Avalon Rare Metals Inc.

RESPONSE TO THE JANUARY 13, 2012 INFORMATION REQUESTS FROM DENINU KUE FIRST NATION FOR THE THOR LAKE RARE EARTH ELEMENT PROJECT DEVELOPER'S ASSESSMENT REPORT

Submitted To:
MACKENZIE VALLEY ENVIRONMENTAL IMPACT REVIEW BOARD

January 23, 2012

Avalon Rare Metals Inc. (Avalon) is pleased to provide the following responses to Deninu Kue First Nation's information requests provided via Mackenzie Valley Environmental Impact Review Board (MVEIRB) on January 13, 2012. Avalon's responses are found after each information request.

IR Number:	**DKFN #1**
Source:	Deninu Kue First Nation
To:	Avalon Rare Metals Inc.
Subject:	
DAR Section:	
TOR Section:	

DKFN Request #1

1. Does the ore, at any point in the routine mining process (including removal, processing, transportation, storage, and tailings disposal and storage) emit a level of radiation, or act synergistically with other elements or compounds to pose risk(s) to the aquatic or terrestrial environment, including plants, fish, and wildlife? If so, what is the nature of those risks?

Avalon Response #1

Avalon recognizes and appreciates that DKFN and other parties are concerned about possible risks associated with the emission of radiation relative to all components of the Thor Lake Project.

As a result, Avalon had retained SENES to prepare a screening-level radioactivity pathways assessment of the Thor Lake Project to determine if there were any potential environmental pathways for radiological exposures, in particular, to humans, vegetation, wildlife or fish and fish habitat (SENES 2011b). The complete memorandum, prepared by SENES, was provided in Appendix G of the DAR, and was summarized in Section 4.9.6.3 of the main DAR. A few key highlights of this section of the DAR are re-presented as follows.

The radiological exposure pathways assessment was conducted to evaluate contaminant sources, assess the environmental fate of released radioactive species, and estimate doses to members of the working public, people who hunt, fish or live in the surrounding area, and to non-human biota (aquatic and terrestrial receptors) present in the area. Using findings of baseline studies of environmental media and receptors (Stantec 2010c), test-run laboratory results of mine wastes (SGS 2011); mathematical modelling of air dispersion (RWDI 2011) and water dispersion (Section 6.4.2 of the DAR), the potential risks to both the human and ecological populations were assessed.

The water quality modelling conducted for the DAR showed that the impact of radionuclides in the tailings is expected to be low. Additional calculations showed that potential radon concentrations due to mine emissions were also very low. Dose Coefficients (DCs) were used to estimate the doses to human receptors as a result of direct radiation, ingestion and inhalation exposure. The incremental doses were then compared to the dose constraint of 0.3 millisieverts per year

(300 μSv/y) recommended by Health Canada in the Canadian Naturally Occuring Radioactive Materials (NORM) Guidelines (Health Canada 2000). Incremental doses below this level are considered as "unrestricted" and no further action is needed to control doses or materials. Since the appropriate comparison benchmark is incremental, the estimated doses excluded background. The estimated doses to both the site worker and Aboriginal peoples were well below the dose constraint.

The results of the pathways assessment showed that the dose to aquatic biota were below the accepted benchmark dose. A range of values of relative biological effectiveness (RBE) for alpha radiation were used in the assessment to account for the uncertainty associated with the choice of RBE. The results showed that no adverse effects on aquatic biota are expected from the release of low levels of radionuclides to the water.

Similar to the approach adopted for aquatic biota, a range of RBE and dose benchmarks were used in the assessment of terrestrial biota. The results showed that no adverse effects on terrestrial biota are expected from the release of low levels of radionuclides to the air and water.

The assessment concluded, that considering the conservative nature of the calculations, it is unlikely that there would be any environmental impacts resulting from exposure to radioactivity from the Thor Lake site.

Given the very low concentrations of other elements and compounds in the effluent based on shake flask and other tests, and given the low radioactivity predicted from Thor Lake operations, synergistic impacts are not anticipated. Extensive chemical and biological monitoring required under the regulations and anticipated license requirements, will be carried out to confirm this. In the unlikely event that impacts are detected, studies to determine the source of the impact will be implemented and action will be taken to mitigate these impacts.

IR Number:	**DKFN #2**
Source:	Deninu Kue First Nation
To:	Avalon Rare Metals Inc.
Subject:	
DAR Section:	
TOR Section:	

DKFN Request #2

1. In the event of a catastrophic accident involving the spillage of one or more barges of ore into Great Slave Lake, what would the risk(s) be to aquatic life? Please comment on the:
   a. nature,
   b. spatial extent, and
   c. temporal duration of the risk(s).

Avalon Response #2

Avalon appreciates and shares the DKFN's concerns over such a potential incident. An assessment of such a potential incident was presented in Section 9.1 (Accidents and Malfunctions) of the DAR For the benefit of the DKFN and other interested parties, this section of the DAR is re-presented in this response in its entirety.

9.1 BARGING OPERATION

The MVEIRB Terms of Reference (MVEIRB (2011) specifically requested Avalon to discuss the potential effects to water/environmental quality of a potential *"complete overturning of all barges during a Great Slave transit of a typical concentrate loaded barge train at various points along the barge corridor between Thor lake and the delivery point on the south shore of Great Slave Lake"*.

9.1.1 Barging Operations on Great Slave Lake

To assess this hypothetical scenario in any reasonable manner, it is initially important to provide some background on the historic operation of barges on Great Slave Lake.

Barging operations have been conducted in Great Slave Lake and points north since 1934 (NTCL 2011). For 75 years, Northern Transportation Company Limited (NTCL) has been providing reliable and critical marine transportation services to communities and resource exploration projects around Great Slave Lake, along the Mackenzie River and across the Western Arctic, from Prudhoe Bay, Alaska as far east as Taloyoak in Nunavut, and from the Port of Churchill to communities in the Kivalliq region of Nunavut on the west coast of Hudson Bay.

Since 1985, NTCL has been a 100% aboriginal-owned company, and is owned by the Inuvialuit Development Corporation of the Western Arctic on behalf of the Inuvialuit of the Western Arctic and Nunasi Corporation, on behalf of the Inuit of Nunavut.

All of NTCL's barges are tested and inspected annually by Transport Canada, Lloyds Register and Imperial Oil. At four year intervals, NTCL's barges are dry-docked, hydro-tested and ultra-sonic thickness tested. Even though NTCL's barges were built in the late 60's and early 70's, the diminution of shell plating is less than 7%. As an example, 20% is the maximum allowable by Transport Canada and Lloyds before the shell plating would need to be replaced. All barges are constructed using mild steel and do not become brittle over time.

9.1.2 Potential Concentrate Spill from Barging Operation

To gain an understanding of possible barge sinking incidents, during preparation of the DAR and more recently in conjunction with the preparation of responses to some Information Requests associated with the MVEIRB review process, Avalon contacted NTCL and the Canadian Coast Guard to identify if any barges have sunk on Great Slave.

The Coast Guard confirmed that a tug boat and barges, owned by Yellowknife Transportation, sunk during a big storm in 1956 while traveling between Hay River and Yellowknife (Mr. Ken Cooper, Senior Response Officer, Canadian Coast Guard, pers. comm. December 21, 2011). No other knowledge or records of barges sinking in Great Slave Lake were located. According to a tugboat captain that worked for NTCL for 42 years, no barges sunk in Great Slave Lake between 1973 to 2011 (Captain David Day, pers. comm. December 20, 2011).

Mr. Cooper (pers. comm. December 21, 2011) stated that the tug and barges used by Yellowknife Transport in 1956 were small compared to those used in NTCL’s current fleet (i.e., the tug was about a quarter of the size of NTCL’s tugboats). He went on to explain that there have been advancements in weather reporting since 1956, which make an accident less likely to occur on Great Slave Lake.

Regarding the possibility that an entire three-barge train loaded with concentrate contained in shipping containers could turn over (capsize), NTCL advised EBA that this was not a realistic possibility because NTCL’s standard operation is that if any of the barges in a barge train was at risk of sinking/capsizing, NTCL’s standard operating practice would be to disconnect the towline between the tug and the barges and then proceed to cut the towlines between the individual barges.

On this basis, as improbable as it would be, a more realistic possible scenario that could potentially occur would involve the overturning or capsizing of one of the barges in a barge train. Assuming that such an incident were to occur, it would be expected that the full load of containers carried on the stricken barge would be dropped into Great Slave Lake and proceed to sink to the bottom

As indicated in Section 4.7.6.7 of the DAR, when fully loaded, a single barge will hold a total of 38 containers stacked two high. Each container will hold 40 tonnes of concentrate for a total container weight of 45 tonnes, comprising a total load of 1,710 tonnes.

Assuming that the containers have all been dumped into the lake, for the purposes of the assessment requested by the MVEIRB, it is subsequently assumed that the containers would remain intact as they sink to the bottom and would not break open on their way down because the containers will not have a perfect seal and thus water and water pressure would equilibrate inside the containers as they sink to the bottom.

As indicated in Section 2.8.6 of the DAR, the bottom of most areas of Great Slave Lake, and in particular in the vicinity of the Slave River delta, are expected to be relatively soft. As a result, it is anticipated that containers landing directly on the lake bottom sediments will most likely remain intact. However, it is also assumed that some containers could break open, particularly if they were to land on other containers. As a result, it is anticipated that a quantity of concentrate, assumed to be in the order of 10% (~171 tonnes) could be released from any damaged containers onto the lake bottom where it would be exposed directly to the receiving environment.

It is then further assumed that, as soon as possible following such an incident, Avalon and its contractors would undertake an initial reconnaissance of the deposition site using Remote Operated Vehicle (ROV) technology to determine the best course of action for the recovery of the containers. Avalon has confirmed that there are recognized underwater salvage firms in Canada (e.g. CanDive) that have direct previous experience with the successful recovery of heavy objects greater than 100 tonnes, including diesel locomotives, sunken ships, etc. from waters up to 300 m deep using conventional, available underwater salvage techniques (Portable Crane and winches – Photo 9.1-1) and hard hat divers.

CanDive has also had direct experience with the recovery of mineral concentrates on underwater substrates using a Venturi Suction system operated by hard hat divers (P. Nuytten (CanDive) Pers Comm 2011). With the combination of proven salvage methods that will be employed, it is anticipated that all of the containers and most of the concentrate can likely be recovered within one year of the incident. Nevertheless, it is assumed that a considerable volume of the spilled concentrate will remain on the lake bottom where it will be exposed to the receiving environment.

Photo courtesy of P. Nuytten, CanDive

Photo 9.1-1
Train Locomotive Recovered from a BC lake

9.1.3 Environmental Effects of Concentrate in Great Slave Lake

As previously discussed, although it is highly unlikely that this scenario will ever occur, if containers filled with concentrate were to be dropped into Great Slave lake off a capsized barge, it has been assumed that a quantity of concentrate in the order of 10% of total cargo (~171 tonnes) would be released from any damaged containers onto the lake bottom where the concentrate would be exposed directly to the receiving environment. Although efforts would be undertaken to recover any spilled concentrate, it is assumed that a considerable volume of the spilled concentrate would remain on the lake bottom where it would be exposed to the receiving environment.

To assist in determining the possible environmental consequences associated with spilled concentrate being present on the lake bottom, it is important to review the chemical nature of the concentrates. As indicated in the fall 2010 MVEIRB scoping sessions, the rare earth metals concentrates will be essentially inert and non-reactive. Shake flask tests conducted by SGS (2011) determined that essentially no chemical parameters went into solution during 24 hours of agitation in water.

Table 9.1-1 adapted from SGS (2011) presents shake flask extraction results for the fresh concentrate produced from a pilot plant and provides a comparison with current MMER criteria. As can be noted, all values reported, including radionuclides and metals, are exceedingly low and at least one magnitude below applicable MMER values. In particular, the concentrations of radionuclides measured were below the detection limit for the three radionuclide parameters measured.

According to Dr. John Goode, Avalon's rare earth metals metallurgical expert, *"the component minerals are recognized as some of the most inert on the planet. Our tests show that we have to use strong acids to get any sort of reaction from the concentrate. To get anything to dissolve from the concentrates takes very high free acid conditions. To get substantial dissolution we need to cook the concentrate at 600 °C in molten sodium hydroxide"* (J.Goode Pers Comm 2011).

TABLE 9.1-1: SHAKE FLASH EXTRACTION RESULTS – CONCENTRATE

Parameter	Unit	*MMER	PP1 Conc
Initial pH	units		8.90
Final pH	units		8.80
Radionuclide Analyses			
^{226}Ra	Bq/L	0.37	< 0.01
^{228}Ra	Bq/L		< 0.3
^{210}Pb	Bq/L		< 0.1
General and Metals Analyses			
pH	units	6.0-9.5	7.78
F	mg/L		1.08
Cl	mg/L		2.0
Hg	mg/L		< 0.0001
As	mg/L	0.50	0.0019
Ca	mg/L		10.4
Cu	mg/L	0.30	0.0006
Fe	mg/L		0.014
K	mg/L		1.73
Mg	mg/L		1.53
Na	mg/L		4.56
Ni	mg/L	0.50	0.0004
Se	mg/L		< 0.001
Si	mg/L		2.65
Th	mg/L		0.000039
U	mg/L		0.00154
Zn	mg/L	0.50	0.004

*Department of Justice Canada. 2002. Metal Mining Effluent Regulations, Fisheries Act SOR-2022-222.

Given the essentially inert and heavy nature of the rare earth metals concentrate, any concentrate that may be released into the water column would rapidly sink to the lake bottom along with the containers. Effects on water quality would be limited to a short-term turbidity cloud that would rapidly disappear as the granular concentrate product descends to the lake bottom. Concentrate reaching the lake bottom, either via the water column or by being released from a broken container on the bottom would stay there in perpetuity. As previously described in Section 2.8.3, the environment of most of Great Slave Lake, and in particular, waters deeper than 30 m, comprise more than 95% of the proposed barging route. The water below 30 m and deeper is typically characterized by relatively low water temperatures (3-10°C) and dissolved oxygen (4-6 mg/l) conditions for most of the year or indeed year round.

The aquatic biota anticipated to be present in the deeper waters are expected to be limited to a few species of clams, worms, crustacea (amphipods and mysids) and bottom-foraging fish such as sculpins, suckers, burbot and deepwater lake trout. The clams, worms, sculpins and suckers are the most likely species that could potentially consume some of the residual concentrate remaining on the lake bottom.

However, because of its essentially inert nature, contaminants bound up in the concentrate would not be expected to be taken up by the biota living on the lake bottom and thus no concentration of potential contaminants in the biota would be expected to occur.

In addition, as previously discussed in Section 2.8-3, much of the bottom of Great Slave Lake, and in particular the area off the front of and to the east of the Slave River Delta (in the vicinity of the barging corridor) is subject to considerable natural sedimentation resulting from the large volume of sediment released annually into Great Slave Lake by the Slave River. Such continuous natural sedimentation would be expected to lead to the eventual burial and isolation of any residual concentrate that may remain on the lake bottom following the completion of all recovery efforts.

Given the essentially inert nature of the rare earth metals concentrate as discussed, this basic assessment would apply to other water depths or locations in Great Slave Lake where such an incident could potentially occur.

As a result of the combination of factors described, the anticipated environmental effects of any residual rare metals concentrates remaining on the bottom of Great Slave Lake in the vicinity of such a most unlikely incident would be expected to be of a negligible and insignificant nature with no significant residual impacts expected to occur.

IR Number:	**DKFN #3**
Source:	Deninu Kue First Nation
To:	Avalon Rare Metals Inc.
Subject:	
DAR Section:	
TOR Section:	

DKFN Request #3

1. In the event of a catastrophic accident involving the spillage of one or more barges of ore into Great Slave Lake, what would be the risk(s) be to humans that might contact the water or consume the fish? Please comment on the:
    a. nature,
    b. spatial extent, and
    c. temporal duration of the risk(s).

Avalon Response #3

The responses to Information Requests #1 and #2 also serve as the basis for responding to this Information request. As a result of the combination of factors described in Sections 4.9.6.3 and 9.1 of the DAR (represented in responses to IRs 1 and 2), Avalon is confident with the results of the third party testwork in concluding that the waters and fish of Great Slave Lake will not become contaminated by the activities associated with all components of the Thor Lake Project and no risks to humans will occur.

IR Number:	**DKFN #4**
Source:	Deninu Kue First Nation
To:	Avalon Rare Metals Inc.
Subject:	
DAR Section:	
TOR Section:	

DKFN Request #4

1. What will be the nature of any cumulative effects to groundwater resulting from tailings disposal at Pine Point -- especially in conjunction with the Tamerlane project and past impacts?

Avalon Response #4

This potential cumulative concern was discussed in Section 10.6.3.1 of the DAR and to assist in answering the information request, key information from this Section, modified as necessary to reflect changes that have occurred to the project, is re-presented as follows.

As people are aware, the proposed Hydrometallurgical Plant tailings facility (HTF) will be located within an historic open pit (L-37 pit) located south of the proposed Hydrometallurgical Plant location. Excess supernatant water from the HTF will be pumped to another historic open pit (N-42 pit), located to the southwest, for discharge and infiltration into the Presqu'ile aquifer.

The results of groundwater flow modelling discussed in Section 6.5.2.1 of the DAR, suggest that there is expected to be very little effect on the groundwater regime at the Pine Point site in response to the pumping and discharge/infiltration proposed as part of the Hydrometallurgical Plant site water management plan. Groundwater drawdown in the vicinity of the T-37 pit (now the J-44 pit) is estimated to be approximately 1 m below the expected pre-pumping level after 20 years of pumping. Groundwater levels in the vicinity of the N-42 pit are expected to increase by approximately 0.1 m above the simulated pre-discharge conditions after 20 years of discharge/infiltration.

Based on the conceptual model of the site and the steady state modelling results, groundwater flowing through the N-42 pit would take approximately 80 years to discharge into Great Slave Lake. Travel time may be reduced if groundwater discharged to surface and flowed towards Great Slave Lake.

A comparison of the projected chemical properties of the tailings water with the historically documented groundwater quality results shows that the concentrations of all metals parameters in the tailings water will be lower than or within the same range of concentrations for these parameters in the existing groundwater of the area. The radionuclide parameters including 226Ra, 228Ra and 210Pb are all expected to be at or below detection limits.

The pH of the tailings water is expected to be slightly above neutral (7.7), while conductivity, sodium, chloride and other parameters that contribute to water hardness, including calcium, magnesium and sulphate will be elevated compared to current background conditions. However, these elevated levels are expected to rapidly diffuse and dilute to natural background values within the Presqu'ile Formation.

To verify these predictions, Avalon is committed to implementing a groundwater quality monitoring program designed to monitor the effects of the proposed tailings water infiltration program on the quality of the groundwater in the area of the Hydrometallurgical Plant and associated infrastructure.

At the Tamerlane R190 Pine Point Pilot Project site, the predicted dispersion of re-injected discharge water from this project was discussed in detail during the Technical Sessions held by the Mackenzie Valley Land and Water Board (MVLWB) in Hay River on August 13, 2008. The technical data presented by Tamerlane predicted that after one (1) year of re-injection of discharge water into the Presquille Aquifer, the wastewater from that project would migrate a distance of approximately 757 metres and achieve 100% dilution.

Based on this analysis, and the further dispersion that would be expected to occur as the groundwater continued to migrate slowly in a northerly direction towards Great Slave Lake, there is no reasonable possibility that this underground discharge could mix with groundwater in the vicinity of the proposed Hydrometallurgical Plant, located approximately 30 km to the east of the Tamerlane Project site.

Since the projected concentrations of all parameters of potential concern will be lower than or within the range of existing conditions, the anticipated residual effects on groundwater quantity and quality in the Pine Point area are expected to be insignificant and no cumulative effects on groundwater quantity or quality in the Pine Point area are predicted to occur.