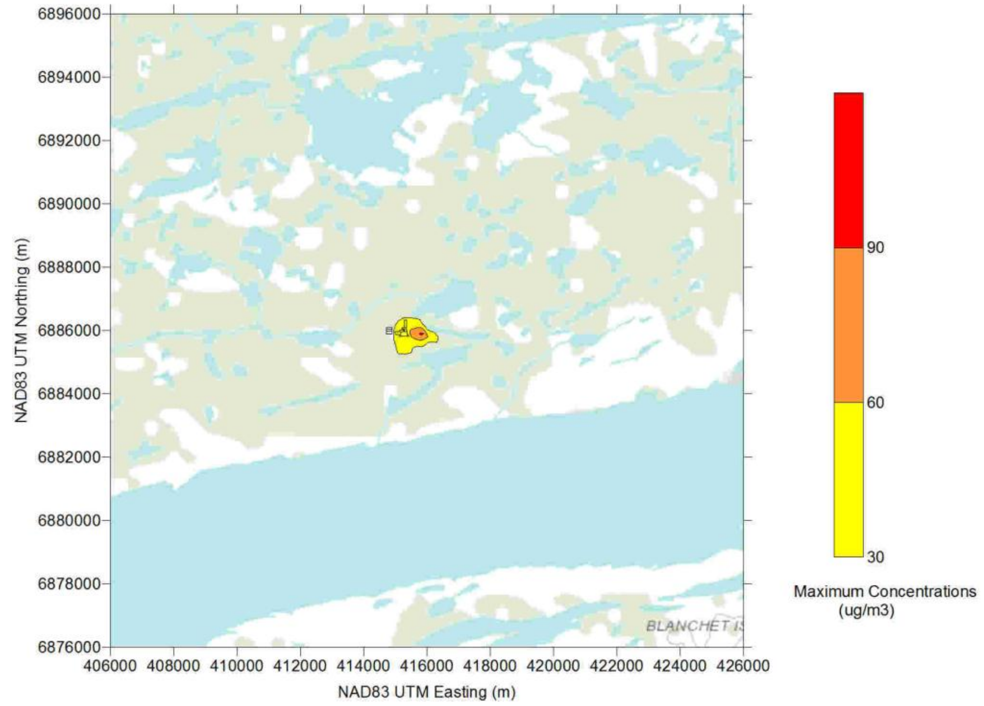


Figure 6.2-4
Isopleths of Maximum Predicted One-Hour Average SO_2 Concentrations

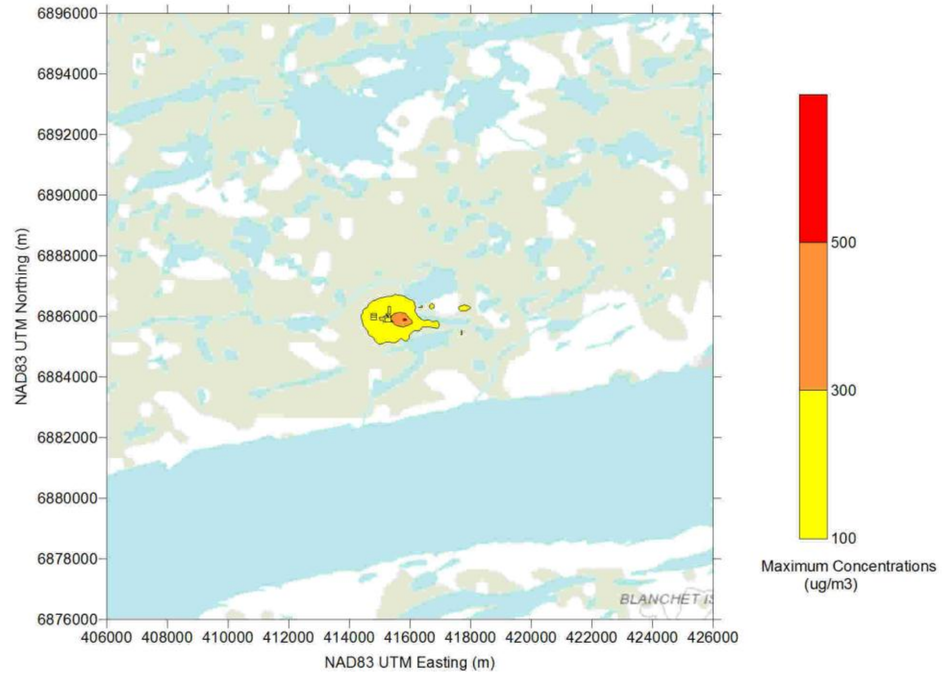


Figure 6.2-5
Isopleths of Maximum Predicted One-Hour Average CO Concentrations

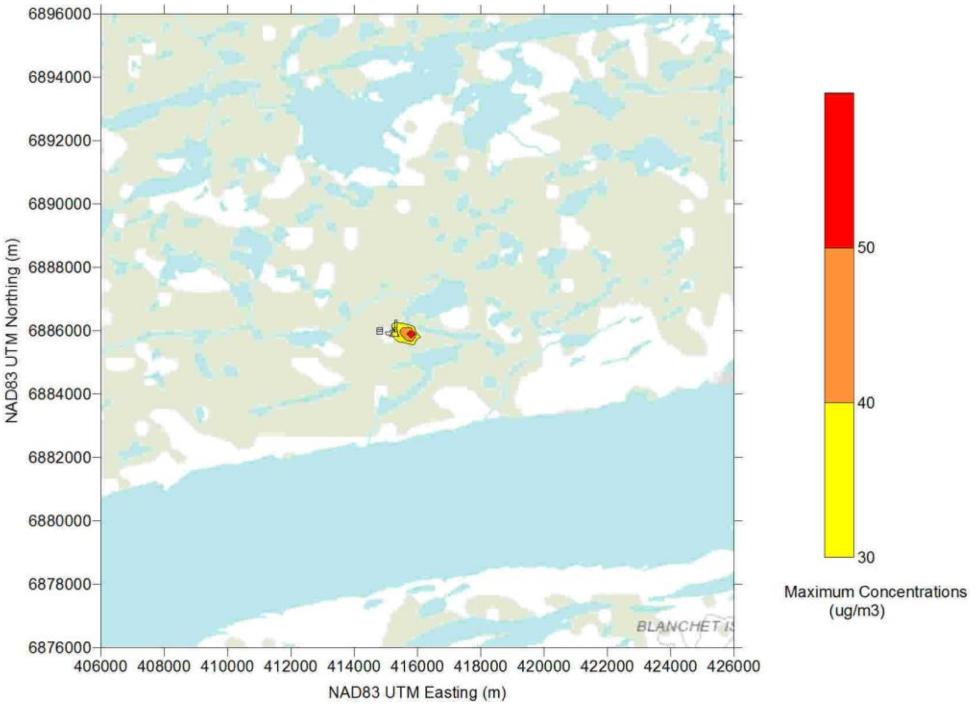


Figure 6.2-6
Isopleths of Maximum Predicted 24-Hour Average TSP Concentrations

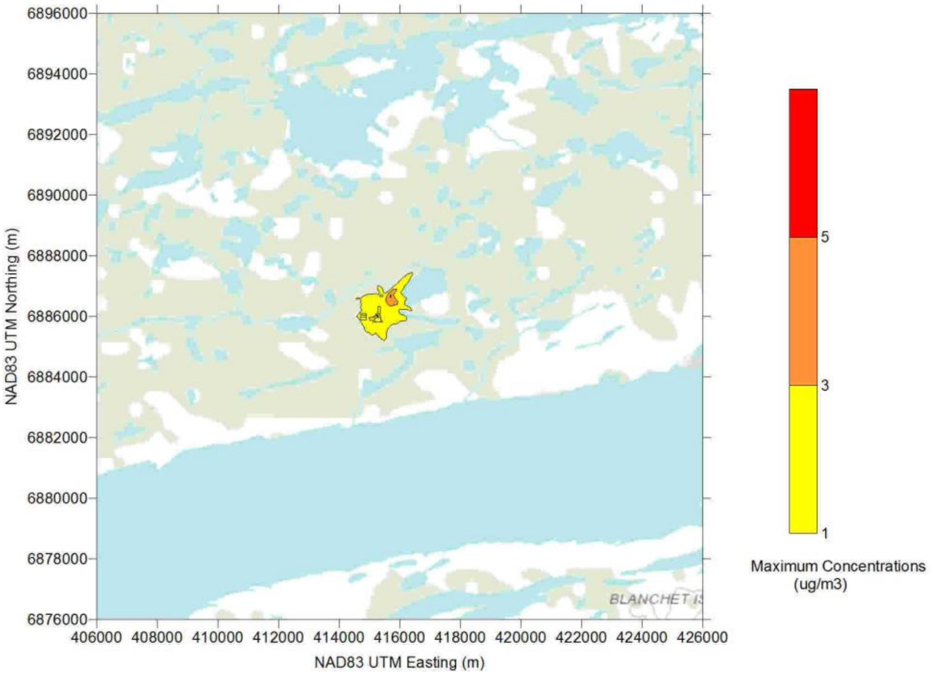


Figure 6.2-7
Isopleths of Maximum Predicted 24-Hour Average $PM_{2.5}$ Concentrations

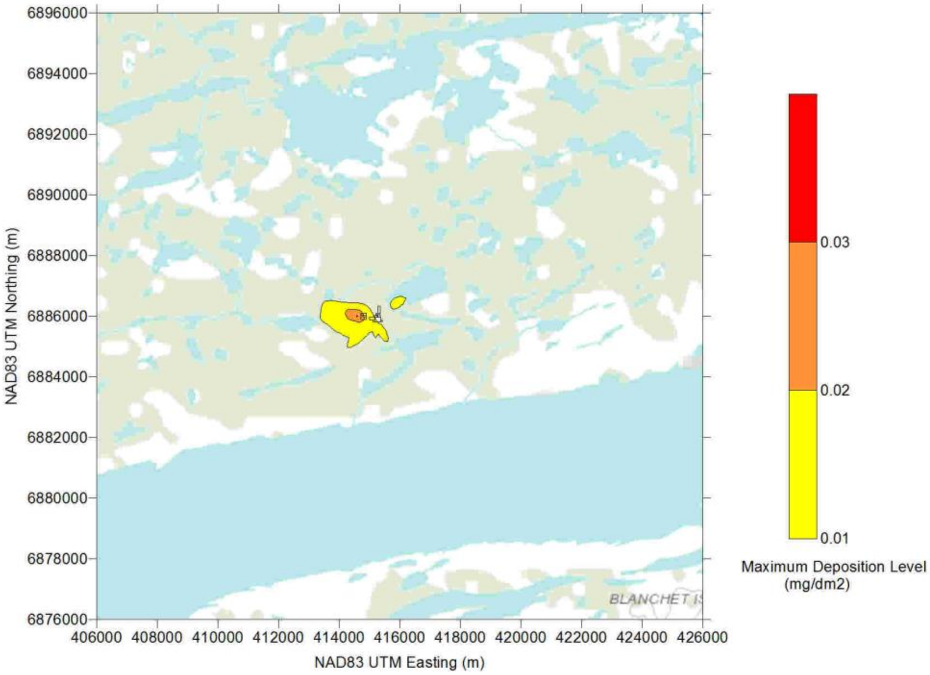


Figure 6.2-8
Isopleths of Maximum Predicted 30-day Average Dustfall Deposition Levels

6.2.2.6 Hydrometallurgical Plant Site

For the Hydrometallurgical Plant, surface meteorological data from Hay River were judged to be the most appropriate available data set. This data set consisted of five years of data from 2002 to 2006. Missing data were filled using data obtained from the Yellowknife Airport meteorological station. Upper air data from Fort Smith were used to determine mixing heights. The data were then processed with CPrammet. Figure 6.2-9 shows the joint frequency distribution of the wind speed and direction data collected at Hay River from 2002 to 2006. The most frequent winds in this area are from the east-northeast, the east and the northwest.

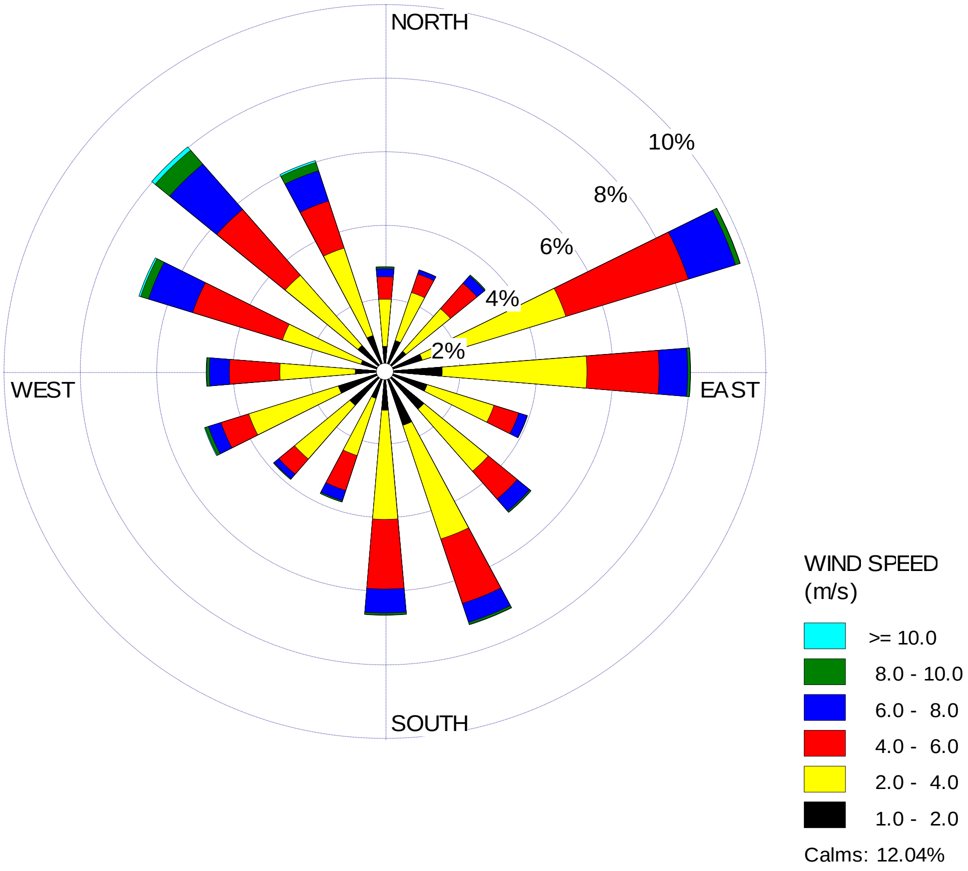


Figure 6.2-9
Joint Frequency Distribution of Wind Direction and Wind Speed Observed at the Hay River Airport for the years 2002 to 2006.

The LSA for the Hydrometallurgical Plant is also a 20 km by 20 km area, but centred on the sulphuric acid plant, illustrated in Figure 6.2-10. As previously noted, the Hydrometallurgical Plant will be located at the former Pine Point Mine site, which is a brownfield site.

A Cartesian receptor grid was adopted with the following receptor spacing:

- 20-m spacing along the plant boundaries where no public access is expected;
- 50-m spacing for a 2.2 by 2.2 km area centred on the sulphuric acid plant;
- 250-m spacing for a 5.2 by 5.2 km area centred on the sulphuric acid plant;
- 500-m spacing for a 11.2 by 11.2 km area centred on the sulphuric acid plant; and,
- 1000-m spacing for the remainder of the 20 km by 20 km LSA.

The terrain elevations for these receptors were extracted from 1: 250,000 scale Canadian Digital Elevation Data (Figure 6.2-10). No discrete receptors were used for this LSA since workers are expected to commute from Hay River, approximately 75 km west of the LSA.

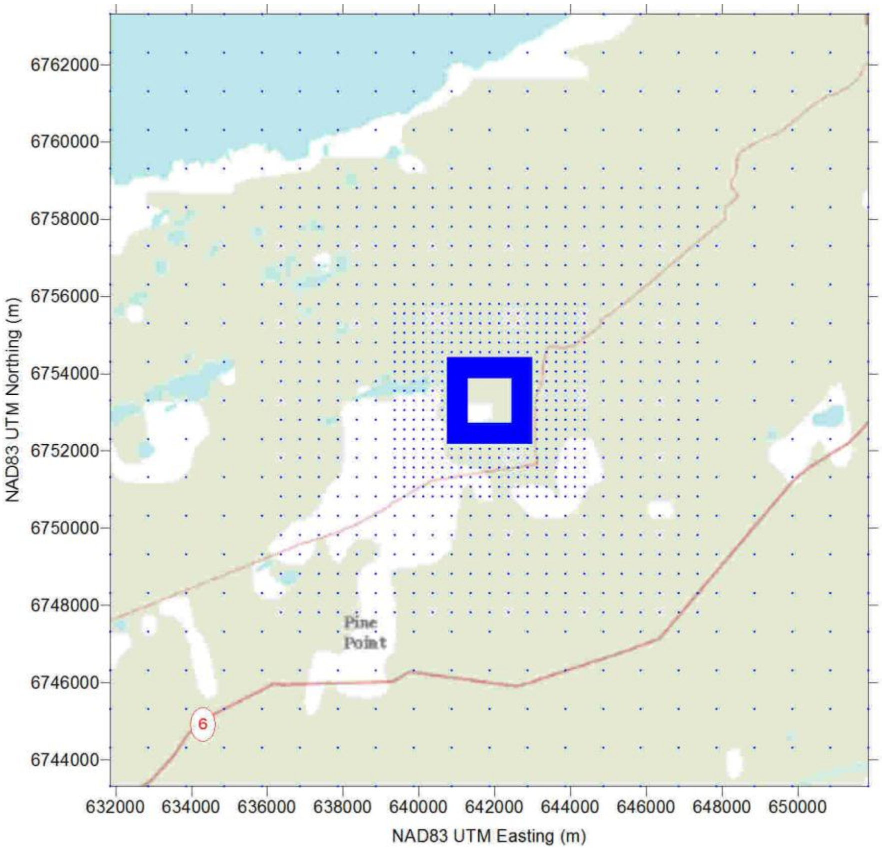


Figure 6.2-10
Hydrometallurgical Plant Air Quality Local Study Area Showing Receptors (Blue Dots)

Sources of Emission

Due to the changes in Project design, there is only one major source of CAC emissions at the Hydrometallurgical Plant which was assessed quantitatively. The sulphuric acid plant emits sulphur dioxide due to chemical reaction rather than combustion. Emission of other CACs from the sulphuric acid plant is not expected.

The Project requires a double absorption sulphuric acid plant to produce 78,840 tpa of sulphuric acid on a 100% acid basis, at an acid strength of about 93%, using elemental sulphur as feed. The Hydrometallurgical Plant is scheduled to operate 351 days per year with a full production rate of 225 tpd of sulphuric acid. It is expected that 2 kg of SO_2 will be emitted for every tonne of sulphuric acid produced, which is equivalent to the sulphur dioxide emission factor for double absorption outlined in US EPA AP-42 Section 8.10. The annual sulphur dioxide emission from the Hydrometallurgical Plant was estimated to be 158 tpa. The hourly SO_2 emission rate of 5.2 g/s was converted from the annual emission rate assuming a constant production rate 351 days per year.

The sulphuric acid plant was modelled using a stack height of 30 m and stack diameter of 1.5 m. The SO_2 flow rate is expected to be 26 Nm^3/h. The exit velocity was calculated to be less than 0.1 m/s and therefore the minimum exit velocity that the model will accept, 0.1 m/s, was used. Exit temperature was assumed to be 430°C based on typical reaction temperatures in sulphuric acid production. Source parameters are summarized in Table 6.2-23.

As the stack is relatively short, the associated plume may be influenced by building downwash. For this reason, building downwash effects were assessed in the dispersion modeling

TABLE 6.2-23: SOURCE PARAMETERS USED FOR HYDROMETALLURGICAL PLANT DISPERSION MODELLING

Sources	SO_2 Emission Rate (g/s)	Stack Height (m)	Stack Inner Diameter (m)	Stack Exit Temperature (°C)	Stack Exit Velocity (m/s)
Sulphuric Acid Plant	5.2	30	1.5	430	0.1

Note: (1) Mine air heater emissions shown indicate emission rates while mine air heater is operating. Mine air heater will operate approximately 4516 h/y.

The maximum predicted SO_2 concentrations are compared to NWT standards in Table 6.2-24. The maximum predicted one-hour, 24-hour and annual SO_2 concentrations are 270, 74, and 7.8 $\mu g/m^3$, respectively. These concentrations are less than the corresponding NWT AQ standards. The spatial distribution of maximum predicted hourly average SO_2 concentrations is shown in Figure 6.2-11. The highest SO_2 concentration was predicted to occur immediately southeast of the sulphuric acid plant.

TABLE 6.2-24: MAXIMUM PREDICTED SO_2 CONCENTRATIONS FOR HYDROMETALLURGICAL PLANT

Pollutant	Averaging Period	Maximum Concentration ($\mu g/m^3$)	NWT AQ Standard ($\mu g/m^3$)
SO_2	1 –hour	270	450
	24-hour	74	150
	Annual	7.8	30

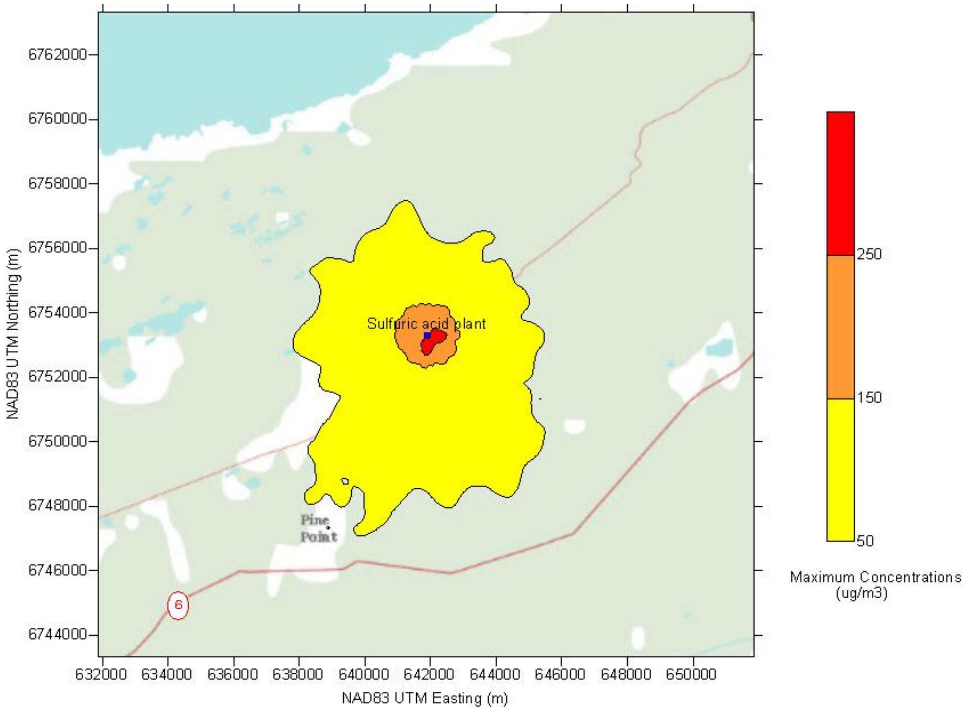


Figure 6.2-11
Isopleths of Maximum Predicted One-Hour Average SO_2 Concentrations

6.2.3 Noise

6.2.3.1 Nechalacho Mine Site

The Nechalacho Mine site is located in a remote area where natural background ambient noise levels are expected to be low, generally in the range of 35 dBA. The acoustic environment is dominated by the sounds of nature, e.g. wind rustling through the foliage, birds singing, waves lapping on the shores of Thor Lake, etc.

Man-made sounds that can currently be heard in the Nechalacho Mine Area from time to time are those associated with the limited and intermittent ongoing exploration drilling program, the existing mining camp at Thor Lake, the camp power generator, local exploration-related vehicle traffic, and the limited fixed-wing aircraft flights that use the airstrip.

During the short (2 year) construction phase, noise levels would be expected to be considerably greater and extend for longer periods of time. Sources of noise at that time would be related primarily to site preparation and infrastructure construction activities, including blasting, excavation, earth-moving, tailings dam and building construction.

Upon completion of construction, noise levels would be expected to be much lower because the mining activities will be underground and the process plant, camp and power generation plant will be contained inside solid, insulated structures. Other sources of noise generated during the long-term operations phase would be associated with mine-related vehicle traffic, including the hauling of concentrate containers to the seasonal dock at Great Slave Lake, the barging operation, and air traffic into and out of the airstrip.

Table 6.2-25 from Harris (1991) identifies typical sound levels associated with common sources of noise that are familiar to the residents of the communities in the region of interest to the Thor Lake Project including the Nechalacho Mine site and the Hydrometallurgical Plant site.

TABLE 6.2-25: TYPICAL SOUND LEVELS OF COMMON NOISES

Description	Type of Noise	Sound Level (dBA)
Rural area – background noise	Continuous	30 - 35
Small town residential – background noise	Continuous	35 - 40
Snowmobile at 15 m	Intermittent	75 (peak)
Snowmobile at 1 km	Intermittent	50 (peak)
Truck at 15 m	Intermittent	85 (peak)
Truck at 1 km	Intermittent	65 (peak)

Mining equipment and activities associated with the Thor Lake Project will produce various kinds of intermittent and/or continuous sounds throughout the initial 20-year life of the Project. The main sources of steady, continuous noise during the operations phase at the Nechalacho Mine site will be produced by the power plant and the Flotation Plant.

Short-term, intermittent noise will be generated by the mobile equipment required to construct and/or operate the Nechalacho Mine and Flotation Plant and associated infrastructure (Table 6.2-26). This would include the earth-moving equipment bulldozers, loaders, dump trucks), construction cranes(s), haul trucks, water truck, pickups/SUVs and other miscellaneous equipment

TABLE 6.2-26: TYPICAL MAXIMUM CONSTRUCTION AND MINING EQUIPMENT SOUND LEVELS

Noise Source	Sound Level (dBA) at Various Distances			
	15 m	30 m	60 m	120 m
Bulldozer	85	79	73	67
Loader	85	79	73	67
Crane	83	77	71	65
Moving dump or haul truck	88	82	76	70
Idling dump truck	65	59	53	47
Diesel generator	70	64	58	52

Notes:

(1) Reference sound level obtained from OMOE Publication NPC-115, contained in the OMOE *Model Municipal Noise Control By-Law* 1977

(2) Reference sound levels obtained from US Department of Transportation , *Transit Noise and Vibration Impacts Assessment*, Chapter 12: Noise and Vibration

(3) Reference sound level obtained from *British Standards No. 5228, Second Edition, May 1997*.

When comparing sound level values, the following general rules from De Beers (2002) may be used:

- a difference in sound level of less than 3 dBA is barely perceptible to the human ear
- a difference of 5 dBA is noticeable
- a difference of 10 dBA corresponds to a halving or doubling in perceived loudness
- a 20 dBA difference corresponds to a four-fold difference in perceived loudness.

It is also important to note that sound propagation between a noise source and receptor (e.g. person or animal listening) is affected by several sound attenuation (reducing) mechanisms. These include the following:

- Distance dissipation - sound naturally decreased with increasing distance from the source.
- Ground attenuation - sound is absorbed by the ground that it passes over.
- Atmospheric absorption – sound is absorbed by the atmosphere it passes through.
- Barrier attenuation – sound can be blocked by physical barriers (e.g. buildings, hills or forest.

Sound is affected by wind conditions (i.e. a distant noise source will be louder under downwind conditions than it will be under calm conditions. Conversely, a distant source will be quieter under upwind conditions than it will be under calm conditions).

Sound is affected by temperature conditions in the atmosphere (i.e. a distant noise source will be louder under atmospheric inversion conditions than it will be under neutral atmospheric conditions).

Sound level attenuation predictions and modelling of construction and operations-related activities, as reported in the environmental assessment conducted for the Snap Lake Project (De Beers 2002) were considered to be relevant and directly applicable to evaluating anticipated noise levels associated with the Thor Lake Project components.

De Beers (2002) determined that "worst case" site construction noise would be at a level of less than 40 dBA at a distance of 1.5 km from the site. As a result of the natural attenuation of outdoor sound with distance, continuous noise from the site would be close to, or less than ambient sound levels at distances of about 6 km from the site.

For the operations phase of the Snap Lake Project average values for continuous noise emanating from the site were also predicted to be less than 40 dBA at a distance of 1.5 km from the site. It was noted that this sound level was similar to the level of continuous background noise that would occur in a small town residential area.

Although the continuous noise produced by the site at this distance was identified to be greater than pre-existing ambient sound levels during calm conditions, the predicted sound level met the guideline criteria of the Alberta EUB Noise Control Directive (EUB 1999) for industrial facilities in remote locations.

The construction and operations phase of the Nechalacho Mine site and associated activities, including local haul truck traffic, are expected to generate similar noise levels to those discussed in this section for the Snap Lake Project.

Based on the available information, noise levels emanating from the Nechalacho development area during all phases of the Project are predicted to be typically less than 40 dBA at a distance of 1.5 km from the site.

As discussed, noise generated by the Nechalacho Mine site and associated activities will be variable and will continue for the life of the Project. Following cessation of Project-related activities noise levels will immediately return to existing ambient conditions.

Some wildlife may show minor displacement behaviour and avoid the immediate Nechalacho development area during periods of particularly loud and irregular noises. The duration of such exposures are expected to be brief, perhaps lasting a few minutes to a few hours, and are reversible upon cessation of the activity or by moving away from the activity. The number and frequency of such exposures to noise disturbance by wildlife would be expected to be limited and sporadic.

The overall environmental consequences of noises generated by the Nechalacho development area and associated activities are expected to be low and the residual impact on the existing noise environment of the LSA and RSA is expected to be negligible.

6.2.3.2 Hydrometallurgical Plant Site

The proposed Hydrometallurgical Plant site and associated infrastructure are also located in an area where ambient noise levels are expected to be low, generally in the range of 35 decibels (dBA). The acoustic environment is again dominated by the sounds of nature, e.g. wind rustling through the foliage.

Man-made sounds that can be heard in the immediate area of the proposed Hydrometallurgical Plant and associated infrastructure from time to time are those associated with the limited and intermittent existing local off-road ATV and snowmobile traffic and associated hunting that occurs seasonally throughout the former Pine Point Mine area and vehicular traffic on nearby Highway 6.

During the short (2 year) construction phase, noise levels would be expected to be considerably greater and extend for longer periods of time. Sources of noise at that time would be related primarily to site preparation and infrastructure construction activities, including excavation, earth-moving, and building construction.

Upon completion of construction, noise levels would be expected to be much lower and mainly limited to those associated with the operation of the Hydrometallurgical Plant, the haul trucks to and from the seasonal dock, the seasonal barging operation and the haul trucks to and from Hay River. Other sources of noise generated during the long-term operations phase would be those associated with the other vehicle traffic (buses, employee/contractor vehicles, etc.

Based on the available information reviewed for the Nechalacho Mine site, noise levels emanating from the Hydrometallurgical Plant area and associated infrastructure during all phases of this component of the Project are also predicted to be typically less than 40 dBA at a distance of 1.5 km from the site.

Some wildlife frequenting the area in the vicinity of the Hydrometallurgical Plant and associated infrastructure may show minor displacement behaviour and avoid the immediate development area during periods of particularly loud and irregular noises. The duration of such exposures are expected to be brief, perhaps lasting a few minutes to a few hours, and are reversible upon cessation of the activity or by moving away from the activity. The number and frequency of such exposures to noise disturbance by wildlife would be expected to be limited and sporadic.

The overall environmental consequences of noises generated by the Hydrometallurgical Plant and associated activities are expected to be low and the residual impact on the existing noise environment of the LSA is expected to be negligible.

6.2.4 Project Design Features and Mitigation Measures

The construction and operation of the Nechalacho Mine and Hydrometallurgical Plant development areas and associated infrastructures will release gaseous and particulate emissions and generate varying degrees and types of noise for the projected initial 20-year life of the Thor Lake Project. Emissions will emanate from fuel combustion, vehicle exhausts, exhausts from the underground mine, the Flotation and Hydrometallurgical plants and other sources associated with operation of the TLP.

6.2.4.1 Air Quality

Various mitigation measures have been incorporated into the revised Project design. Most notably, coal combustion has been eliminated. Dust emissions will be mitigated by crushing and transferring ore in the underground mine. There will be sufficient dust control devices on the mining and processing equipment to meet the Mine Health and Safety Regulations in the underground mine. Grinding will be a wet process with negligible emissions of fugitive dust. The open ore stockpile on the surface during operations has been eliminated thereby reducing potential fugitive dust emissions. The sulphuric acid plant will be equipped with a scrubber to reduce emission released to the ambient air. The acid bake kiln will be powered by electricity rather than to coal or diesel. The concentrate will be shipped in containers thereby minimizing fugitive dust emissions.

Avalon is committed to employ an adaptive management approach including a number of applicable mitigation measures. To minimize potential effects on local and regional air quality and to control greenhouse gas emissions, additional mitigation measures that will be employed by the Thor Lake Project will include:

- Full compliance with Land Use Permit and Water License and license conditions to be issued by the MVLWB.
- Conformance with the Guidelines for Ambient Air Quality Standards in the NWT.

- Use of low sulphur diesel fuel and regular equipment and engine maintenance.
- Use of low NOx and SOx diesel power generators at the Nechalacho Mine site.
- Use of line power as the main source of power for the Hydrometallurgical Plant.
- Conformance with GNWT Guideline for Dust suppression through the application of dust suppressants – e.g., water or approved dust suppressant products.
- Use of existing highways for all Hydrometallurgical Plant-related vehicle traffic.
- Secure containment of concentrate product during transportation from the Nechalacho Mine site to the Hydrometallurgical Plant site and from there to the Hay River railhead.
- Conformance with GNWT and WCB standards for mine and process plant(s) air quality.
- Disposal of all hazardous wastes in an approved manner.

6.2.4.2 Noise

The construction and operation of the Nechalacho Mine and Hydrometallurgical Plant will generate varying degrees and types of noise for the projected initial 20-year life of the TLP.

The overall environmental consequences of noises generated by the TLP and associated activities are expected to be low, with no residual effects to the environment. Avalon is committed to employing an adaptive management approach including a number of mitigation measures to minimize potential effects on the existing noise environment. Such mitigation measures will include:

- Regular maintenance of mobile and stationary equipment used during construction and operations;
- Use of high performance engine exhaust silencers at the power plant

6.2.5 Residual Effects

6.2.5.1 Air Quality

As previously discussed in Section 6.2.2.4, based on professional judgment, it is expected that the majority of emissions will occur during the operations phase and therefore the assessment of the operations phase will bound both the construction and closure phases. Therefore operations were assessed quantitatively whereas construction and closure were assessed qualitatively. The residual effects of the Thor Lake Project components are summarized in Table 6.2-27 for Criteria Air Contaminants (CACs) and Table 6.2-28 for greenhouse gas emissions (GHGs).

Construction of the mine, flotation plant and Hydrometallurgical Plant is expected to result in localized, short-term, periodic, low magnitude and rapidly reversible increases in ambient concentrations of CACs. Construction activities will also release GHGs which will contribute to the total GHGs produced during the life of the Thor Lake Project. Due to the low magnitude, periodic nature and reversibility of emissions during construction, the potential residual effects on ambient air quality and GHG emissions are considered to be not significant.

During the longer term operations phase of the Thor Lake Project the maximum CAC concentrations due to emissions from the major sources at the Nechalacho Mine, the Flotation Plant and the Hydrometallurgical Plant are predicted to be lower than the corresponding NWT AQ Standards. In addition, the maximum predicted dustfall levels are less than criteria of other Canadian jurisdictions.

Mobile sources, including fuel combustion in aircraft, tugs used to tow barges, and vehicles, will emit CACs; however, the emissions are expected to be relatively low in magnitude, periodic and rapidly reversible. Road dust emissions tend to be deposited within several hundred metres of the roads and are not considered transportable particulate matter; therefore the spatial extent is local and the magnitude of potential effect on ambient CAC concentrations is low.

In summary, considering both the quantitative assessment of the major sources and qualitative assessment of the minor sources, the potential residual effects of CAC emissions during operations on ambient air quality are considered to be not significant.

Thor Lake Project operations will result in an increase in GHG emissions. The predicted GHG emissions associated with the Project are approximately 3% of GHG emissions in the Northwest Territories and less than 0.01% of the total emissions in Canada. Since the magnitude is medium and the effect is reversible, the potential residual effect of Project GHG emissions is considered not significant.

During the short-term closure phase, CACs and GHGs will be emitted by equipment and vehicles. This is predicted to result in localized, short-term, periodic, low magnitude and rapidly reversible increases in ambient concentrations of CACs and GHGs which will contribute to the total GHGs produced during the life of the Thor Lake Project. Due to the low magnitude, periodic nature and reversibility of emissions during the closure phase, the potential residual effects on ambient air quality and GHG emissions are considered to be not significant.

TABLE 6.2-27: RESIDUAL EFFECTS ASSESSMENT FOR CRITERIA AIR CONTAMINANTS (CACS)

	Evaluation of Residual Effect							
Description of Residual Effect (after Mitigation)	**Magnitude**	**Geographic Extent**	**Duration**	**Frequency**	**Reversibility**	**Likelihood**		**Consequence**
Change in ambient CAC concentration or deposition – Construction	Low	Local	Short-term	Periodic	Reversible Short-term	High	**Magnitude**	**H** 🟨 🟧 🟧 **M** 🟨 🟨 🟧 **L** 🟩X 🟨 🟨 **S M L** **Duration**
Change in ambient CAC concentration or deposition – Operations	Low-Moderate	Local-Regional	Medium-term	Continuous	Reversible Long-term	High	**Magnitude**	**H** 🟨 🟧 🟧 **M** 🟨 🟨X 🟧 **L** 🟩 🟨X 🟨 **S M L** **Duration**
Change in ambient CAC concentration or deposition – Closure	Low	Local	Short-term	Isolated	Reversible Short-term	High	**Magnitude**	**H** 🟨 🟧 🟧 **M** 🟨 🟨 🟧 **L** 🟩X 🟨 🟨 **S M L** **Duration**

TABLE 6.2-28: RESIDUAL EFFECTS ASSESSMENT FOR CRITERIA FOR GREENHOUSE GAS EMISSIONS

	Evaluation of Residual Effect						
Description of Residual Effect (after Mitigation)	**Magnitude**	**Geographic Extent**	**Duration**	**Frequency**	**Reversibility**	**Likelihood**	**Consequence**
Change in GHG emissions – Construction	Low	Beyond Regional	Long-term	Periodic	Reversible Long-term	High	**Magnitude** **H** 🟧 🟧 🟥 🟥 **M** 🟨 🟧 🟧 🟥 **L** 🟩 🟨 🟨**X** 🟧 **S M L I** **Duration**
Change in GHG emissions – Operations	Moderate	Beyond Regional	Long-term	Continuous	Reversible Long-term	High	**Magnitude** **H** 🟧 🟧 🟥 🟥 **M** 🟨 🟧 🟧**X** 🟥 **L** 🟩 🟨 🟨 🟧 **S M L I** **Duration**
Change in GHG emissions – Closure	Low	Beyond Regional	Long-term	Isolated	Reversible Long-term	High	**Magnitude** **H** 🟧 🟧 🟥 🟥 **M** 🟨 🟧 🟧 🟥 **L** 🟩 🟨 🟨**X** 🟧 **S M L I** **Duration**

6.3 SURFACE HYDROLOGY

6.3.1 Thor Lake Watershed Area

As previously indicated in Section 2.5, the Nechalacho Mine and associated infrastructure is located in the Thor Lake watershed area (estimated 2,100 ha), which drains into a larger watershed area (estimated 6,700 ha) downstream before flowing into Great Slave Lake.. Sub-catchment areas within the Thor Lake watershed have been identified and are shown in Figure 6.3-1.

6.3.2 Site Layout and Water Management

The proposed site water management for the Thor Lake Project will consist of a closed loop system to minimize effects to the natural hydrologic flows. The Tailings Management Facility (TMF) will be located within a basin in the upper portion of the northern watershed area reporting to Thor Lake. Water will be withdrawn from Thor Lake and recycled from the TMF to operate the Flotation Plant.

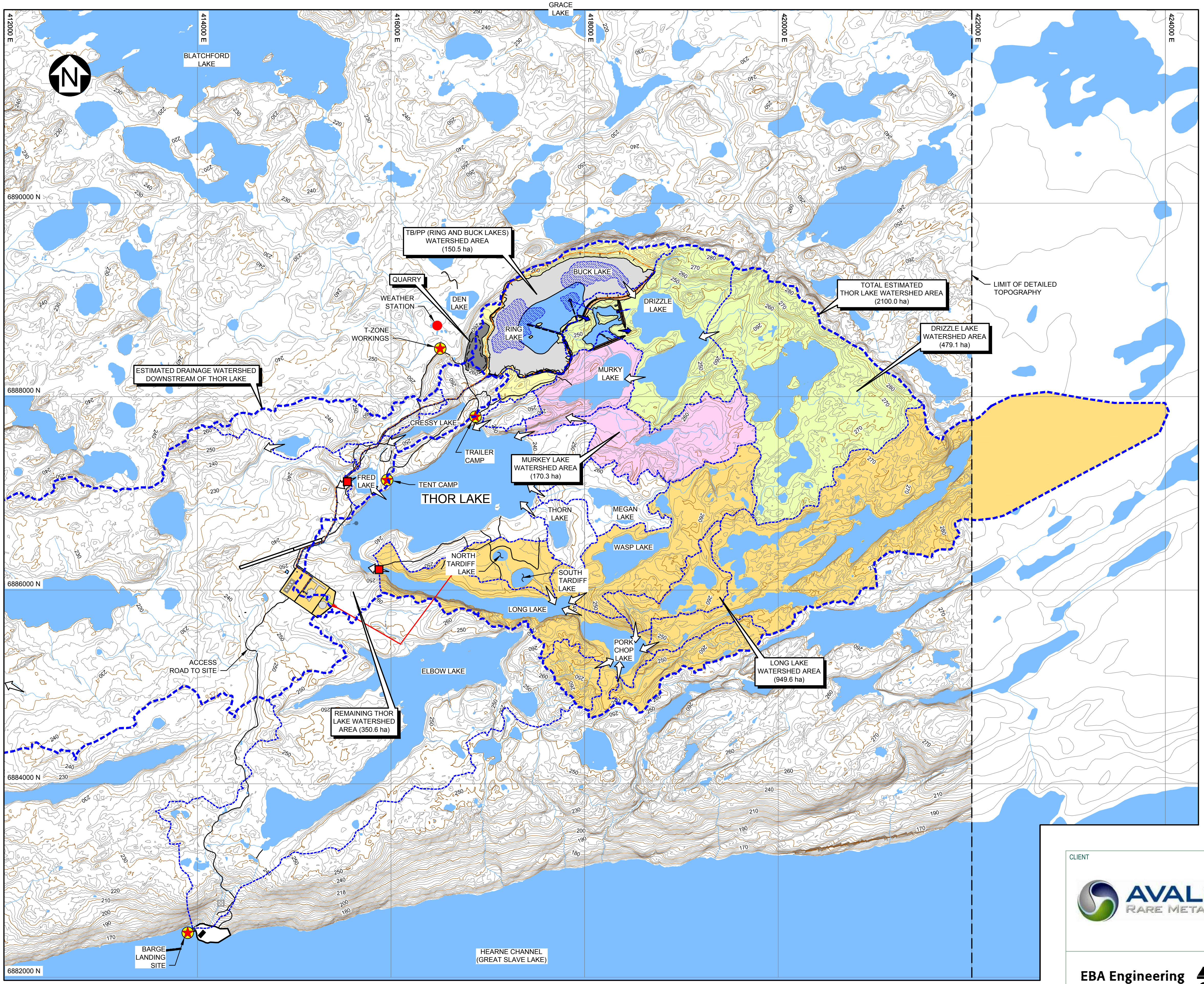
Excess water from the TMF will be treated (if necessary) and discharged to Drizzle Lake from the Polishing Pond. Ultimately, all excess water from the TMF will return to Thor Lake via the Drizzle Lake/Murky Lake drainage system. A Settling Pond will be established to collect runoff water from the Flotation Plant site and may also be used to reclaim small amounts of water for use in the Flotation Plant.

Figures 6.3-2 and 6.3-3 show the proposed general arrangement of the TMF for Phases 1 and 2, respectively. Phase 1 consists of the proposed arrangement for the first two years of operations where Buck Lake will act as the Polishing Pond. Phase 2 consists of the arrangement for Years 3 onwards where the Tailings Basin will encompass both Ring and Buck Lakes and the Polishing Pond will be constructed if necessary for water treatment.

6.3.3 Watershed Flow Analysis

An analysis of the affected watershed areas was completed for the Nechalacho Mine area by Knight Piésold (2011c). This analysis was completed to compliment the water/solids balance analysis (Knight Piésold 2011b). The water/solids balance analysis was used to estimate flows based on the following general assumptions:

- Average meteorological conditions from analysis of historical data from regional weather stations including precipitation (rainfall and snow), evaporation, temperature, and snowmelt.
- Probabilistic analysis to predict dry and wet conditions (5th and 95th percentiles, respectively).
- Natural runoff coefficients from an analysis of regional flow discharge measurements.
- Project design criteria including mine production rates, tailings throughput rates, process water requirements, water recycle rates, and other considerations.



LEGEND:

🟦	WATER
───	ROAD
■ ■ ■ ■ ■	WATERSHED BOUNDARY
▪▪▪▪▪▪▪▪▪	SUB WATERSHED DIVIDE
⇨	DRAINAGE DIRECTION
🟥	BASELINE MONITORING LOCATION
●	WEATHER STATION

NOTES:

1. COORDINATE GRID IS SHOWN IN UTM (NAD83) ZONE 12N AND IS IN METRES.
2. CONTOURS ARE IN METRES. CONTOUR INTERVAL WITHIN DETAILED TOPOGRAPHY IS 2 METRES. SURROUNDING CONTOUR INTERVAL IS 10 METRES.
3. LAKE AREAS ARE INCLUDED IN CATCHMENT AREA TOTAL.
4. FIGURE SOURCE IS KNIGHT PIÉSOLD CONSULTING REF. NB11-00132 FIGURE 2 DATED MARCH 11, 2011.

SCALE 1:40,000

0.4 0 0.4 1.0 1.6km

ISSUED FOR USE

CLIENT

AVALON RARE METALS INC.

THOR LAKE PROJECT

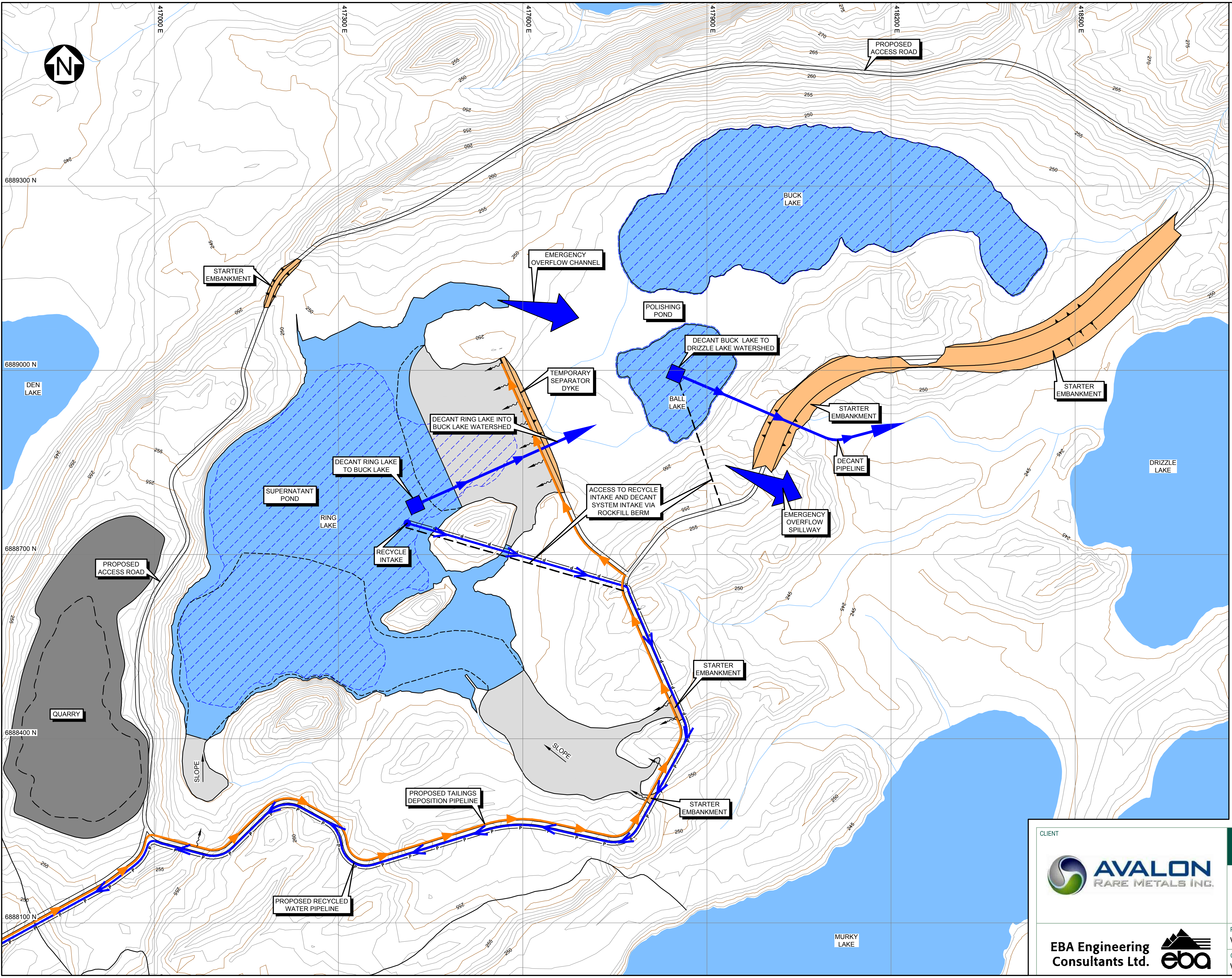
Estimated Project Site Watershed Areas

EBA Engineering Consultants Ltd.

PROJECT NO.	DWN	CKD	REV
V15101007.006.014	JAB	RH	1
OFFICE	DATE		
VANC	April 28, 2011		

Figure 6.3-1

Q:\Vancouver\Drafting\Engineering\V151\V15101007\006\014\V15101007.006.014_FIG 6.3-1_R1.dwg [FIGURE 6.3-1] April 28, 2011 - 4:45:18 pm (BY: BOKIC, JON)



LEGEND:

- 🟦 WATER
- ⬜ TAILINGS
- 🟫 EMBANKMENT
- ▨ EXISTING LAKE FOOTPRINT
- — EXISTING ACCESS ROAD
- ═ PROPOSED ROAD
- → PROPOSED TAILINGS DELIVERY PIPELINE
- ← PROPOSED TAILINGS DEPOSITION PIPELINE
- ← PROPOSED RECYCLED WATER PIPELINE
- –P– PROPOSED POWERLINE
- ➔ DISCHARGE

NOTES:

1. COORDINATE GRID IS UTM (NAD83) ZONE 12N AND IS IN METRES.
2. CONTOURS ARE IN METRES. CONTOUR INTERVAL IS 1 METRE.
3. TAILINGS CONFIGURATION SHOWN REPRESENTS ESTIMATED LAYOUT FOR END OF YEAR 2 OPERATIONS.
4. FIGURE SOURCE IS KNIGHT PIÉSOLD CONSULTING REF. NB11-00148 FIGURE 3 DATED MARCH 11, 2011.

SCALE 1:6000

50 0 50 150 250m

ISSUED FOR USE

CLIENT

AVALON RARE METALS INC.

EBA Engineering Consultants Ltd.

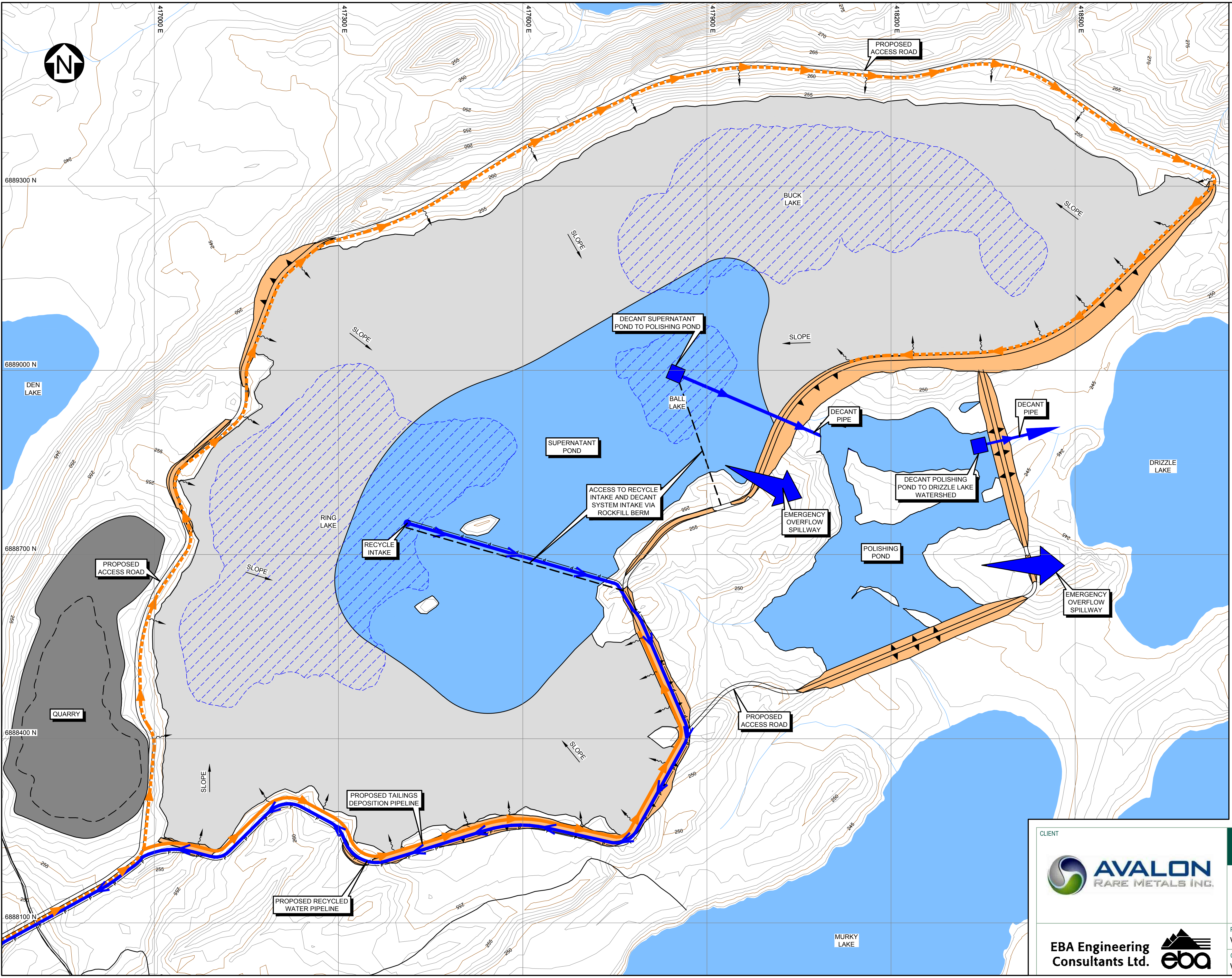
THOR LAKE PROJECT

Feasibility Tailings Facility
Phase 1 Plan

PROJECT NO.	DWN	CKD	REV
V15101007.006.014	JAB	RH	1
OFFICE	DATE		
VANC	April 28, 2011		

Figure 6.3-2

Q:\Vancouver\Drafting\Engineering\V151\V15101007\006\014\V15101007.006.014_FIG 6.3-2_R1.dwg [FIGURE 6.3-2] April 28, 2011 - 4:45:32 pm (BY: BOKIC, JON)



LEGEND:

- ▨ WATER
- ▨ TAILINGS
- ▨ EMBANKMENT
- ▨ EXISTING LAKE FOOTPRINT
- — EXISTING ACCESS ROAD
- ═ PROPOSED ROAD
- → PROPOSED TAILINGS DELIVERY PIPELINE
- ← PROPOSED TAILINGS DEPOSITION PIPELINE
- ← PROPOSED RECYCLED WATER PIPELINE
- –P– PROPOSED POWERLINE
- ➡ DISCHARGE

NOTES:

1. COORDINATE GRID IS UTM (NAD83) ZONE 12N AND IS IN METRES.
2. CONTOURS ARE IN METRES. CONTOUR INTERVAL IS 1 METRE.
3. TAILINGS CONFIGURATION SHOWN REPRESENTS ESTIMATED LAYOUT FOR END OF YEAR 20 OF OPERATIONS.
4. FIGURE SOURCE IS KNIGHT PIÉSOLD CONSULTING REF. NB11-00148 FIGURE 4 DATED MARCH 11, 2011.

SCALE 1:6000

50 0 50 150 250m

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AVALON RARE METALS INC.

THOR LAKE PROJECT

Feasibility Tailings Facility
Phase 2 Final Plan

EBA Engineering Consultants Ltd.

PROJECT NO.	DWN	CKD	REV
V15101007.006.014	JAB	RH	1
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Figure 6.3-3

The main Project design criteria considered included:

- Mining rate of 2,000 dtpd throughout the mine life, with the exception of a 1,200 dtpd, 3 month ramp up period at the start of production.
- A projected and modelled initial mine life of 20 years.
- Use of a thickener in the Flotation Plant, which would increase the outgoing slurry solids content to 50% for Years 1 to 4 and 31.5% for Years 5 to 20 (after the Paste Plant begins operations).
- Adjustment of the minimum and maximum pond sizes as a result of the decrease in water being sent to the TMF.
- Estimated specific gravity of the tailings of 2.85 and estimated dry density of 1.3 t/m^3.
- Incorporation of Monte Carlo simulation analysis into the model to simulate dry and wet climatic conditions for the site and their effects.
- Estimated potable water extraction rate from Thor Lake - 10,950 m^3/year (30 m^3/day).
- Assumed seepage rate from the Tailings Basin and the Polishing Pond – 1,825 m^3/year (5 m^3/day).
- Estimated amount of water in paste backfill – 0.25 m^3/tonne.
- Amounts of water in concentrate and ore based on 2,000 dtpd case and information provided by Bruce Fielder in an email dated December 14, 2009.
- Assumed pumping rate for mine dewatering – 157,000 m^3/year (432 m^3/day).
- Assumed reclaim rate from Settling Pond to Flotation Plant – 27,500 m^3/year (30 m^3/day).
- Runoff from the Flotation Plant site will be collected and routed to the TMF via the plant.
- Estimated maximum ice thickness used in the water/solids balance model was 1.0 m.

The main objectives of the analysis were to provide the following:

1. Estimated pre-production monthly discharge volumes from the Drizzle Lake and Thor Lake watersheds.
2. Estimated change to discharge volumes during mine operations from pre-production values.
3. Estimated change to discharge volumes during a five year post-production period.
4. An estimate of the ratio of discharge volume from the proposed Tailings Management Facility (TMF – Ring and Buck Lakes basin) compared to the overall water volumes reporting to Thor Lake on an annual basis.

During operations, the general water management plan for the Nechalacho Mine and Flotation Plant will be as follows:

- Fresh water for the Project will be drawn from Thor Lake;
- Mine water and Plant site runoff will be collected and directed into the process as appropriate;
- The TMF will be located within the Ring and Buck Lakes basin in the upper portion of the northern watershed area reporting to Thor Lake. All excess water released from the TMF will return to Thor Lake via the Drizzle Lake/Murky Lake drainage system;
- Water will be recycled from the TMF to the greatest extent possible to minimize the fresh water requirement (currently 50% recycle and 50% fresh water has been modelled);
- Extraction of fresh water from Thor Lake will be managed to conform to the 2010 Department of Fisheries and Oceans (DFO) Protocol for Winter Water Withdrawal (DFO 2010), which specifies the use of no more than 10% of the available under-ice water volume; and
- Natural flows and conditions will be monitored and mimicked as closely as possible throughout operations to minimize possible effects on the local hydrological regime.

The pre-production, operations phase and post-production water balance/flow analyses were completed using a spreadsheet approach for a twelve month period and a 5 year period, respectively. The model estimated the flow of water between the watersheds on a monthly basis using various inputs including watershed areas, runoff coefficients and effective precipitation data. The volumes of water reporting to each watershed were calculated on a monthly basis by summing inputs from other watersheds (if applicable) and direct runoff within the watershed area.

The same runoff coefficients were applied to each watershed area, by month, and varied between 17% in August and 49% in May. The runoff coefficients were based on the average for recorded regional data.

It was assumed that any additional water inputs for a watershed would also be output from the watershed during the same month. This is based on the principle that the various lakes and rivers are expected to maintain relatively steady volumes and surplus water resulting from rainfall cycles through the various watersheds is discharged downstream.

To represent conditions during the mine life (20 years of production), estimated flows from the water balance analyses (Knight Piésold 2011b) were incorporated. The amount of water reporting to the outlet of the Drizzle Lake watershed and to the outlet of the Thor Lake watershed during operations were specifically modelled for comparison with the pre-development conditions.

6.3.4 Watershed Flow Analysis Results

6.3.4.1 Pre-Production

Figure 6.3-4 presents a flowsheet summarizing the estimated annual flows anticipated to occur within the Thor Lake system during pre-production conditions. The pre-production annual amount of water that discharges from Thor Lake to Fred Lake is estimated to be 1.725 million m^3 per year. The estimated annual discharge from the Ring and Buck Lakes watershed (proposed TMF) is 133,800 m^3 per year or approximately 8% of the Thor Lake watershed discharge. Similarly the estimated annual discharge from the Drizzle Lake watershed is 481,800 m^3 per year or approximately 28% of the Thor Lake watershed discharge. Monthly flow estimates from each watershed are graphically shown on Figure 6.3-5.

A review of measured flows from baseline work completed to date by Stantec (2010a) indicates that the annual flows estimated by Knight Piésold (2011c) are reasonable.

6.3.4.2 Mine Operations

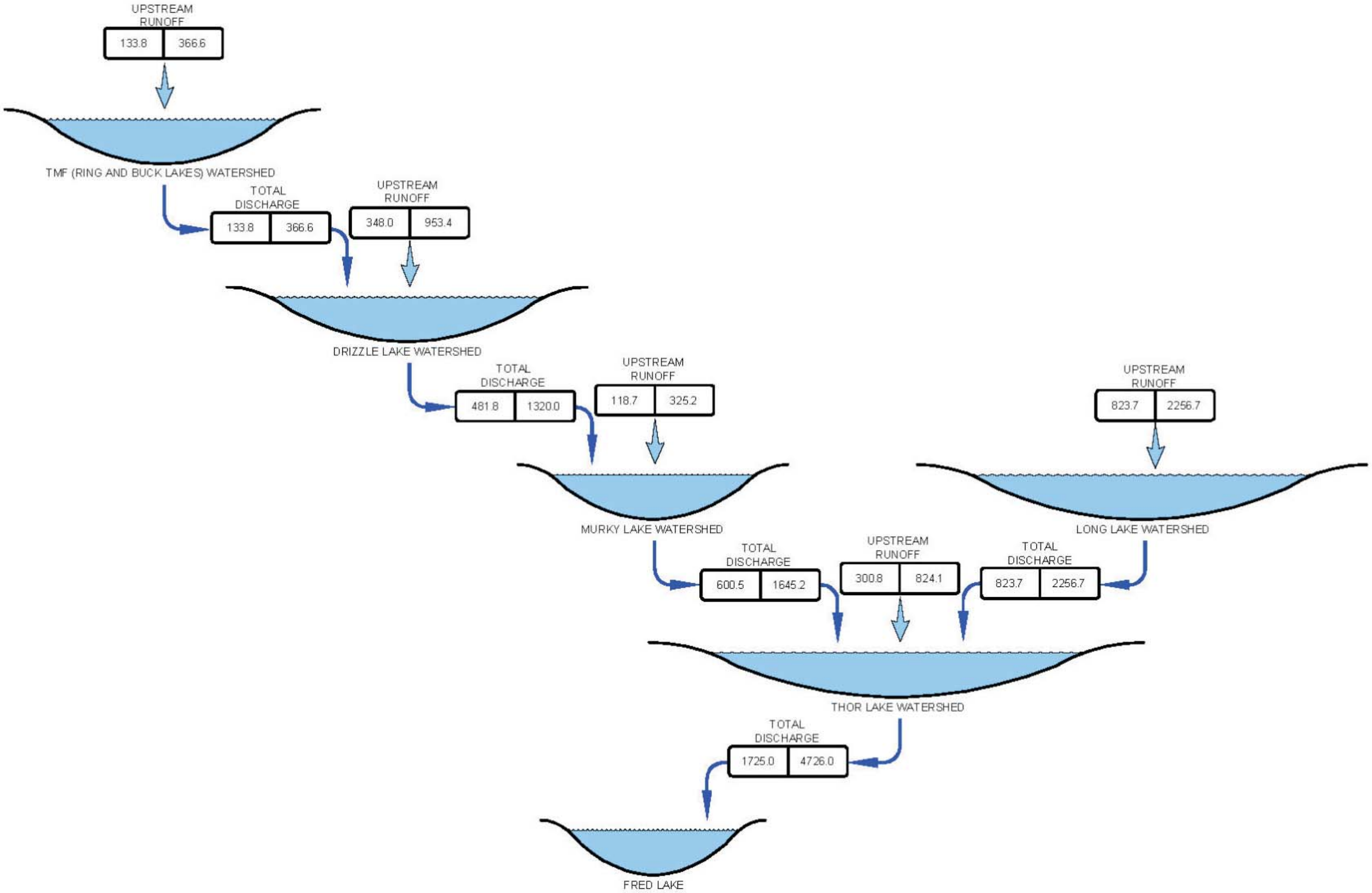
Figure 6.3-6 presents a flowsheet that estimates annual operating inputs and outputs as well as flows anticipated to occur between the same watershed areas discussed above during the mine operations phase. Estimated average flows for Years 1 to 4 (Phase 1) and 5 to 20 (Phase 2) from the mine site water balance have been incorporated.

Two key points have been selected for comparing pre-production and operations conditions – the outlet from the Drizzle Lake watershed and the outlet from the Thor Lake watershed. The following comments are provided regarding the changes from the pre-production conditions.

The mine operations will result in a lower annual flow being discharged from Thor Lake. The outflow from the Thor Lake basin is estimated to drop approximately 8.8% annually (1.725 million m^3 to 1.574 million m^3) compared to pre-production conditions. The main reason for the lower outflow is due to a loss of water during mine operations as a result of:

- Water located in Tailings voids within TMF.
- Evaporation from TMF resulting in lower net upstream runoff.
- Moisture stored underground in paste backfill.

During mine operations, there will be an initial increase in flow from Drizzle Lake due to excess water discharged from the TMF, which in time will decrease as the solids deposition rate decreases in year 5 and evaporation increases. Based on the 50% maximum recycle rate adopted for the Feasibility Study, the initial flow increase will be approximately 7.8% of the pre-development flows on an annual basis.



LEGEND:

ANNUAL FLOW IN THOUSAND m^3/yr

AVERAGE FLOW IN m^3/day

133.8	366.6

NOTES

1. Estimates are for average precipitation conditions and do not include extreme precipitation events.
2. Upstream runoff to each lake includes direct precipitation and evaporation on the lake.
3. Figure Source: Knight Piesold Consulting, March 2011 (Ref No. NB11-00132, Figure 3).

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THOR LAKE PROJECT

Annual Watershed Flowsheet Pre-Production

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OFFICE	DATE
EBA-VANC	April 5, 2011

Figure 6.3-4

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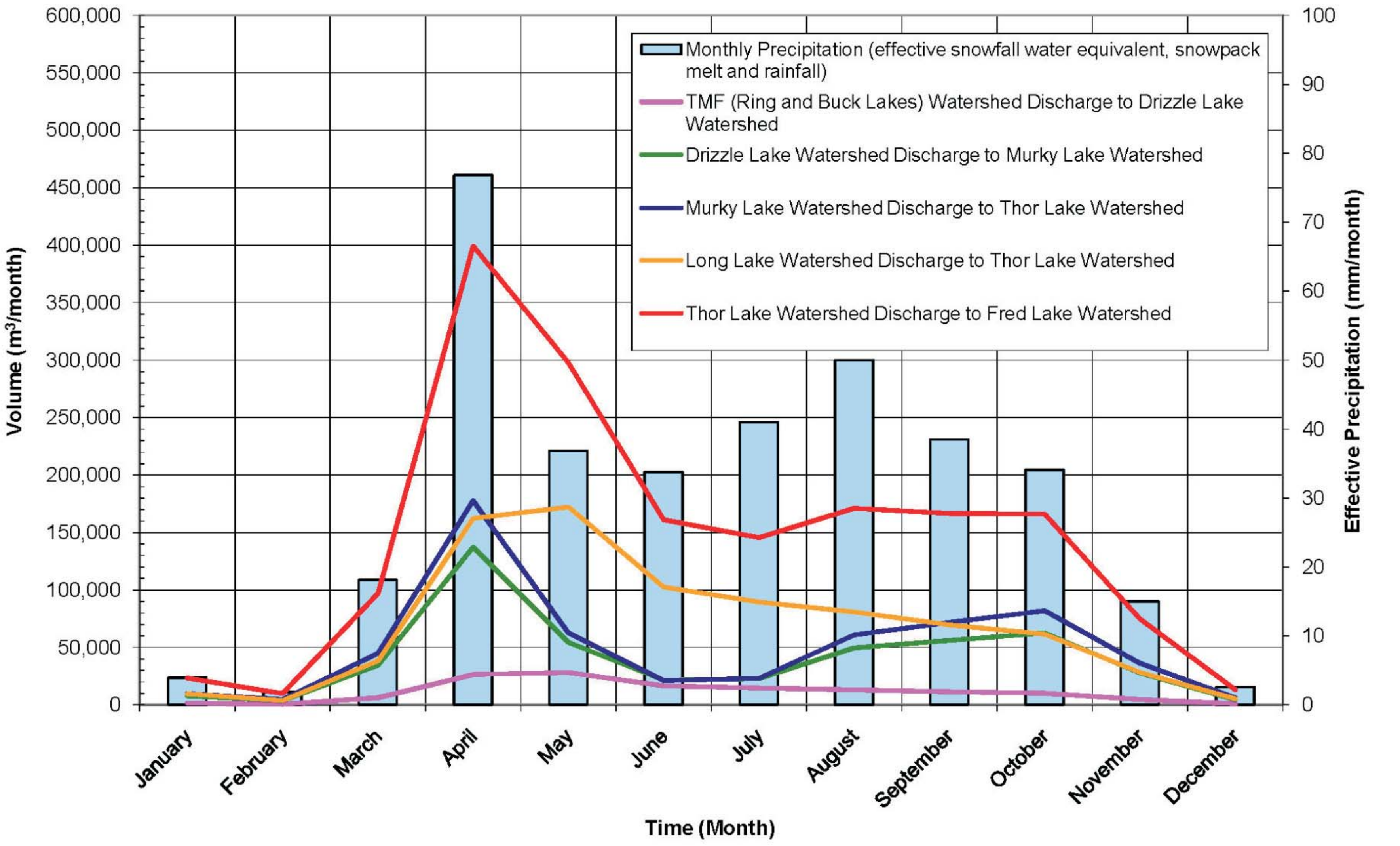

NOTES

1. Figure Source: Knight Piesold Consulting, March 2011 (Ref No. NB11-00132, Figure 4).

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THOR LAKE PROJECT

Estimated Watershed Discharge By Month
Pre-Production Average Conditions

PROJECT NO.	DWN	CKD	REV
V15101007.006	SL	RH	0

OFFICE	DATE
EBA-VANC	April 5, 2011

Figure 6.3-5

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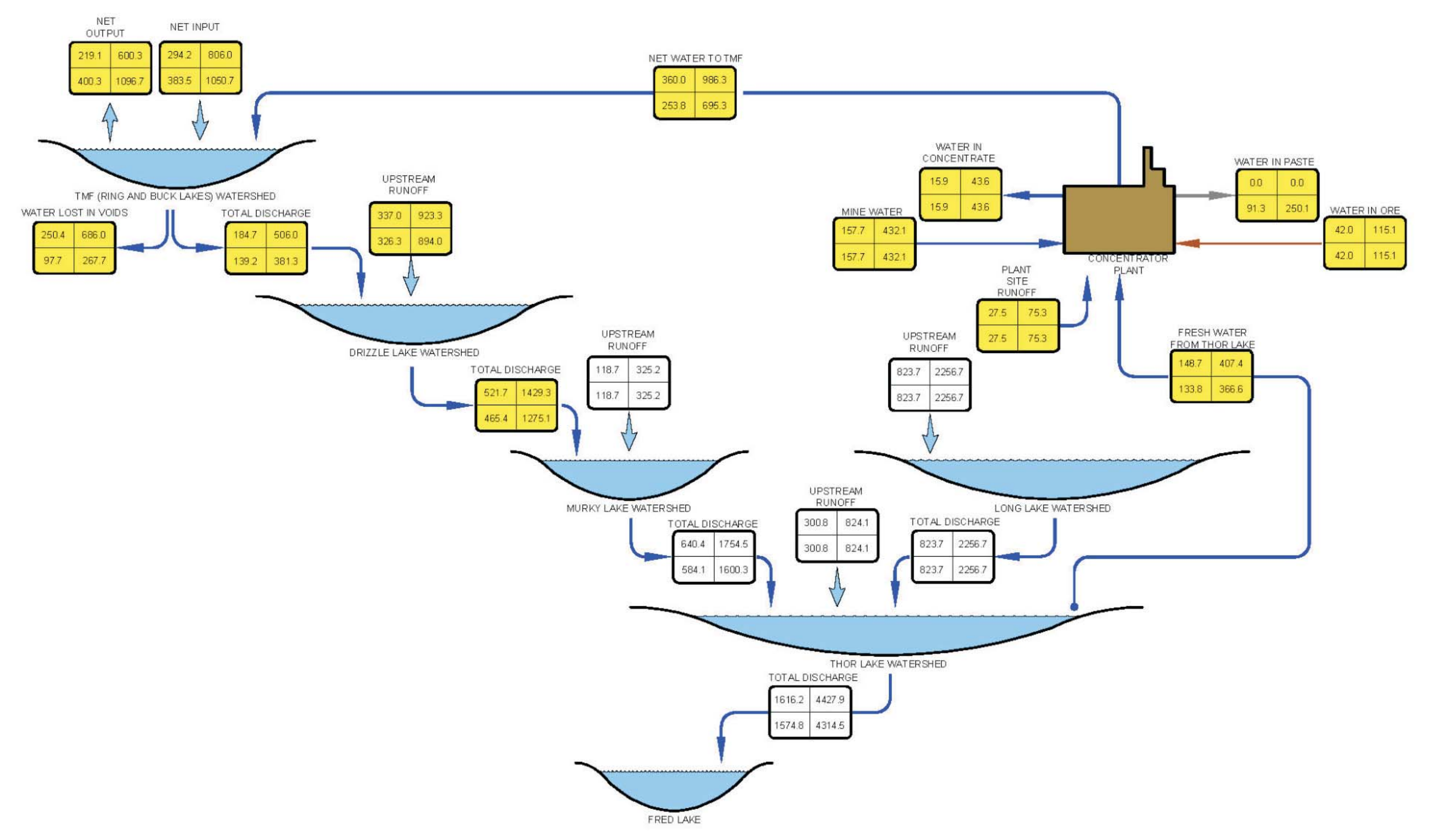

LEGEND:

	ANNUAL FLOW IN THOUSAND m³/yr	AVERAGE FLOW IN m³/day
Years 1 to 4	1616.2	4427.9
Years 5 to 20	1574.8	4314.5

NOTES

1. Estimates are for average precipitation conditions and do not include extreme precipitation events.
2. Highlighted values are taken from KPL Memo Cont. No. NB10-00596.
3. Upstream runoff to each lake includes direct precipitation and evaporation on the lake.
4. Figure Source: Knight Piesold Consulting, March 2011 (Ref No. NB11-00132, Figure 5).

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THOR LAKE PROJECT

Annual Watershed Flowsheet Mine Operations

PROJECT NO.	DWN	CKD	REV
V15101007.006	SL	RH	0
OFFICE	DATE		
EBA-VANC	April 5, 2011		

Figure 6.3-6

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