Aboriginal Affairs and Northern Development Canada | Affaires autochtones et Développement du Nord Canada

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January 13, 2012

MVEIRB File Number: EA1011-001
Paul Mercredi
Environmental Assessment Officer
Mackenzie Valley Environmental Impact Review Board
P.O. Box 938
Yellowknife, NT X1A 2N7

BY EMAIL: pmercredi@reviewboard.ca

Re: Avalon Rare Earth Elements Incorporated Environmental Assessment Information Requests

Dear Mr. Mercredi:

Aboriginal Affairs and Northern Development Canada (AANDC) provides the following information requests (IRs) for the Avalon Rare Earth Elements Incorporated Environmental Assessment. AANDC believes that this information is necessary in assessing the potential impacts of the Thor Lake project.

AANDC officials, and its technical consultants Robertson GeoConsultants Incorporated and Hatfield Consultants, are available to discuss these IRs and their associated rationale with the Mackenzie Valley Environmental Impact Review Board staff or the proponent.

Thank you for the opportunity to provide information requests. If you have any questions, please contact Krystal Thompson at 669-2595 or via email at Krystal.Thompson@aandc-aadnc.gc.ca.

Sincerely,

Teresa Joudrie
Director
Renewable Resources and Environment Directorate – NT Region

Aboriginal Affairs and Northern Development Canada

IR: AANDC 1
To: Avalon Rare Earth Metals Incorporated
Source: DAR Section 6.3 & 6.4 and Conformity Responses
Subject: Water – Water Quality – Water Quality Objectives

Preamble:

Water Quality Objectives (WQOs) are determined to ensure that the aquatic environment will not be significantly impacted by the project (terms used to describe WQOs in other Northern projects include EA Threshold and Water Quality Benchmarks).

AANDC notes that if effluent release/discharges are causing downstream receiving water quality to exceed WQOs, then the effluent is considered to be potentially causing significant impacts at the current concentration (i.e. EQC) or discharge rates (i.e. volumes).

WQOs can be established based on local environmental sensitivities, generic water quality guidelines and background conditions. AANDC notes that Avalon has compared downstream water quality to CCME water quality guidelines and MMER regulations in Section 6.4.2.5 of the DAR.

Request:

1. Please detail the anticipated last point of control and mixing zone (including efficiency of mixing within Drizzle Lake for all parameters such as metals, nutrients and major ions) for effluent pipe decant/discharge.
2. Determine appropriate WQOs for the receiving environment.
3. Identify if WQOs can be achieved at the edge of the mixing zone under the currently proposed discharge strategy. Describe how possible release/discharge complications could affect the environment and the previous mixing analysis from things such as freezing/icing of the ditch, plugging of the decant pipe and unexpected high TSS releases to Drizzle Lake.
4. Discuss how far downstream general changes in water quality and aquatic community are expected and identify any long-term change/impact on Drizzle Lake, Murky Lake, Thor Lake, Fred Lake, etc.

IR: AANDC 2
To: Avalon Rare Earth Metals Incorporated
Source: DAR and Conformity Responses
Subject: Water Quality – Choice of Contaminant of Potential Concern (COPCs)

Preamble:

The Developers Assessment Report (DAR) shows that Avalon did screen predicted downstream water quality against the CCME (and MMER), and it appears that the choice of COPCs is based on whether or not an element exceeded available guidelines. A concern with applying this approach is that the ore being mined is enriched with elements for which there is little toxicity data and consequently there are few toxicity-based benchmarks available.

AANDC acknowledges, as stated in the DAR, that rare earth elements in the ore and concentrate tend to be inert and are not liberated easily. However, it is difficult to have confidence that there will be no effects without investigating the chemistry data further.

Another possible approach for selecting COPCs is to include elements if their predicted concentrations in mine effluent are notably higher than the local background water concentrations. Data required for this comparison appears to be provided in the SGS 2011 report.

Once a COPC list is established, benchmarks would be needed to identify which elements may result in unacceptable effects. These benchmarks may be taken directly from available government guidelines, criteria or standards, or they may be based on available toxicity data from the scientific literature. One excellent place to find available toxicity data is USEPA's ECOTOX database (USEPA 2007).

Another approach is to create benchmarks based on a reasonable upper range of natural background concentrations of rare earth elements (REEs) in the receiving water body. Typically, a mean+2SD concentration (or 90th percentile) is calculated and adopted as a benchmark (background concentration procedure; CCME 2003). The rationale is that if the estimated concentration of an RRE in the receiving environment is still within the range of background variation after the mine becomes operational, then the possibility of observing a significant ecological effect is low.

Request:

1. Please compare the predicted concentrations of REEs as they are being discharged from the polishing pond with baseline concentrations of the same elements in the Drizzle, Murky and Thor Lakes. Please use the full list of elements provided in the SGS (2011) report. A table showing the difference as a factor would

be very helpful. Those elements exhibiting a significant increase should be included as COPCs, and additional assessment should be considered.

2. For identified COPCs, please show that you have consulted literature, government sources and on-line databases (i.e., USEPA's ECOTOX Database) for available toxicity-based benchmarks.
3. For COPCs which have no available toxicity data, please consider and discuss physio-chemical and/or Quantitative Structure–Activity Relationship (QSAR) reasons why that element should not result in any effects; and
4. If an element is a COPC, but there is no available toxicity data, and there is no compelling reason to drop it from the list of COPCs, please describe how the proponent proposes to derive benchmarks.

IR: AANDC 3
To: Avalon Rare Earth Metals Incorporated
Source: DAR and Conformity Responses
Subject: Water Quality – toxicity testing

Preamble:

There is insufficient information to assess the potential for toxicity. AANDC understands that those elements in the proposed effluent with specific CCME guidelines or MMER criteria are generally predicted to be present at concentrations below their respective guidelines/criteria. However, there is likely a wide range of elements for which there are no toxicity benchmarks available and; therefore, it is not possible to assess whether or not the expected concentrations of these elements will be below toxicity thresholds. Furthermore, the effluent will contain numerous contaminants that may result in additive or synergistic effects. One way to assess a complex effluent for potential effects is to subject a simulated effluent to toxicity testing. This testing should be done with representative species of different levels of biological organization (i.e., fish, invertebrates, plants). The testing should also favor chronic or sublethal tests as these are more sensitive and representative of possible effects within the receiving environment.

The SGS report (2011) reported the results of two acute toxicity tests (*Daphnia magna* and trout survival); however, these tests are not sufficiently sensitive to identify potential effects at environmentally relevant concentrations. If toxicity is observed at concentrations expected in Thor Lake, then a toxicity identification evaluation (TIE) would be appropriate. A TIE would help Avalon identify the contaminant most likely resulting in the toxicity. Avalon could then consider mitigative approaches.

Request:

Please provide the results of sublethal and chronic toxicity tests on a sample of simulated effluent. If this is not practical, please provide a compelling reason why toxicity testing should not be done.

IR: AANDC 4
To: Avalon Rare Earth Metals Incorporated
Source: DAR and Conformity Responses
Subject: Water Quality – Hydrometallurgical Site

Preamble:

AANDC assumes that the decant discharged to pit L-42 will result in an increase of hydraulic head within the Presqu'ile aquifer.

Request:

Please explain how an increased hydraulic head will change the movement of groundwater and estimate how long it will take for water from L-42 to daylight (i.e. downstream or in Great Slave Lake).

IR: AANDC 5
To: Avalon Rare Earth Metals Incorporated
Source: DAR, Appendix 1 and Conformity Responses
Subject: Biomagnification – fish tissue assessments

Preamble:

The final Baseline Assessment by Stantec (May 2011) indicates that concentrations of mercury and selenium in fish tissue were close to, or for some fish, above fish tissue guidelines. Selenium body burdens in fish can have significant effects on fish embryo development; the best predictor of selenium-related effects in fish appears to be selenium concentration in the ovaries or eggs of mature females (Deforest *et al* 2011). Mercury in fish muscle can pose a health risk to humans that consume fish. Given that an active mine will likely result in an incremental input of mercury and selenium, and given that an increase in nutrient loadings may result in increased uptake of mercury and selenium (via methylation), some predictions regarding future concentrations of mercury and selenium in fish tissue should be made.

Request:

Please estimate the mercury and selenium concentrations in the tissues of fish once the mine becomes active, and after 20 years operation.

IR: AANDC 6
To: Avalon Rare Earth Metals Incorporated
Source: DAR Section 6.3 & 6.4 and Conformity Responses and Conceptual AEMP
Subject: Water – Effluent Quality – Nutrification

Preamble:

Nitrogen (ammonia, nitrate, and nitrite) is a major by-product of blasting residues (e.g. ANFO). It is also a nutrient in aquatic systems. At higher concentrations, and in certain forms, it can be toxic. Phosphorous, another major nutrient, may be present in both process and mine water. As local water bodies are relatively pristine and exhibit low nutrients, the addition of nutrients is of concern. When discussing nutrient additions into an aquatic system it is important to consider nitrogen's relationship with Dissolved Oxygen (DO). Generally, as nutrient levels increase biological activity increases, this growth and decomposition consumes oxygen (O_2) thus lower DO concentrations (particularly under ice). Low DO conditions can impact aquatic organisms and fish.

Major Ions, such as TDS, chloride, fluoride, sulphate, calcium, etc., can also affect water quality. The accumulation of major ions in the receiving environment can cause toxicity and impair the aquatic environment. At other operations in the North, connate groundwater has typically been high in both TDS and chloride.

Request:

1. Please discuss possible sources of phosphorus from the mine.
2. Provide estimates of major ion concentrations in the receiving environment over the life of the project. Describe impacts from increased nutrient and major ion concentrations have on the immediate receiving body (i.e. initial dilution zone) and beyond (Drizzle Lake, Murky Lake, Thor Lake, Fred Lake, etc.) from both a nutrient and toxicity perspective. Provide these calculations using expected worst case concentrations/loads.
3. Determine how shifts in the aquatic community (phytoplankton and zooplankton) may effect DO concentrations in these receiving lakes during operations and closure with emphasis on under ice DO concentrations.

IR: AANDC 7
To: Avalon Rare Earth Metals Incorporated
Source: MVEIRB TOR, DAR Section 6.14.1, Conformity Responses #46 & #47, MVERIB Request #1.3 and Conceptual AEMP
Subject: Water Quality – Project Effects – Assessment Boundaries – Conceptual AEMP – Action Levels/ Triggers – Adaptive Management

Preamble:

The Environmental Assessment process is used to determine the potential significance of a Project. The DAR provides information on significance and assessment tools/scales such as Magnitude, Frequency, Duration, Extent, Reversibility, etc. As the EA moves forward, impact assessment boundaries (i.e. spatial boundaries) specific to environmental effect metrics (e.g. water quality, eutrophication, wildlife, etc.) should be further delineated and discussed. This will form the basis for action levels and triggers in the AEMP and Adaptive Management Plan (AdMP). The AEMP and AdMP are intended to ensure that any unforeseen water quality impacts or unexpected ecological impacts can be detected and acted upon before unacceptable impacts occur.

Avalon has demonstrated that their proposed mining operation will cause some degree of change in the receiving environment. It is the monitoring program's role to assess these changes/ impacts and determine if these changes/impacts are within the acceptable range. Triggers or action levels are used in the AEMP and AdMP to initiate response/mitigation to reduce impacts. The EA is a critical component for establishing the action levels within these monitoring programs, which rely on the assessment of impacts on a scale of Low (Early Warning), Moderate and High levels. These effects level classifications are directly linked to the assessment tools mentioned above (Magnitude, Frequency, Duration, Extent, etc.).

The Conceptual AEMP provided by Avalon as part of IR Response #1.3 provides a general description of a monitoring program for the site. However, the framework provides very few details and is missing key linkages regarding assessment locations, action/trigger levels and the potential scale of response actions based on severity of effects (Low, Moderate or High).

Request:

1. Rationalize the choice of downstream monitoring points (e.g. assessment boundaries and sample site locations) to ensure actions levels/triggers (based on levels of significance such as negligible, low, medium, and high) can and will be applied before unacceptable impacts occur in the downstream environment.
2. Generally identify low, medium and high level response actions. Note that a 'high action level' is generally considered to be a point that should not be reached and requires an immediate halt to discharge.

3. Provide a discussion on how potential responses (e.g. reduced discharge volume or load) will impact site operations and the tailings impoundment capacity.

IR: AANDC 8
To: Avalon Rare Earth Metals Incorporated
Source: DAR and Conformity Responses and Conceptual AEMP
Subject: Water Use – Water Quality – AEMP

Preamble:

AANDC's AEMP Guidelines (2009) identify community consultation as a key component to the development monitoring questions, assessment endpoints and acceptable levels of change.

The AEMP functions as a "safety net" with respect to those concerns addressed through consultation. Avalon has identified that even relatively small additions of some substances could result in adverse effects to water quality and aquatic biota. Synergistic and unanticipated effects may also occur once operations commence. Accordingly, from an ecological perspective, the measurement endpoints contained within the AEMP should be sensitive to the contaminants being released and with a known relationship between observed changes and cascading effects in the ecosystem of the receiving environment.

AANDC requests the following information to assess the appropriateness of the AEMP as provided by the proponent to identify potential downstream effects relevant to local Aboriginal Groups and users.

Request:

1. The proponent should describe the community consultation with respect to measurement endpoints and levels of acceptable changes for the proposed AEMP.

IR: AANDC 9
To: Avalon Rare Earth Metals Incorporated
Source: DAR and Conformity Responses and Conceptual AEMP
Subject: Water Quality – Effects – AEMP

Preamble:

Avalon has correctly identified that "the development of an AEMP involves a multidisciplinary approach to defining the aquatic environmental issues that may result from the construction, operations, and decommissioning phases of a project, and identification of mitigation measures to avoid or minimize potential adverse effects." Avalon has also provided an overview of Pathways of Effects and has correctly noted that the effects of various components based on terrestrial and aquatic habitat disturbances must be examined. AANDC believes more work is required to improve this assessment and identify pathways at both project sites.

AANDC has specific technical comments on sample location, sampling frequencies and AEMP concepts identified in the Conceptual AEMP. AANDC feels these comments are better addressed in face to face meetings and is willing to meet with Avalon to discuss AEMP framework and its further refinement as the EA progresses.

However, AANDC requires the following information to assess the thoroughness and appropriateness of the AEMP to monitor for and confirm project related effects.

Request:

1. Document and explain linkages between the local groundwater monitoring that will occur at the Pine Point project and the AEMP/SNP plans.
2. Include an overview of how local surface water will be sampled and assessed as part of the AEMP to confirm that no leachate from tailings at the Pine Point site make its way to surface water bodies, streams and Great Slave Lake.
3. Include an overview of monitoring that will occur near dock and barge loading facilities at the south shore of Great Slave Lake near the Pine Point site.

IR: AANDC 10
To: Avalon Rare Earth Metals Incorporated
Source: DAR and Conformity Responses
Subject: Water Balance and Effluent Discharge and Site Hydrology

Preamble:

Sections 4.7.3 and 4.7.4 of the DAR describe the proposed waste management and discharge strategy and provide a water balance flowsheet. The water balance is negative for years 1 to 4 and 5 to 20.

Figure 6.3.9 plots the estimated monthly discharge from the Thor Lake Watershed, and shows mean discharges pre-production, during production and post-production as well as the pre-production discharges for dry and wet conditions. Production discharges are predicted to be slightly above pre-production dry season flows from April to June, but will generally be less than dry season flows for the remainder of the year.

This pattern suggests that discharge from the Thor Lake watershed during a dry period could be very low once the mine is producing.

AANDC requires additional information and detail to assess the water balance and discharge strategy to assess potential environmental impacts.

Request:

1. Provide an assessment of expected discharges from Thor Lake during a dry period, once production has started.
2. Provide greater detail on the water balance and discharge plan. Include any adjustments based on seasonal changes to water balance (higher runoff wet years, lower or higher mine inflows, lower or higher processing recycling rates, etc).

IR: AANDC 11
To: Avalon Rare Metals Incorporated
Source: DAR and Conformity Responses and Appendix 1
Subject: Hydrology - Uncertainty in Thor Lake water supply

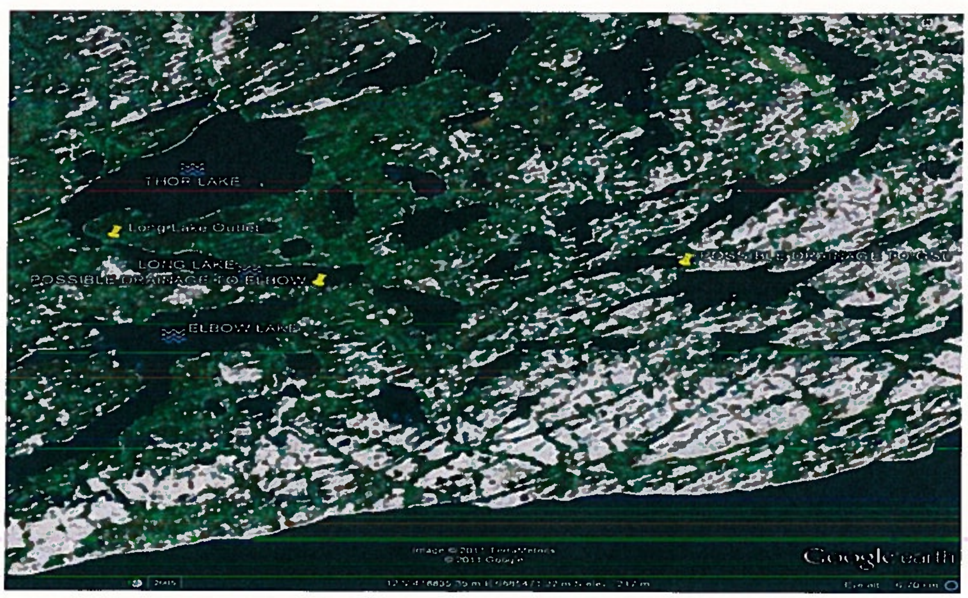
Preamble:

In the NWT, the major source of water is precipitation. To estimate flows and to adequately manage water, accurate input values of all environmental variables to the water balance equation must be available. The water balance simulations presented in the DAR calculate the water supply into Thor Lake on a monthly timescale, based primarily on i) estimated precipitation inputs from long-term climate data (from snowmelt release or rainfall); ii) the upstream contributing areas (including the proposed TMF area, Drizzle and Murky watersheds- 38%, Long Lake catchment- 45%, and remaining areas- 17%); and iii) spatially-invariant, monthly runoff coefficients. However, there are various sources of information in the DAR and consultant reports that suggest that the hydrology of the area requires improved understanding. In particular, the water supply from Long Lake (the largest sub-catchment) to Thor Lake appears uncertain for the following reasons:

- Stantec Final Interim Report (section 4.2.1, p10)- 'The stream flow in the channel between Long and Thor Lakes is relatively stagnant and was observed to reverse during stream measurements. The banks along the Long Lake outlet feature many failures and fallen trees in the water. The decreased capacity of the stream and low stream power may reflect changes in lake levels in Thor and Long Lakes, which may be related to beaver activity or changes in the drainage at Thor Lake, and (section 4.2.3, p11) - 'During site visits in 2008 and 2009, reverse flows were observed in both Long Lake outlet and Beaver Dam channel at Thor Lake indicating stream flow was traveling into Long Lake from Thor Lake'.

- As a result, there is no stage-discharge relationship ($R^2 = 0.00$) from 5 measurements at the Long Lake Outlet (stage remains the same for all five measured discharges which vary one order of magnitude: 0.005 - 0.05 m^3/s; Appendix D, Stantec Final Interim Report).

- In the Stantec Final Interim Report (section 3.3.3, p7), it is stated that 1:250,000 NTS topographic maps were used for basin delineation and site drainage, with some assistance from air photos and site reconnaissance on air and foot (although this was believed to concentrate on the area draining Thor Lake to Fred Lake and down to GSL). Delineation in this rolling, near-flat topography is inevitably very difficult, especially given the scale of topographic data used. Drainage patterns will also vary as pond and lake levels e.g. increase during freshet and become more interconnected, but field verification of these differences may be prohibited by the environmental conditions during freshet (e.g. ease of walking access, air temperatures etc). In the case of Long Lake, the topographic maps alone indicate at least two places where elevation changes were small (2-4m) or non-existent, where water could potentially drain south and directly into Elbow and Great Slave Lakes, therefore effectively bypassing Thor Lake. The potential of this occurrence would increase during snowmelt (or strong precipitation) inputs, and this is critical since a large proportion of the projected water supply from Long to Thor Lake occurs during freshet in April and May (see Figure 2.5-11, p65 of the DAR). On further inspection using Google Earth, although the imagery is coarse and difficult to accurately decipher, it appears there is a discernible drainage channel through at least one of the two query locations (closest to Long Lake outlet in the image below, note that this appears more discernible than Long Lake outlet itself). (See also Figure 2.5-3 p53 in the DAR for higher resolution image; this image also apparently indicates likely flow direct to Elbow Lake).



Request:

Please summarize available field observations relating to observed drainage patterns, especially at locations where flat topography separating water sources would raise the potential for drainage courses to vary in direction. Specifically discuss the potential for water in Long Lake (and Long Lake catchment) to flow south towards Great Slave Lake (GSL) instead of through Thor Lake. Also discuss the implications of such a flow on the hydrological modeling conducted to date.

Even if a southerly flow of Long Lake water occurs during freshet alone, when water levels rise, much of the annual volume will not reach Thor Lake. In a 'worst-case' scenario, given the close proximity of the (western) potential Elbow Lake drainage location to the Long Lake outlet, assume that the freshet water supply to Thor Lake is reduced by 10% increments up to a maximum of 40% (the runoff into Thor Lake from Long Lake, based on the relative area of Long Lake watershed). Present water balance diagrams for each of these four scenarios, during the production phase, to identify the resulting water available at Thor Lake and the necessary adjustments that would need to occur on the outflows to the concentrator plant. Based on these calculations, if more water were required for the production process, identify other potential sources. Describe any adjustments to the constructions such as tailings dams (crest heights and spillways etc) that would be required in light of these recalculations.

IR: AANDC 12
To: Avalon Rare Metals Incorporated
Source: DAR and Conformity Responses
Subject: Hydrology - Uncertainty in Thor Lake drainage

Preamble:

As discussed in AANDC IR 11, there is some evidence of hydraulic conductivity between Thor Lake and Great Slave Lake via Long Lake and Elbow Lake. This assertion was made after a review of contour maps, satellite imagery and flow rates in and out of Thor Lake. Some reported flow data have indicated flows into Fred Lake less than flows into Thor Lake, suggesting that under certain circumstances water may exit Thor Lake via Long Lake. Possible situations where this may occur include: (1) periods where beaver or debris dams partially obstruct flow to Fred Lake; and (2) freshet, when water levels in the lakes are at a seasonal high resulting in short term seasonal hydraulic conductivity. There is a lack of hydraulic data/observations during freshet and therefore it is possible that a modified seasonal flow patterns have not been observed.

Request:

Please comment on the probability that Thor Lake may discharge to Long Lake under certain conditions. If there is very little probability of this occurring, please provide evidence capable of dismissing this possibility. If Thor Lake may discharge to Great Slave Lake via Long Lake and Elbow Lake, please comment on how this shorter flow path influences the dilution of mine-related discharges once water reaches Great Slave Lake. Please include the possible influence of the relative size of drainage areas that the two paths follow (67 km^2 if Thor Lake drains via Fred Lake, 6 km^2 if Thor Lake drains via Long Lake).

IR: AANDC 13
To: Avalon Rare Metals Incorporated
Source: DAR and Conformity Responses
Subject: Hydrology - Absence of baseline monitoring in the proposed TMF (Tailings Area)

Preamble:

It appears that there is very little baseline monitoring information of the water resources upstream of Thor Lake, including those forming an integral part of the proposed TMF (Tailings Management Facility, at Ring and Buck Lakes), and Drizzle Lake in between the TMF and Thor Lake (more data is available at the Murky Lake Outlet). These are the aquatic areas most affected by the project (section 2.5, p48), and where water toxicity and quality are likely to be of most concern. Since site hydrological characteristics are used in annual flow estimations, and water balance estimates, additional baseline data upstream of Murky Lake would be useful to better characterize the baseline water quality, water levels and runoff characteristics of the Upper Thor basin. It is stated that the stream flows between these upstream lakes were of insufficient depth to reliably obtain water depth data with pressure transducers, but this is not the case with lake levels.

Request:

Please estimate based on the topography and upstream contributing areas, how the response times of Ring, Buck and Drizzle Lake depths may have varied in comparison to those measured downstream (e.g. at Thor and Fred) assuming the same precipitation inputs such as melt water release and rainfall events.
Related to this, please comment on the safety margins applied in the design of proposed dams (specifically dam heights) given that response times may be expected to be faster in these smaller headwater lakes (these constructions are based on predicted water volumes at a monthly time scale and use spatially-invariant runoff coefficients).

There is also mention of wave effects at Thor Lake due to the high winds occasionally experienced in this wider area; please identify to what extent extreme wind events may affect lake levels at the TMF lakes and to what extent this may also reduce safety margins to proposed dam heights etc.

IR: AANDC 14
To: Avalon Rare Metals Inc.
Source: DAR and Conformity Responses
Subject: Hydrology – Stream flow comparison at Fred and Thor Lakes

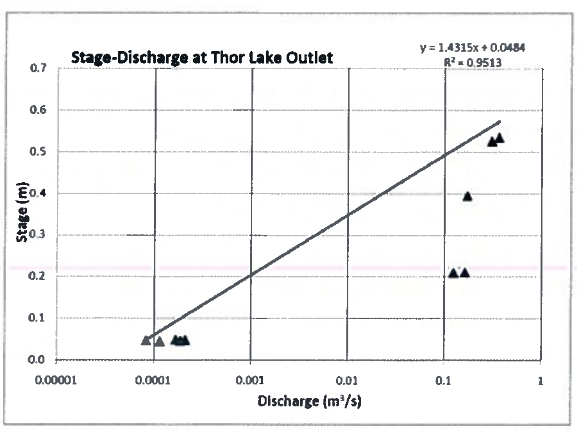
Preamble:

In section 2.5.2 of the DAR (p50), it is stated that 'water flows from Thor Lake to Fred Lake through a defined channel that has a 1.5 m waterfall near its outlet', and is simulated accordingly in all water balances. In 2009 (Figure 2.5-8, p58 of the DAR), both measured and estimated discharges appear to be greater at Thor Lake than Fred Lake and the causes of this pattern are not immediately apparent. The potential source of error in estimated flows using rating curve information is outlined below. In 2008, the opposite occurred and flows from Fred Lake were consistently higher, with observations that a debris blockage altered flow patterns between the two lakes. In 2010, discharge was higher from Fred Lake outlet in May and October, and vice versa from June-September.

Related to this, in the rating curve developed from Stantec's measurements for Thor Lake Outlet (see below), please note that the rating curve developed for Thor Lake incorporates measurements obtained under very different stream conditions during 2008 (outlet blocked by debris; all flows less than 0.01 m^3/s) and 2009 (outlet not blocked from June; flows all above 0.1 m^3/s).

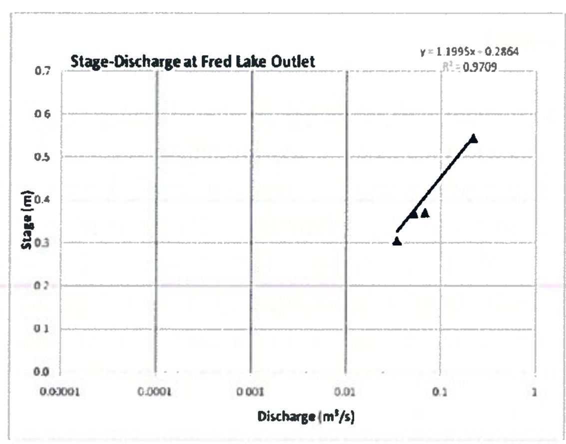
Thor Lake Rare Earth **Metals Baseline Project**
Environmental Baseline Report
Volume 1 – Hydrology
Interim Report

Appendix D – Stage Discharge Plots, 2008 – 2009



Thor Lake Rare Earth Metals **Baseline Project**
Environmental Baseline Report
Volume 1 – Hydrology
Interim Report

Appendix D – Stage Discharge Plots, 2008 – 2009



Request:

Thor Lake inevitably represents a key component of the proposed mining project, and requires a clear understanding of the water supply into and out of the lake. Uncertainties in the water supply inputs to Thor Lake were introduced in AANDC IRs 11 and 12, and this IR focuses more on the output supply.

Please identify a set of physical processes that would combine to explain the relative differences observed in measured discharges from Thor (upstream) and Fred (downstream), for each year including 2008 (F > T), 2009 (T > F) and 2010 (both F > T and T > F). For instance, if there were other potential outlets from Fred Lake than the one measured, especially during higher water levels, please provide any supporting information. If the candidate processes include physical impoundments (as noted for Thor Lake in 2008, but this may also be the case at Fred Lake), how would this be expected to affect the timing and quantity of Thor Lake outflow (stated as 1.725 million m^3/yr)? This could be addressed by re-estimating the Thor Lake outflows using separate rating curves developed from measurements obtained during blocked conditions (pre-June 2009) and unblocked conditions. If water supply does become 'impounded' at Thor Lake, what would the implications be on water quality?

IR: AANDC 15
To: Avalon Rare Metals Inc.
Source: DAR and Conformity Responses
Subject: Hydrology - Baseline precipitation measurements

Preamble:

A short-term climate station was set up at the Nechalacho Mine Site for the purpose of characterizing local-scale weather patterns and assessing the similarity of data with nearest long-term stations maintained by Environment Canada (e.g. Yellowknife, Hay River). There are potentially several sources of error within the estimated precipitation data at Nechalacho Mine due to the methods used, and may explain the lower absolute precipitation values measured compared to the EC stations, and lower correlation coefficients (R^2 = 0.79) relative to other variables (e.g., air temperature- R^2 = 0.99). Potential reasons for this lower correlation include i) the more random, local-scale process of precipitation occurrence, ii) real and detectable differences in long-term precipitation inputs between the Thor Lake area and regional stations due to topographic or other factors, and iii) errors within the precipitation measurements both within the Environment Canada (EC) and Avalon data. Some level of measurement error can be expected given the harsh conditions experienced in the NWT, and less frequent maintenance visits due to trip costs, but the DAR should at least identify potential sources of error so that any revisions can be made to measured or estimate precipitation data. A selection of potential errors are introduced below.

Rainfall

There was no wind shielding of the tipping bucket rain gauge, located at height on the weather station. In windy environments such as this one, there is likely to be substantial underestimation of true rainfall amounts due to the decrease of surface area for the gauge to collect falling rain at large incident angles. If a wind-shield could not be used due to cost and maintenance, an attempt should have been made to apply standard wind correction factors to the unshielded TBRG data (where precipitation is corrected as a function of wind speed, e.g. http://hydroviz.cilat.org/hydro/rain_gauges.pdf). This study states that for US 8-inch standard rain gauges, under-catch can be in the order of 5 to 10% on an annual basis but can be relatively larger on individual storm scales.

Snowfall

In lieu of expensive, weighing-scale precipitation gauges, winter adapters exist to convert tipping-bucket gauges into all-season measuring devices, although occasional maintenance (e.g. checking of antifreeze levels used to melt snowfall) is recommended to obtain the highest quality of data. Winter precipitation can also be estimated as the product of snowfall amounts (as measured by the snow-sensor) and an assumed snowfall density, but large errors can be inherent in both data sources (standard density estimates for NWT are available at: http://www.usask.ca/geography/MAGS/Data/Public_Data/precip_corr/pcpncor_e.htm).

The method chosen as part of this study, to estimate a seasonal (winter) precipitation amount equivalent to the mean snowpack snow-water equivalent (SWE) value at the end of March, can incur large errors since this assumes that there is no prior losses of snowpack due to processes such as sublimation, or any melting during the shoulder seasons (e.g., October-November). This also assumes that no further snowfall occurs in April subsequent to the snowpack measurement. Note that errors can also be introduced depending on the snow tube used to obtain SWE and snow density measurements (e.g. published snow density measurements are commonly overestimated by approximately 10% using a Federal Snow Tube). At the very least, the estimated value of winter precipitation in 2009 using the snow course method, (94 mm, section 2.3.1.6) should be compared with more robust estimates collected at regional climate stations.

Request:

To reduce the uncertainties in precipitation data, please provide revised estimates of precipitation using accepted correction techniques and algorithms on the measured data; these may include those outlined above (e.g. rainfall corrections as a function of wind speed; snowfall estimates compared to the EC direct measurements or using snow sensor and assumed density estimates) or from other sources. Based on the revisions, please update monthly precipitation estimates at Thor Lake and update the correlation coefficient to EC data, for the purpose of more accurately determine the representativeness of EC data and whether any modifications should be introduced for the local Thor Lake area.

IR: AANDC 16
To: Avalon Rare Metals Inc.
Source: DAR Section 2.3.2, Table 2.3-3 and Conformity Responses
Subject: Hydrology - Use of steady-state inputs to water balance scenarios

Preamble:

In the DAR Section 2.3.2, trend analysis is performed on the long-term EC climate datasets as measured at Yellowknife/Fort Reliance/Hay River, including temperature, precipitation, and related variables (e.g. date of first snowfall and snow-free ground). As with most northern areas, air temperatures have been and continue to increase, precipitation is increasing, and snow-free conditions occur earlier in the year. For simplicity, simulations of water volumes available to the Tailings Facility and Thor Lake over the 20-year project (including pre-production/production and post-production phases) appear to be run using steady-state input conditions. A deterministic approach using average precipitation conditions is used in calculations, although a probabilistic approach is introduced to forecast extreme wet and dry precipitation conditions. Implicitly, the 'wet' precipitation conditions used in the probabilistic approach can instead be used to infer runoff conditions in much wetter conditions if the estimated increases in precipitation actually occur in future decades. In snowmelt dominated environments such as this, changes to the timing of precipitation amounts (including snowmelt release) under future climate scenarios may be as important as changes in the precipitation volume.

Additionally, the water balance scenarios do not introduce the potential risk of rain-on-snow events (when rain causes enhanced snowmelt and runoff rates) to increase runoff and potential flooding during the freshet months. This may not be important in the Thor Lake watershed; Table 2.3-3 of the DAR summarizes the monthly average climate data from Hay River and indicates that monthly precipitation is lowest in April (13.1mm). Conversely, while rain-on-snow events increase during fall (rain- and snowfall amounts are ~18mm each in October), active layer depths and ground storage capacity are often increased due to summertime heating and evaporation, reducing the potential of rapid surface runoff.

Request:

In current water-balance and runoff simulations, both precipitation and discharges across the Thor Lake project area are simulated to be highest in April, since the accumulated snow and ice is assumed to melt at ratios of 15/70/15% for March/April/May respectively (Appendix C-13, p4).

Given that the average snow free date in Yellowknife is now in April (formerly second week of May historically; Figure 2.3-21 chapter 2), an assumption can be made that towards the end of the production (and post-production) phases in 15+ years time, snow consistently melts out before May. Given simulated upstream flows into Lakes are already greatest in April (often 2x all other months; Figure 2.5-11), would there be ramifications for pond storage amounts and required dam crest elevations, if monthly runoff became even higher during April (and less in May). For instance, instead of the ratio 15/70/15 being used in calculations, what would the effect be of using 20/80/0? Associated with this, please discuss qualitatively the effect that possible rain-on-snow events would have on water resources and stream flows, especially during freshet. To provide a simple quantitative model estimate of a large rain-on-snow event, please provide a revised version of Figure 2.5-11 (p65 of the DAR) estimating effective precipitation inputs and lake-to-lake discharges, by artificially raising the current runoff coefficients during April and May (currently 49%), by an amount that would be acceptable based on rain-on-snow literature or otherwise. Based on these simulations, re-run the estimated water levels at the TMF and identify any risk increase to the tailings dams from overtopping during the freshet period. Note that any increase to the coefficient values in April and May should be offset by decreases to the coefficients in subsequent months, to simulate the effects of reduced water supplies available in these subsequent months.

IR: AANDC 17
To: Avalon Rare Metals Inc.
Source: DAR Section 2, Figure 2.5-11 and Conformity Responses
Subject: Hydrology – Stream flow estimates.

Preamble:

For the purpose of forecasting available water supply at Thor Lake, monthly stream flows are simulated in Fig.2.5-11 of the DAR including both the inflows to Thor Lake (e.g. from Murky and Long Lake watersheds) and outflow (into Fred Lake). It appears that each of these monthly flow values are estimated as the product of upstream contributing area, precipitation values that vary monthly (using historical regional data), and runoff coefficients that also vary monthly based on expected surface conditions (e.g. highest during freshet when the soil is saturated, lower during fall). No attempt appears to be made; however, to check the accuracy of this model using a sample of the collected field data and other estimated values.

Request:

Please identify months in which both precipitation and stream flow were measured during fieldwork. For these months, please simulate monthly stream flows as per the DAR; i.e. the product of monthly precipitation totals, the appropriate monthly runoff coefficient, and the appropriate upstream contribution area. Then compare these estimated values with measured stream flow values, and outline % differences. Please identify the most likely sources of any major discrepancies between these values, such as beaver impoundments or possible errors in drainage area due to the aforementioned seasonal changes in connectivity. Based on this, please identify whether these natural processes could be incorporated within the model to improve the accuracy of estimated flows and overall water resources. Outline key data gaps that may still exist and that would benefit most from any future field sampling.

IR: AANDC 18
To: Avalon Rare Metals Inc.
Source: DAR and Conformity Responses
Subject: Fish Habitat – Possible Reduction in Available Food for Fish.

Preamble:

Information provided in DAR indicates that the drainage area currently containing Buck and Ring Lakes will be used as the Tailings Management Facility (TMF) and will no longer be functional lakes. Baseline monitoring suggests that these lakes are not fish bearing, although they do contain significant benthic invertebrate communities. Given the hydraulic connection between these lakes and Thor and Long Lake, which are fish bearing, there is uncertainty as to whether 1) Buck and Ring lakes represent a source of food for fishes of Thor lake (e.g., through benthic drift), and 2) to what extent the loss of this food resource will have on fishes of Thor Lake.

Request:

Please comment on 1) the likelihood that Buck and Ring Lakes provide food for fishes of Thor Lake; and 2) the loss of this food resource would have an impact on fishes of Thor Lake.

IR: AANDC 19
To: Avalon Rare Metals Inc.
Source: DAR Section 2.6.3; Table 2.6-8
Subject: Baseline groundwater quality at Nechalacho Mine Site

Preamble:
The Proponent pointed out that several total metal concentrations observed in local groundwater at the Nechalacho mine site exceed MMER and/or CSR guidelines (see table 2.6-8). However the dissolved concentrations for most of those metals

(including aluminum, iron) were much lower (often below the detection limit). Total metal concentrations may not be representative of actual metal concentrations in groundwater due to the presence of suspended solids which will be digested as part of the total metal analysis.

Request:
Please explain why total metal analyses (instead of dissolved metal analyses) were used to describe baseline groundwater quality at the Nechacho mine site.

IR: AANDC 20
To: Avalon Rare Metals Inc.
Source: DAR Section 2.7.1
Subject: Hydrogeological characterization of Nechalacho Mine Site

Preamble:
The DAR acknowledges that the hydrogeological characterization of the Nechalacho mine site is limited. For example, "due to the limited number of monitoring wells there is little information to estimate flow direction in bedrock" (p. 101). Furthermore, no hydrogeological characterization work (drilling, hydraulic testing, groundwater monitoring) was completed in proximity of the proposed TMF prior to submission of the DAR. Seven additional monitoring wells ("HG series") and geotechnical holes ("GT series") were installed in March/April 2011. However, no information was available on additional hydraulic testing and/or water level monitoring in those wells/boreholes.

Additional monitoring and testing at the Nechacho mine site (in particular near the proposed TMF site) will be required to evaluate the environmental impact on local groundwater and surface water.

Request:
Please provide details on the scope and scheduling of additional baseline characterization work (drilling, hydraulic testing, monitoring of groundwater levels and groundwater quality) the Proponent has recently completed (HG series and GT series in March/April 2011(?)) and/or is planning to complete at the Nechalacho mine site, in particular in proximity of the proposed TMF.

IR: AANDC 21
To: Avalon Rare Metals Inc.
Source: DAR Section 2.7.2
Subject: Hydrogeological characterization at Hydrometallurgical Site (Pine Point)

Preamble:

The DAR relies heavily on historical information to describe the regional and local hydrogeology of the former Pine Point mine site. While this historical information is valuable and adequate to describe the regional hydrogeology it lacks site-specific data in close proximity of the open pits proposed to be used for groundwater extraction, tailings deposition and process water infiltration. Of particular interest in this context is the potential interaction of these pits with the local groundwater system.

Request:

Please provide additional information on the local hydrogeology at the Pine Point plant site in proximity of the proposed pits to be used for water supply (T-37), HMF (L-37) and infiltration pit (N-42), including:

1. Information on total depth, volume and historic dewatering rates in each of these open pits
2. Information on the local hydrostratigraphy near these open pits, including depth of overburden, thickness and type of bedrock units (within depth range of these open pits)
3. Information on hydraulic testing completed (or planned) in proximity of these pits (e.g. slug testing in the new monitoring wells, pumping tests)
4. Information on seasonal fluctuations in pit water levels and local groundwater levels (to determine the interaction of these pits with local groundwater)
5. Information on current direction of groundwater flow (using geodetic groundwater levels observed in new and existing monitoring wells and geodetic pit water levels)
6. Estimates of seasonal flow and quality of shallow seepage discharging into these pits

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IR: AANDC 22
To: Avalon Rare Metals Inc.
Source: DAR Section 2.7.2.2 and 6.5.2.4
Subject: Baseline groundwater quality at Pine Point Hydrometallurgical Plant Site

Preamble:
The text and photos in section 2.7.2.2 suggests that the local groundwater at the Pine point plant site "is highly mineralized and sulphurous" (p. 103). In section 6.5.2.4, three groundwater quality types are described: (i) calcium-bicarbonate water,

(ii) sulphur water, and (iii) salty water. Historical groundwater quality data from historic dewatering operations at the former Pine Point Mine are presented in Table 6.5-4 to support this general description.

No recent site-specific groundwater quality data was presented in the DAR. However, the Proponent provided additional groundwater quality data (collected in 2011) in a subsequent submission (Knight Piesold memo dated September 30, 2011). The data provided in this memo suggested that pit water typically contains higher mineralization than the surrounding groundwater screened in the new (DH-2010) monitoring wells.

Request:

Please provide more details on the baseline groundwater quality at the Pine Point hydrometallurgical site:

1. Provide a definition for "sulphurous" groundwater and provide details on the spatial and vertical extent of such sulphurous groundwater in the Pine Point region and the local area surrounding the proposed plant and tailings facilities
2. Provide details on the depth interval where saline water was historically encountered at Pine Point
3. Reconcile the chemical composition of local groundwater observed in recently installed monitoring wells and baseline groundwater quality provided in Table 6.5-4
4. Explain the difference in chemical composition of pit water (e.g. SO_4 ~400-1,700 mg/L) versus local groundwater in nearby monitoring wells (e.g. SO_4 ~10-300 mg/L);
5. Please clarify whether the Proponent considers the most recent groundwater quality data obtained from the 2010 series of wells to be representative of baseline groundwater quality at Pine Point
6. What is the chemical composition of the groundwater near the proposed infiltration pit N-42 (no monitoring well is available near this pit)
7. Is there any evidence of groundwater quality impacts in proximity of these pits due to historical (or present) seepage from the old Cominco tailings storage facility?

IR: AANDC 23
To: Avalon Rare Metals Inc.
Source: DAR Section 4.7.3.3 and 6.5.1.5; Figure 4.7-10
Subject: Seepage from TMF at Nechalacho Mine Site

Preamble:
Section 4.7.3.3 describes the design of the tailings management facility (TMF) for the flotation plant at the Nechalacho mine site. However, very little information is provided on aspects of seepage control through the foot print of the TMF. Test pitting in the foot print area has shown the presence of fractured bedrock outcrops and

glaciolacustrine and glaciofluvial sediments which represent a potential for tailings seepage. Furthermore, any shallow permafrost which could inhibit tailings seepage can be expected to thaw subsequent to placement of tailings.

Figure 4.7-10 indicates a seepage estimate of 1,800 m3/year (or 0.06 L/s) from the tailings deposit and the Polishing Pond each. However, no rationale is provided for this estimate. The only reference to tailings seepage is in section 4.7.3.3 indicating that "Foundation preparation may also include the treatment of fractures and discontinuities within the bedrock surface with slush grout to reduce any potential" (p. 498).

Note that tailings seepage is not discussed at all under section 6 (Environmental Assessment) and no mitigation measures are proposed to minimize tailings seepage through the foundation of the TMF (tailings deposit and associated polishing ponds) (see section 6.5.1.5).

Request:

Please provide additional details on the potential for, and implications of, seepage of process water through the foundation of the tailings deposit and associated polishing ponds, including:

1. Provide assumptions and calculations to estimate seepage through the base of the tailings deposit and polishing ponds
2. Evaluate potential for environmental impact to local receiving water (groundwater and surface water) from tailings seepage
3. Provide details on potential mitigation measures to minimize seepage from the TMF at Nechalacho

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IR: AANDC 24
To: Avalon Rare Metals Inc.
Source: DAR Section 4.8.3.1 and 6.5.3.2; Figure 4.8-7
Subject: Seepage from HMF (pit L-37) at Pine Point

Preamble:

Section 4.8.3.1 describes the design of the hydrometallurgical tailings management facility (HMF) for the Metallurgical Plant at the Pine Point plant site. However, very little information is provided on the potential for seepage from this facility to the surrounding environment. Historical information and recent drilling near pit L-37 suggests that the pit walls consist of glacial tills and highly permeable dolostone of the Presquile formation with significant potential for seepage of process water.

Section 4.8.3.1 discusses options for seepage control including use of local materials (till and/or waste rock) as a separation/filter barrier to the tailings solids, collection of supernatant process water in a lined portion of the pit and water treatment. However, it is unclear when such seepage mitigation measures would be implemented.

Figure 4.8-7 indicates a seepage estimate of 1,800 m3/year (or 0.06 L/s) from the HMF. No rationale is provided for this seepage estimate and it is unclear whether this estimate assumes that seepage mitigation measures are implemented or not.

Note that tailings seepage is not discussed at all under section 6 (Environmental Assessment) and no mitigation measures are proposed to minimize tailings seepage through the base and walls of the HMF (see section 6.5.3.2).

Request:

Please provide additional details on the potential for, and implications of, seepage of process water through the side walls and base of the HMF (pit L-37), including:

1. Provide assumptions and calculations for seepage estimate used in water balance (Figure 4.8-7)
2. Describe potential for shallow seepage from the backfilled pit into surrounding till or shallow bedding planes in unsaturated bedrock
3. Describe potential for discharge of (perched) seepage impacted by process water at surface (in local depressions, nearby pits and/or surface runoff etc)

IR: AANDC 25
To: Avalon Rare Metals Inc.
Source: DAR Section 4.8.3.1 and 6.5.3.2; Figure 4.8-7
Subject: Seepage from Infiltration Pit (pit N-42) at Pine Point

Preamble:
Section 4.8.3.1 discusses discharge of supernatant process water into an infiltration pit ("N-42"). The water flow sheet shown in Figure 4.8-7 indicates that on average 152,000 m3/year (or 4.8 L/s) will have to infiltrate through the base of this pit into the surrounding aquifer. A regional flow model has been used to demonstrate that the local aquifer can accept this flow without significant local mounding (see IR # 10 below). However, no site-specific hydraulic information has been presented to confirm that the permeability of the materials exposed in the local pit walls is adequate to accept this flow rate.

The water quality for the tailings process water (Table 6.5-6) is predicted to have significantly (up to 100 times) higher TDS, hardness and sulphate than the surrounding local groundwater. Selected dissolved metals (Ni, Cu) and nitrate are also predicted to be elevated relative to local groundwater. The flow sheet in Figure 4.8-7 indicates the potential for treatment of the supernatant water prior to discharge into the pit. However, no details are provided on what type of treatment would be required and under what circumstances such a treatment plant would be operated.

Request:

Please provide additional details on the feasibility to infiltrate the required amount of supernatant process water into the N-42 pit and the requirements for treatment of the supernatant process water prior to discharge into the infiltration pit.

IR: AANDC 26
To: Avalon Rare Metals Inc.
Source: DAR Section 6.5.1.2 to 6.5.1.4
Subject: Groundwater model for Nechalacho Mine Site

Preamble:

The Proponent used a groundwater flow model to predict groundwater inflow to the underground workings (including ramp) and to predict reflooding times after closure (KP, 2011f). Insufficient information is provided in the DAR (and accompanying Appendix C17) to evaluate the flow model with respect to modeling assumptions such as model grid, model boundaries, recharge etc used for those predictions.

Request:

Please provide additional details on the groundwater flow model for the Nechalacho mine site including:

1. Model domain and model discretization (including a figure showing FD grid)
2. Boundary conditions used (including a figure showing the spatial representation of the ramp and mine workings in MODFLOW)
3. Recharge assumed for the steady-state model
4. Details on model calibration, model convergence and model water balance

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IR: AANDC 27
To: Avalon Rare Metals Inc.
Source: DAR Section 6.5.1.2 to 6.5.1.3
Subject: Estimates of groundwater inflow to Nechalacho U/G Mine

Preamble:
The Proponent estimated that steady-state groundwater inflows to the underground workings would range from 3 to 10 L/s. The drawdown in the surrounding bedrock aquifer was predicted to range from 2 to 10m. Several assumptions were made to arrive at these estimates: (i) shallow and deep bedrock have identical hydraulic properties, (ii) the bedrock K has an upper limit of Kh=2*10-8 m/s and Kv=1*10-8 m/s, and (iii) the open area of the mine was greatest just prior to the start of paste

backfilling (at the end of Year 4). Information provided in the DAR suggests that these assumptions may not be sufficiently conservative for estimating mine inflow. First, the conceptual model described in section 2.7.1.5 distinguishes a shallow (more permeable) aquifer and a deep (less permeable aquifer. No such differentiation is made in the numerical model.

Second, hydraulic testing completed in the shallow aquifer ranged from 7.6*10-7 m/s to 3.1*10-5 m/s (p. 101 of DAR) and hydraulic testing completed in the deep bedrock aquifer ranged from 4.1*10-8 m/s to 1.7*10-7 m/s (p. 101 of DAR). Packer testing completed in the Nechalacho Deposit rock mass indicated bedrock permeabilities ranging from 3*10-9 m/s to 2*10-7 m/s (p. 102 of DAR). The upper limit of K values observed is significantly greater than the "high K" estimate. In fact the "high K" used for modeling is equal to the geometric mean of the packer testing completed in deep bedrock (2*10-8 m/s).

Finally, the third assumption appears to assume that all backfilled mine workings have the same K as "tight" bedrock. This seems unlikely considering the stress relief in mined-out areas, the difficulty of "complete" backfilling and the presence of open tunnels for access and venting.

Request:

Please provide additional justification(s) for the selection of the above model assumptions for mine inflow estimates. Please also provide results of sensitivity analyses that illustrate the sensitivity of the predicted mine inflow rates and drawdown in the local aquifer to the assumed modeling assumptions discussed above.

IR: AANDC 28
To: Avalon Rare Metals Inc.
Source: DAR Section 6.5.2.1
Subject: Groundwater model for Pine Point Metallurgical Plant Site

Preamble:

The Proponent used a groundwater flow model to predict to estimate the effects of implementing the water management plan for the Hydrometallurgical Site, including the withdrawal of water from the T-37 pit and the infiltration of excess water into the N-42 pit. Insufficient information is provided in the DAR (and accompanying Appendix C10) to evaluate the flow model with respect to modeling assumptions such as model grid, model boundaries, recharge etc used for those predictions.

Request:

Please provide additional details on the groundwater flow model for the Pine Point mine site including:

1. Explain discrepancy between rate of groundwater extraction used for water balance (695 m3/day in figure 4.8-7) and rate used in modeling for impact assessment (1,950 m3/d)
2. Describe model domain and model discretization (including a figure showing FD grid)
3. Describe boundary conditions used (including a figure showing the BCs in MODFLOW)
4. Specify aquifer thickness assumed in model (specifically near the pits to be used)
5. Specify recharge assumed for the steady-state model
6. Provide details on model calibration, model convergence and model water balance
7. Clarify assumption on type of aquifer (Confined vs Unconfined)
8. Explain what, if any, effects the high TDS of the process water (saline seepage) has on local groundwater flow and migration of the seepage plume in the local aquifer

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IR: AANDC 29
To: Avalon Rare Metals Inc.
Source: DAR Section 6.5.3.2
Subject: Environmental Impact - Groundwater quality at Metallurgical Plant Site

Preamble:

In section 6.5.3.2 that proponent states "*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*". (p. 729 of DAR)

No calculations or numerical modeling is presented in the DAR to support the contention that the saline seepage plume will "rapidly diffuse and dilute" in the Presquile aquifer.

Request:

Please provide additional information on the potential impact of seepage from the infiltration pit N-42 on the local aquifer:

1. Evaluate the spatial extent of a seepage plume developing downgradient of the infiltration pit N-42.

2. Provide details on a groundwater monitoring plan that would be implemented to monitor the effect of the proposed infiltration on the local aquifer.

IR: AANDC 30
To: Avalon Rare Metals Inc.
Source: DAR Section 6.5.3.2
Subject: Environmental Impact – Contingency Planning

Preamble:

No mitigation measures and/or contingency plans are discussed in section 6.5.3.2 that would be implemented if the process water quality (or supernatant water quality) does not meet applicable effluent water quality guidelines. Note, however, that a water treatment plant is indicated on the flow sheet (Figure 4.8-7).

Request:

Please provide additional information on proposed mitigation measures that would be implemented if the process water quality (or supernatant water quality) does not meet applicable effluent water quality guidelines. Clarify if and when these mitigation measures would be implemented.

IR: AANDC 31
To: Avalon Rare Metals Inc.
Source: DAR Section 10.6.2.1
Subject: Cumulative Effects on Surface Water Quality at Nechalacho mine site

Preamble:

Section 10.6.2.1 only considers the potential for surface water quality impact to Thor lake via surface flow from the TSF but does not consider the potential cumulative impact due to additional seepage from the TSF (via shallow groundwater) to Thor Lake.

Request:
Please provide additional information on the cumulative impact of surface and subsurface loading of potential contaminants of concern to Thor Lake.

IR: AANDC 32
To: Avalon Rare Metals Inc.
Source: DAR Section 10.6.3.1
Subject: Cumulative Effects on Groundwater Quality at Hydrometallurgical Pant Site

Preamble:

Section 10.6.3.1 briefly discusses the potential for groundwater quality impacts to the local groundwater due to infiltration of process water from the infiltration pit N-42. However, this section does not address the potential cumulative effects on the local groundwater quality due to (i) historic operations at the site (including seepage from the historic tailings impoundment; seepage from open pits) plus proposed new operations (seepage from pits L-37 and N-42).

Request:

Please provide additional information on the cumulative effects on groundwater quality in the local aquifer(s), including:

1. Describe existing and/or potential future impacts to local groundwater from the historic mine operations, including seepage from Cominco tailings pond and/or seepage from/to historic open pits
2. Describe migration of any historic seepage plume from the tailings impoundment (if any) over the last 40 years
3. Discuss potential influence of proposed activities (HMF and infiltration pit) on future movement of any impacted groundwater at Pine Point

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IR: AANDC 33
To: Avalon Rare Earth Metals Incorporated
Source: DAR Section 11 & Section 6.1.1.6 & Section 6.1.3.2 & Conceptual AEMP
Subject: Closure and Reclamation – Post Closure Assessments

Preamble:

Avalon states that " The closure and reclamation of all TLP site facilities will be conducted in accordance with the terms and conditions of the future MVLWB Land Use Permit and Water Licence and accepted mine reclamation practices in the NWT that are applicable (e.g., INAC 2007, 2002)." Avalon also indicates that it will conduct "long-term water outflow monitoring and water management around the mine site" (Section 6.1.1.6 – Closure and Reclamation, Both Sites).

However, Section 6.1.3.2 of the DAR suggests that the closure period is estimated to be "2 years and five years of post closure monitoring." Section 11.1 of the DAR suggests "Post-closure monitoring will be limited to evaluating the success of the re-vegetation effort. Post-closure monitoring for re-vegetation success is envisioned to be conducted at Year 1 and Year 5 post-closure." Section 11.4 indicates that monitoring will occur until conditions stabilizes and water licences conditions are met but then suggests that monitoring after reclamation will only occur for re-vegetation.

AANDC understands that Avalon is planning to design the mine for closure but Avalon must assess the performance of the reclamation strategies and cover designs by monitoring seepage quality and runoff from various mine components and disturbed areas. AANDC notes that other northern mine site have conducted closure and reclamation activities and post closure monitoring for many years (e.g. Pine Point, Colomac, Tundra, Discovery, etc.).

Request:

1. Avalon must explain how they will optimize mine designs for closure and ensure that post closure groundwater, surface water, and site runoff form both project sites will be acceptable and achieve reclamation goals. AANDC notes that tailings water quality will continually degrade over the course of operations and Avalon has indicated that tailings water treatment may be an option during operations. Will Avalon consider post closure water treatment to achieve reclamation goals in the timelines they are currently proposing?
2. Avalon must provide more details on the type and schedule of post-closure monitoring of surface and groundwater quality at both the Nechalacho mine site and the Pine Point Hydrometallurgical Plant site.
3. Avalon must explain how re-vegetation will be enhanced to be successful at both mine sites (including vegetation succession) and that potential contaminant uptake from plant roots on reclaimed tailings facilities will not pose a risk to local wildlife.
4. Have any agreements been reached with the GNWT or CN (limestone Quarry and Railhead). In the end, who will hold liability for limestone quarry and railhead post closure?

IR: AANDC 34
To: Avalon Rare Metals Inc.
Source: DAR Section 11.2.2
Subject: Closure and Reclamation at Nechalacho Mine Site – TMF Closure

Preamble:

Section 11.2.2 indicates that the exposed tailings surface of the TMF will be capped after closure and revegetated. No details are provided on the length of time that will be required for settlement of the tailings (in particular the slimes) prior to final tailings recontouring and cover placement.

Request:

Please provide more details on the consolidation characteristics of the tailings and the influence of tailings consolidation on the timing of cover placement.

IR: AANDC 35
To: Avalon Rare Metals Inc.
Source: DAR Section 11.3.2
Subject: Closure and Reclamation at Hydromet Site – HMF Closure

Preamble:
Section 11.3.2 indicates that the exposed tailings surface will be stabilized and capped after closure. No details are provided on the length of time that will be required for settlement of the tailings (in particular the slimes) prior to final tailings recontouring and cover placement.

Request:
Please provide more details on the consolidation characteristics of the tailings and the influence of tailings consolidation on the timing of cover placement.