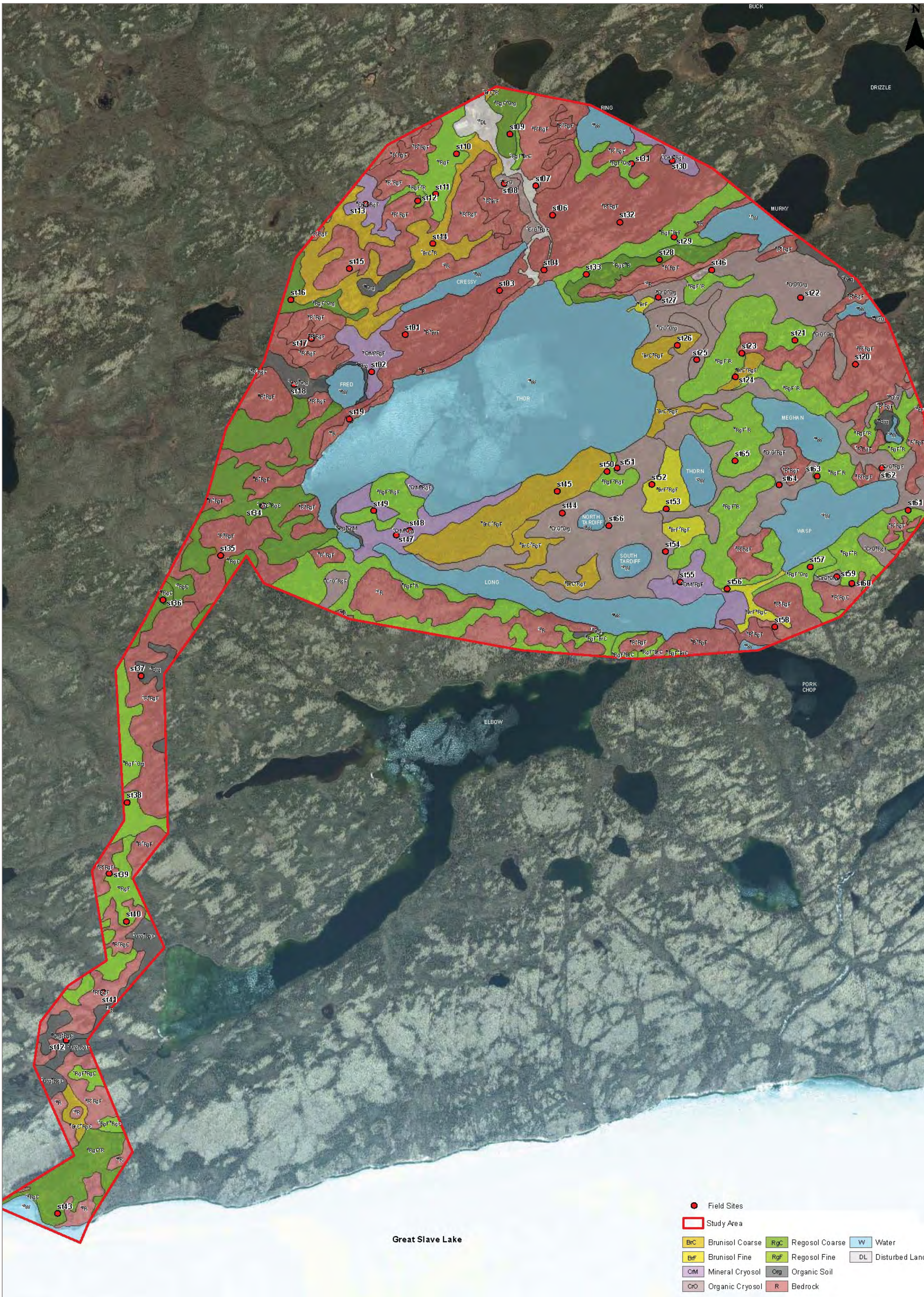

NOTES

Figure Source: Figure 2-12. Stantec 2010d

STATUS
ISSUED FOR USE

CLIENT
AVALON RARE METALS INC.

eba A TETRA TECH COMPANY

THOR LAKE PROJECT

Soils of the Thor Lake Project Area

PROJECT NO.	DWN	CKD	APVD	REV	
V15101007.004	MEZ	DM	DM	0	Figure 2
OFFICE	DATE				
EBA-VANC	January 10, 2012				

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