Appendix C.18

Thor Lake Project – Hydrometallurgical Site - Feasibility Study Water/Solids Balance Analysis Results. Report NB11-00130

Knight Piésold
CONSULTING

MEMORANDUM

To:	Mr. David Swisher	Date:	March 7, 2011
Copy To:	John Goode, Bill Mercer, Rick Hoos, Kevin Hawton, Cara Stapley	File No.:	NB101-390/2-A.01
From:	Michelle Liu	Cont. No.:	NB11-00130
Re:	Thor Lake Project – Hydrometallurgical Site - Feasibility Study Water/Solids Balance Analysis Results		

This memo supersedes the previous Hydrometallurgical Site - Feasibility Study Water/Solids Balance Analysis Results Memo (Cont. No. NB11-00024).

A Feasibility level water balance analysis has been completed for the Avalon Rare Metals Inc. (Avalon) Thor Lake Project to determine the Hydrometallurgical Tailings Facility (HTF) filling schedule and capacity (in the L-37 historic pit) and to model the water extraction volume (from the T-37 historic pit) and water infiltration volume (in the N-42 historic pit) from/to the Presqu'ile aquifer groundwater source. The main objectives of this water balance are as follows:

1. Provide an estimate of the volume of water pumped from the T-37 pit (groundwater source).
2. Provide an estimate of the volume of tailings and water reporting to the HTF in order to predict filling schedule for the L-37 pit and ensure that the capacity of the pit is adequate for containing all of the tailings solids and the maximum supernatant water pond under average climatic conditions as well as dry and wet (extreme) conditions, including the 1 in 25 year, 24 hour Environmental Design Storm (EDS) event.
3. Provide an estimate of the volume of water pumped from the L-37 pit to the N-42 pit for infiltration into the groundwater.

Monthly water balance analyses were completed for a projected 20-year mine life. A deterministic approach was taken using average precipitation conditions and a probabilistic approach was taken using a risk based/simulation analysis which forecasts a range of wet and dry (extreme) precipitation conditions as well as the 1 in 25 year 24-hour EDS.

This memo provides a summary of the analysis results, based on various design and process criteria. Included herein are a description of the site layout, the design constraints, the methodology for completing the water/solids balance analysis and a discussion of the results.

Site Layout and Water Management

The Hydrometallurgical Site and corresponding HTF are located approximately 75 km east of the town of Hay River, approximately 8 km north of the all-weather Territorial Highway 5 from the former town of Pine Point, as shown on Figure 1. The Hydrometallurgical Site is located within the Great Slave Lowlands Mid-Boreal Ecoregion. Background information on site meteorological characteristics has been previously summarized in the memo "Meteorological Data for Thor Lake Project - Pine Point Site - Updated" (KPL Cont. No. NB10-00641). Regional watershed boundaries have been estimated based on available topography and previous work (Stevenson, 1984), as shown on Figure 1.

The general project site layout and location is shown on Figure 2. The tailings stream from the Hydrometallurgical Plant sent to the HTF will be in slurry form at a solids content by weight or pulp density of 40%. The HTF is proposed to be located within an historic open pit (L-37 pit). It is proposed

that excess supernatant water accumulation within the pit be pumped to another historic pit (N-42 pit) for infiltration into the Presqu'ile aquifer.

The water balance flowsheet is provided on Figure 3. The flowsheet depicts the water management arrangement/model proposed for the Hydrometallurgical Site and the estimated annual volumes of water that will flow between the various facilities and historic open pits based on average precipitation conditions.

Design Criteria

The design basis and process criteria used for the water/solids balance are based on the available information and operational requirements confirmed with Avalon. The background information and basis of developing the design parameters are summarized in the memo "Thor Lake Project – Hydrometallurgical Site – Updated Tailings & Water Management Design Basis for Feasibility Study" (KPL Cont. No. NB11-00102). Criteria/assumptions are summarized below:

- An assumed conservative seepage rate from the HTF- 1,825 m^3/year (5 m^3/day)
- The amount of Water in Concentrate from the Thor Lake Flotation Plant is 43.6 m3/day based on the flowsheet produced for the Thor Lake Site water balance (KPL Memo NB11-00100)
- The amount of water in Secondary Concentrate from Hydrometallurgical Plant is 0.136 t per 1 t of concentrate, based on an email from John Goode (dated December 1, 2010)
- Assumed that all excess supernatant water volume pumped to the infiltration pit (N-42) will infiltrate into the groundwater at the same rate and will not cause the groundwater level in the pit to rise.
- It is assumed runoff from the Hydrometallurgical Site will be collected and routed to a settling pond for use in the Plant and discharge to the HTF.
- The estimated maximum ice thickness used in the water/solids balance model is 1.0 m based on experience at the Project site and recent baseline investigations by Stantec.

It should be noted that the design criteria are subject to change as more information about the Project site, acid-bake process or tailings characteristics becomes available.

Water Management Constraints

Various water management constraints have been incorporated into the water/solids balance model. The constraints include minimum and maximum water pond storage capacities which determine the amount of water that will be stored within the system and pumped to the N-42 pit for infiltration. In addition, storm surcharge storage has been established. The various constraints are summarized as follows:

- Minimum Pond Volume - This is the minimum supernatant pond volume in the HTF. There will be no water pumped from the HTF if the volume is equal to or less than this amount.
    - The HTF Minimum Pond Volume is 80,000 m^3, which will provide the equivalent of 2 weeks of retention time (2,084,000 m^3 / 52) * 2 = 80,154 m^3 (~80,000 m^3), based on the process flow, and no reclaim from the HTF.

- Maximum Pond Volume - This is the maximum operating supernatant pond volume in the HTF. Excess water above this volume will be pumped to the N-42 pit for infiltration.
    - The Maximum Operating Supernatant HTF Volume is 340,000 m^3. This volume has been selected to correspond to 1.5 months (6 weeks) of process flows in excess of the Minimum Required Volume, (2,084,000 m^3 / 8) + 80,154 m^3 = 340,654 m^3 (~340,000 m^3).

- Environmental Design Storm (EDS) - This is the amount of storage, above the Maximum Operating Supernatant Pond Volume, required to contain the proposed 1 in 25 year 24-hour storm event of 37 mm. The modelling was completed to ensure that the HTF will provide storage capacity for both the Maximum Operating Supernatant Pond Volume and the EDS, in addition to the 2 m of freeboard recommended to accommodate the inflow design flood and wave run-up.

Methodology

The water balance analysis was completed using a spreadsheet approach, and was developed for a three month 'ramp-up' period (October 1 – December 31) followed by the projected 20 year mine life. The water balance model estimates the water surplus/deficit for the HTF on a monthly basis, using various inputs including catchment areas, runoff coefficients, and precipitation, snowmelt and evaporation data. The volume of water reporting to the HTF is calculated on a monthly basis by adding the total inputs and outputs (losses).

Snowpack and ice melt parameters for the model were estimated such that the accumulated snow and ice up to the months of March, April and May is assumed to melt at a rate of 15 percent in March, 70 percent in April and 15 percent in May, meaning that 100 percent of the accumulated snow and ice will be melted by the end of May.

The local catchment areas for the open pits incorporated into the water balance were determined to be just slightly larger than the pits themselves. The selection of runoff coefficients was based on the results described in the "Discharge and Runoff" section of the Hydrological Data Review Memo (KP Cont. No. NB09-00546). The runoff coefficients for the tailings active and dry beaches have been determined based on past experience with similar tailings disposal facilities and on consideration for sublimation of falling snow based on work done for the Mackenzie River Basin (Burford, 1998).

The water balance spreadsheet model also incorporates elevation versus storage capacity data for the HTF and Infiltration Pond derived from the topography of the site. The elevation versus capacity relationship allows the filling schedule for the HTF to be estimated over the mine life.

Two different precipitation conditions were analysed as follows:

1. Average precipitation and evaporation conditions
2. Dry/wet (extreme) precipitation conditions

Average precipitation and evaporation conditions were analysed using deterministic analysis and dry/wet precipitation conditions were analysed using probabilistic analysis, as described below.

Deterministic Analysis

The deterministic analysis was completed using average precipitation and evaporation data, as well as average estimated snowmelt data to estimate the expected water reporting to the HTF and Infiltration pit over the course of the mine life.

Simulation or Risk Based Analysis

A simulation or risk based approach was applied to the water balance to estimate the potential climatic variability (wet/dry conditions). This analysis used synthetic total monthly precipitation data generated randomly from statistical parameters based on the historic precipitation data. Probable precipitation for

each month was modelled as truncated distributions. The distributions were truncated on their lower tail at zero since it is not possible to have negative precipitation. Upon analysis of the highly variable rainfall data, four best fit distribution types were chosen to use in the simulation: the Normal and the Logistic, Expon and Loglogistic distributions. Best fit distribution functions were selected accordingly for each month.

The modelling utilized the Microsoft Excel add-on program @RISK, which permits cell inputs to be modelled as the chosen distributions rather than as single values. The @RISK program has the capability to perform Monte Carlo type simulations and track the various outputs that result from variations in the input. This allows for a prediction of how the water availability and discharge may vary over a certain period of time under a range of possible climatic conditions. The model was run for 10,000 iterations, such that 10,000 different sequences of monthly precipitation over the mine life were considered.

Selected outputs from the water balance model are presented as a range including the 5th percentile, mean and 95th percentile results. The 5th percentile volume is statistically the lowest volume of water anticipated with a 5 percent chance of the volume being below this level (extreme dry case). The 95th percentile volume is statistically the highest volume of water anticipated with a 5 percent chance of the volume exceeding this level (extreme wet case).

Results

The results of the deterministic and probabilistic (risk-based) water/solids balance analyses are provided on Figures 3 through 6 and are summarized as follows:

- Figure 3 shows the average results from the water balance analyses on a flowsheet.
- Figure 4 shows the tailings, ice and water estimated elevation and the HTF maximum elevation (Top of L-37 pit).
- Figure 5 shows the total volume of water withdrawn from T-37 pit.
- Figure 6 shows the volume of water pumped from HTF (L-37) to the infiltration pit (N-42).

Figures 7 and 8 show the HTF (L-37 pit) as it is projected to look in Years 2 and 20 (ultimate), respectively. The proposed water management concept for the HTF is shown on Figures 7 and 8. The excess water transferred from the HTF to the infiltration pit (N-42) will be pumped from the supernatant pond via a water reclaim barge.

Conclusions/Recommendations

The proposed historic open pit that will be used as the HTF will provide adequate storage for tailings solids and the maximum supernatant pond volume over the mine life. The impact of drawing water from the T-37 historic pit (Presqu'ile aquifer) is expected to have little impact on the local and regional groundwater regime, which will be verified upon completion of a groundwater model of the Pine Point area, to be provided under separate cover. The water pumped to the N-42 pit for infiltration is expected to infiltrate into the aquifer at the same rate at which it is pumped, which will also be confirmed by the groundwater model.

We trust that this memo provides you with the information that you require at this time. Should you have any questions or comments, please feel free to contact us.

Signed: Michelle Liu, E.I.T
Civil Engineering

Approved: Kevin Hawton, P.Eng.
Senior Engineer

References:

1) Buford, J. And Stewart, R., "The Sublimation of Falling Snow Over the Mackenzie River Basin", York University, July 1998.
2) Stevenson International Groundwater Consultants Ltd., Report, March 1984.

Attachments:

Figure 1 Rev 0 Hydrometallurgical Site Location and Estimated Regional Watershed Plan
Figure 2 Rev 0 General Hydrometallurgical Site Layout
Figure 3 Rev 0 Flowsheet
Figure 4 Rev 0 HTF Water and Maximum Elevation
Figure 5 Rev 0 Total Volume of Water Withdrawn From T-37 Pit
Figure 6 Rev 0 Volume of Water Pumped From HTF (L-37) To Infiltration Pond (N-42) Pit
Figure 7 Rev 0 Hydrometallurgical Tailings Facility – L37 Pit – Year 2
Figure 8 Rev 0 Hydrometallurgical Tailings Facility – L37 Pit – Year 20 (Ultimate)

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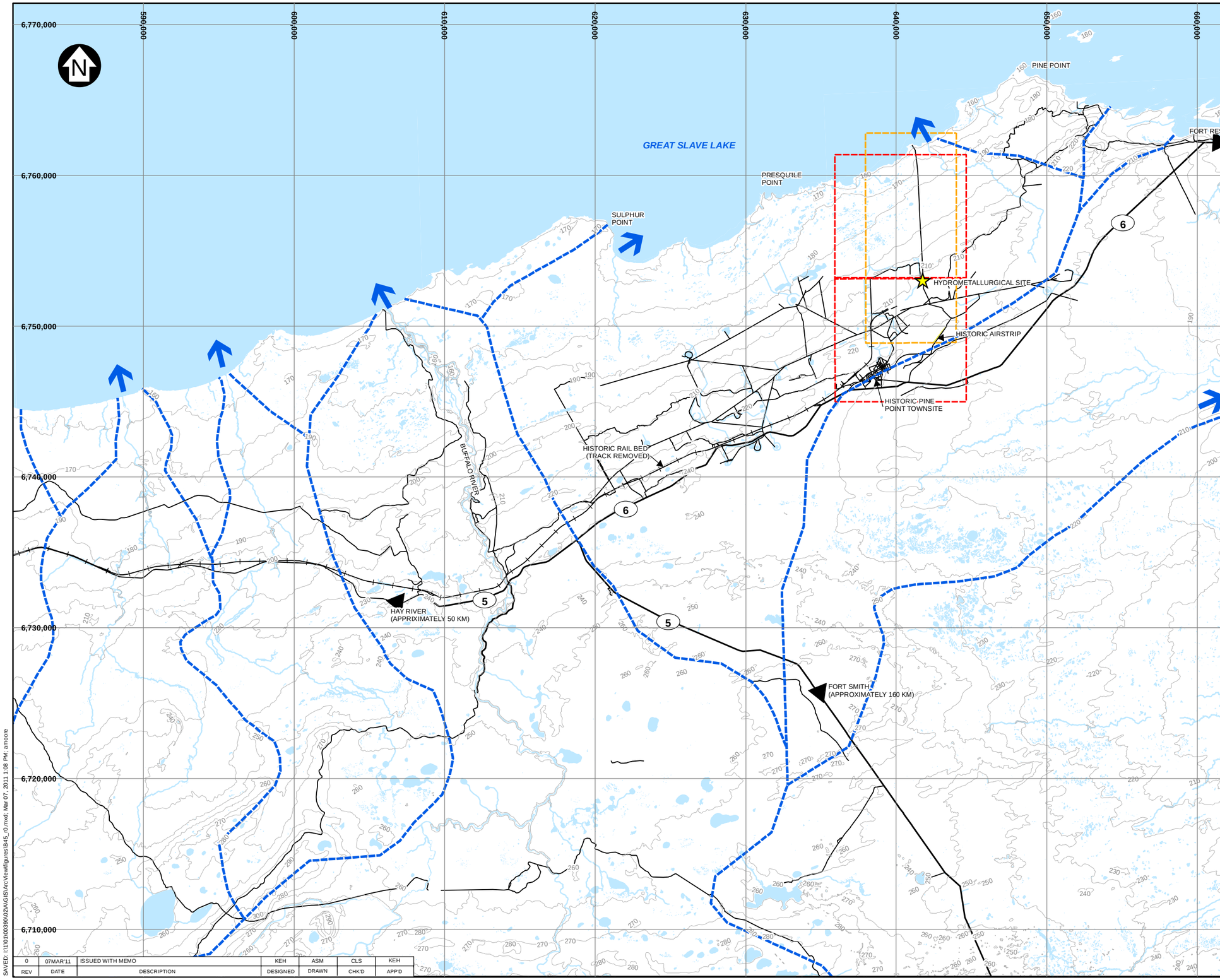

LEGEND:

- HYDROMETALLURGICAL SITE
- TERRITORIAL HIGHWAY
- ROAD
- RAIL BED (TRACK REMOVED)
- CONTOUR
- RIVER/STREAM/DRAINAGE
- WATER
- WETLAND
- TAILINGS AREA
- EXTENT OF IMAGERY
- EXTENT OF DETAILED TOPOGRAPHY
- WATERSHED

LEGEND:

1. BASE MAP 1:50,000 © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA DEPARTMENT OF NATURAL RESOURCES (2009.) ALL RIGHTS RESERVED.
2. CO-ORDINATE GRID IS IN METRES.
   DATUM: NAD83
   PROJECTION: UTM ZONE 11 N
3. CONTOUR INTERVAL IS 10 METRES.
4. WATERSHED BOUNDARIES HAVE BEEN ADOPTED BASED ON MARCH 1984 REPORT BY STEVENSON INTERNATIONAL GROUNDWATER CONSULTANTS LTD. INTERPRETIVE REFINEMENTS WERE MADE BASED ON AVAILABLE TOPOGRAPHIC DATA SHOWN.

SCALE 2 1 0 2 4 6 8 10 km

AVALON RARE METALS INC.

THOR LAKE PROJECT

FEASIBILITY WATER/SOLIDS BALANCE HYDROMETALLURGICAL SITE LOCATION AND ESTIMATED REGIONAL WATERSHED PLAN

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P/A NO.	REF NO.
NB101-390/2	NB11-00130

FIGURE 1 REV 0

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	07MAR'11	ISSUED WITH MEMO	KEH	ASM	CLS	KEH

SAVED: I:\1\01\00390\02\A\GIS\Arc\View\figures\B45_r0.mxd; Mar 07, 2011 1:08 PM; amoore

PLAN
SCALE A

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	07MAR'11	ISSUED WITH MEMO	CLS	SIR	CLS	KEH

LEGEND:

- HISTORIC TAILINGS
- PROPOSED WATER PONDS
- PROPOSED HYDROMETALLURGICAL TAILINGS
- PROPOSED ACCESS ROAD
- HYDRO POWER SUPPLY
- PROPOSED TAILINGS PIPELINE PIPELINE
- PROPOSED WATER SUPPLY PIPELINE
- PROPOSED EXCESS WATER DISCHARGE PIPELINE

NOTES:

1. COORDINATE GRID IS UTM NAD83 ZONE 11N.
2. IMAGE PROVIDED BY AVALON METALS INC.

SCALE A: 600 300 0 1000 2000 3000 m

AVALON RARE METALS INC.

THOR LAKE PROJECT

FEASIBILITY WATER / SOLIDS BALANCE
GENERAL HYDROMETALLURGICAL SITE LAYOUT

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB101-390/2	NB11-00130

FIGURE 2 REV 0

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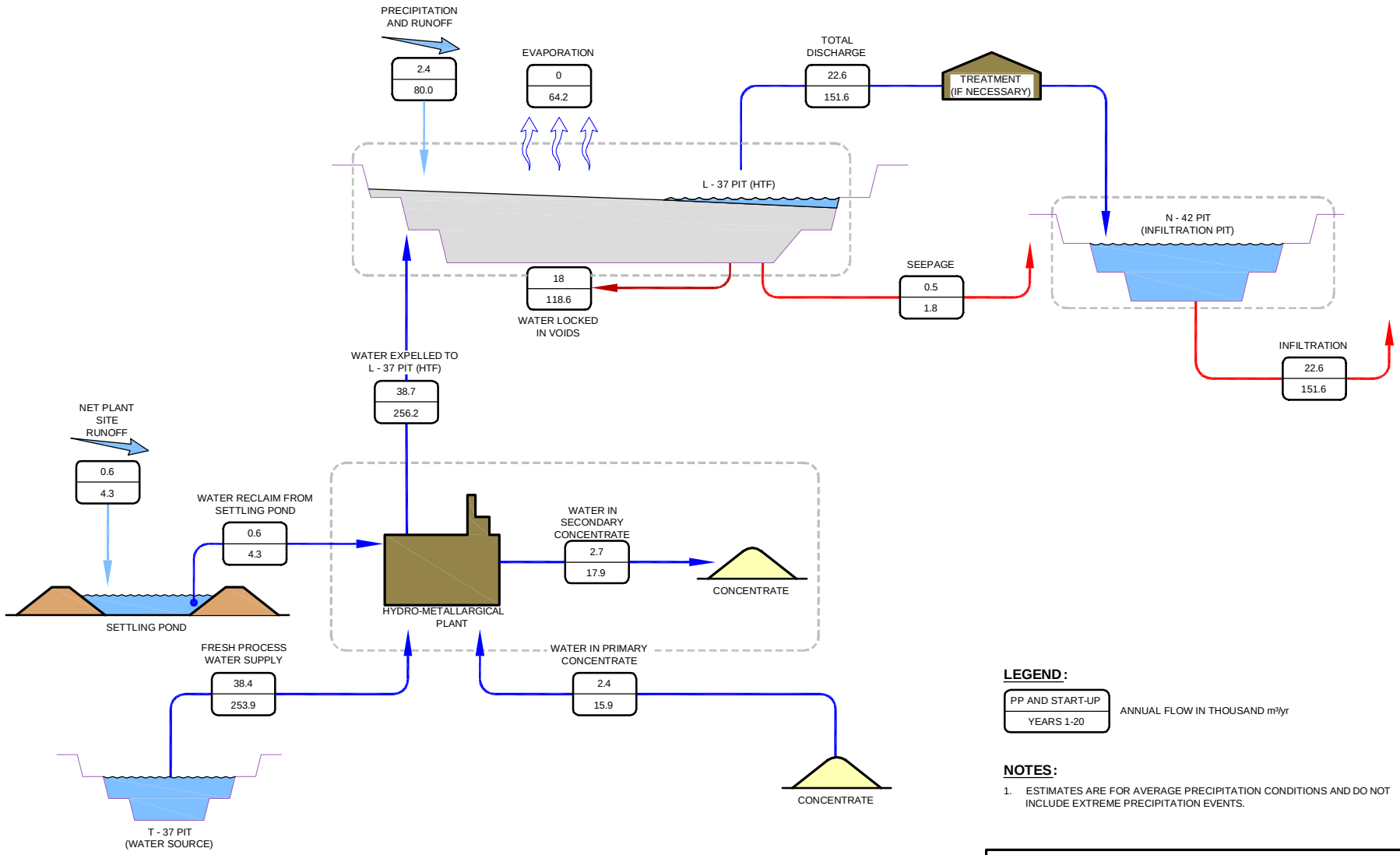

LEGEND:

PP AND START-UP
YEARS 1-20

ANNUAL FLOW IN THOUSAND m³/yr

NOTES:

1. ESTIMATES ARE FOR AVERAGE PRECIPITATION CONDITIONS AND DO NOT INCLUDE EXTREME PRECIPITATION EVENTS.

REV	DATE	DESCRIPTION	PREPARED	DRAWN	CHK'D	APP'D
0	07MAR'11	ISSUED WITH MEMO	CLS	ML	CLS	KEH

AVALON RARE METALS INC.

THOR LAKE PROJECT

FEASIBILITY WATER / SOLIDS BALANCE FLOWSHEET

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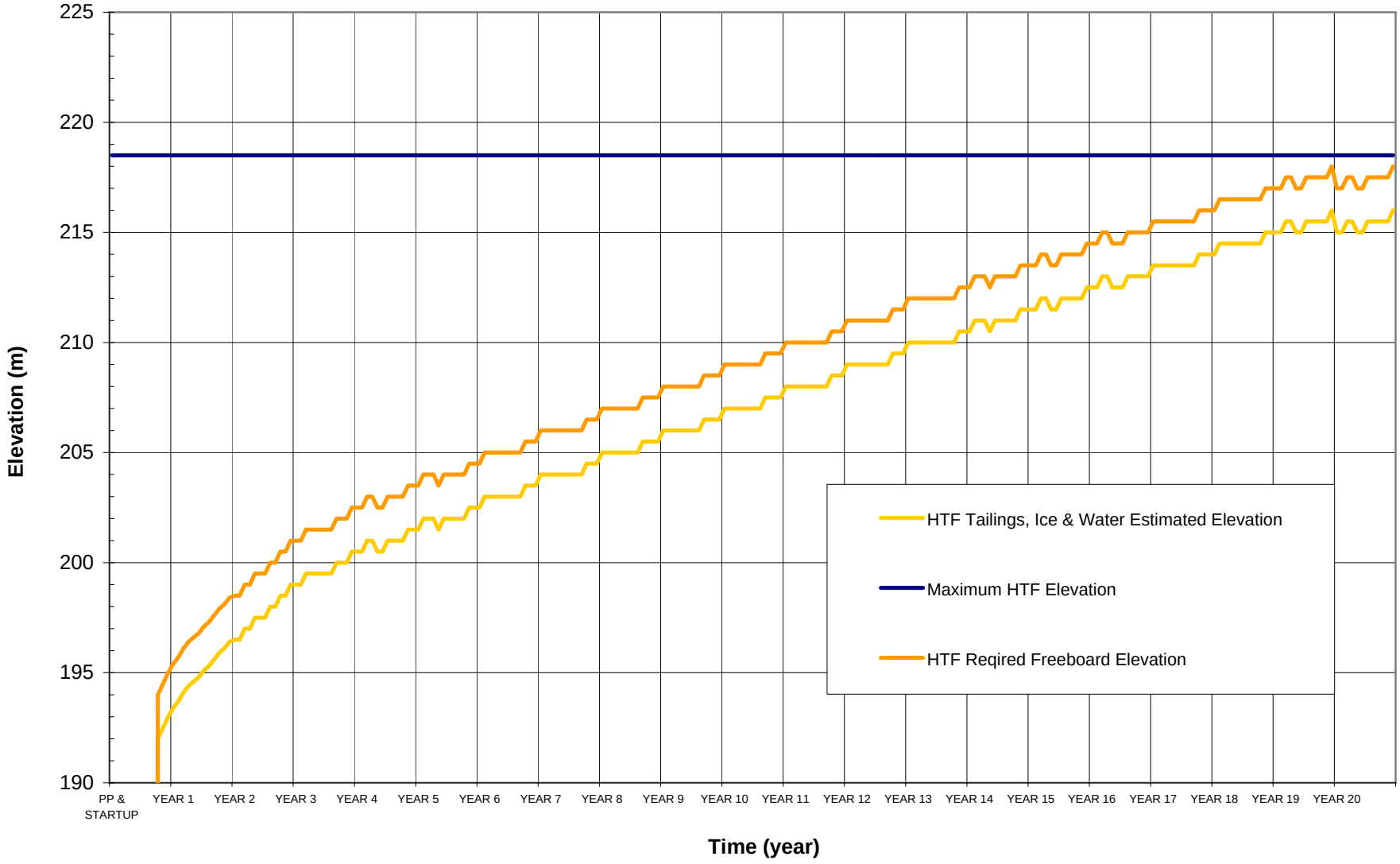
P/A NO.	REF NO.
NB101-390/2	NB11-00130

FIGURE 3 REV 0



NOTES:

1. THE MINE LIFE IS PROJECTED TO BE 20 YEARS IN LENGTH.

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0	07MAR'11	ISSUED WITH MEMO	ML	CLS	KEH

AVALON RARE METALS INC.

THOR LAKE PROJECT

FEASIBILITY WATER/SOLIDS BALANCE
HTF WATER AND MAXIMUM ELEVATION

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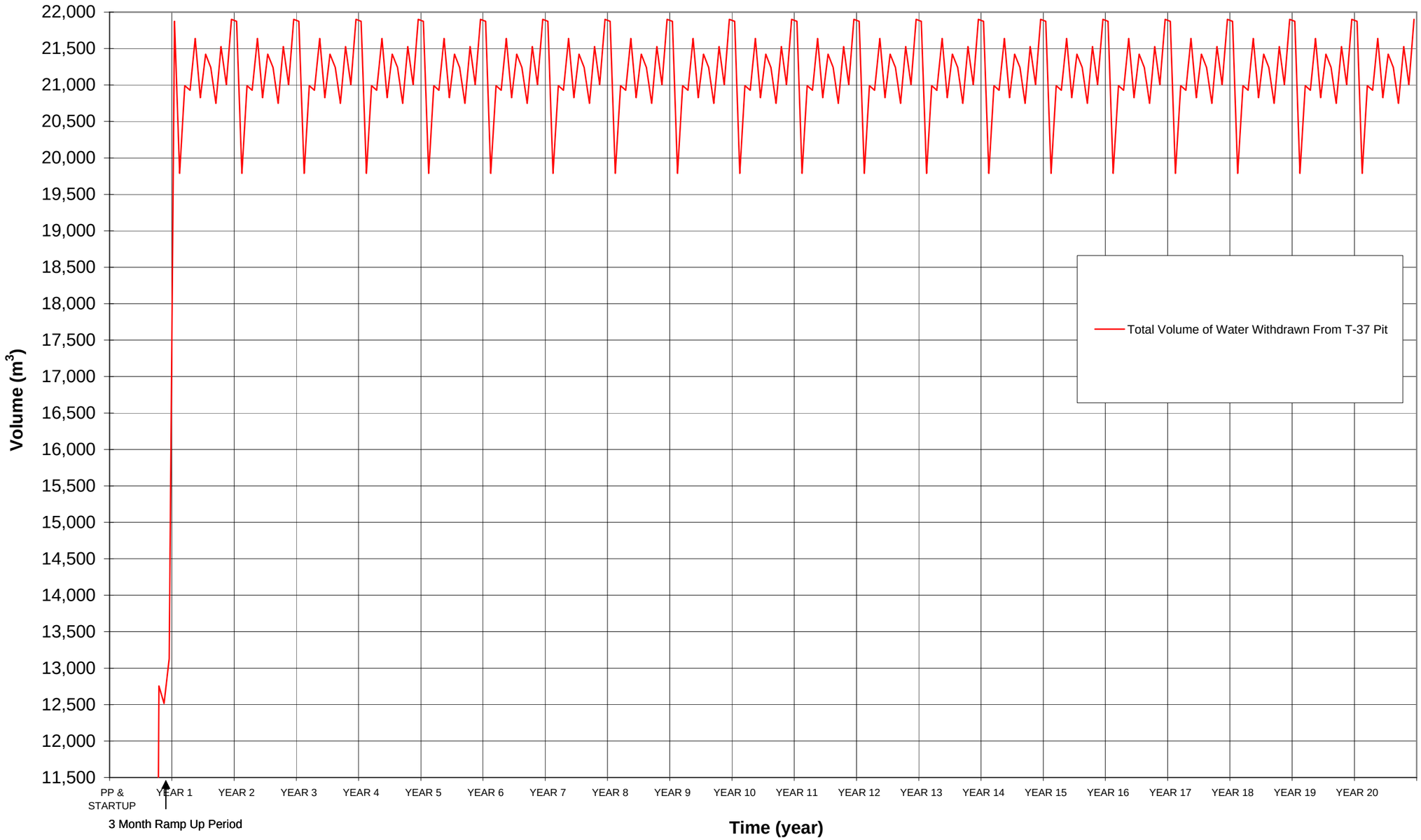
P/A NO. NB101-390/2

REF. NO. NB11-00130

FIGURE 4

REV 0



NOTES:

1. THE MINE LIFE IS PROJECTED TO BE 20 YEARS IN LENGTH.

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AVALON RARE METALS INC.

THOR LAKE PROJECT

FEASIBILITY WATER/SOLIDS BALANCE
TOTAL VOLUME OF WATER WITHDRAWN FROM T-37 PIT

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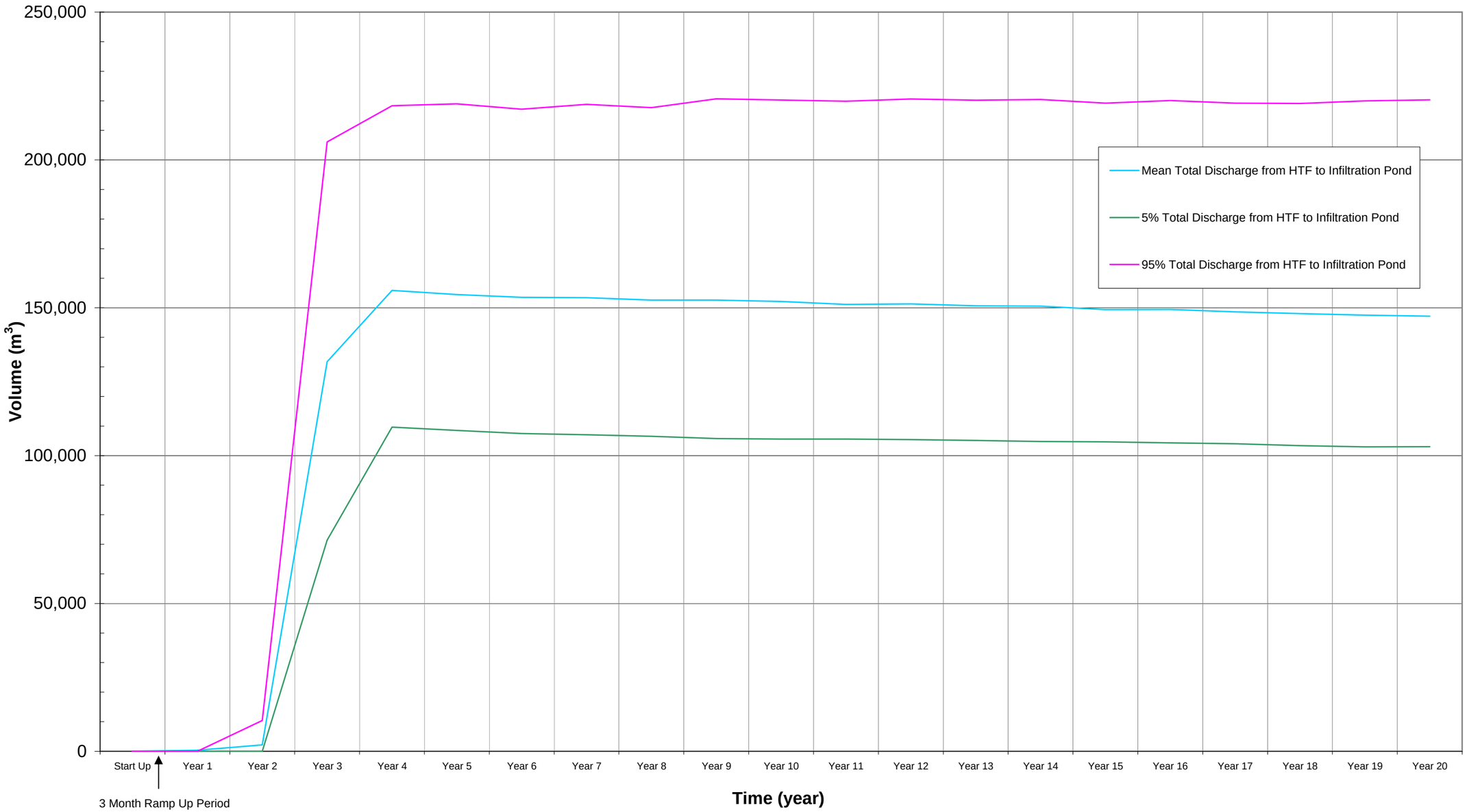
P/A NO. NB101-390/2

REF. NO. NB11-00130

FIGURE 5

REV 0



NOTES:
1. THE MINE LIFE IS PROJECTED TO BE 20 YEARS IN LENGTH.

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	07MAR'11	ISSUED WITH MEMO	ML	CLS	KEH

AVALON RARE METALS INC.

THOR LAKE PROJECT

FEASIBILITY WATER/SOLIDS BALANCE
VOLUME OF WATER PUMPED FROM HTF (L-37) TO INFILTRATION POND (N-42) PIT

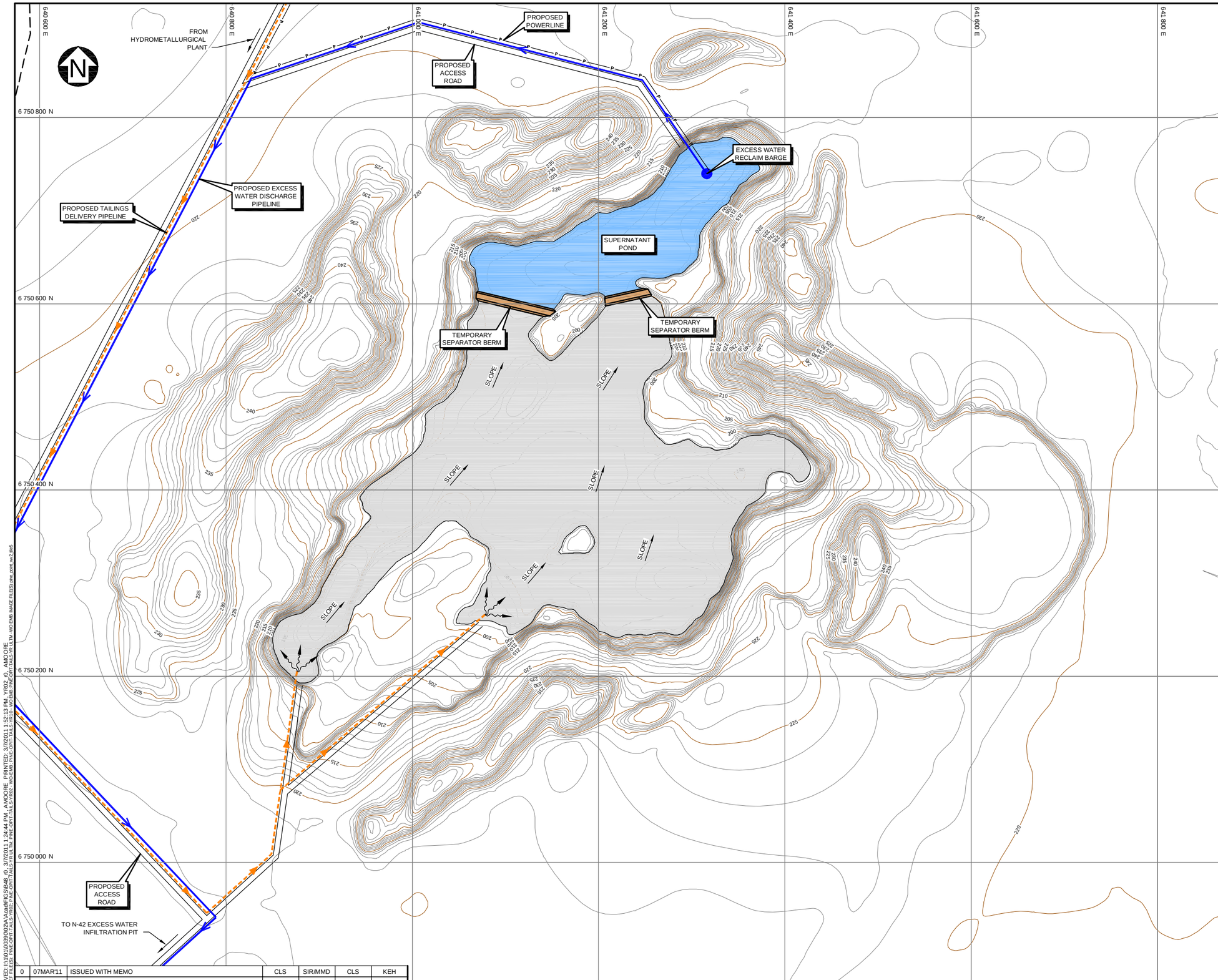
Knight Piésold CONSULTING

P/A NO. NB101-390/2

REF. NO. NB11-00130

FIGURE 6

REV 0



REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	07MAR'11	ISSUED WITH MEMO	CLS	SIR/MMD	CLS	KEH

LEGEND:

- WATER
- TAILINGS
- SEPARATOR BERM
- PROPOSED ACCESS ROAD
- PROPOSED TAILINGS DELIVERY PIPELINE
- PROPOSED TAILINGS DEPOSITION LOCATION
- PROPOSED RECYCLED WATER PIPELINE
- PROPOSED POWERLINE

NOTES:

1. COORDINATE GRID IS UTM (NAD83) ZONE 11N AND IS METRES.
2. PLAN BASED ON INFORMATION PROVIDED BY AVALON RARE METALS INC., DATED NOVEMBER 1, 2010.
3. CONTOURS ARE IN METRES. CONTOUR INTERVAL IS 1 METRE.
4. TAILINGS CONFIGURATION SHOWN REPRESENTS ESTIMATED LAYOUT FOR END OF YEAR 2 OPERATIONS.

SCALE A 40 20 0 40 80 120 160 200 m

AVALON RARE METALS INC.

THOR LAKE PROJECT

FEASIBILITY WATER/SOLIDS BALANCE
HYDROMETALLURGICAL TAILINGS FACILITY
L37 PIT - YEAR 2

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB101-390/2	NB11-00130

FIGURE 7 REV 0

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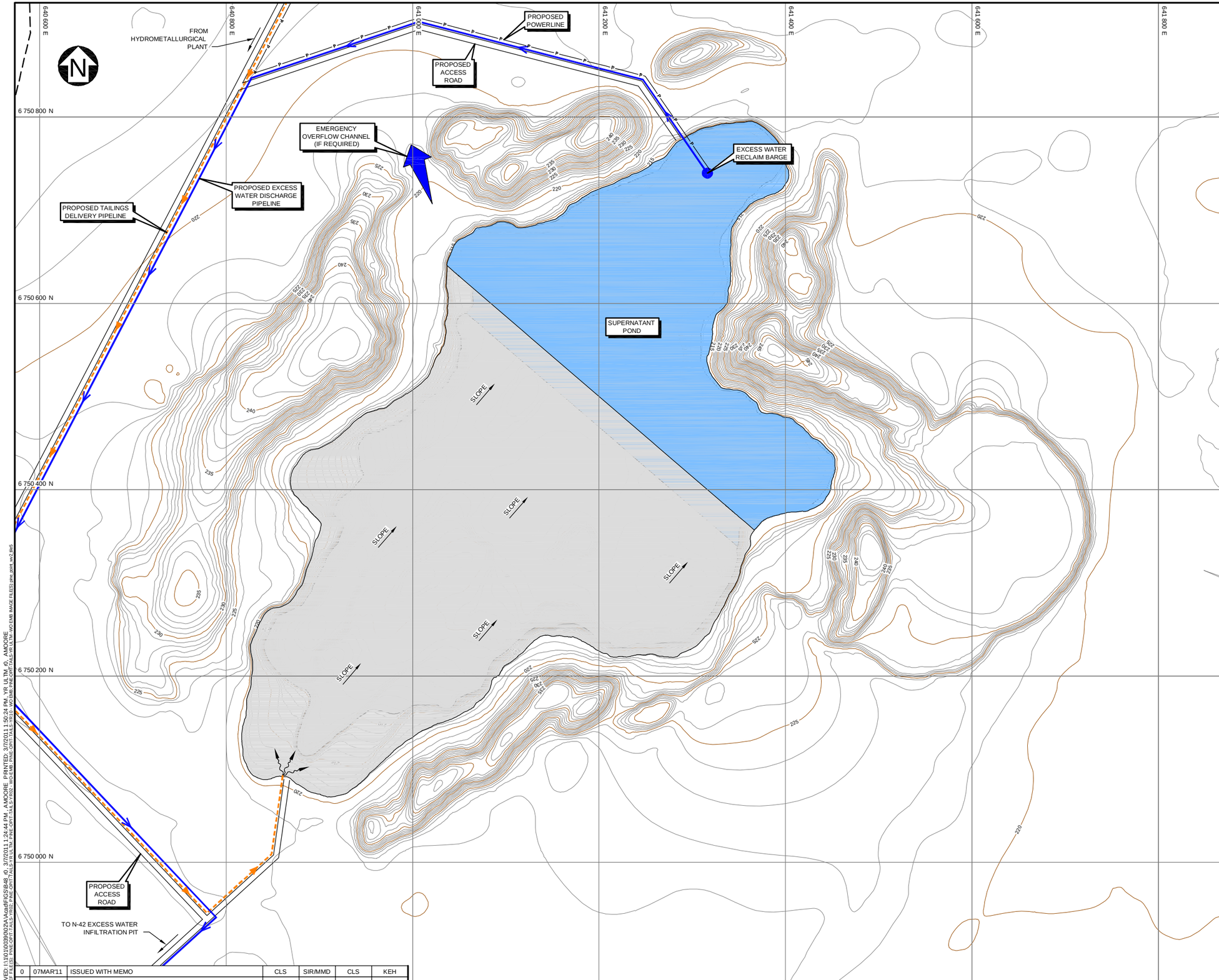

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
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LEGEND:

- WATER
- TAILINGS
- PROPOSED ACCESS ROAD
- PROPOSED TAILINGS DELIVERY PIPELINE
- PROPOSED TAILINGS DEPOSITION LOCATION
- PROPOSED RECYCLED WATER PIPELINE
- PROPOSED POWERLINE
- PROPOSED EMERGENCY OVERFLOW CHANNEL

NOTES:

1. COORDINATE GRID IS UTM (NAD83) ZONE 11N AND IS METRES.
2. PLAN BASED ON INFORMATION PROVIDED BY AVALON RARE METALS INC., DATED NOVEMBER 1, 2010.
3. CONTOURS ARE IN METRES. CONTOUR INTERVAL IS 1 METRE.
4. TAILINGS CONFIGURATION SHOWN REPRESENTS ESTIMATED LAYOUT FOR END OF YEAR 20 OPERATIONS.

SCALE A 40 20 0 40 80 120 160 200 m

AVALON RARE METALS INC.

THOR LAKE PROJECT

FEASIBILITY WATER/SOLIDS BALANCE HYDROMETALLURGICAL TAILINGS FACILITY L37 PIT - YEAR 20 (ULTIMATE)

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB101-390/2	NB11-00130

FIGURE 8 REV 0

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Appendix C.19

Thor Lake Project - Hydrometallurgical Site - Updated Tailings & Water Management Design Basis for Feasibility Study. Report NB11-00102

Knight Piésold
CONSULTING

MEMORANDUM

To:	David Swisher	Date:	February 23, 2011
Copy To:	John Goode, Bill Mercer, Kevin Hawton, Matt Parfitt	File No.:	NB101-390/2-A.01
From:	Cara Stapley	Cont. No.:	NB11-00102
Re:	Thor Lake Project - Hydrometallurgical Site - Updated Tailings & Water Management Design Basis for Feasibility Study		

The design basis for the tailings and water management for the Hydrometallurgical Site (at Pine Point) will be based on the updated process flow information provided by Avalon and summarized herein. This information has been updated to reflect the new design process (acid bake), as indicated by Avalon. Estimated tailings properties and water management design values that are proposed for the Feasibility Study design of the Hydrometallurgical Tailings Facility (HTF) for this site are also included. This memorandum supersedes Memo NB10-00643, issued on December 1, 2010.

Meteorological Data

The updated meteorological data for the Pine Point area have been summarized in Memo NB10-00641, issued on December 1, 2010. This data supersedes data previously issued in Memo NB10-00123 (March 18, 2010) for the Pre-Feasibility Study.

Process Criteria

The tailings stream from the Hydrometallurgical Plant sent to the HTF will be in slurry form at a solids content by weight or pulp density of 40% (email from John Goode dated Thursday, February 10, 2011). The HTF is proposed to be located within an historic open pit (L-37 pit) and it is proposed that excess water accumulation within the pit be pumped to a nearby pit (N-42 pit) for discharge and infiltration within the Presqu'ile aquifer, as required. The use of these historic pits is described in Memo NB11-00008, issued on January 6, 2011.

1. The annual throughput of tailings from the Hydrometallurgical Plant will be 170,820 tonnes based on a concentrate production rate of 131,400 tpa (360 tpd), and a 1.3:1 ratio of tailings to concentrate (as described in an email by John Goode dated Wednesday, February 9, 2011).
2. Should the concentrate production rate increase Year 5, it is expected that the throughput from the Hydrometallurgical Plant will increase proportionately.

A mining and process flow summary, by production year for Hydrometallurgical tailings which corresponds to the predicted mining rates is provided on Table 1. Currently it has been assumed that there will be no reclaim of water from the HTF back to the Hydrometallurgical Plant.

Tailings Properties

There is currently no direct information available concerning the physical characteristics of the Hydrometallurgical tailings stream. Therefore it is necessary to make some assumptions regarding the physical characteristics of the tailings. Tailings properties to be used for the Feasibility Study design will be as follows:

1. The tailings solids from the proposed milling process will predominantly be gypsum (approx. 85%) with some leach residue (approx. 6%) and miscellaneous other solids (approx. 9%) and are expected to be similar to phosphogypsum tailings in terms of void ratio, dry densities and consolidation properties (confirmed in email from John Goode dated Thursday, February 17, 2011 and in previous emails on March 5, 2010 and November 16 and 28, 2010).

2. The specific gravity for tailings solids is estimated to be 2.40 based on a high gypsum content (Vick, 1990).
3. Given a final solids content or pulp density of approximately 65% by weight (email from John Goode dated Friday, March 5, 2010) and a void ratio of 1.3 (Vick, 1990) the calculated final average settled dry density for phosphogypsum tailings is 1.05 t/m^3. A slightly lower or conservative density value of 0.9 t/m^3 has been selected for HTF design until testwork on tailings samples has been completed.
4. Tailings discharge will generally be from end of pipe rather than by spigots due to the cold operating temperatures.
5. Tailings beach slopes are estimated to be approximately 1%.
6. Tailings will be inert due to treatment, as required, prior to discharge from the Hydrometallurgical Plant.

HTF and Excess Water Infiltration Pit - Capacity and Freeboard Requirements

The required capacity in the HTF will be a function of solids storage requirements and water management design assumptions. The following summarizes preliminary values to be used for the Feasibility Study design:

1. Tailings solids storage requirement will be based on the aforementioned tailings properties and subsequent estimated annual volume, as indicated on Table 1.
2. The Minimum Supernatant Pond Volume will be based on 2 weeks of retention time or 2,084,000 m^3 / 52) * 2 = 80,154 m^3 (~80,000 m^3).
3. The Maximum Operating Supernatant Pond Volume has been selected to correspond to 1.5 months (6 weeks) of process flows in excess of the Minimum Required Pond Volume, i.e. (2,084,000 m^3 / 8) + 80,154 m^3 = 340,654 m^3 (~340,000 m^3). This volume will be used to determine the Normal Maximum Operating Water Level in the HTF.
4. Design Storm storage in the HTF will be equivalent to a 1 in 25 year 24 hour storm. This will ensure that no effluent water is released from the pit unless a storm with greater magnitude than the 1 in 25 year event occurs.
5. The maximum storage capacity of the Excess Water Infiltration Pit (N-42 pit) is dependent on the total volume of the pit, less the freeboard. The maximum storage capacity of the pit is estimated to be at least 2,000,000 m^3.
6. For both the HTF and the Excess Water Infiltration Pit, a minimum of 2 m of freeboard will be incorporated into the design, to accommodate storm events and wave run-up.

We trust this provides you with the information you require at this time. If you have any questions or comments, please do not hesitate to contact us.

Signed: _____ Approved: _____

Cara Stapley, E.I.T.
Geological Engineering

Kevin Hawton, P.Eng.
Senior Engineer

Attachments:
Table 1 Rev 0 Updated Hydrometallurgical Plant Tailings Process Rate Summary

References:
1. Vick, S.G., 1990. Planning, Design, and Analysis of Tailings Dams. BiTech Publishers Ltd., Vancouver, B.C.

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TABLE 1

AVALON RARE METALS INC.
THOR LAKE PROJECT

HYDROMETALLURGICAL SITE - UPDATED TAILINGS & WATER MANAGEMENT DESIGN BASIS FOR FEASIBILITY STUDY
UPDATED HYDROMETALLURGICAL PLANT TAILINGS PROCESS RATE SUMMARY

Print Feb/23/11 13:36:52

ASSUMPTIONS					
Slurry Percent Solids	40.0%	Recycle Rate:	0%	Density (t/m^3):	0.9

Year	Tailings tpa[1]	Process Water m^3/yr	Recycle m^3/yr	Fresh Water m^3/yr	Cumulative Tailings (t)	Cumulative Volume (m^3)
1	153,738	230,607	-	230,607	153,738	170,820
2	170,820	256,230	-	256,230	324,558	360,620
3	170,820	256,230	-	256,230	495,378	550,420
4	170,820	256,230	-	256,230	666,198	740,220
5	170,820	256,230	-	256,230	837,018	930,020
6	170,820	256,230	-	256,230	1,007,838	1,119,820
7	170,820	256,230	-	256,230	1,178,658	1,309,620
8	170,820	256,230	-	256,230	1,349,478	1,499,420
9	170,820	256,230	-	256,230	1,520,298	1,689,220
10	170,820	256,230	-	256,230	1,691,118	1,879,020
11	170,820	256,230	-	256,230	1,861,938	2,068,820
12	170,820	256,230	-	256,230	2,032,758	2,258,620
13	170,820	256,230	-	256,230	2,203,578	2,448,420
14	170,820	256,230	-	256,230	2,374,398	2,638,220
15	170,820	256,230	-	256,230	2,545,218	2,828,020
16	170,820	256,230	-	256,230	2,716,038	3,017,820
17	170,820	256,230	-	256,230	2,886,858	3,207,620
18	170,820	256,230	-	256,230	3,057,678	3,397,420
19	170,820	256,230	-	256,230	3,228,498	3,587,220
20	170,820	256,230	-	256,230	3,399,318	3,777,020

I:\1\01\00390\02\A\Correspondence\NB11-00102 - New Pine Point Design Basis\Table 1.xls

NOTES:

1. tpa = TONNES PER ANNUM OR YEAR (DRY).

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Appendix C.20

Thor Lake Project - Hydrometallurgical Site - L-37 Pit Tailings Management Design Summary. Report NB11-00115

Knight Piésold
CONSULTING

MEMORANDUM

To:	Mr. David Swisher	Date:	March 25, 2011
Copy To:	Bill Mercer, Kevin Hawton	File No.:	NB101-390/2-A.01
From:	Cara Stapley	Cont. No.:	NB11-00115
Re:	Thor Lake Project - Hydrometallurgical Site - L-37 Pit Tailings Management Design Summary		

The proposed Thor Lake Project Hydrometallurgical Site is located near the historic mining town of Pine Point, Northwest Territories, on the south shore of Great Slave Lake, as shown on Figure 1. Concentrate from the Thor Lake Mine site will be processed at the Hydrometallurgical Plant, using an acid-bake method, to form a secondary concentrate suitable for distribution.

Fresh water to be used in the Hydrometallurgical Plant is proposed to be taken from the T-37 historic open pit where the water table associated with the Presqu'ile groundwater aquifer is exposed. Tailings produced in the Plant will be pumped to the L-37 historic pit, which will act as the Hydrometallurgical Tailings Facility (HTF) for contained disposal. Excess water from the supernatant pond will be pumped to the nearby N-42 historic pit for infiltration into the Presqu'ile aquifer. The site plan, including proposed fresh water source pit, HTF and infiltration pit, is shown on Figure 2.

The L-37 pit has been selected as the HTF for several reasons:

- Proximity to the Hydrometallurgical Plant Site
- Limited free water/groundwater exposed in the pit
- Availability of local till and waste rock sources nearby
- No evidence that historic pit was used for other types of waste disposal
- Volume of pit is projected to be sufficient to contain all tailings solids and the proposed maximum supernatant water pond

An updated design basis memo was issued (KPL Memo NB11-00102) which summarizes the process flow information for the Hydrometallurgical Plant, given the proposed acid-bake method. This information was used to determine the volume of tailings and process water expected to be produced over the operational life. The cumulative volume of solids and water for Years 2 and 20 (ultimate case) were modelled in the L-37 pit as shown on Figures 3 and 4, respectively. A section through the HTF that shows the pit at these filling stages is shown on Figure 5. As shown, the Year 20 (ultimate) tailings and supernatant water will be contained within the L-37 pit without the need for external embankment construction.

Prior to tailings deposition into the pit, it is currently proposed (if required) that the floor and walls of the L-37 pit be prepared, through the placement of a separation/filter barrier using locally available materials (i.e. till and/or processed waste rock). This barrier would prevent migration of the fine tailings solids into the highly porous and fractured bedrock that hosts the Presqu'ile aquifer.

It is currently proposed that tailings deposition be carried out from the southern side of the pit and a temporary separator dyke be established near the northern side of the pit for the initial years, as shown on Figure 3. This dyke would allow separation of the water from the tailings and if required, the area containing the supernatant could be lined in the event that water quality testing is required prior to allowing uncontrolled infiltration of the supernatant water into the aquifer. The northward sloping tailings

will cover the remainder of the pit bottom and ensure that the supernatant pond remains at the northern side of the pit over the life of the facility, to allow for successful reclaim of excess supernatant water to be sent to the N-42 infiltration pit.

If you have any questions regarding this information, please don't hesitate to contact us.

Signed: _____ Approved: _____

FOR Cara Stapley, E.I.T.
Geological Engineering

Kevin Hawton, P.Eng.
Senior Engineer

Attachments:

Figure 1 Rev 0 Project Location Map
Figure 2 Rev 0 General Hydrometallurgical Site Layout
Figure 3 Rev 0 Year 2 - HTF Layout
Figure 4 Rev 0 Year 20 (Ultimate) HTF Layout
Figure 5 Rev 0 HTF Section

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NOTES:

1. IMAGERY FROM NASA WORLD WIND.

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AVALON RARE METALS INC.

THOR LAKE PROJECT

L-37 PIT
TAILINGS MANAGEMENT DESIGN SUMMARY
PROJECT LOCATION MAP

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB101-390/2	NB11-00115

FIGURE 1 REV 0

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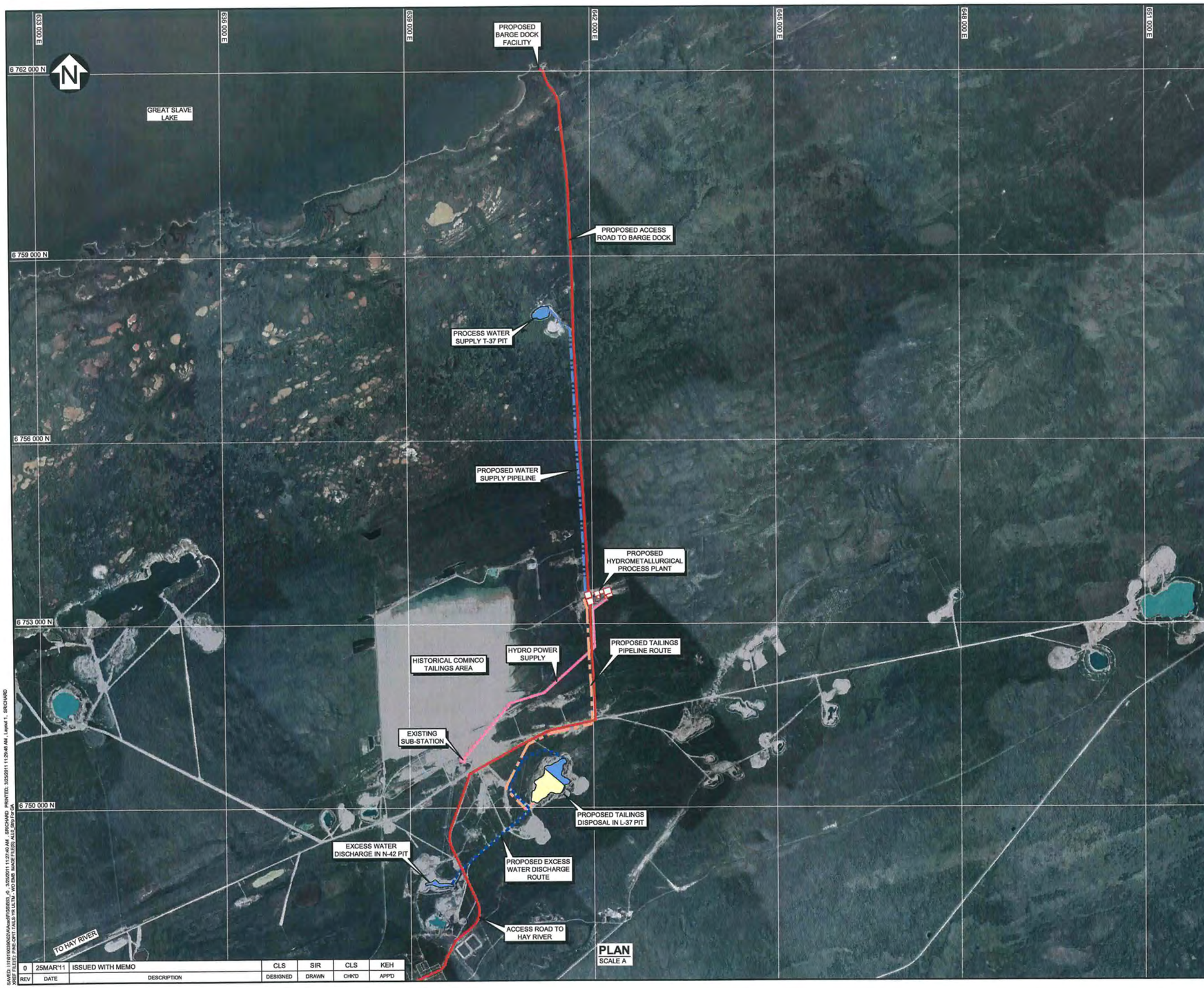

PLAN
SCALE A

LEGEND:

- HISTORIC TAILINGS
- PROPOSED WATER PONDS
- PROPOSED HYDROMETALLURGICAL TAILINGS
- PROPOSED ACCESS ROAD
- HYDRO POWER SUPPLY
- PROPOSED TAILINGS PIPELINE PIPELINE
- PROPOSED WATER SUPPLY PIPELINE
- PROPOSED EXCESS WATER DISCHARGE PIPELINE

NOTES:

1. COORDINATE GRID IS UTM NAD83 ZONE 11N.
2. IMAGE PROVIDED BY AVALON METALS INC.

SCALE A 600 300 0 1000 2000 3000 m

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AVALON RARE METALS INC.

THOR LAKE PROJECT

L-37 PIT
TAILINGS MANAGEMENT DESIGN SUMMARY
GENERAL HYDROMETALLURGICAL SITE LAYOUT

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P/A NO.	REF NO.
NB101-390/2	NB11-00115

FIGURE 2 REV 0

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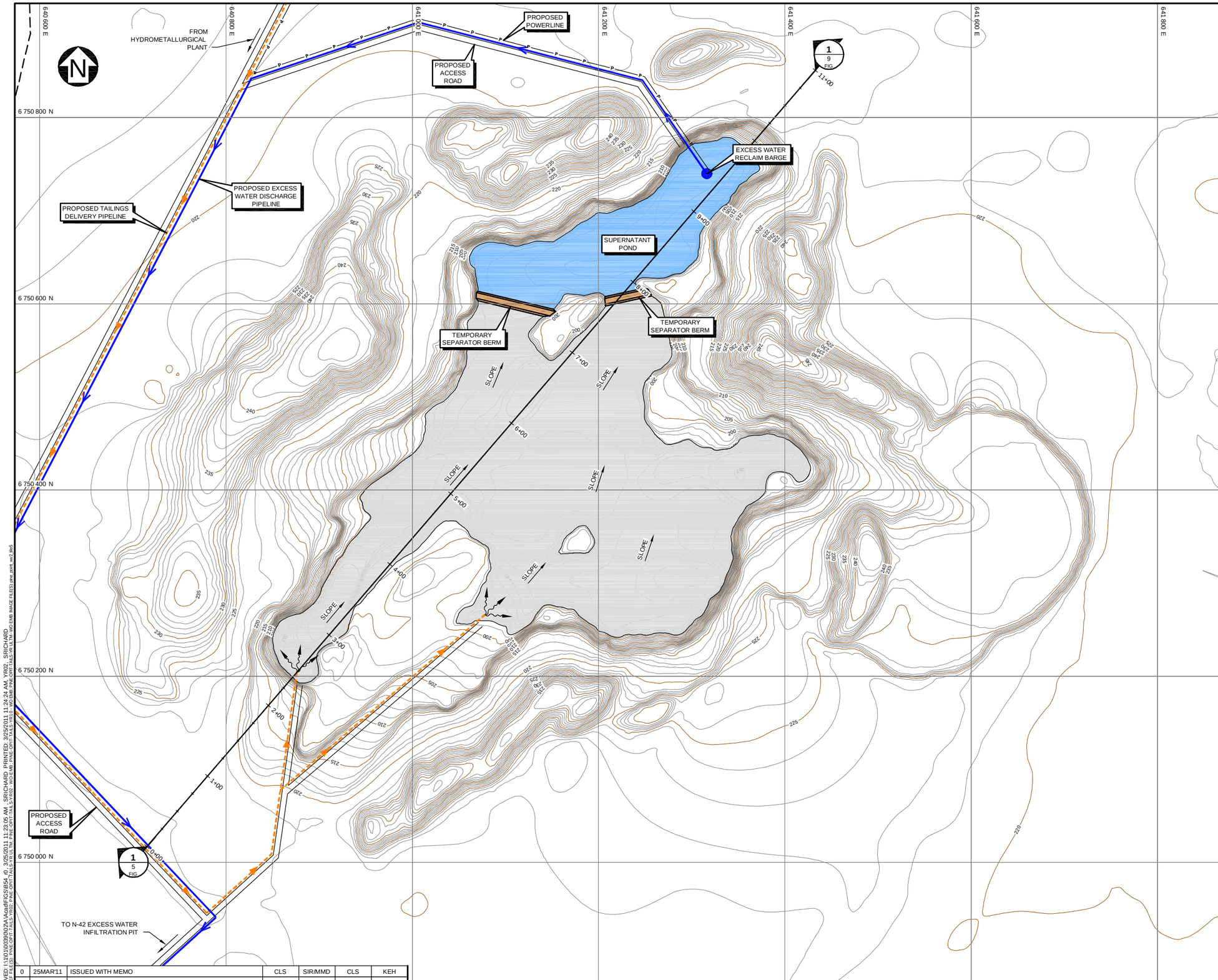

LEGEND:

- WATER
- TAILINGS
- SEPARATOR BERM
- PROPOSED ACCESS ROAD
- PROPOSED TAILINGS DELIVERY PIPELINE
- PROPOSED TAILINGS DEPOSITION LOCATION
- PROPOSED RECYCLED WATER PIPELINE
- PROPOSED POWERLINE

NOTES:

1. COORDINATE GRID IS UTM (NAD83) ZONE 11N AND IS METRES.
2. PLAN BASED ON INFORMATION PROVIDED BY AVALON RARE METALS INC., DATED NOVEMBER 1, 2010.
3. CONTOURS ARE IN METRES. CONTOUR INTERVAL IS 1 METRE.
4. TAILINGS CONFIGURATION SHOWN REPRESENTS ESTIMATED LAYOUT FOR END OF YEAR 2 OPERATIONS.

SCALE A 40 20 0 40 80 120 160 200 m

AVALON RARE METALS INC.

THOR LAKE PROJECT

L-37 PIT
TAILINGS MANAGEMENT DESIGN SUMMARY
YEAR 2 - HTF LAYOUT

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P/A NO.	REF NO.
NB101-390/2	NB11-00115

FIGURE 3 REV 0

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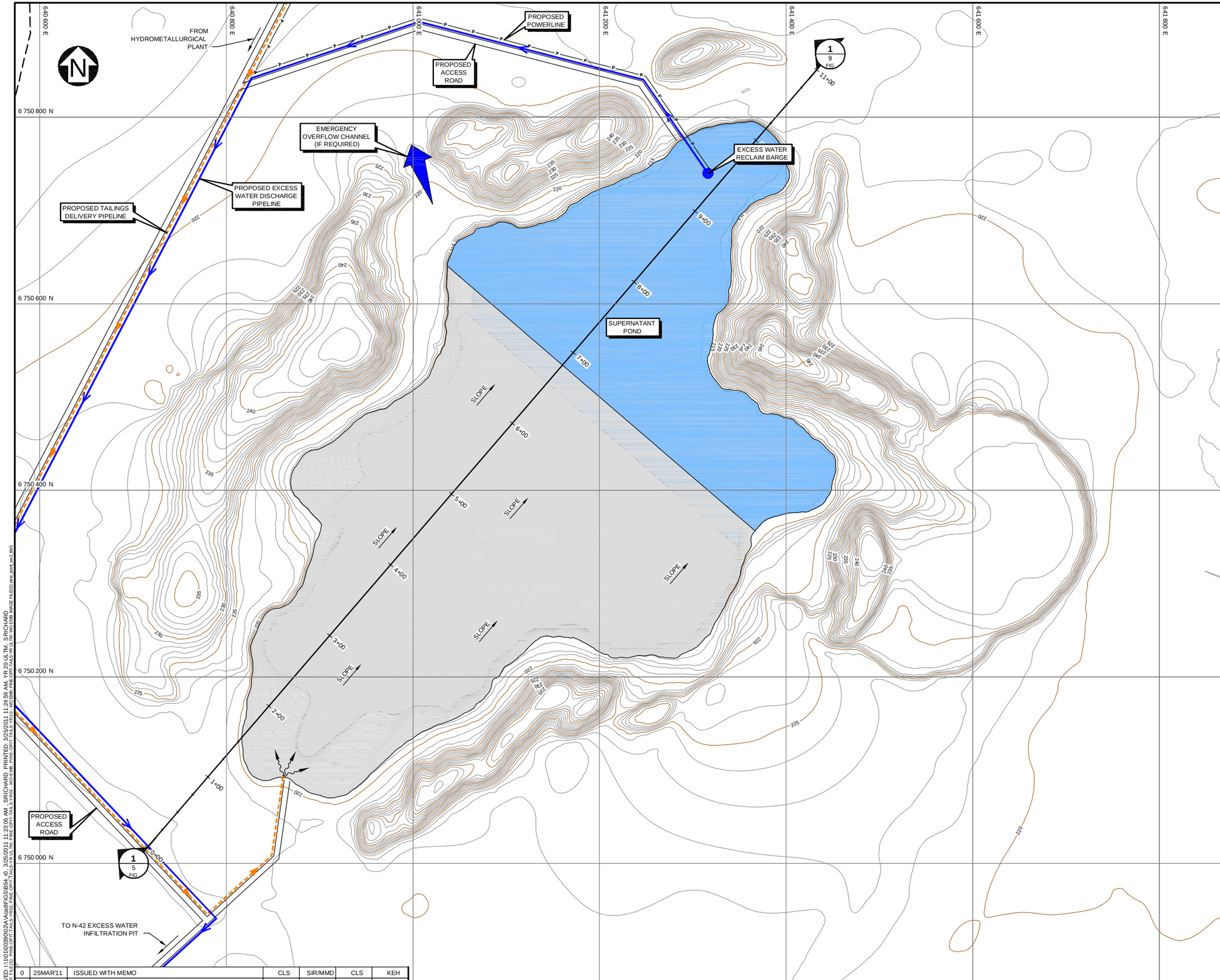
XREF FILE(S): PINE-OPT-TAILS-YR02; PINE-OPT-TAILS-YR02; PINE-OPT-TAILS-YR02; PINE-OPT-TAILS-YR02; WO EMB; PINE-OPT-TAILS-YR10; WO EMB; PINE-OPT-TAILS-YR LTM; WO EMB IMAGE FILE(S): pinc_post_wo2.jpg5



LEGEND:

- WATER
- TAILINGS
- PROPOSED ACCESS ROAD
- PROPOSED TAILINGS DELIVERY PIPELINE
- PROPOSED TAILINGS DEPOSITION LOCATION
- PROPOSED RECYCLED WATER PIPELINE
- PROPOSED POWERLINE
- PROPOSED EMERGENCY OVERFLOW CHANNEL

NOTES:

1. COORDINATE GRID IS UTM (NAD83) ZONE 11N AND IS METRES.
2. PLAN BASED ON INFORMATION PROVIDED BY AVALON RARE METALS INC., DATED NOVEMBER 1, 2010.
3. CONTOURS ARE IN METRES. CONTOUR INTERVAL IS 1 METRE.
4. TAILINGS CONFIGURATION SHOWN REPRESENTS ESTIMATED LAYOUT FOR END OF YEAR 20 OPERATIONS.

SCALE A 40 20 0 40 80 120 160 200 m

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AVALON RARE METALS INC.

THOR LAKE PROJECT

L-37 PIT
TAILINGS MANAGEMENT DESIGN SUMMARY
YEAR 20 (ULTIMATE) HTF LAYOUT

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FIGURE 4 REV 0

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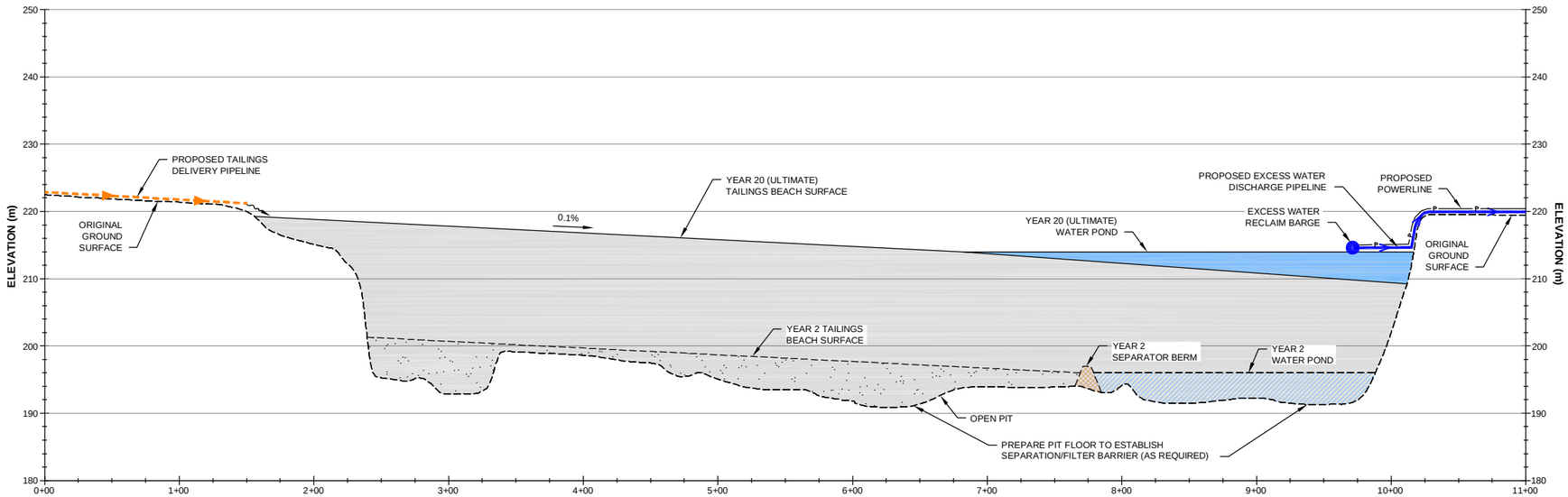

1 / 3,4 FIG

SECTION

HORIZONTAL: SCALE A
VERTICAL: SCALE B

LEGEND:

- WATER (YEAR 20) ULTIMATE
- WATER (YEAR 2)
- TAILINGS (YEAR 20) ULTIMATE
- TAILINGS (YEAR 2)
- SEPARATOR BERM (YEAR 2)
- PROPOSED TAILINGS DELIVERY PIPELINE (ULTIMATE)
- PROPOSED TAILINGS DEPOSITION LOCATION (ULTIMATE)
- PROPOSED RECYCLED WATER PIPELINE (ULTIMATE)
- PROPOSED POWERLINE (ULTIMATE)

NOTES:

1. ELEVATIONS ARE IN METRES.

SCALE A: 40 20 0 40 80 120 160 200 m

SCALE B: 8 4 0 10 20 30 40 m

AVALON RARE METALS INC.

THOR LAKE PROJECT

L-37 PIT
TAILINGS MANAGEMENT DESIGN SUMMARY
HTF SECTION

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P/A NO.	REF NO.
NB101-390/2	NB11-00115

FIGURE 5 REV 0

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