TMAC Resources Inc.

HOPE BAY PROJECT

Proponent's Response to Information Requests on Water Licence Applications

February 2018

Prepared by:

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Proponent's Response to Information Requests on Water Licence Applications

TABLE OF CONTENTS

1. ID #KIA-IR01

1.1 SUBJECT/TOPIC

Contact Water Pond Berm Stability (BGC)

1.2 REFERENCES

- Package P5-3 Hope Bay Project: Contact Water Pond Berm Design, Attachment 1: Contact Water Pond Berm Thermal Model

1.3 SUMMARY

Section 3 notes that 'seasonal thaw beneath the contact water pond is estimated to be 9.5 m below ground surface using the conservative model boundary conditions' and for the surge pond the seasonal thaw 'is estimated to be 9.8 m bgs using the conservative model boundary conditions.'

1.4 DISCUSSION

1.4.1 Importance of Issue to the Impact Assessment Process

While these estimates of seasonal thaw may be conservative given the boundary conditions modelled and the proposed operation of the ponds, increased seasonal thaw compared to current conditions (pre-development) should be anticipated within the pond footprint. Given the likelihood of fine-grained soils containing ground ice in the footprint, thaw settlement within the pond area should be anticipated. This thaw settlement may have an impact on the stability of the upstream slope of the contact water pond berm. The issue may be even more pertinent for the surge pond in CWP2 at the Boston site, which it is understood to retain water on a more regular basis.

1.4.2 Detailed Review Comment

Gap/Issue

Anticipation of thaw settlement within pond footprint, upstream of contact water pond berm and its impact on berm stability and liner stability in the surge pond.

Disagreement with DEIS Conclusion

Thermal analysis assessing thermal impacts of pond operation included in reference report, but assessment of potential impact on stability is not included within report.

Reasons for Disagreement with Conclusion

Information to address the above noted issues is not provided in the project documentation.

1.5 RECOMMENDATION/REQUEST

Please comment on potential for thaw settlement in pond area and its potential impact on stability of contact water pond berm and the liner in the surge pond. Additionally, if thaw settlement has the potential to impact berm stability or the surge pond liner, please provide potential contingency measures to address the instabilities if observed.

1.6 TMAC RESPONSE

The potential for increased thaw to occur within the surge pond area as demonstrated by Supporting Document P5-3 (Hope Bay Project Contact Water Pond Berm Design – SRK Consulting, November 2017), Attachment 1 has been conservatively considered in the stability assessment of the surge pond berms shown in Section 4 of Supporting Document P5-3 (Hope Bay Project Contact Water Pond Berm Design – SRK Consulting, November 2017).

Thaw settlement is a separate issue to thaw induced instability of the berm. If the ground below the pond area, or below the berm undergoes increased thaw, there is the potential for the ground surface to undergo differential settlement, which may cause the liner and/or the berm to deform. This is a slow process which is highly unlikely to cause damage to the liner. The deformation of the liner and berm would be monitored as part of regular inspections. Following inspection and observation of deformation, adjustment or preventative maintenance of the liner would be made as required. The same process would also apply to the berm itself, which would be raised if settlement has occurred, whether this is thaw related settlement or otherwise.

Thaw settlement impacting the berm stability or the surge pond liner is considered unlikely based on observation of existing lined facilities at the Hope Bay site. Specifically the Sedimentation Pond which has an identical design concept has been operated since 2011 without any observed impacts from thaw settlement.

2. ID #KIA-IR02

2.1 SUBJECT/TOPIC

Boston Dry Stack Stability (BGC)

2.2 REFERENCES

- Package P5-26 Hope Bay Project: Boston Tailings Management Area Preliminary Design, Hope Bay Project, Appendix F – Dry Stack Creep Deformation Analysis.

2.3 SUMMARY

A creep deformation analysis was undertaken to assess long-term stability of the dry stack tailings facility. The results suggest maximum vertical and horizontal displacements of 2.9 and 5.7 m, respectively.

2.4 DISCUSSION

2.4.1 Importance of Issue to the Impact Assessment Process

The closure plan for the dry stack tailings facility includes placement of a HDPE liner over the tailings (overlain by crushed rock and Run of Quarry rockfill) to reduce infiltration. Deformation of the dry stack tailings facility over the long term may have negative impacts on the integrity of the HDPE and effectiveness of the closure cover. This could result in impacts to run-off and / or seepage water quality.

2.4.2 Detailed Review Comment

Gap/Issue

Impacts to integrity and effectiveness of closure cover from long term creep deformation of the tailings dry stack.

Disagreement with DEIS Conclusion

Deformations reported in referenced project documentation would negatively affect long-term closure cover performance.

Reasons for Disagreement with Conclusion

Information to address the above noted issues is not provided in the project documentation.

2.5 RECOMMENDATION/REQUEST

Please comment on the potential impact to closure cover performance from long-term creep deformations noted in referenced project documentation.

2.6 TMAC RESPONSE

An incorrect version of Hope Bay Project: Boston Tailings Management Area – Dry Stack Creep Deformation Analysis was accidentally included in the submission of Supporting Document P5-26 (Hope Bay Project: Boston Tailings Management Area Preliminary Design, Hope Bay Project – SRK Consulting, November 2017), Appendix F. The previous version used erroneous parameters and should be ignored. The erroneous values led to excessively high creep deformation predictions which has lead the reviewer to the above conclusion. The final version of Supporting Document P5-25 (Hope Bay Project: Boston Tailings Management Area – Dry Stack Creep Deformation Analysis), Appendix F is attached and supersedes the submitted version.

Displacements due to creep 80 years after construction were predicted to reach a maximum of 0.15 m in the vertical direction and 0.25 m in the horizontal direction. These deformations are not expected to have any impact on the closure cover performance.

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Memo

To:	John Roberts, PEng, Vice President Environment Oliver Curran, MSc, Environmental Affairs	**Client:**	TMAC Resources Inc.
From:	Eric Lino	**Project No:**	1CT022.013
Reviewed By:	Arcesio Lizcano, PhD Maritz Rykaart, PhD, PEng	**Date:**	February 19, 2018
Subject:	Hope Bay Project: Boston Tailings Management Area – Dry-Stack Creep Deformation Analysis		

1 Introduction

1.1 General

The Hope Bay Project (the Project) is a gold mining and milling undertaking of TMAC Resources Inc. The Project is located 705 km northeast of Yellowknife and 153 km southwest of Cambridge Bay in Nunavut Territory and is situated east of Bathurst Inlet. The Project comprises of three distinct areas of known mineralization plus extensive exploration potential and targets. The three areas that host mineral resources are Doris, Madrid, and Boston.

The Project consists of two phases: Phase 1 (Doris project), which is currently being carried out under an existing Water Licence, and Phase 2 (Madrid-Boston project), which is in the environmental assessment and regulatory stage. Phase 1 includes mining and infrastructure at Doris only, while Phase 2 includes mining and infrastructure at Madrid and Boston located approximately 10 and 60 km due south from Doris, respectively.

Tailings deposition at Boston will be in the form of dewatered (i.e., filtered) tailings placed in a compacted dry-stack. This tailings management area (TMA) is located approximately 1.2 km east of the proposed Boston camp and processing facilities, and is accessed via the Boston-Madrid all-weather road. At closure, the dry-stack will be covered with a geosynthetic low permeability infiltration reducing cover.

1.2 Objective of the Creep Deformation Analysis

The objective of the creep deformation analysis is to anticipate if long-term strains occurring over the dry-stack design life can affect the performance or compromise the stability of the Boston TMA. The analysis also confirms whether the integrity of the underlying saline foundation will be affected by creep deformations.

2 Boston Dry-Stack Details

2.1 General

The dry-stack facility will occupy a flat area in the east of the Aimaokatalok Lake extension, south of the proposed new Boston airstrip. This area is separated from the mining infrastructure (SRK 2017a) by the extension of the Aimokatalok Lake and the outflow creek from Stickleback Lake. The footprint of the dry-stack facility is in the shape of an irregular heptagon, with an area of about 19.8 hectares as shown in Figure 1.

The facility will have 5 m high intermediate benches with side slopes of 3H:1V. Setback benches of 5 m will result in an overall slope configuration of about 3.9H:1V and a final height of 25 m. A detailed cross section is shown in Figure 2.

2.2 Foundation materials

The foundation profile was assumed to consist of 7 m of frozen overburden soils (marine silt and clay) overlying competent bedrock. The upper 1 m of the overburden profile, immediately beneath the first bench, is assumed to be thawed. The average temperature in the dry-stack foundation is -4.0°C (see Section 2.3).

In absence of specific data within the footprint of the dry-stack, it is assumed that the foundation has an average pore water salinity of 37 parts per thousand (ppt) based on site wide salinity measurements (SRK 2017b).

2.3 Thermal Modeling

Thermal modelling for the Boston dry-stack was completed for the years 25, 50 and 85 after the end of construction (SRK 2017c). The results are included in Figures 3 to 5. The modeling predicts temperatures in the dry-stack foundation varying between -6°C and -4°C. For year 85 specifically, the modeling predicts temperatures between -4.6°C and -4.7°C. An average foundation temperature of -4°C at the year 50 was selected as representative for the frozen ice-rich marine silt and clays to perform the creep deformation analysis.

According to the results of the thermal modeling, it is also predicted that the tailings will freeze. However, tailings are not expected to experience creep since they are not ice-rich materials.

2.4 Creep Deformation Evaluation Criteria

Creep deformation evaluation criteria for the frozen foundation establish limits to insure long-term integrity. The criteria guarantee long-term strains occur slowly and in a ductile manner.
The criteria are based on the original design criteria proposed by EBA (2006) and require that the frozen foundation underneath the dry-stack maintain the long-term shear strain at or below 10% and the maximum shear strain rate at or below 1.0E-05 sec^{-1} (3.2E+02 $year^{-1}$).

3 Creep Deformations Analysis

3.1 Model description

Creep deformations were assessed by plane strain conditions using the two-dimensional non-linear finite difference code, Fast Lagrangian Analysis of Continua (FLAC 2-D), by Itasca (2012). The analysis was carried out along the typical cross section included in Figure 2. The thermal modelling outlined in Section 2.3 was completed for the same cross section.

Figure 6 presents the 2D finite difference model (FDM) of the typical cross section developed for the analysis with FLAC. The model considered four material regions: dry tailings, thawed foundation, frozen foundation and bedrock. The 1 m closure cover was not represented in the model.

3.2 Basis for the Assessment

Secondary creep (i.e., constant creep strain rate) were assumed for the frozen marine silt and clay in the foundation. This type of soil exhibits a short primary-creep period and a prolonged secondary-creep phase (Andersland and Landanyi 2004).

Based on the Bailey-Norton law (Norton 1929 and Bailey 1935), creep strains rates ($\dot{\varepsilon}$) of frozen soils due to the deviatoric part of the stresses ($\bar{\sigma}$) can be described by the following general equation:

$$\dot{\varepsilon} = (B\bar{\sigma}^n) \cdot mt^{m-1} \qquad (1)$$

where B is a creep parameter that depends on soil type and temperature, n and m can be considered temperature independent parameters, and t is the elapsed time after load application.

Secondary creep is commonly described by Equation (1) with $m = 1$. In this case, the equation can be rewritten as

$$\dot{\varepsilon} = B\bar{\sigma}^n \qquad (2)$$

Equation (2) can be written as follows:

$$\frac{\dot{\varepsilon}}{\dot{\varepsilon}_r} = \left(\frac{\bar{\sigma}}{\sigma_r}\right)^n \qquad (3)$$

where $\dot{\varepsilon}_r$ and σ_r are reference values for the strain rate and stress. According to Equation (3), the creep parameter B in Equation (2) is:

$$B = \frac{\dot{\varepsilon}_r}{(\sigma_r)^n} \qquad (4)$$

Based on the experimental work from Nixon and Lem (1984) on saline fine grained frozen soils, Andersland and Landanyi (2004) proposed the following empirical expression for σ_r in kPa as a function of temperature and salinity:

$$\sigma_r = 0.323(1-T)^2\left(\frac{49.505-S}{8.425+S}\right) \quad (5)$$

where T is the temperature in Celsius degrees and S is the salinity in ppt.

The parameter B $(\mathrm{kPa}^{-n}\cdot \mathrm{year}^{-1})$ can be then calculated with Equation (4) as a function of temperature and salinity using the Equation (5) for the reference stress σ_r and a reference strain rate of $\dot{\varepsilon}_r = 10^{-4}\ \mathrm{year}^{-1}$ (Anderson and Landanyi 2004).

With Equation (2), frozen soils are always predicted to creep for any given deviatoric stress. Even for very small stresses, frozen soil will be predicted to creep. This may lead to overestimating actual long-term displacements. A threshold stress (σ_{th}) for frozen soils likely exists, as for metals (Norton 1929), below which creep cannot be measured and Equation (2) no longer applies. Equation (2), as most constitutive equations for creep, is however formulated without a threshold stress.

For the analysis, a threshold stress for the deviatoric part of the stresses was introduced in equation (2) as follows:

$$\dot{\varepsilon} = A(\bar{\sigma}-\sigma_{th})^n \quad (6)$$

The creep parameter A in equation (6) includes the threshold stress and is determined with:

$$A = \frac{\dot{\varepsilon}_r}{(\sigma_r+\sigma_{th})^n} \quad (7)$$

In the performed analysis, creep strains were evaluated using a constitutive relation represented by Equation (6) implemented in FLAC, described as “The Two-Components Power Law” (Itasca 2012). For the analysis, a threshold stress of 30 kPa was determined for the frozen foundation based on the methodology proposed by F.A. Mohamed (1983) and Wolfenstine (1991). The parameter A was calculated with Equation (7) for a temperature of -4°C (see Section 2.3) and the reported average salinity of 37 ppt (Section 2.2). No creep strains were predicted ($\dot{\varepsilon} = 0$) for $\bar{\sigma} < \sigma_{th} = 30$ kPa. This stress is considered to be low relative to the expected peak deviatoric strength in triaxial condition in the laboratory (Arenson 2002).

3.3 Methodology

The thermal conditions used in the creep analysis were predicted by the thermal modelling at the typical section. It is expected that the creep behavior of the frozen foundation changes as the temperature changes over the dry-stack design life. An accurate prediction of long-term creep deformations therefore requires a thermomechanical coupled constitutive model. However, an efficiently implemented coupled thermo-mechanical model is not available in commercial codes. Hence, long-term creep behavior was evaluated for the ground temperature distribution predicted fifty years after dry-stack construction (Figure 4). This time interval is considered as representative for the long-term creep deformation in the Boston dry-stack.

The analysis followed the following steps:

1. Initial state: The initial stresses of the bedrock and foundation (frozen and thawed) was achieved in the FDM by using elastic properties for all materials and turning gravity on.
2. Elasto-plastic phase: bedrock and foundation (frozen and thawed) were changed from elastic to Mohr-Coulomb materials, and the FDM was brought again to equilibrium.
3. Construction phase with creep behavior: Five construction stages were simulated. Each stage was analyzed as follows:
   (a) The first lift was placed using the Mohr-Coulomb constitutive model for all the materials, and then the FDM was brought to equilibrium;
   (b) Temperature dependent elastic and creep properties were assigned to the frozen marine silt and clays and the FDM was allowed to deform for six months;
   (c) After six months, all materials were changed back to Mohr-Coulomb materials, the next lift was placed and the FDM was brought to equilibrium.
   (d) The placement of the remaining lifts followed the steps (b) and (c).
4. Creep phase after construction: At the end of dry-stack construction, elastic and creep properties were kept in the frozen soils and the FDM was allowed to deform for 80 years.

3.4 Material Properties

Elastic and creep material properties from laboratory tests are not available. Elastic and creep properties used in the deformation analysis were estimated based on previous reports (e.g., EBA (2006)), published data in the literature, and engineering judgment.

3.4.1 Elastic Properties

Table 1 presents the material elastic properties used for achieving the initial state in the FDM.

Table 1: Elastic Properties for the Initial State[1]

Geotechnical Unit	Unit Weight (kN/m^3)	Elastic Modulus (kPa)	Poisson's Ratio (-)
Tailings	17.5	1.0E+05[1]	0.30[1]
Thawed foundation	17.0	5.0E+03[1]	0.30[1]
Frozen foundation	17.0	1.5E+05[1]	0.30[1]
Bedrock	26.0	1.0E+08[2]	0.25[2]

Notes:

1. Source: Dry-Stack Stability Memo (SRK 2017d)
2. Source: Creep Deformation Memo North Dam (SRK 2017e)

3.4.2 Shear Strength Properties

The Mohr-Coulomb properties suitable for the elasto-plastic phase of the analysis are included in Table 2 based on SRK (2017b) and SRK (2017e).

Table 2: Shear Strength Properties

Model Region	Cohesion (kN/m^2)	Friction Angle (º)
Tailings	0	40[1]
Thawed foundation	0	30[1]
Frozen foundation	112[1]	26[1]
Bedrock	1000[2]	0[2]

Notes:

1. Source: Stability Memo (SRK 2017d)
2. Source: Creep Deformation Memo North Dam (SRK 2017e)

3.4.3 Creep Parameters

The parameter n for the frozen marine silt and clay (Equation (2)) was estimated to be 3 based on published laboratory testing results from saline fine-grained soils (Nixon and Lem 1984 and Wijeweera and Joshi 1991). The temperature-dependent value A used in the analysis is 3.0E-09 kPa^{-3}year^{-1} and was calculated with equation (7) for a constant salinity of 37 ppt.

The temperature dependent elastic moduli of the frozen foundation soils required for the elastic strains was estimated to be 3.2E+04. Since the elastic part of creep is considered to be a constant volume process (undrained process), the analysis used a Poisson's ratio of 0.5 for the frozen foundation soils.

4 Results

4.1 Shear Strain Rates and Shear Strains

The results of the creep analysis in terms of shear strains and shear strain rates are presented in Figures 7 to 10. The analysis predicts shear strain localization in the frozen marine silt and clay. The strain localization zone is almost planar. This surface can be considered as a likely failure surface if the material strength is mobilized along this surface. To assess the stability of the dry-stack, an limit equilibrium analysis was performed considering the strain localization surface as a potential failure surface. The results are included in Section 4.5.

The maximum predicted shear strain is around of 3.3E-02 m/m (3.3%) 80 years after dry-stack construction (Figure 7). The maximum shear strain rate is 3.0E-08 $year^{-1}$ for the same period (Figures 8). Maximum shear strain and shear strains rates are predicted to occur in points within the shear localization zone (i.e., inside the frozen foundation). Histories of the shear strains and shear strain rates for two selected control points of the FDM (Figure 6) are presented in Figures 9 and 10, respectively.

The predicted creep shear strains and shear strain rates in the frozen marine silt and clay in the foundation meets the design criteria for ductile material behavior (Section 2.4).

4.2 Principal Stresses Difference

Creep strain rates were evaluated as a response to induced deviatoric stresses by the dry-stack weight. Maximum principal stresses differences of around 40 kPa are predicted to be almost constant in the frozen foundation, throughout the 80 years period of analysis after the end of the dry-stack construction. Figure 11 presents the principal stress difference at the year 80. History of the deviatoric stress is presented in Figure 12 for the control points 4 and 5 of the FDM (Figure 6).

The predicted stress differences in the frozen foundation can be considered as low compared with the expected peak deviatoric stress of ice-rich frozen soils under typical triaxial conditions in the laboratory (Arenson 2002).

4.3 Shear Stresses

Figure 13 includes the results of the shear stresses at year 80. In general, the shear stresses in the frozen marine silt and clay are predicted to be relatively low throughout the period of analysis compared with expected shear strengths of ice-rich frozen soils (Arenson 2002).

4.4 Displacements

Figures 14 and 15 show the distribution of the vertical- and horizontal creep displacements predicted at year 80. Figures 16 and 17 present vertical- and horizontal displacement histories for control points 1 to 4 shown in Figure 6. At year 80, the maximum predicted vertical and horizontal displacement at the selected control points are as follows:

- Maximum vertical displacement: 0.15 m in control point 1(Figure 16); and
- Maximum horizontal displacement: 0.25 m in control point 2 (Figure 17).

4.5 Stability Assessment

Limit equilibrium back-analysis was performed to assess the effect of the long-term creep on the stability of the dry-stack. The creep strain localization surface described in Section 4.1 and presented in Figure 7 was considered as a potential failure surface for the analysis. The analysis consisted of back calculating of the friction angle in the frozen marine silt and clay required to met the long-term stability criterion (FOS=1.5). The analysis assumed as a worst-case scenario that the strain rate dependent cohesion of the frozen marine silt and clay vanishes because of the predicted strain rates. The friction angle, on the other hand, was considered dependent on the ice content and independent of the strain rate. In other words, the strength of the frozen marine silt and clays tends to the long-term strength when the strain rate tends to zero.

Based on the limit equilibrium analysis, the frozen marine silt and clay requires a friction angle of 8.6° to meet the long-term stability criterion considering the creep strain localization surface (Section 4.1). Figure 18 shows the result of the stability analysis.

5 Conclusions

Main conclusions from deformation assessment of the Boston dry-stack due to creep of the frozen marine silt and clays are as follows:

- The deformation analysis was completed using the ‘Two Component Power Law model’ implemented in FLAC. In absence of constitutive parameters of the frozen soil within the footprint of the Boston dry-stack, the analysis was performed with the best estimate creep parameter considering material type, temperature and salinity and using engineering judgment. No creep strains were predicted below the selected threshold stress of 30 kPa.
- A long-term ductile behavior is predicted for the frozen marine silt and clay. Creep shear strains in this layer will occur very slowly and remain below the strain rate for brittle failure.
- Shear strains are predicted to localize in the frozen marine silt and clay layer. Eighty years after dry-stack completion, maximum shear strains of about 3.3% occurring at low strain rates of about 3.0E-08 $year^{-1}$ are predicted within the localization zone.
- The maximum calculated vertical and horizontal displacements in the analyzed cross section are predicted to be 0.15 and 0.25 m, respectively, eighty years after the end of the dry-stack construction.
- A minimum friction angle of 8.6° is required to met the long-term stability criterion when the shear strain localization surface is considered a potential failure surface, and the cohesion is assumed to vanish. The designed dry-stack meet the long-term stability criterion since the friction angle of the frozen marine silt and clay is 26°.

6 References

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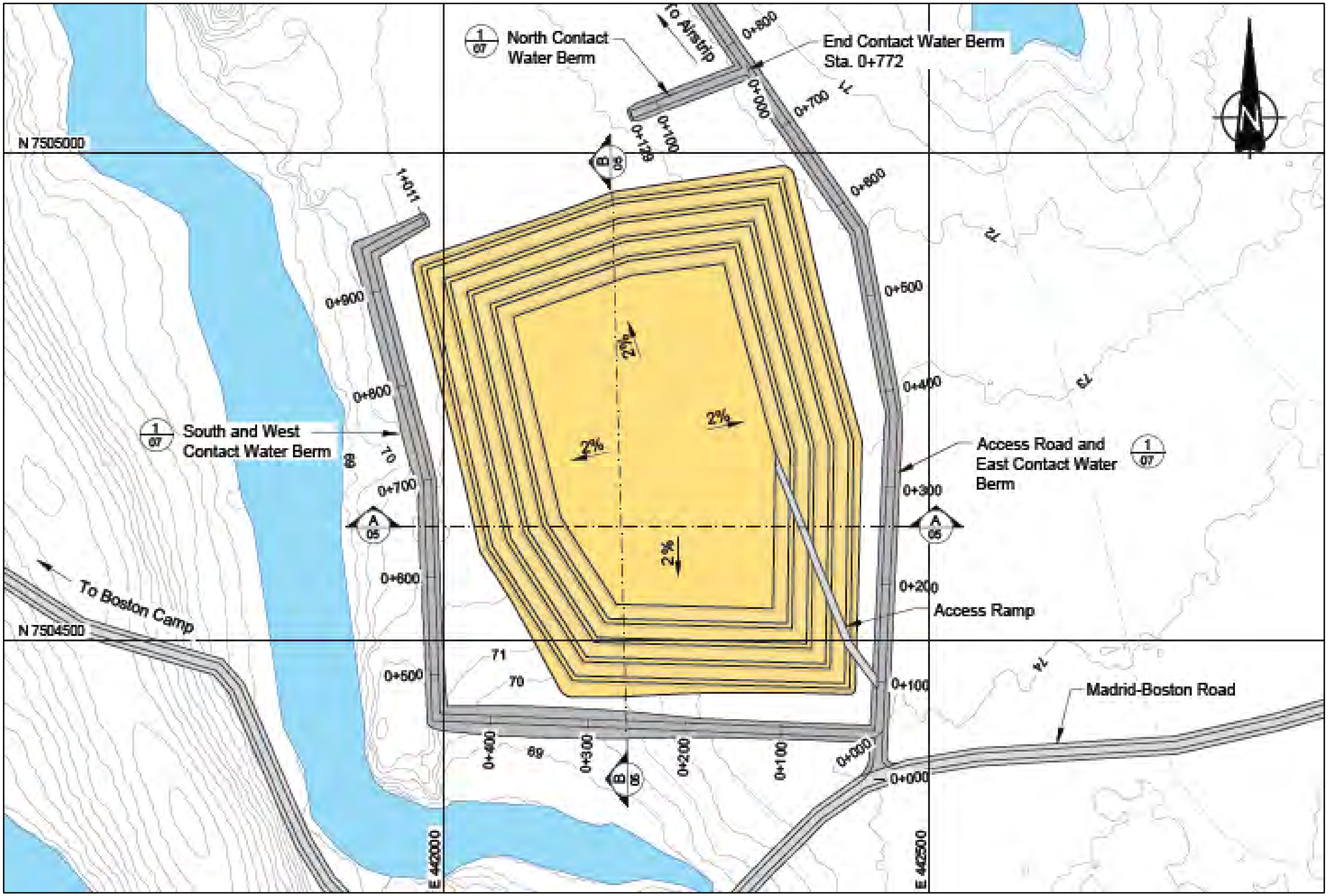
Figures



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MAC RESOURCES

Boston TMA Creep Deformation Analysis

Boston TMA
General Arrangement

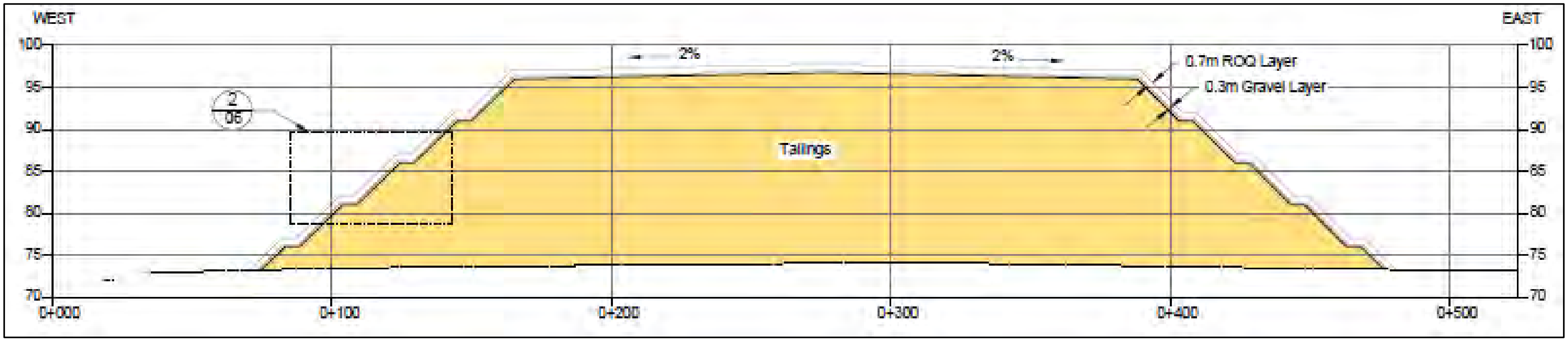
Job No: 1CT022.013

Filename: Boston_DSTSF_CreepDeformationAnalysis_Memo_Figures_1CT022-013_Rev06.pptx

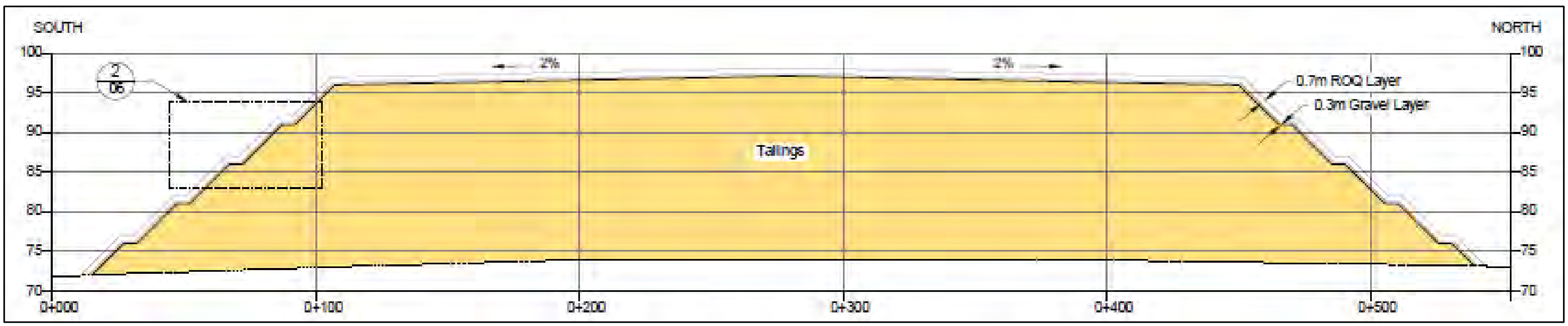
HOPE BAY PROJECT

Date:	Approved:	Figure:
11/28/2017	EL	1

Section A-A



Section B-B



Notes:

1. Sections have 3x Vertical Exaggeration

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TMAC RESOURCES

Boston TMA Creep Deformation Analysis

Boston TMA
Typical section

Job No: 1CT022.013

Filename: Boston_DSTSF_CreepDeformationAnalysis_Memo_Figures_1CT022-013_Rev06.pptx

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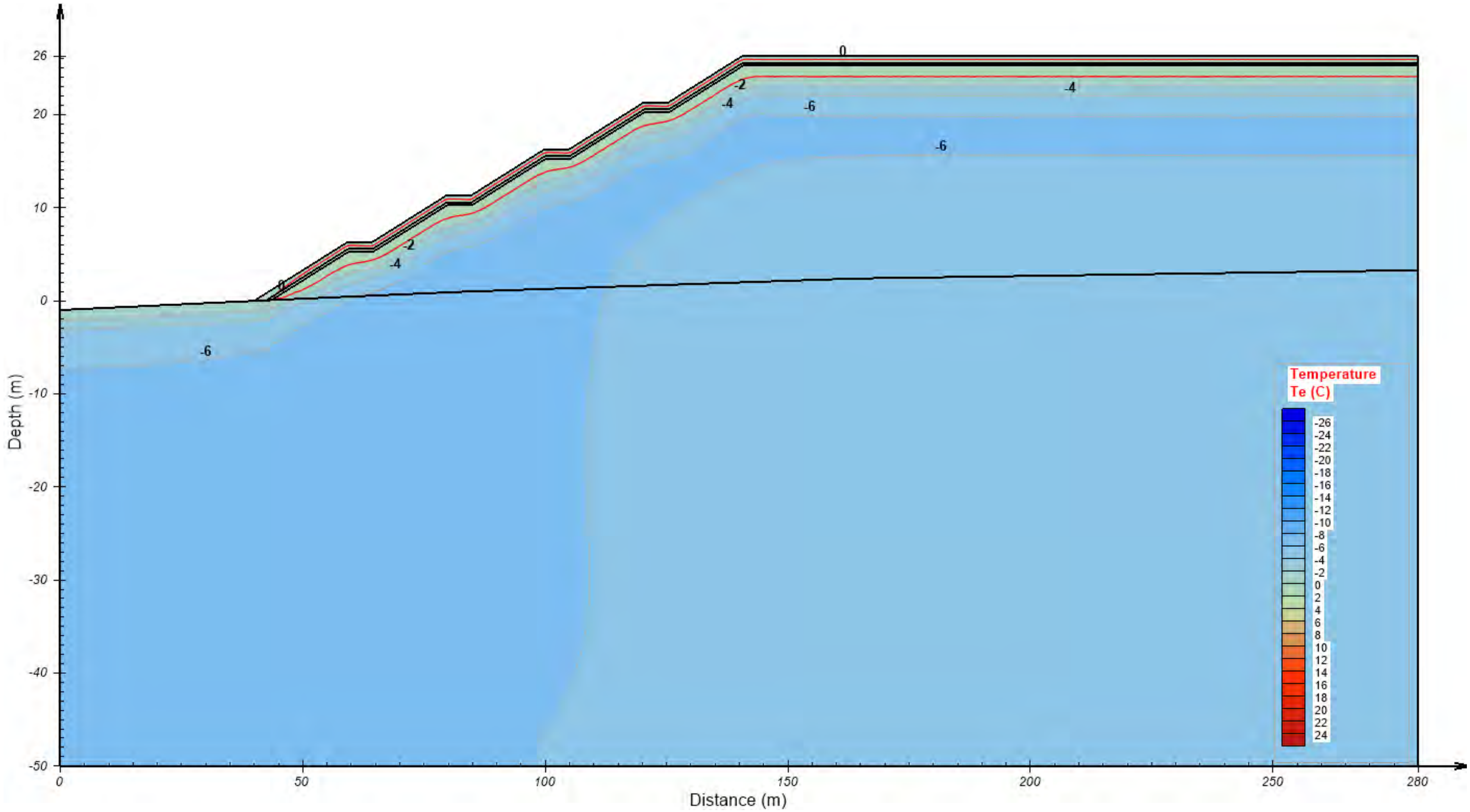
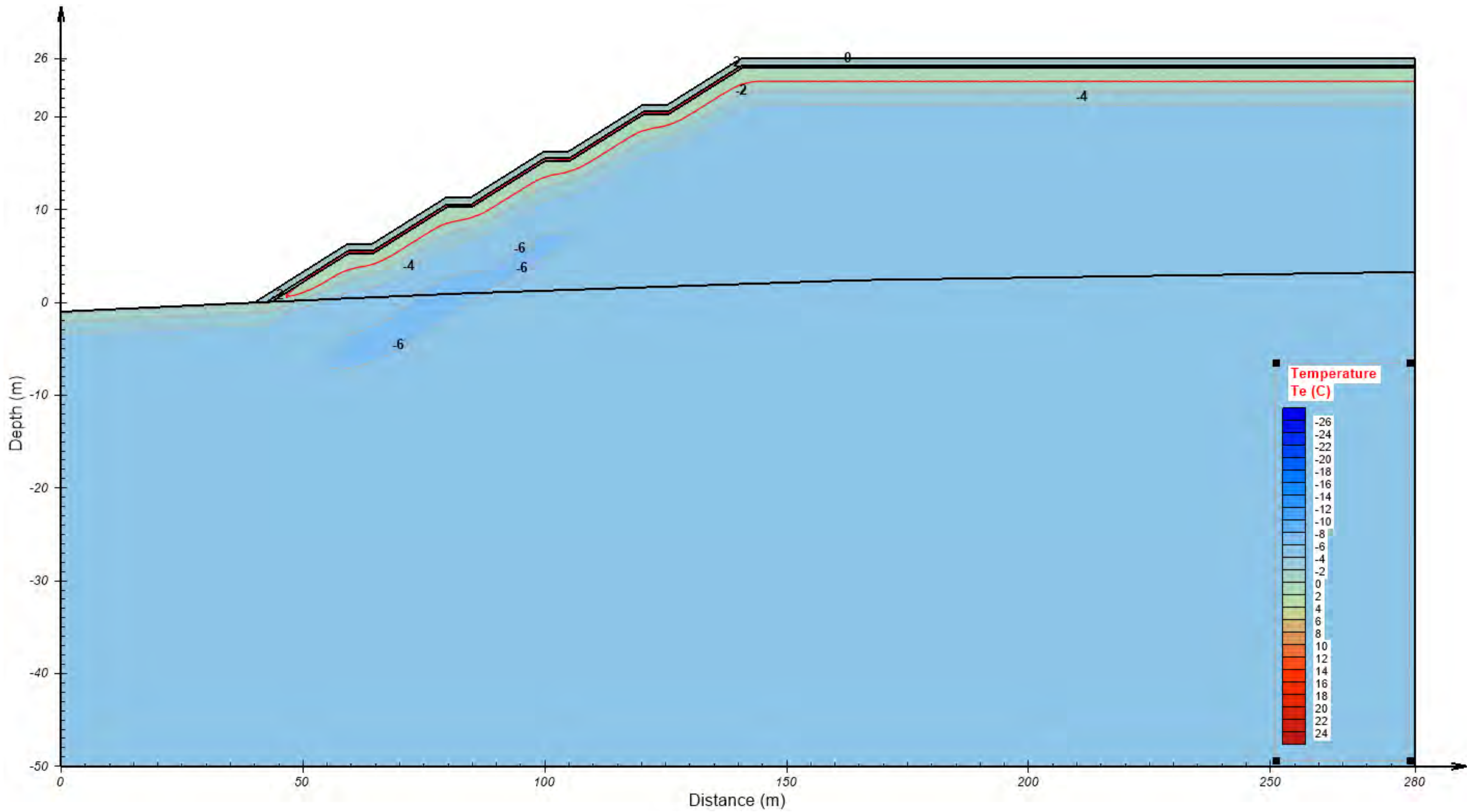


Notes:

1. Model section represents maximum position of -2°C isotherm (solid red line) during Year 25

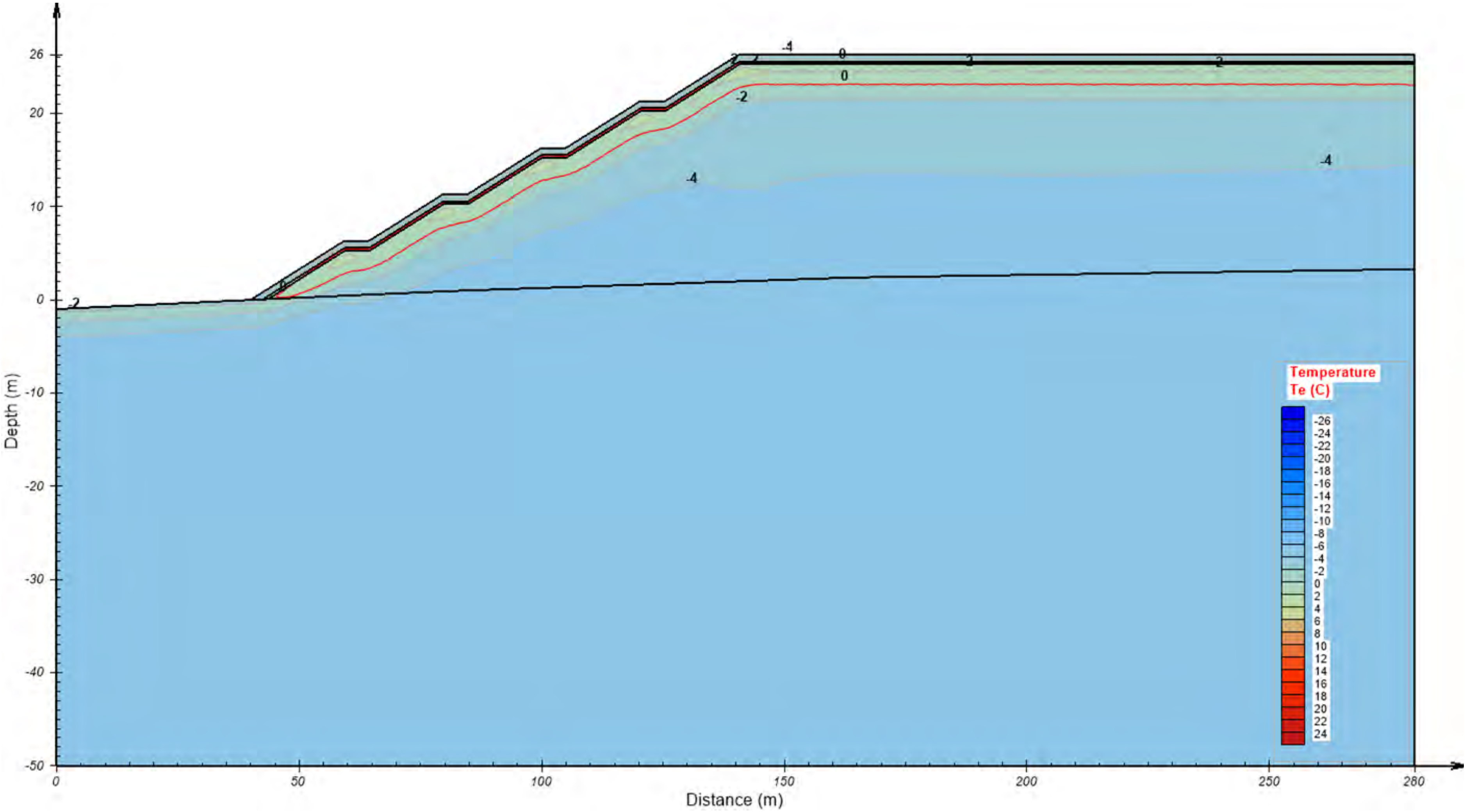
srk consulting	TMAC RESOURCES	Boston TMA Creep Deformation Analysis
		Thermal Model Results – Boston TMA (Year 25)
Job No: 1CT022.013 Filename: Boston_DSTSF_CreepDeformationAnalysis_Memo_Figures_1CT022-013_Rev06.pptx	HOPE BAY PROJECT	Date: 11/28/2017 · Approved: EL · Figure: 3



Notes:

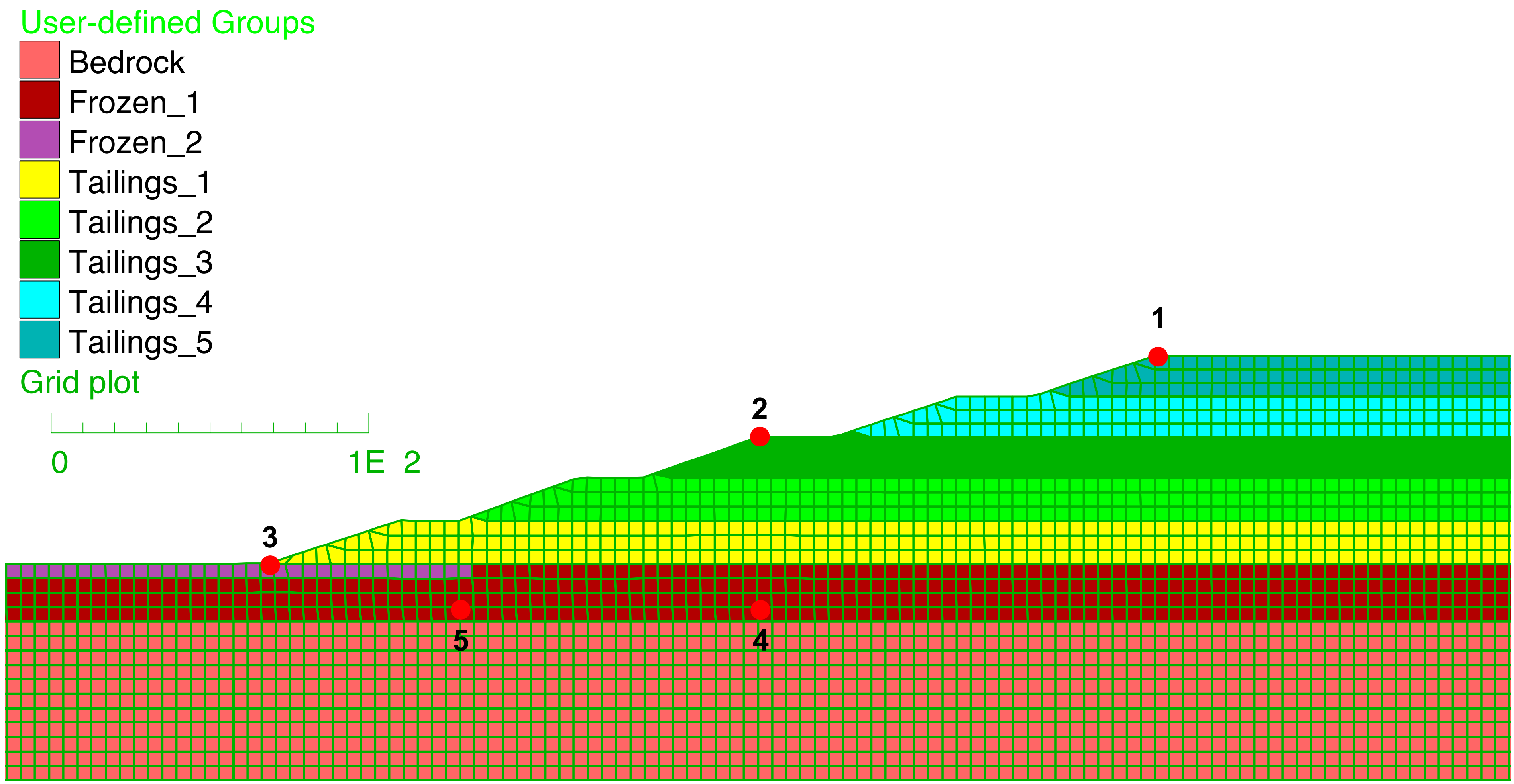
1. Model section represents maximum position of -2°C isotherm (solid red line) during Year 50

srk consulting	TMAC RESOURCES	Boston TMA Creep Deformation Analysis
		Thermal Model Results – Boston TMA (Year 50)
Job No: 1CT022.013 Filename: Boston_DSTSF_CreepDeformationAnalysis_Memo_Figures_1CT022-013_Rev06.pptx	HOPE BAY PROJECT	Date: 11/28/2017 | Approved: EL | Figure: 4



Notes:

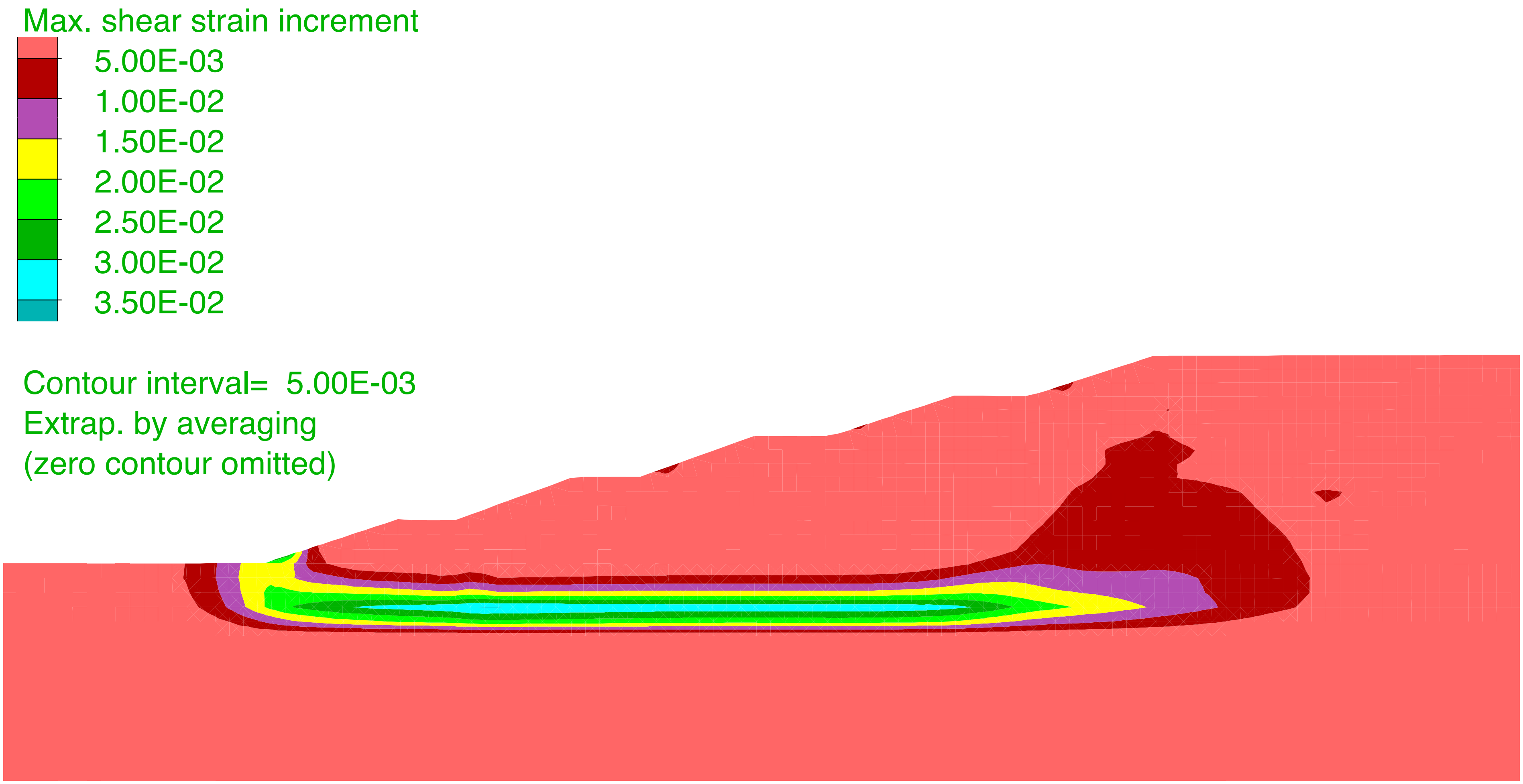
1. Model section represents maximum position of -2°C isotherm (solid red line) during Year 85



Notes:

1. Bedrock is included in the Figure
2. Points 1, 2, 3, 4 and 5 are displacements and stress points
3. The group 'Frozen 2' represents the thawed foundation.

srk consulting	TMAC RESOURCES	Boston TMA Creep Deformation Analysis
		Model Set Up – Typical Section
Job No: 1CT022.013 Filename: Boston_DSTSF_CreepDeformationAnalysis_Memo_Figures_1CT022-013_Rev06.pptx	HOPE BAY PROJECT	Date: 11/28/2017 | Approved: EL | Figure: 6



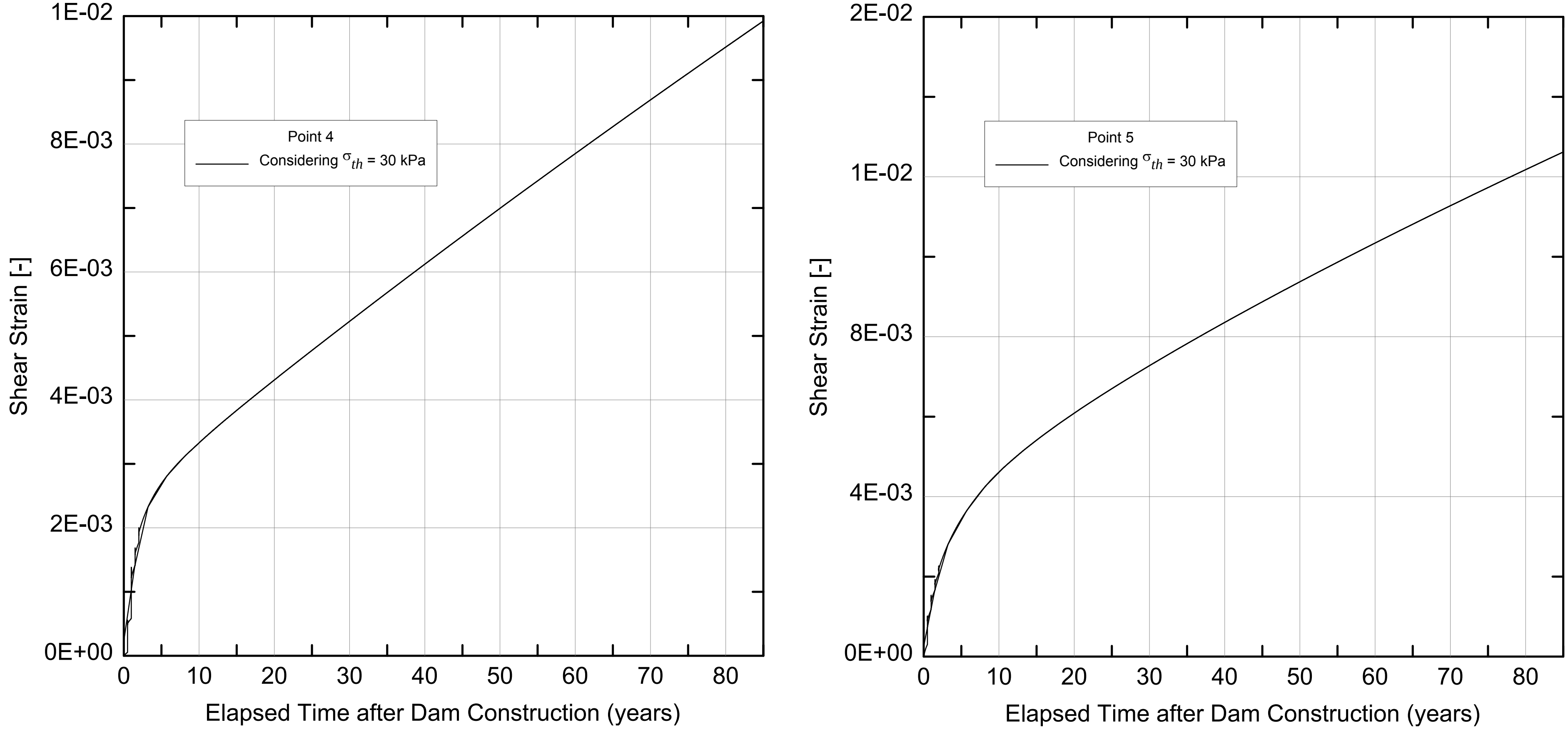
Notes:
1. Units in meters/meters
2. Bedrock is included in the Figure
3. Results for a salinity of 37 ppt in the frozen foundation and a threshold stress of σ_{th} =30 kPa

srk consulting	TMAC RESOURCES	Boston TMA Creep Deformation Analysis
		Maximum Shear Strain 80 Years After Dam Construction
Job No: 1CT022.013 Filename: Boston_DSTSF_CreepDeformationAnalysis_Memo_Figures_1CT022-013_Rev06.pptx	HOPE BAY PROJECT	Date: 11/28/2017 · Approved: EL · Figure: 7

Notes:

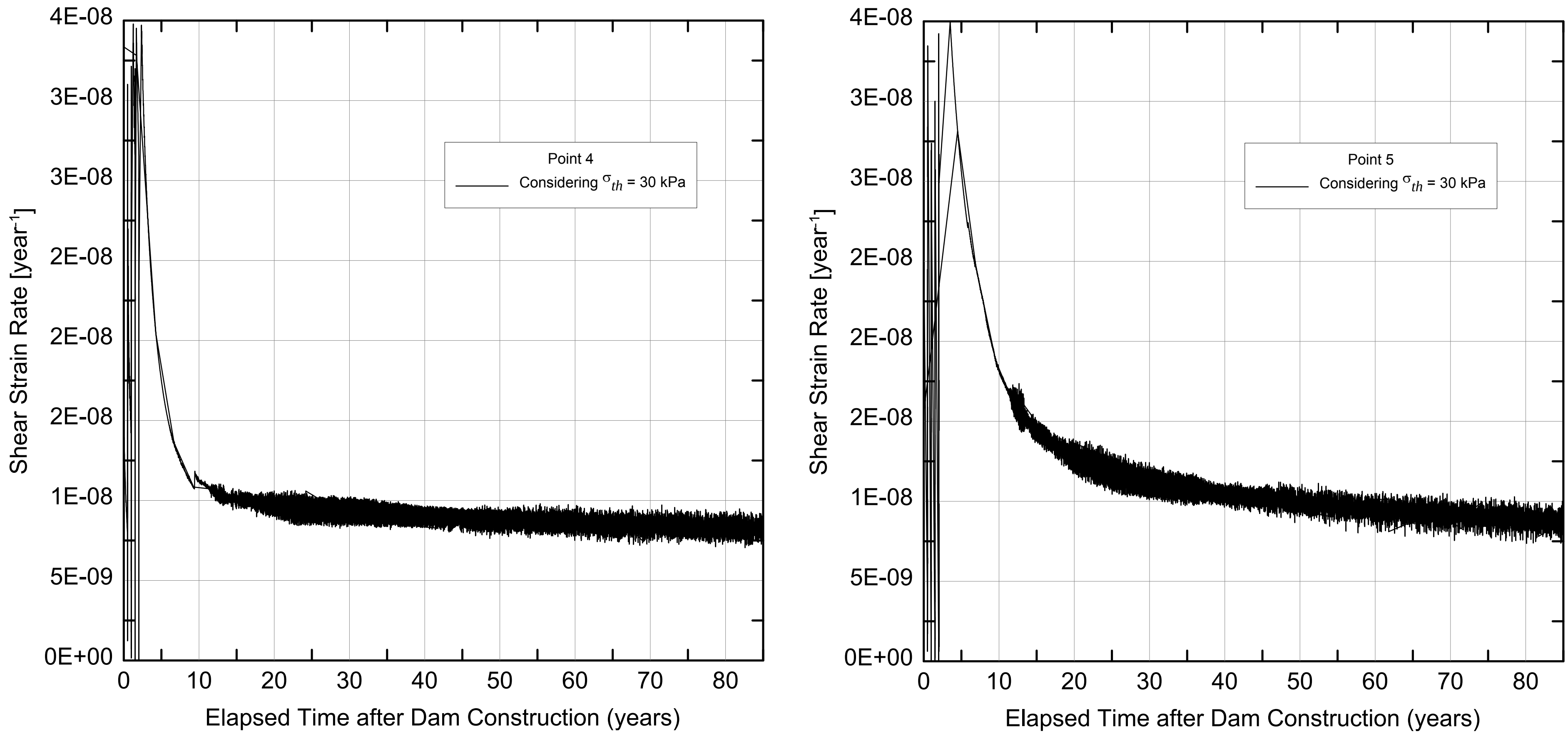
1. Units in year^{-1}
2. Bedrock is included in the Figure
3. Results for a salinity of 37 ppt in the frozen foundation and a threshold stress of σ_{th} =30 kPa

srk consulting	TMAC RESOURCES	Boston TMA Creep Deformation Analysis
		Shear Strain Rate 80 Years After Dam Construction
Job No: 1CT022.013 Filename: Boston_DSTSF_CreepDeformationAnalysis_Memo_Figures_1CT022-013_Rev06.pptx	HOPE BAY PROJECT	Date: 11/28/2017 | Approved: EL | Figure: 8



Notes:
1. See Figure 6 for reference (Points 4 and 5)

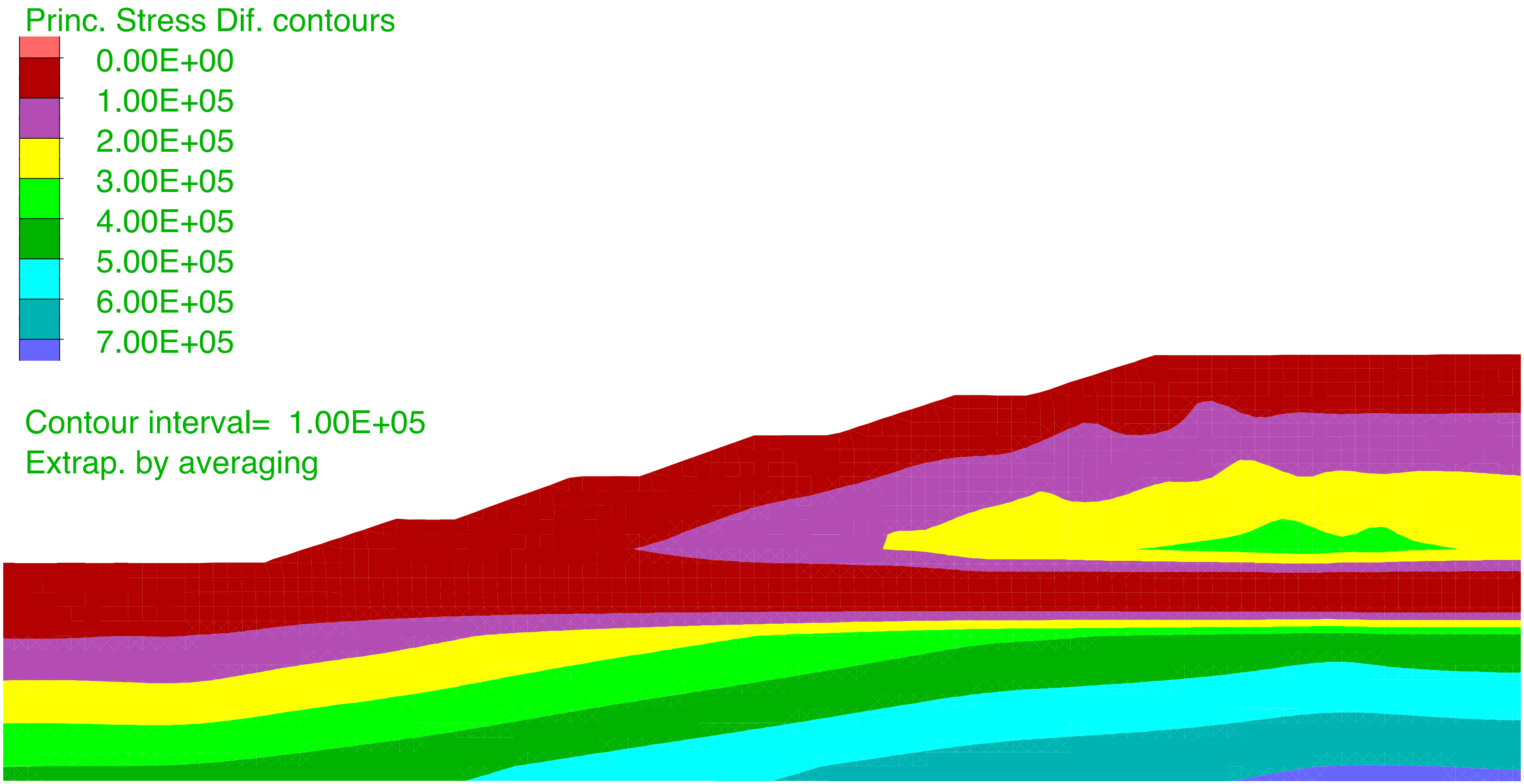
srk consulting	TMAC RESOURCES	Boston TMA Creep Deformation Analysis
		Shear Strain History Points 4 and 5
Job No: 1CT022.013 Filename: Boston_DSTSF_CreepDeformationAnalysis_Memo_Figures_1CT022-013_Rev06.pptx	HOPE BAY PROJECT	Date: 11/28/2017 / Approved: EL / Figure: 9



Notes:

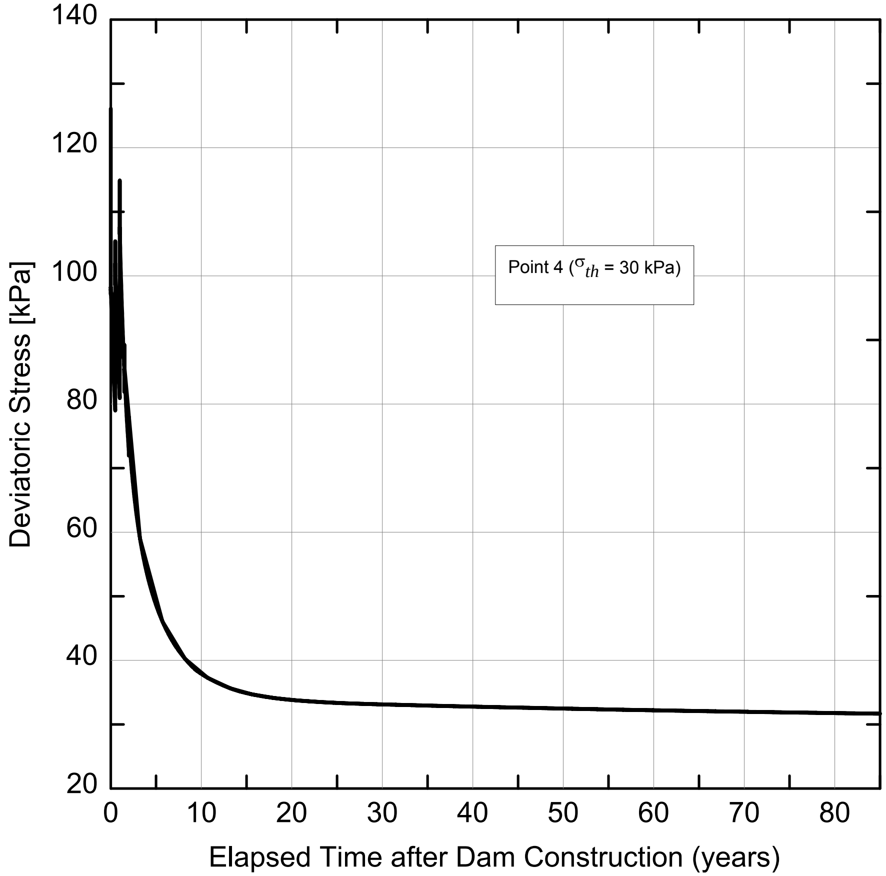
1. See Figure 6 for reference (Points 4 and 5)

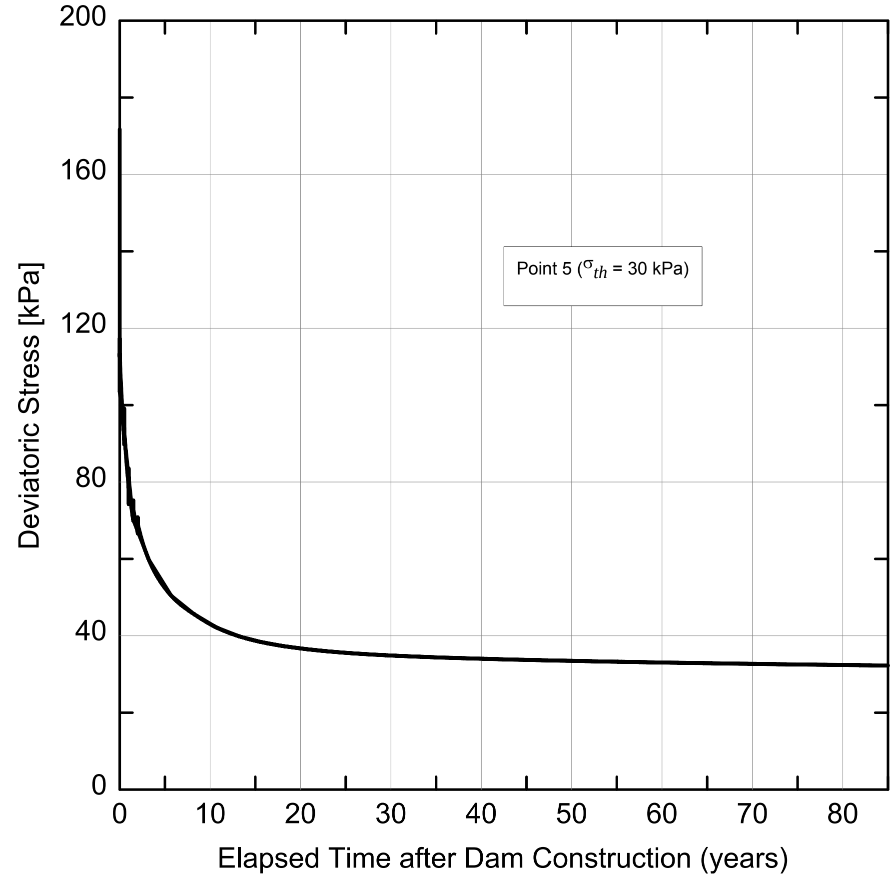
srk consulting	TMAC RESOURCES	Boston TMA Creep Deformation Analysis
		Shear Strain Rate History Points 4 and 5
Job No: 1CT022.013 Filename: Boston_DSTSF_CreepDeformationAnalysis_Memo_Figures_1CT022-013_Rev06.pptx	HOPE BAY PROJECT	Date: 11/28/2017 / Approved: EL / Figure: **10**



Notes:
1. Units in Pascals
2. Bedrock is included in the Figure
3. Results for a salinity of 37 ppt in the frozen foundation
   and a threshold stress of σ_{th} =30 kPa

srk consulting	TMAC RESOURCES	Boston TMA Creep Deformation Analysis
		Principal Stress Difference 80 years After Dam Construction
Job No: 1CT022.013 Filename: Boston_DSTSF_CreepDeformationAnalysis_Memo_Figures_1CT022-013_Rev06.pptx	HOPE BAY PROJECT	Date: 11/28/2017 · Approved: EL · Figure: 11

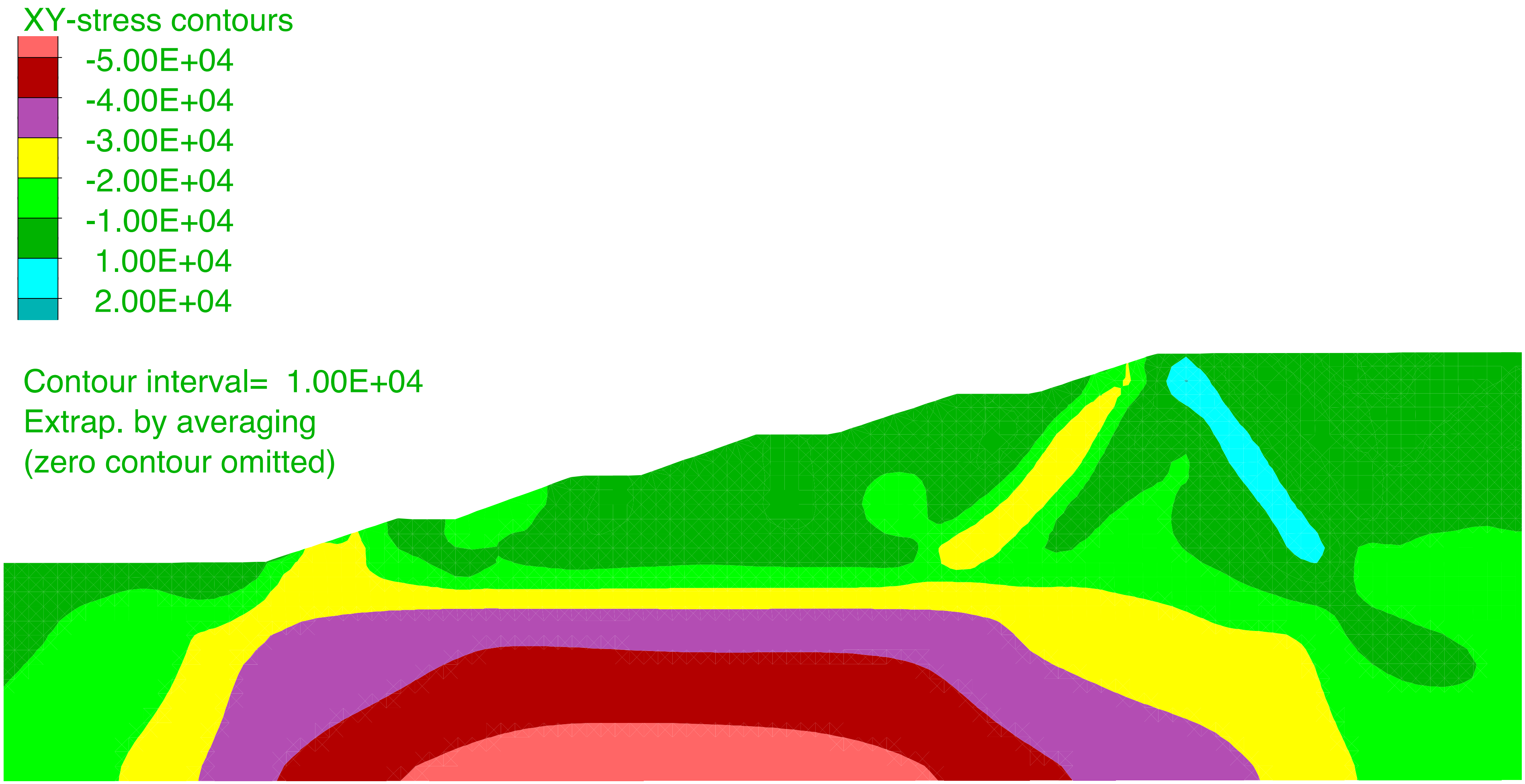




Notes:

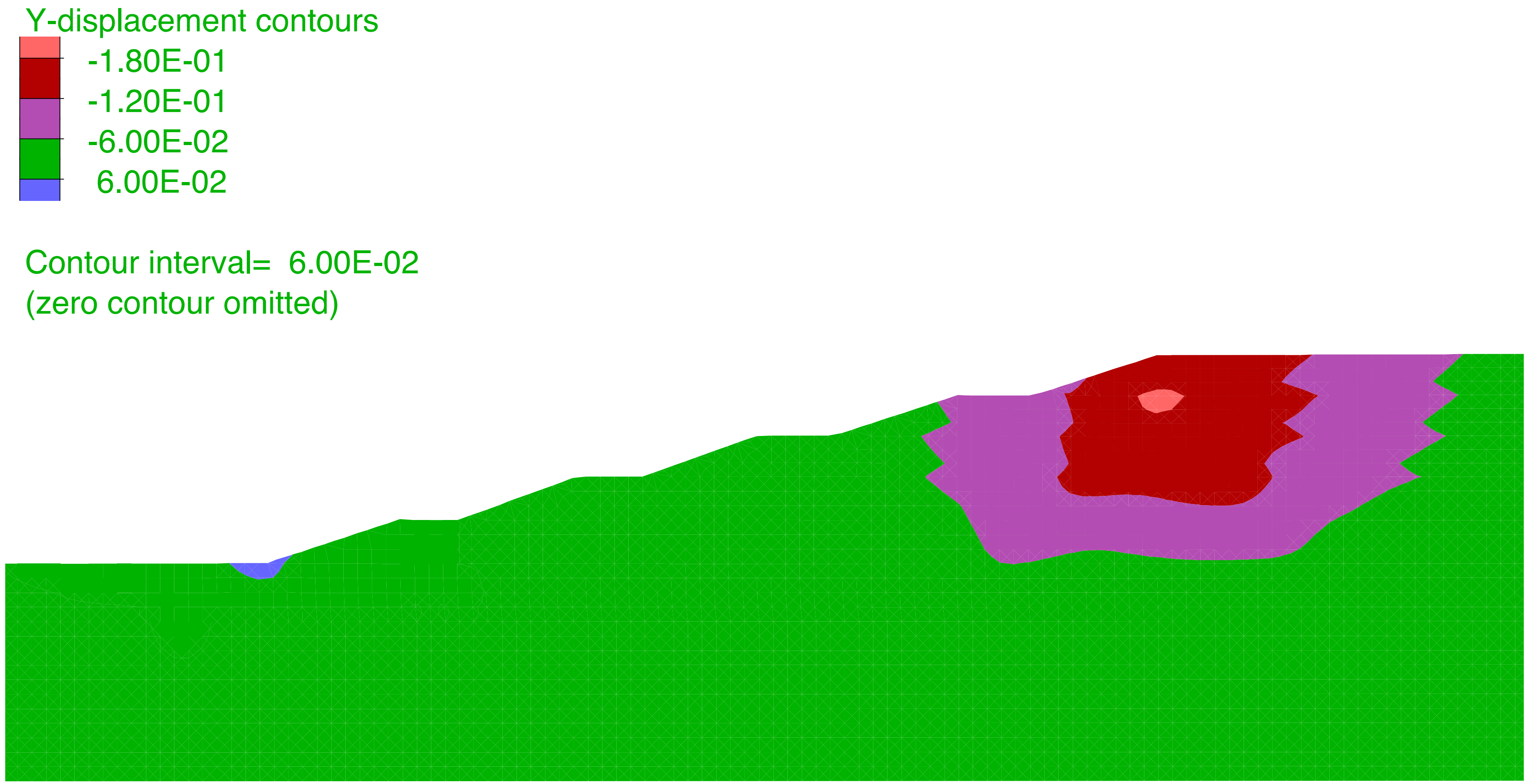
1. See Figure 6 for reference (Points 4 and 5)

srk consulting	TMAC RESOURCES	Boston TMA Creep Deformation Analysis
		Deviatoric Stress History Points 4 and 5
Job No: 1CT022.013 Filename: Boston_DSTSF_CreepDeformationAnalysis_Memo_Figures_1CT022-013_Rev06.pptx	HOPE BAY PROJECT	Date: 11/28/2017 · Approved: EL · Figure: **12**



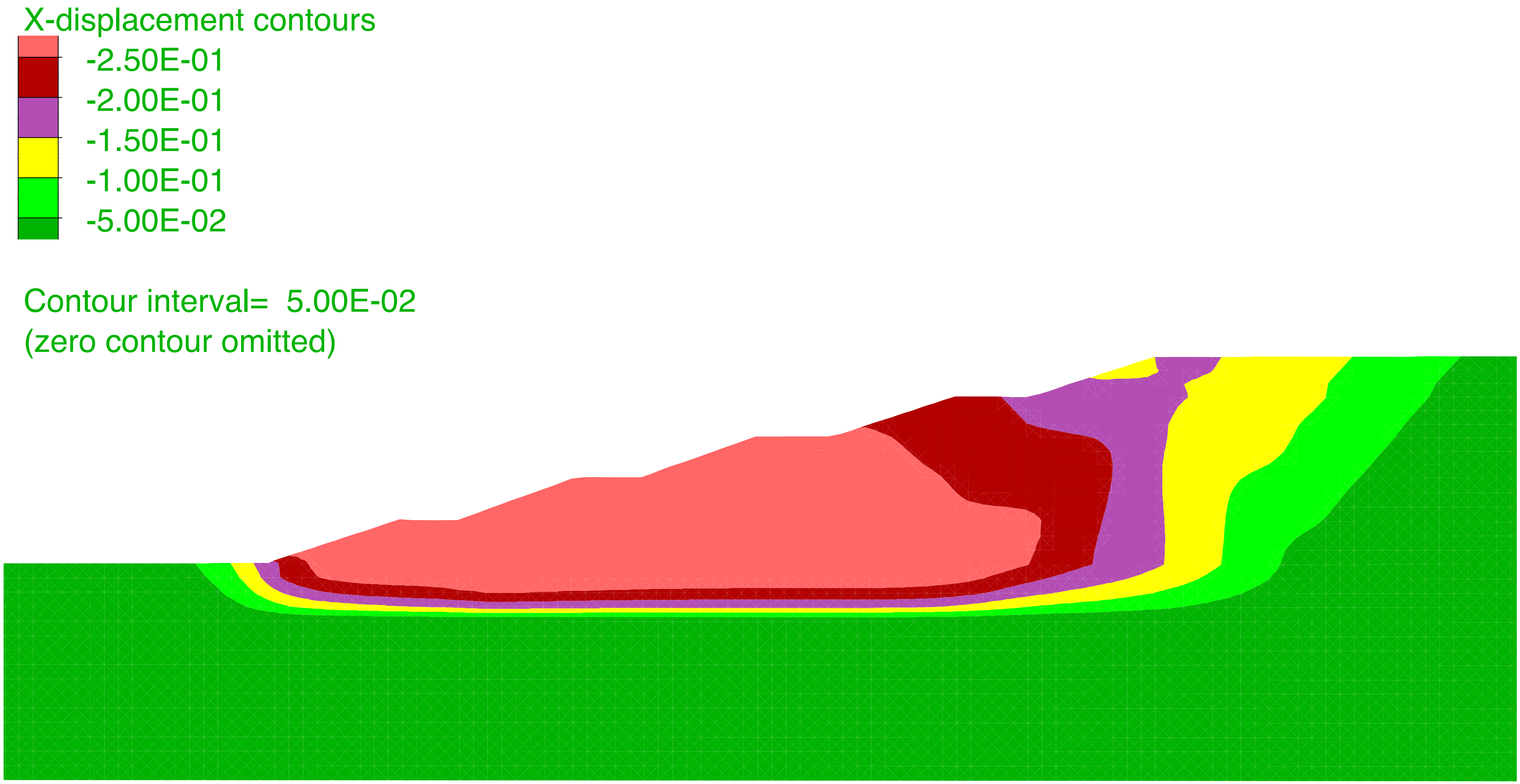
Notes:
1. Units in Pascals
2. Bedrock is included in the Figure
3. Results for a salinity of 37 ppt in the frozen foundation and a threshold stress of σ_{th} =30 kPa

srk consulting	TMAC RESOURCES	Boston TMA Creep Deformation Analysis
		Shear Stresses 80 years After Dam Construction
Job No: 1CT022.013 Filename: Boston_DSTSF_CreepDeformationAnalysis_Memo_Figures_1CT022-013_Rev06.pptx	HOPE BAY PROJECT	Date: 11/28/2017 / Approved: EL / Figure: 13



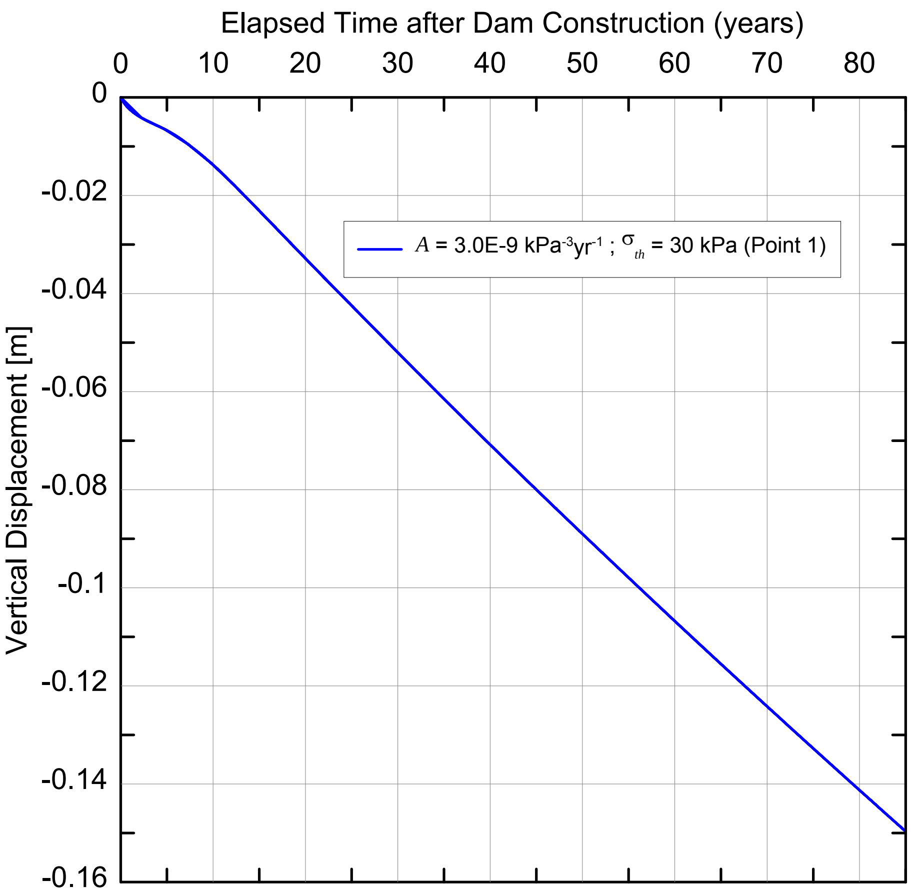
Notes:
1. Units in meters
2. Bedrock is included in the Figure
3. Results for a salinity of 37 ppt in the frozen foundation and a threshold stress of σ_{th} =30 kPa

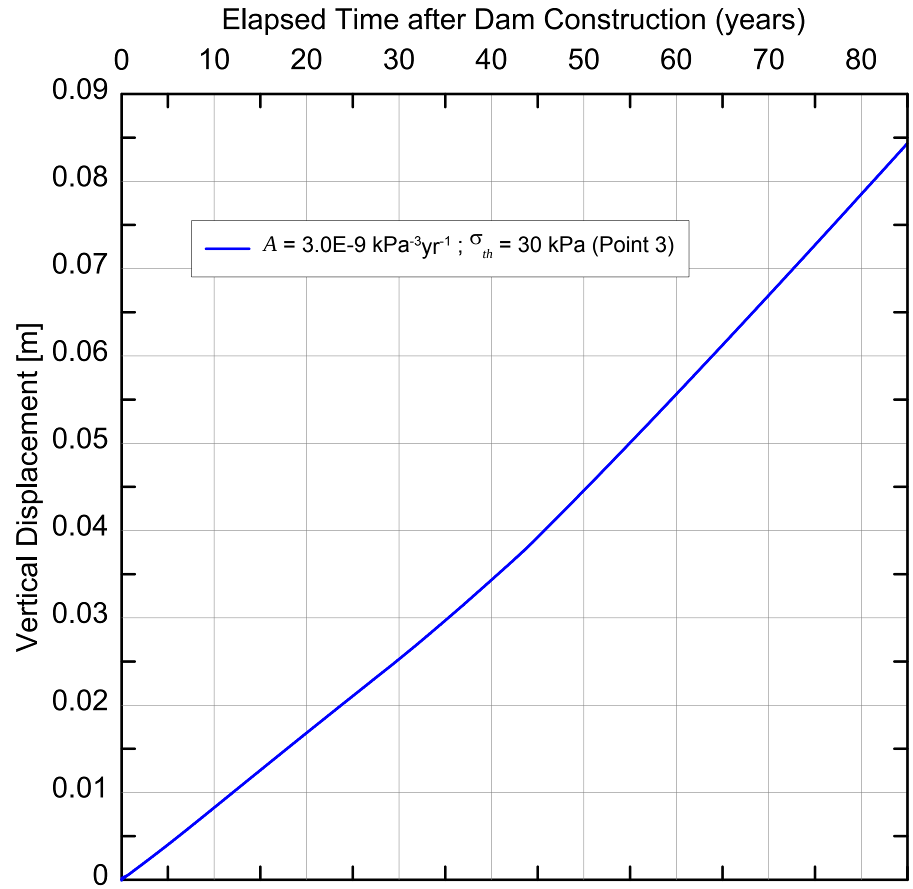
srk consulting	TMAC RESOURCES	Boston TMA Creep Deformation Analysis
		Vertical Displacements 80 years After Dam Construction
Job No: 1CT022.013 Filename: Boston_DSTSF_CreepDeformationAnalysis_Memo_Figures_1CT022-013_Rev06.pptx	HOPE BAY PROJECT	Date: 11/28/2017 · Approved: EL · Figure: **14**



Notes:
1. Units in meters
2. Bedrock is included in the Figure
3. Results for a salinity of 37 ppt in the frozen foundation and a threshold stress of σ_{th} =30 kPa

srk consulting	TMAC RESOURCES	Boston TMA Creep Deformation Analysis
		Horizontal Displacements 80 years After Dam Construction
Job No: 1CT022.013 Filename: Boston_DSTSF_CreepDeformationAnalysis_Memo_Figures_1CT022-013_Rev06.pptx	HOPE BAY PROJECT	Date: 11/28/2017 · Approved: EL · Figure: **15**





Notes:

1. See Figure 6 for reference (Points 1 and 3)

srk consulting

TMAC RESOURCES

Boston TMA Creep Deformation Analysis

Vertical Displacements History Points 1 and 3

Job No: 1CT022.013

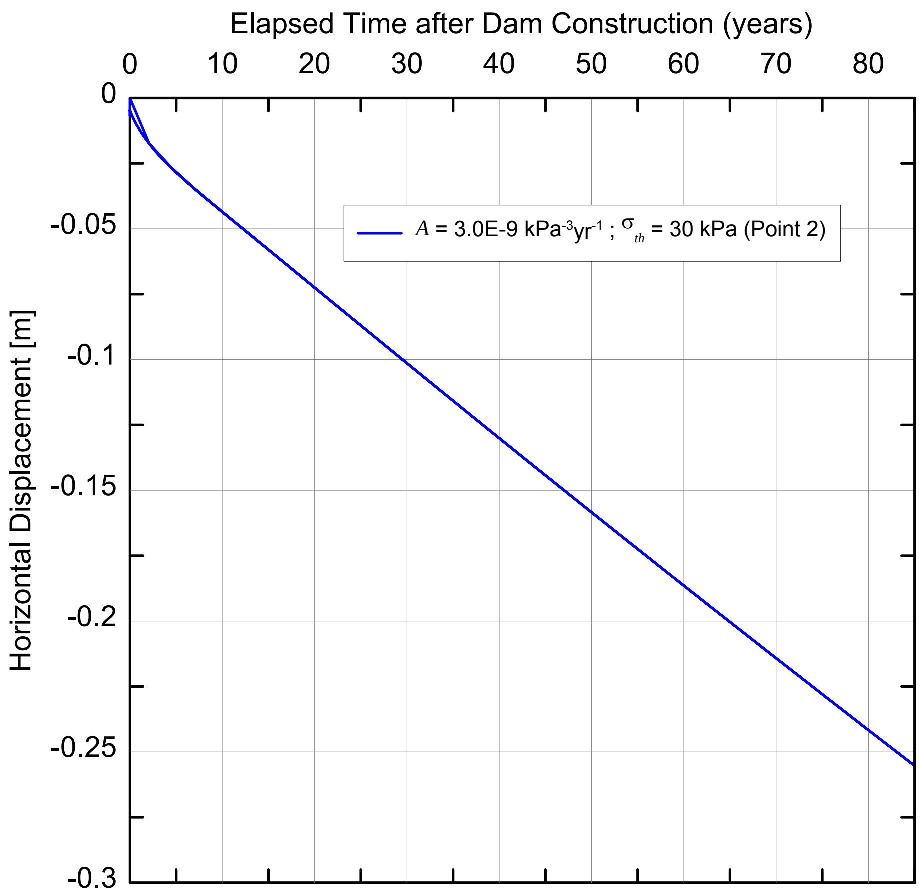
Filename: Boston_DSTSF_CreepDeformationAnalysis_Memo_Figures_1CT022-013_Rev06.pptx

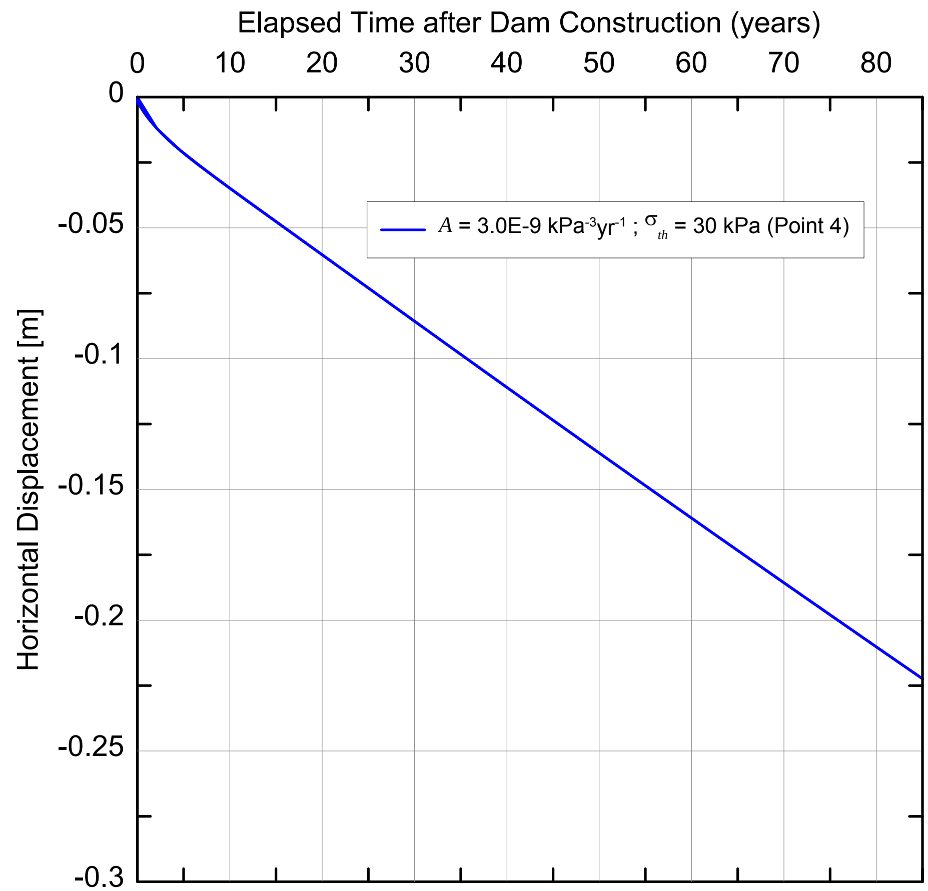
HOPE BAY PROJECT

Date: 11/28/2017

Approved: EL

Figure: 16

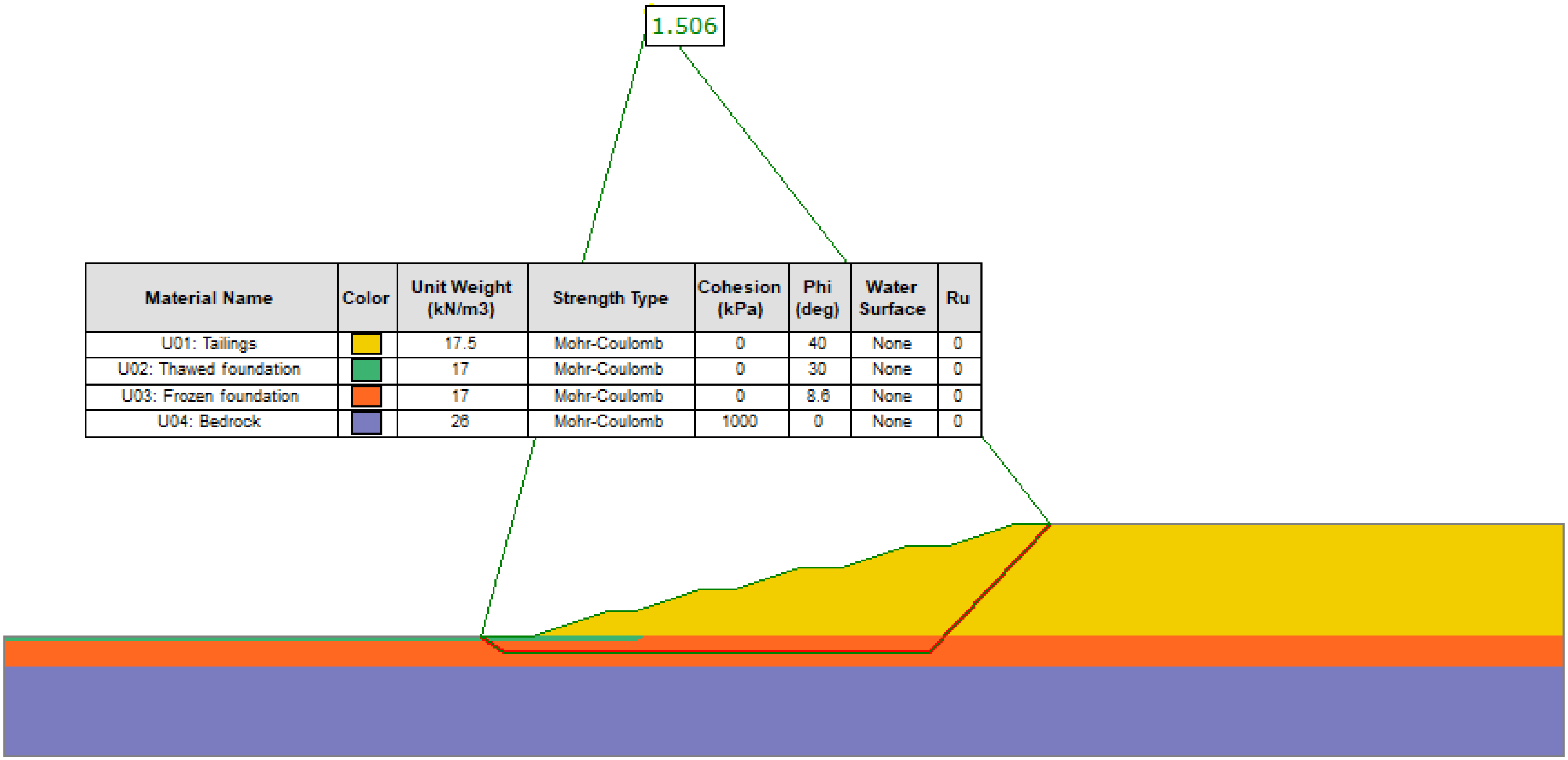




Notes:

1. See Figure 6 for reference (Points 2 and 4)

srk consulting	TMAC RESOURCES	Boston TMA Creep Deformation Analysis
		Horizontal Displacements History Points 2 and 4
Job No: 1CT022.013 Filename: Boston_DSTSF_CreepDeformationAnalysis_Memo_Figures_1CT022-013_Rev06.pptx	HOPE BAY PROJECT	Date: 11/28/2017 · Approved: EL · Figure: **17**



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
U01: Tailings		17.5	Mohr-Coulomb	0	40	None	0
U02: Thawed foundation		17	Mohr-Coulomb	0	30	None	0
U03: Frozen foundation		17	Mohr-Coulomb	0	8.6	None	0
U04: Bedrock		26	Mohr-Coulomb	1000	0	None	0

srk consulting

TMAC RESOURCES

Boston TMA Creep Deformation Analysis

Stability Analysis

Job No: 1CT022.013

Filename: Boston_DSTSF_CreepDeformationAnalysis_Memo_Figures_1CT022-013_Rev06.pptx

HOPE BAY PROJECT

Date: 11/28/2017

Approved: EL

Figure: 18

3. ID #KIA-IR03

3.1 SUBJECT/TOPIC

Hope Bay Project Doris-Madrid Water Management Plan / Discharge of Contact Water to Tundra (BGC)

3.2 REFERENCES

- P4-7 Hope Bay Project Doris-Madrid Water Management Plan / Section 4.2, and Figure 1

3.3 SUMMARY

The sections describing monitoring of the Contact Water Ponds suggest that discharge of excess contact water to tundra is contemplated, as an alternative to dewatering to the TIA. However, Figure 1 does not illustrate whether that discharge would be directly from the contact water ponds, or how that effluent would be managed and monitored. Suggest providing more clarity about how contact water would be managed and monitored prior to discharge to tundra. Recommend illustrating the potential discharge of contact water to tundra on Figure 1.

3.4 DISCUSSION

3.4.1 Importance of Issue to the Impact Assessment Process

It is important to understand how contact water would be managed and monitored in order to assess the adequacy of plans.

3.4.2 Detailed Review Comment

Additional information on the discharge of contact water is required.

3.5 RECOMMENDATION/REQUEST

Recommend providing more clarity about how contact water would be managed and monitored prior to discharge to tundra. Recommend illustrating the potential discharge of contact water to tundra on Figure 1.

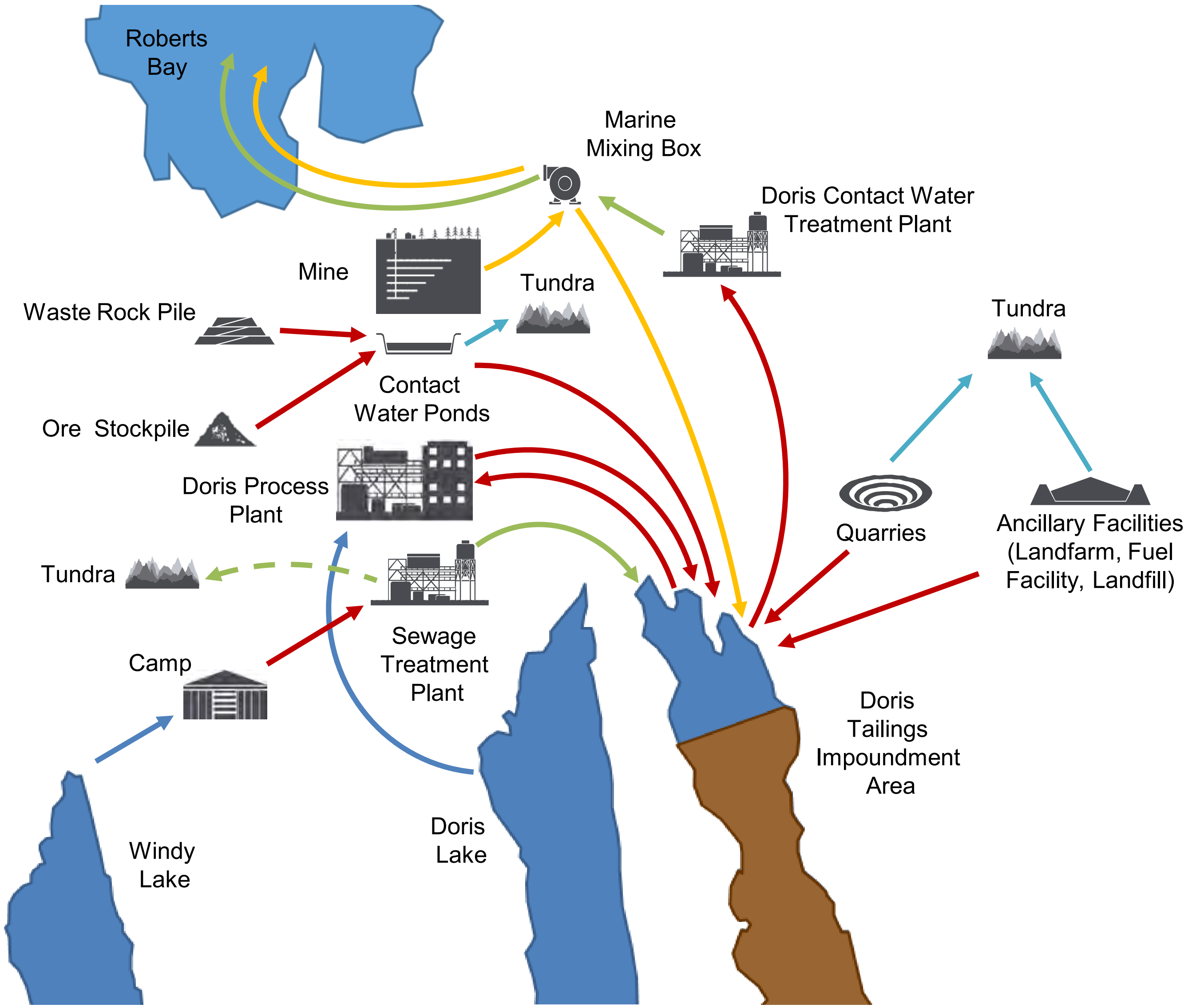
3.6 TMAC RESPONSE

TMAC acknowledges that the previous Figure 1 does not show the potential discharge from the contact water ponds to the tundra. An updated Figure 1 and Figure 2 is provided as an attachment to this document.

Contact water within the Contact Water Ponds at Madrid will be managed and monitored prior to discharge to tundra, in the same manner as for all other contact water ponds and consistent with existing practices at the Doris mine.

As stated in Supporting Document P4-7 (Hope Bay Project – Doris and Madrid Water Management Plan – SRK Consulting, November 2017), Sections 3.2.2, 3.2.3; 4.2.1, 4.2.2 and 4.2.3: "A water quality sample will be collected prior to discharge. If water quality meets the designed criteria for discharge, excess water may be discharged to tundra at an approved location."

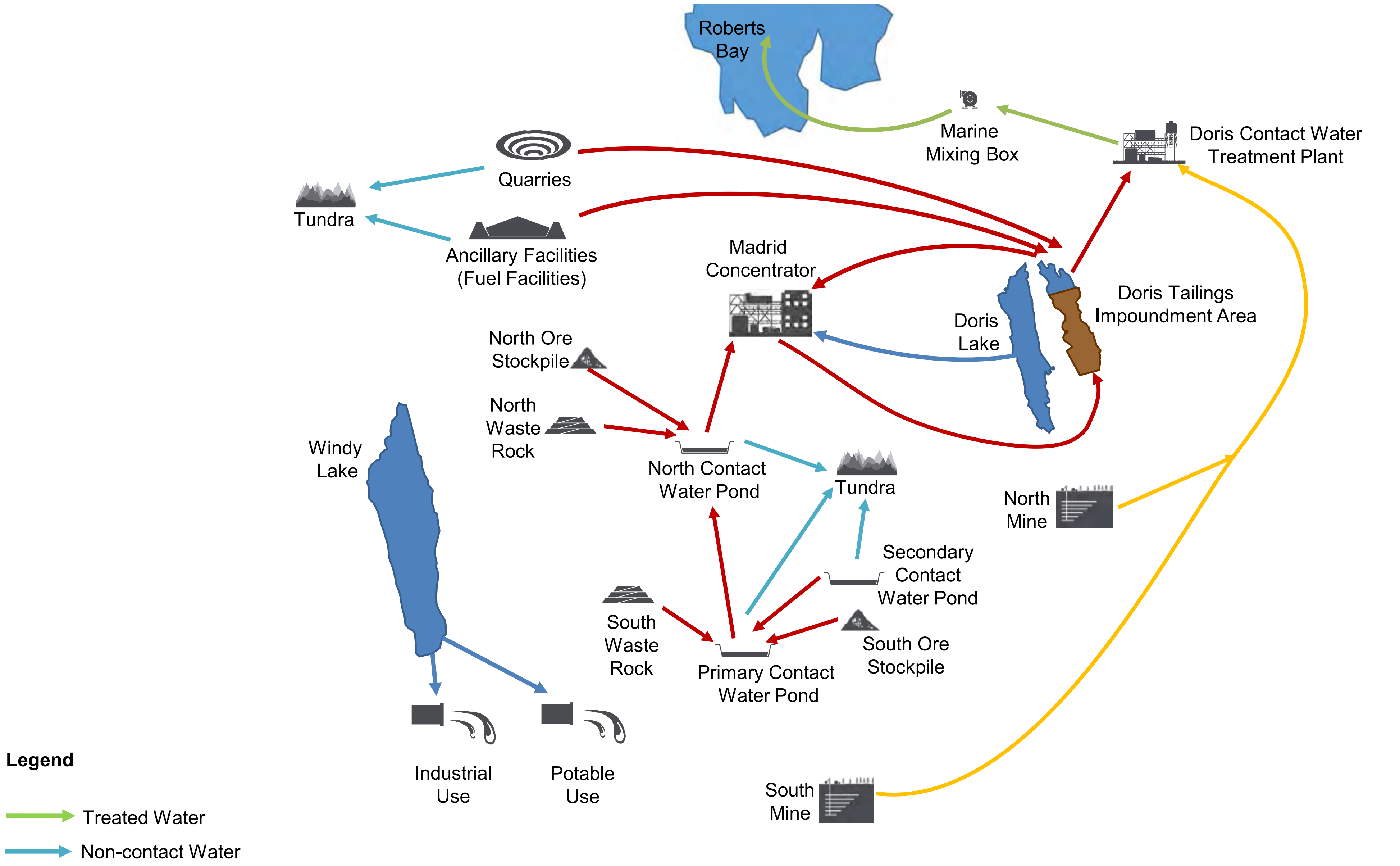
All volumes of water movements will be monitored with flow meters, tracked by truck load, or otherwise quantified as appropriate during the transfers, including, discharges to tundra as per Supporting Document P4-7 (Hope Bay Project - Doris and Madrid Water Management Plan), Section 5.5.2.



Legend

- Treated Water (Operations)
- Non-contact Water
- Freshwater
- Contact Water
- Mine Water
- Treated Water (Closure and Construction

srk consulting	MAC RESOURCES	Water Management
		Water Management Schematic-Doris
Job No: 1CT022.013 Filename: HopeBay_WaterMgmtSchematics_20171121_1CT022-012_sab_ajb_CH_sst.pptx	HOPE BAY PROJECT	Date: Feb. 2018 / Approved: SAB / Figure: 1



srk consulting

MAC RESOURCES

Water Management

Water Management Schematic-Madrid

Job No: 1CT022.013
Filename: HopeBay_WaterMgmtSchematics_20171121_1CT022-012_sab_ajb_CH_sst.pptx

HOPE BAY PROJECT

Date:	Approved:	Figure:
Feb. 2018	SAB	2

4. ID #KIA-IR04

4.1 SUBJECT/TOPIC

Hope Bay Project Boston Water Management Plan / Discharge of Contact Water to Tundra (BGC)

4.2 REFERENCES

- P4-8 Hope Bay Project - Boston Water Management Plan / Sections 3.2, 3.4, and Figure 1

4.3 SUMMARY

The sections describing monitoring of Contact Water Pond #1 and the TMA Contact Water Ponds suggest that discharge of contact water to tundra is contemplated, if discharge criteria are met. However, Figure 1 does not illustrate whether that discharge would be directly from the contact water ponds, or how that effluent would be managed and monitored. We suggest providing more clarity about how contact water would be managed and monitored prior to discharge to tundra.

4.4 DISCUSSION

4.4.1 Importance of Issue to the Impact Assessment Process

It is important to understand how contact water would be managed and monitored in order to assess the adequacy of plans.

4.4.2 Detailed Review Comment

Additional information on the management and monitoring of contact water is required.

4.5 RECOMMENDATION/REQUEST

- We recommend providing more clarity about how contact water from Contact Water Pond #1 and the TMA Contact Water Ponds would be managed and monitored prior to discharge to tundra.

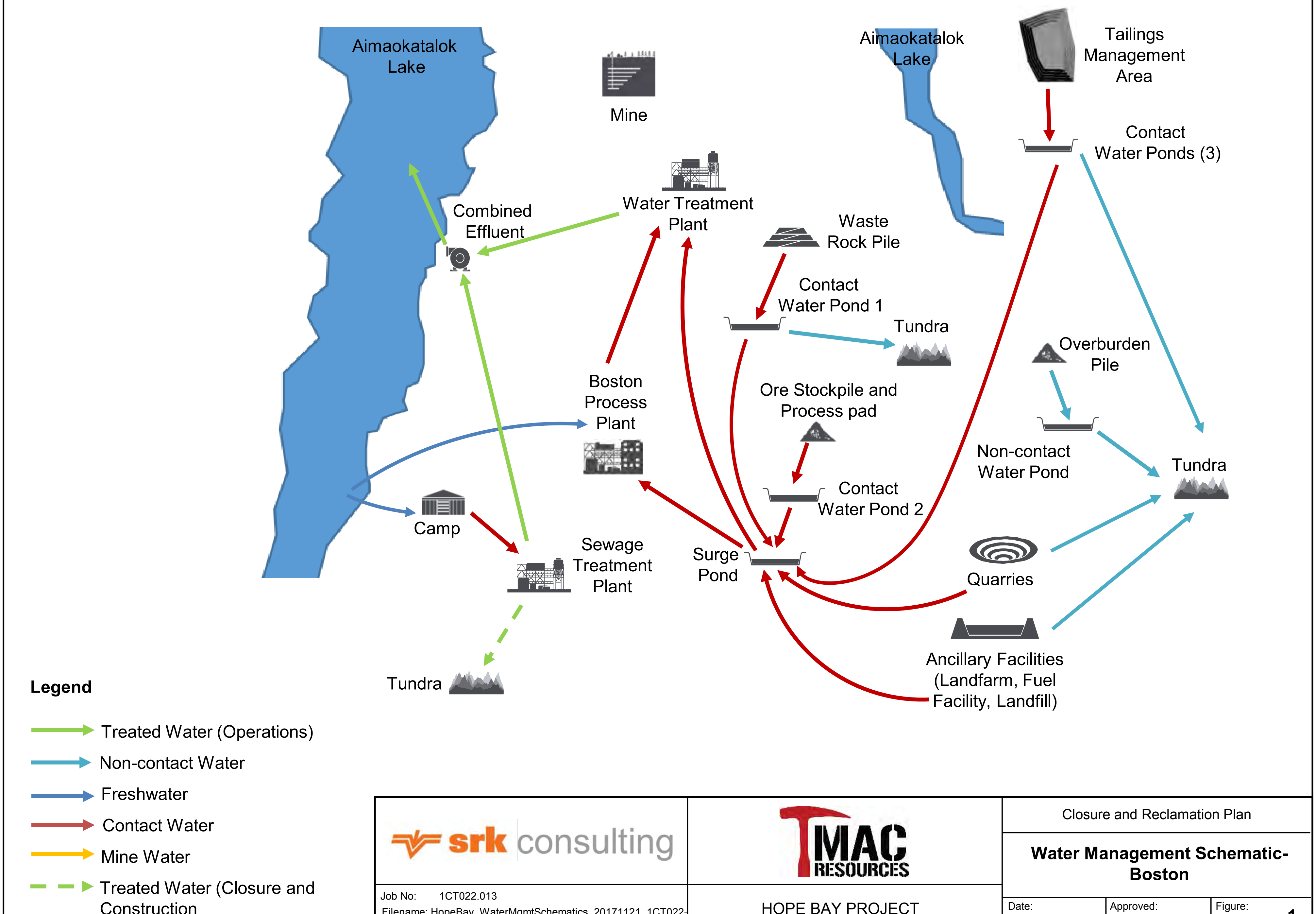
4.6 TMAC RESPONSE

TMAC acknowledges that the previous Figure 1 does not show the potential discharge from the contact water ponds to the tundra. An updated Figure 1 is provided as an attachment to this document.

Contact water within the Boston Contact Water Ponds will be managed and monitored prior to discharge to tundra, in the same manner as for all other water contact water ponds and consistent with the existing practices at the Doris mine.

As stated in Supporting Document P4-8(Hope Bay Project - Boston Water Management Plan), Sections 3.2.2, 3.4.2 and 3.5.2: "A water quality sample will be collected prior to discharge. If water quality meets the designed criteria for discharge, excess water may be discharged to tundra at an approved location."

All volumes of water movements will be monitored with flow meters, tracked by truck load, or otherwise quantified as appropriate during the transfers, including, discharges to tundra as per Supporting Document P4-8 (Hope Bay Project - Boston Water Management Plan), Section 4.4.2.



srk consulting	MAC RESOURCES	Closure and Reclamation Plan
		Water Management Schematic-Boston
Job No: 1CT022.013 Filename: HopeBay_WaterMgmtSchematics_20171121_1CT022-012_sab_ajb_CH_sst.pptx	HOPE BAY PROJECT	Date: Feb. 2018 / Approved: SAB / Figure: 1

5. ID #KIA-IR05

5.1 SUBJECT/TOPIC

Boston Conceptual Closure & Reclamation Plan/ General Comments (BGC)

5.2 REFERENCES

- P4-19 Hope Bay Project Boston Conceptual Closure and Reclamation Plan – SRK Consulting, November 2017

5.3 SUMMARY

Overall, we find the CCRP to be very well written, comprehensive, and consistent with best practices and relevant guidelines. As discussed in more detail in the comments below, there are two areas where we recommend additional information: 1) A more complete discussion of the overall closure goal, principles, and objectives consistent with NWT 2013 closure guidelines; and 2) More clarity regarding those uncertainties which could delay or prevent meeting the closure objectives, or requiring additional water management activities, for the TMA.

5.4 DISCUSSION

5.4.1 Importance of Issue to the Impact Assessment Process

A clear and complete closure goal is important for providing the overall vision and purpose; Closure principles are important for guiding the selection of specific objectives, which in turn describe what the selected closure activities are aiming to achieve. A better understanding of the geochemical uncertainties is important for ensuring that adequate contingency has been considered for those facilities.

5.4.2 Detailed Review Comment

Additional clarity on closure goals is required.

Additional clarity on the uncertainties regarding being able to achieve closure goals is required.

5.5 RECOMMENDATION/REQUEST

We recommend: 1) A more complete discussion of the overall closure goal, principles, and objectives consistent with NWT 2013 closure guidelines; and 2) More clarity regarding those uncertainties, which could delay or prevent meeting the closure objectives, or may require additional water management/treatment activities, at the TMA.

5.6 TMAC Response

Supporting Document P4-19 (Hope Bay Project Boston Conceptual Closure and Reclamation Plan – SRK Consulting, November 2017), Section 1.6 clearly states the overarching closure objectives and criteria for the project, and in accordance with the NWT 2013 closure guideline, component specific closure objectives and criteria are detailed in Section 4.4. Considering the adopted closure principles, objectives and criteria are completely consistent with the NWT 2013 closure guidelines, no additional discussion is needed.

Supporting Document P4-19, Section 8 describes contingencies specifically as a result of project uncertainties. In this regard it is specifically recognized that should water quality predictions not materialize there may be a need for longer term water quality monitoring, and possibly water treatment. Comprehensive details regarding the water quality modeling is presented in Supporting Document P5-4 (Madrid-Boston Project Water and Load Balance, Hope Bay Project), and therefore this information is not repeated in the closure plan.

6. ID #KIA-IR06

6.1 SUBJECT/TOPIC

Boston Conceptual Closure & Reclamation Plan/ Closure Goal, Principles, and Objectives (BGC)

6.2 REFERENCES

- P4-19 Hope Bay Project Boston Conceptual Closure and Reclamation Plan – SRK Consulting, November 2017.

6.3 SUMMARY

Recommend making the discussion of Closure Goals, Principles, and Objectives consistent between the Boston CRCP and Doris-Madrid IRCP. We acknowledge that each site may have unique aspects, and therefore different objectives and criteria. However, the guiding goals and principles should be generally consistent across the project. Both documents state that the plan follows the NWT Closure guidance (MVLWB/AANDC 2013), so we recommend that the document include a discussion of the closure goal and principles consistent with the NWT closure guidance. For reference, we suggest considering the approach in Figure 2 of the NWT guidance document.

6.4 DISCUSSION

6.4.1 Importance of Issue to the Impact Assessment Process

Consistency between Hope Bay plans is important for ensuring that project goals are met.

6.4.2 Detailed Review Comment

The current discussion of closure goals, principles, and objectives is currently inconsistent between plans. The Doris-Madrid ICRP does not discuss a closure goal.

6.5 RECOMMENDATION/REQUEST

Recommend making the discussion of Closure Goals, Principles, and Objectives consistent between the Boston CRCP and Doris-Madrid IRCP. For reference, we suggest considering the approach in Figure 2 of the 2013 NWT guidance document.

6.6 TMAC RESPONSE

Sections 1.6 of both Supporting Document P4-19 (Hope Bay Project Boston Conceptual Closure and Reclamation Plan – SRK Consulting, November 2017), and Supporting Document P4-21 (Hope Bay Project Doris-Madrid Interim Closure and Reclamation Plan – SRK Consulting, November 2017), describe the closure principles, objectives and goals of the respective closure plans. Although these sections are not word-for-word identical, the overriding principles, objectives and goals are identical and match exactly the NWT 2013 closure guidelines. Furthermore, both these closure plans are following exactly the process outlined in Figure 2 of the NWT guideline.

7. ID #KIA-IR07

7.1 Subject/Topic

Boston Conceptual Closure & Reclamation Plan/ Closure Principles (BGC)

7.2 References

- P4-19 Hope Bay Project Boston Conceptual Closure and Reclamation Plan – SRK Consulting, November 2017 / Section 1.6.

7.3 Summary

The stated objectives are consistent with the NWT closure guidance principals of chemical stability, physical stability, and future use. However, they do not address the 4th principle of "No long-term active care". If that is assumed, it should be stated here. If that is not an objective for this site, we recommend making that clear to the reader.

7.4 Discussion

7.4.1 Importance of Issue to the Impact Assessment Process

It is important for closure planning to know whether achieving no long-term active care will be a principle at this site, as it guides facility objectives.

7.4.2 Detailed Review Comment

The current document does not state whether the closure principles for this site includes no long-term active care.

7.5 Recommendations/Request

We recommend either including closure principle of no long-term active care, or alternatively state that it is not a principle used for developing closure objectives at this site. We also recommend that the "future land use goals" be better defined here.

7.6 TMAC Response

Although not stated explicitly that no long-term active care is a closure principle, it should be evident that in no place does the proposed closure plan require long-term active care. This is further demonstrated by Supporting Document P4-20 (Hope Bay Project Boston Interim Closure and Reclamation Plan, Detailed Cost Estimate – SRK Consulting, November 2017) which does not include any long-term active care costs. Future land use goals are explicitly stated in Section 1.6 of the closure plan.

8. ID #KIA-IR08

8.1 SUBJECT/TOPIC

Boston Conceptual Closure & Reclamation Plan/ Tailings Management Area (BGC)

8.2 REFERENCES

- P4-19 Hope Bay Project Boston Conceptual Closure and Reclamation Plan – SRK Consulting, November 2017 / Section 4.4.4.

8.3 SUMMARY

A low-infiltration cover placed over the tailings at closure will minimize seepage, but it is not clear that it would eliminate seepage altogether. A sentence here describing how any metal-leaching seepage would be managed is recommended. It is also recommended that any uncertainties about the ability to meet discharge water quality objectives at the TMA be clearly described here.

8.4 DISCUSSION

8.4.1 Importance of Issue to the Impact Assessment Process

Understanding the uncertainty about tailings seepage, and the ability to meet discharge criteria from the closed tailings is important for assessing contingencies.

8.4.2 Detailed Review Comment

The document currently does not state whether seepage from the closed tailings would be eliminated, how it would be managed, and if it is anticipated to meet discharge criteria.

8.5 RECOMMENDATIONS/REQUEST

- We recommend clearly stating whether seepage from the closed tailings is anticipated, how it would be managed, and if it would meet discharge criteria. If this is not known, we recommend a more detailed discussion of the uncertainties.

8.6 TMAC RESPONSE

Supporting Document P4-19 (Hope Bay Project Boston Conceptual Closure and Reclamation Plan – SRK Consulting, November 2017), Section 4.4.4 stipulates the Tailings Management Area (TMA) closure objectives and criteria which includes chemical stability, to ensure that a low infiltration cover is required. A detailed assessment of the seepage rate through the TMA low infiltration cover is provided in Supporting Document P5-26 (Boston Tailings Management Area Preliminary Design Hope Bay Project) Appendix E, and Supporting Document P5-4 (Madrid-Boston Project Water and Load Balance, Hope Bay Project) which provides details regarding the efficacy of this cover to meet the stated objectives.

9. ID #KIA-IR09

9.1 Subject/Topic

Boston Conceptual Closure & Reclamation Plan/ Temporary Closure (BGC)

9.2 References

- P4-19 Hope Bay Project Boston Conceptual Closure and Reclamation Plan – SRK Consulting, November 2017 / Section 6.4.

9.3 Summary

This section currently states that is the case of temporary closure that "all treatments (physical, chemical, biological) in accordance with the Project" would be continued. It should be clarified in this section if the Water Treatment Plant would remain in operation during temporary closure, and if contact water would continue to accumulate in the contact water ponds, thereby requiring active management.

9.4 Discussion

9.4.1 Importance of Issue to the Impact Assessment Process

Understanding the requirement for water management and treatment during temporary closure is important for assessing the scope of required activities during temporary closure.

9.4.2 Detailed Review Comment

It is currently not clear if the Water Treatment Plant would remain in operation during temporary closure, and if contact water would continue to accumulate in the contact water ponds, thereby requiring active management.

9.5 Recommendations/Request

We recommend clarifying in this section if the Water Treatment Plant would remain in operation during temporary closure, and if contact water would continue to accumulate in the contact water ponds, thereby requiring active management.

9.6 TMAC Response

Contact water will continue to collect in contact water ponds and active water management will continue, including any water treatment as has been clearly stated in

Supporting Document P4-19 (Hope Bay Project Boston Conceptual Closure and Reclamation Plan – SRK Consulting, November 2017), Section 6.4: "Continue all treatments (physical, chemical, biological) in accordance with the Project".

10. ID #KIA-IR10

10.1 SUBJECT/TOPIC

Boston Interim Closure & Reclamation Plan Detailed Cost Estimate (BGC)

10.2 REFERENCES

- P4-20 Hope Bay Project Boston Interim Closure and Reclamation Plan, Detailed Cost Estimate – SRK Consulting, November 2017

10.3 SUMMARY

Overall, we find the Boston Detailed Cost Estimate to be comprehensive, and inline with the information provided in the accompanying CCRP. Our review found no data gaps, and all category cost estimates seem appropriate. A contingency of 20% of direct costs seems reasonable at this stage of the planning process. However, this assumes that our comments to the CCRP document regarding potential seepage from the covered tailings will be addressed. If it is not possible to provide additional details about potential seepage from the tailings, then a higher contingency amount may be warranted. The only additional item that we recommend revision to is the assumed frequency of post-closure water monitoring.

10.4 DISCUSSION

10.4.1 Importance of Issue to the Impact Assessment Process

Understanding the uncertainty about the ability to meet discharge criteria from the TIA is important for assessing contingencies.

10.4.2 Detailed Review Comment

Annual post-closure water sampling does not seem adequate given some uncertainty about seepage from the covered tailings. Until there is more certainty about the seepage, and that discharge criteria would be met, sampling should at least be quarterly for the first year. If criteria are being met, then an annual sampling program after that seems reasonable.

10.5 RECOMMENDATIONS/REQUEST

Recommend assuming quarterly water quality monitoring for the first year. If criteria are being met, then annual sampling for the remainder of the post-closure period.

10.6 TMAC RESPONSE

TMAC disagrees that quarterly sampling would be required for the first year; however, assuming it would be required, it should be pointed out that the cost of an annual sampling campaign is $35,000. Totalling the costs of three sampling campaigns would result in the need to increase the overall cost estimate by $105,000. The current closure cost estimate is $35,487,000 which includes a contingency allowance of $4,731,000. Therefore, this additional cost is 0.3% of the overall closure cost estimate and as a result more than adequately covered by the contingency.

11. ID #KIA-IR11

11.1 SUBJECT/TOPIC

Doris-Madrid Interim Closure & Reclamation Plan/ General Comments (BGC)

11.2 REFERENCES

- P4-21 Hope Bay Project Doris-Madrid Interim Closure and Reclamation Plan – SRK Consulting, November 2017.

11.3 SUMMARY

Overall, we find the ICRP to be very well written, comprehensive, and consistent with best practices and relevant guidelines. As discussed in more detail in the detailed review comments, there are two areas where we recommend additional information: 1) A more complete discussion of the overall closure goal, principles, and objectives consistent with NWT 2013 closure guidelines; and 2) More clarity regarding those geochemical uncertainties which could delay or prevent meeting the closure objectives, or may result in additional water management activities, at the TIA.

11.4 DISCUSSION

11.4.1 Importance of Issue to the Impact Assessment Process

A clear and complete closure goal is important for providing the overall vision and purpose; Closure principles are important for guiding the selection of specific objectives, which in turn describe what the selected closure activities are aiming to achieve. A better understanding of the geochemical uncertainties is important for ensuring that adequate contingency has been considered for those facilities.

11.4.2 Detailed Review Comment

The current document does not state whether the closure principles for this site include no long-term active care.

The document currently does not state whether seepage from the closed TIA is anticipated to meet discharge criteria.

The document currently does not describe what the uncertainty is regarding discharge water quality from the covered tailings surface

11.5 RECOMMENDATIONS/REQUEST

Recommend the following: 1) A more complete discussion of the overall closure goal, principles, and objectives consistent with NWT 2013 closure guidelines; and 2) More clarity regarding those geochemical uncertainties, which could delay or prevent meeting the closure objectives, or may result in additional water management activities, at the TIA.

11.6 TMAC RESPONSE

Supporting Document P4-21 (Hope Bay Project Doris-Madrid Interim Closure and Reclamation Plan – SRK Consulting, November 2017), Section 1.6 clearly states the overarching closure objectives and criteria for the project, and in accordance with the NWT 2013 closure guideline, component specific closure objectives and criteria are detailed in Section 4.4. Considering the adopted closure principles, objectives and criteria are completely consistent with the NWT 2013 closure guidelines, no additional discussion is needed.

Supporting Document P4-21, Sections 4.6 and 4.8 describes uncertainties and contingencies specifically as a result of project uncertainties. In this regard it is specifically recognized that should water quality predictions not materialize there may be a need for longer term water quality monitoring, and possibly water treatment. Comprehensive details regarding the water quality modeling is presented in Supporting Document P5-4 (Madrid-Boston Project Water and Load Balance, Hope Bay Project), and therefore this information is not repeated in the closure plan.

12. ID #KIA-IR12

12.1 Subject/Topic

Doris-Madrid Interim Closure & Reclamation Plan/ Closure Goal, Principles, and Objectives (BGC)

12.2 References

- P4-21 Hope Bay Project Doris-Madrid Interim Closure and Reclamation Plan – SRK Consulting, November 2017

12.3 Summary

Recommend making the discussion of Closure Goals, Principles, and Objectives consistent between the Boston CRCP and Doris-Madrid IRCP. We acknowledge that each site may have unique aspects, and therefore different objectives and criteria. However, the guiding goals and principles should be generally consistent across the project. Both documents state that the plan follows the NWT Closure guidance (MVLWB/AANDC 2013), so it is recommended that the document include a discussion of the closure goal and principles consistent with the NWT closure guidance. For reference, we suggest considering the approach in Figure 2 of the NWT guidance document.

12.4 Discussion

12.4.1 Importance of Issue to the Impact Assessment Process

Consistency between Hope Bay plans is important for ensuring that project goals are met.

12.4.2 Detailed Review Comment

The current discussion of closure goals, principles, and objectives is currently inconsistent between plans. The Doris-Madrid ICRP does not discuss a closure goal.

12.5 Recommendations/Request

We recommend making the discussion of Closure Goals, Principles, and Objectives consistent between the Boston CRCP and Doris-Madrid IRCP. For reference, we suggest considering the approach in Figure 2 of the 2013 NWT guidance document.

12.6 TMAC RESPONSE

Sections 1.6 of both Supporting Document P4-19 (Hope Bay Project Boston Conceptual Closure and Reclamation Plan – SRK Consulting, November 2017), and Supporting Document P4-21 (Hope Bay Project Doris-Madrid Interim Closure and Reclamation Plan – SRK Consulting, November 2017), describe the closure principles, objectives and goals of the respective closure plans. Although these sections are not word-for-word identical, the overriding principles, objectives and goals are identical and match exactly the NWT 2013 closure guidelines. Furthermore, both these closure plans are following exactly the process outlined in Figure 2 of the NWT guideline.

13. ID #KIA-IR13

13.1 Subject/Topic

Doris-Madrid Interim Closure & Reclamation Plan/ Closure Principles (BGC)

13.2 References

- HP4-21 Hope Bay Project Doris-Madrid Interim Closure and Reclamation Plan – SRK Consulting, November 2017 / Section 1.6.

13.3 Summary

The stated objectives are consistent with the NWT closure guidance principals of chemical stability, physical stability, and future use. However, they do not address the 4th principle of "No long-term active care". If that is assumed, it should be stated here. If that is not an objective for this site, we recommend making that clear to the reader.

13.4 Discussion

13.4.1 Importance of Issue to the Impact Assessment Process

It is important for closure planning to know whether achieving no long-term active care will be a principle at this site, as it guides facility objectives.

13.4.2 Detailed Review Comment

The current document does not state whether the closure principles for this site includes no long-term active care.

13.5 Recommendations/Request

We recommend either including closure principle of no long-term active care, or alternatively state that it is not a principle used for developing closure objectives at this site.

13.6 TMAC Response

Although not stated explicitly that no long-term active care is a closure principle, it should be evident that in no place does the proposed closure plan require long-term active care. This is further demonstrated by Supporting Document P4-22 (Hope Bay Project Doris-Madrid Interim Closure and Reclaim Detailed Cost) which does not include any long-term active care costs.

14. ID #KIA-IR14

14.1 SUBJECT/TOPIC

Doris-Madrid Interim Closure & Reclamation Plan/ Tailings Storage Area (BGC)

14.2 REFERENCES

- P4-21 Hope Bay Project Doris-Madrid Interim Closure and Reclamation Plan – SRK Consulting, November 2017 / Section 4.5.3

14.3 SUMMARY

This section does not discuss how seepage of metal leaching from the closed TIA will be minimized. There is some discussion about how water and load balance confirms that neutral metal leaching does not pose a "limitation" in ensuring that the water quality from the closed TIA meet the required closure water quality criteria. However, we recommend clearly stating whether seepage from the closed TIA is anticipated to meet discharge criteria. If uncertainty exists about this, it should be clearly stated here.

14.4 DISCUSSION

14.4.1 Importance of Issue to the Impact Assessment Process

Understanding the uncertainty about the ability to meet discharge criteria from the TIA is important for assessing contingencies.

14.4.2 Detailed Review Comment

1. The document currently does not state whether seepage from the closed TIA is anticipated to meet discharge criteria.

14.5 RECOMMENDATIONS/REQUEST

We recommend clearly stating whether seepage from the closed TIA is anticipated to meet discharge criteria. If not, we recommend more discussion of the uncertainties.

14.6 TMAC RESPONSE

Supporting Document P4-21 (Hope Bay Project Doris-Madrid Interim Closure and Reclamation Plan – SRK Consulting, November 2017), Section 4.5.3 stipulates the Tailings Impoundment Area (TIA) closure objectives and criteria which includes chemical stability to ensure that, only an isolation cover is required. A detailed assessment of the seepage rate through the isolation cover is provided in Supporting Document P5-9 (Geochemical Source Term Predictions for the Proposed Madrid-Boston Project – SRK Consulting, November 2017) Appendix C; additionally, Supporting Document P5-4 (Madrid-Boston Project Water and Load Balance, Hope Bay Project – SRK Consulting, November 2017) provides details regarding the efficacy of this cover to meet the stated objectives.

15. ID #KIA-IR15

15.1 SUBJECT/TOPIC

Doris-Madrid Interim Closure & Reclamation Plan/ Closure Uncertainties (BGC)

15.2 REFERENCES

- P4-21 Hope Bay Project Doris-Madrid Interim Closure and Reclamation Plan – SRK Consulting, November 2017 / Section 4.6

15.3 SUMMARY

This section currently states, "Discharge water quality from the covered tailings surface caries uncertainty which will only become clear once operational data has been evaluated in the period immediately preceding closure". The reason for this uncertainty regarding discharge water quality should be discussed in more detail. It is not clear if this uncertainty is related to inadequate geochemical characterization of the tailings, or about controls, which have not been engineered at this stage. We recommend some additional discussion about what the uncertainties are, and why they cannot be assessed prior to the end of mine life.

15.4 DISCUSSION

15.4.1 Importance of Issue to the Impact Assessment Process

Understanding the uncertainty about the ability to meet discharge criteria is important for assessing contingencies.

15.4.2 Detailed Review Comment

The document currently does not describe what the uncertainty is regarding discharge water quality from the covered tailings surface.

15.5 RECOMMENDATIONS/REQUEST

We recommend some additional discussion about what the discharge water quality uncertainties are, and why they cannot be assessed prior to the end of mine life.

15.6 TMAC RESPONSE

A detailed assessment of the seepage rate through the proposed isolation cover is provided in Supporting Document P5-9 (Geochemical Source Term Predictions for the

Proposed Madrid-Boston Project – SRK Consulting, November 2017) Appendix C, while Supporting Document P5-4 (Madrid-Boston Project Water and Load Balance, Hope Bay Project) provides details regarding the efficacy of this cover to meet the stated objectives. Inherent in these analysis are uncertainty which will be better understood as operational data becomes available.

16. ID #KIA-IR16

16.1 SUBJECT/TOPIC

P4-22 Doris-Madrid Interim Closure & Reclamation Plan Detailed Cost Estimate (BGC)

16.2 REFERENCES

- Hope Bay Project Doris-Madrid Interim Closure and Reclamation Plan, Detailed Cost Estimate – SRK Consulting, November 2017

16.3 SUMMARY

Overall, we find the ICRP Detailed Cost Estimate to be comprehensive, and inline with the information provided in the accompanying ICRP. Our review found no data gaps, and all category cost estimates seem appropriate. Of note, we find that a cost contingency of 20% of direct costs seems reasonable and adequate given the level of information at the site, and the known uncertainties. The only item that we recommend revision to is the assumed frequency of post-closure water monitoring.

16.4 DISCUSSION

16.4.1 Importance of Issue to the Impact Assessment Process

Understanding the water sampling requirements is required to assess the costs and adequacy of the post closure-monitoring plan.

16.4.2 Detailed Review Comment

Annual post-closure water sampling does not seem adequate given some uncertainty about discharge water quality described in the plan. Until there is more certainty that discharge criteria would be met, sampling should at least be quarterly for the first year. If criteria are being met, then an annual sampling program after that seems reasonable.

16.5 RECOMMENDATIONS/REQUEST

We recommend assuming quarterly water quality monitoring for the first year. If criteria are being met, then annual sampling for the remainder of the post-closure period.

16.6 TMAC RESPONSE

TMAC disagrees that quarterly sampling would be required for the first year; however, assuming that it would be required it should be pointed out that the cost of an annual sampling campaign is $35,000. Totalling the costs of three sampling campaigns would result in the need to increase the overall cost estimate by $105,000. The current closure cost estimate is $58,964,000 which includes a contingency allowance of $7,803,000. Therefore, this additional cost is 0.2% of the overall closure cost estimate and as a result more than adequately covered by the contingency.

17. ID #KIA-IR17

17.1 SUBJECT/TOPIC

P4-22 Doris-Madrid Interim Closure & Reclamation Plan Detailed Cost Estimate (BGC)

17.2 REFERENCES

- Hope Bay Project Doris-Madrid Interim Closure and Reclamation Plan, Detailed Cost Estimate – SRK Consulting, November 2017

17.3 SUMMARY

Overall, we find the ICRP Detailed Cost Estimate to be comprehensive, and inline with the information provided in the accompanying ICRP. Our review found no data gaps, and all category cost estimates seem appropriate. Of note, we find that a cost contingency of 20% of direct costs seems reasonable and adequate given the level of information at the site, and the known uncertainties. The only item that we recommend revision to is the assumed frequency of post-closure water monitoring.

17.4 DISCUSSION

17.4.1 Importance of Issue to the Impact Assessment Process

Understanding the water sampling requirements is required to assess the costs and adequacy of the post closure-monitoring plan.

17.4.2 Detailed Review Comment

Annual post-closure water sampling does not seem adequate given some uncertainty about discharge water quality described in the plan. Until there is more certainty that discharge criteria would be met, sampling should at least be quarterly for the first year. If criteria are being met, then an annual sampling program after that seems reasonable.

17.5 RECOMMENDATIONS/REQUEST

We recommend assuming quarterly water quality monitoring for the first year. If criteria are being met, then annual sampling for the remainder of the post-closure period.

17.6 TMAC RESPONSE

TMAC disagrees that quarterly sampling would be required for the first year; however, assuming that it would be required it should be pointed out that the cost of an annual sampling campaign is $35,000. Totalling the costs of three sampling campaigns would result in the need to increase the overall cost estimate by $105,000. The current closure cost estimate is $35,487,000 which includes a contingency allowance of $4,731,000. Therefore, this additional cost is 0.3% of the overall closure cost estimate and as a result more than adequately covered by the contingency.

18. ID #KIA-IR18

18.1 SUBJECT/TOPIC

Climate Change Analysis (BGC)

18.2 REFERENCES

- FEIS Volume 1 – Annex V1-7 Type A Water Licence Applications, Package P5-1 (Climate Change Analysis Approach Report, Hope Bay Project, November 2017, SRK Consulting)
- Section 4.2 / 4.3.

18.3 SUMMARY

TMAC presents air temperature projections for Doris/Madrid and Boston. The differences in these projections are significant with Doris/Madrid having a projected MAAT of -4.6° (2080) compared to -5.9°C (2080) for Boston, which is about 50 km south of Doris. However, both started with the similar current condition. On the other hand, snow accumulation at Boston is projected to be up to twice as high as Doris in the future. This may all be related to the proximity to the ocean.

18.4 DISCUSSION

18.4.1 Importance of Issue to the Impact Assessment Process

The difference in the projected air temperatures can affect the stability of the foundation. In addition, in order to have confidence in the climate model projection results it is important to understand regional effects. In particular, in Arctic regions, climate models still have significant uncertainties and downscaling can result in erroneous values that may end up being misinterpreted.

18.4.2 Detailed Review Comment

Gap/Issue

Significant discrepancies in projected air temperature values for the two locations Doris/Madrid and Boston.

Disagreement with WL information/ conclusion

Unclear which projection to use.

Reasons for Disagreement

See above.

18.5 RECOMMENDATIONS/REQUEST

TMAC should provide clarification on this issue and their confidence in the projected values.

18.6 TMAC RESPONSE

Differences in temperature projections between the Doris/Madrid site and Boston site should be expected due to the slight differences between the sites. For example, their distance from the ocean, as the reviewer mentions.

In regards to confidence in the projected values, as stated in Supporting Document P5-1 (Climate Change Analysis Approach Report, Hope Bay Project – SRK Consulting, November 2017) Section 2.1:

> *"There are few best practices and no common standards of practice that provide a prescribed and/or consistent process for incorporating climate change into engineering design (IAIA, 2010). This shortcoming has been identified as a barrier in the ability to address the impacts of climate change to infrastructure (CSA, 2012)."*

SRK Consulting (Canada) Inc. has developed a Standardized Procedure for Climate Change Integration into Engineering Design (Procedure). This Procedure was specifically developed to provide a practical, transparent and consistent approach for establishing defensible climate change design criteria for integration into engineering design. The process recognizes that engineering judgement is required, and ensures that these decisions are properly documented.

It is important to note that this Procedure is in addition to normal engineering best practices that are already implemented as a matter of course during engineering design. Such best practices already account for climate using historical records and projected trends, with consideration of site-specific scientific and engineering investigations, design codes, and the use of safety factors, risk management and professional judgement."

For example the reviewer raises concerns regarding foundation stability, all stability analyses for the project conservatively assume thawed foundation conditions.

19. ID #KIA-IR19

19.1 SUBJECT/TOPIC

Climate Change Analysis (BGC)

19.2 REFERENCES

- FEIS Volume 1 – Annex V1-7 Type A Water Licence Applications, Package P5-1 (Climate Change Analysis Approach Report, Hope Bay Project, November 2017, SRK consulting), Section 4.4.2.

19.3 SUMMARY

TMAC indicates specific and different changes in mean annual air temperatures. In Section 4, however, the site wide change in active layer thickness is projected to be 0.93 m, which implies high accuracy. Considering that the differences in the projected air temperatures are more than 1.3°C and the second and third order changes in the surface conditions it would have been more practical to provide a range of expected changes in active layer thicknesses for different soil types. In Table 5.1, the projection from Section 4.4.2 is put into perspective, but it is too qualitative.

19.4 DISCUSSION

19.4.1 Importance of Issue to the Impact Assessment Process

Changes in active layer thickness are important design parameters and can affect surface hydrology, during the project or at closure. Understanding potential ranges in active layer thickening over time and its regional difference is an important parameter.

19.4.2 Detailed Review Comment

Gap/Issue

Regional differences and range in changes of the active layer due to climate change are unclear.

Disagreement with WL information/ conclusion

Insufficient understanding of potential changes in the active layer thickness.

Reasons for Disagreement with DEIS Conclusion

See above.

19.5 RECOMMENDATIONS/REQUEST

TMAC should provide a comment on the projected range in active layer change.

19.6 TMAC RESPONSE

TMAC understands there is both regional differences and ranges in active layer thickness and natural active layer thickening over time. As stated in Supporting Document P5-1 (Climate Change Analysis Approach Report, Hope Bay Project – SRK Consulting, November 2017) Section 4.4.2: The active layer depth, based on ground temperatures measured in overburden soil averages 1.0 m, with a range from 0.5 to 1.7 m.

Whereas, in Supporting Document P5-1 (Climate Change Analysis Approach Report, Hope Bay Project – SRK Consulting, November 2017), Section 5: The depth and extent of the active layer increase will be variable as it is dependent on many factors including material, and snow cover. TMAC has modelled a realistic and conservative scenario (clay overburden) for assessment of the natural active layer thickness increase with climate change, and considers this in combination with the stated ranges in current active layer thickness on site sufficient for the understanding of the potential changes over the long term with climate change.

20. ID #KIA-IR20

20.1 SUBJECT/TOPIC

Water Balance Modelling – Baseline lake elevations (Palmer)

20.2 REFERENCES

- P5-4 Hope Bay Water Load Balance Report, Figure 6-4 (Wolverine Lake); Figure 6-7 (Imniagut Lake); Figure 6-11 (Patch Lake); Figure 6-17 (Doris Lake); Figure 6-20 (Windy Lake); Figure 6-24 (Stickleback Lake); Figure 6-28 (Aimaokatalok Lake)

20.3 SUMMARY

No baseline lake elevation lines are included in the plots showing predicted lake elevations

20.4 DISCUSSION

20.4.1 Importance of Issue to the Impact Assessment Process

Including the line representing baseline lake elevations in the figures helps with the interpretation of the water balance results and potential project effects.

20.4.2 Detailed Review Comment

Baseline lake elevation lines are not included in the modelled lake elevation plots.

20.5 RECOMMENDATIONS/REQUEST

Please add baseline lake elevation lines in the plots showing the lake elevations predicted in the water balance model.

20.6 TMAC RESPONSE

The following figures have been updated and are provided as an attachment to this document:

- Figure 6-4 - Wolverine Lake,
- Figure 6-7 - Imniagut Lake,
- Figure 6-11 - Patch Lake,
- Figure 6-17 - Doris Lake,

- Figure 6-20 - Windy Lake,
- Figure 6-24 - Stickleback Lake, and
- Figure 6-28 - Aimaokatalok Lake.

Baseline lake elevations at assessment nodes under the average, 1-in-20-year dry, and 1-in-20-year wet conditions are presented in Appendix V5-1N of the FEIS.

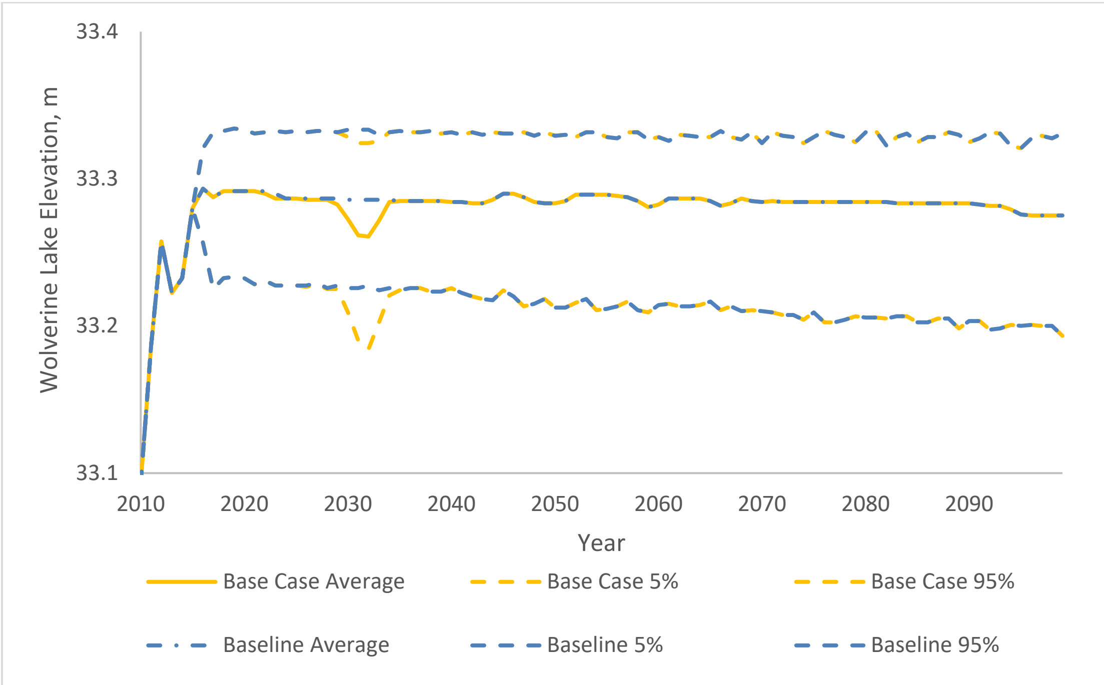


Figure 6-4: Annual Average Wolverine Lake Elevation Probabilities

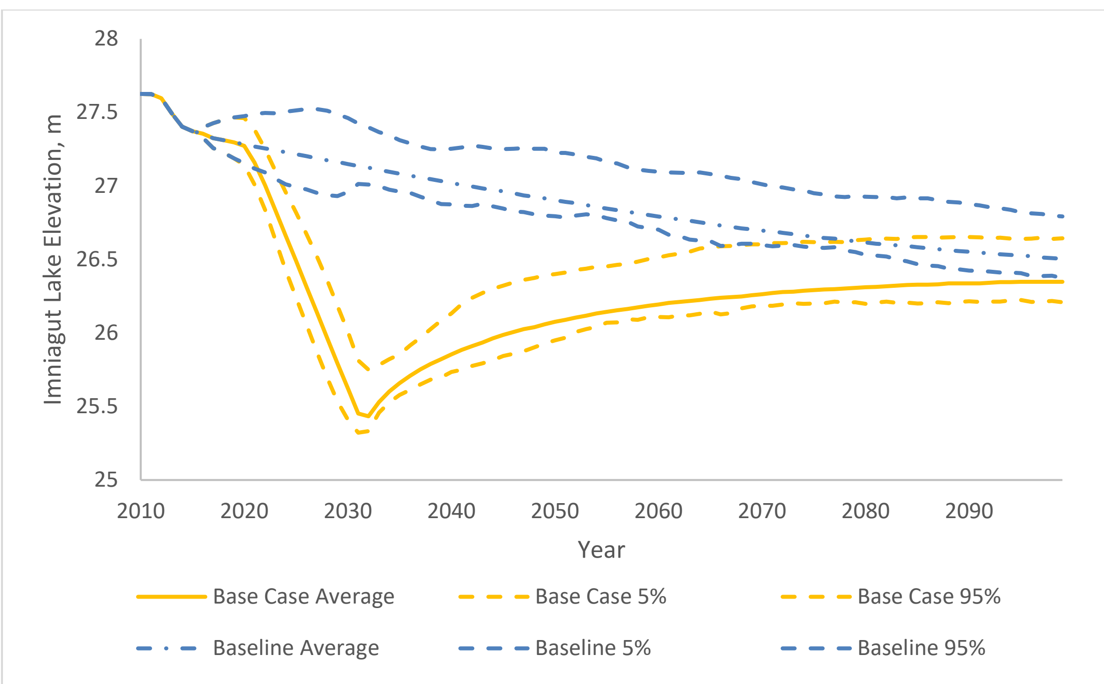


Figure 6-7: Annual Average Imniagut Lake Elevation Probabilities

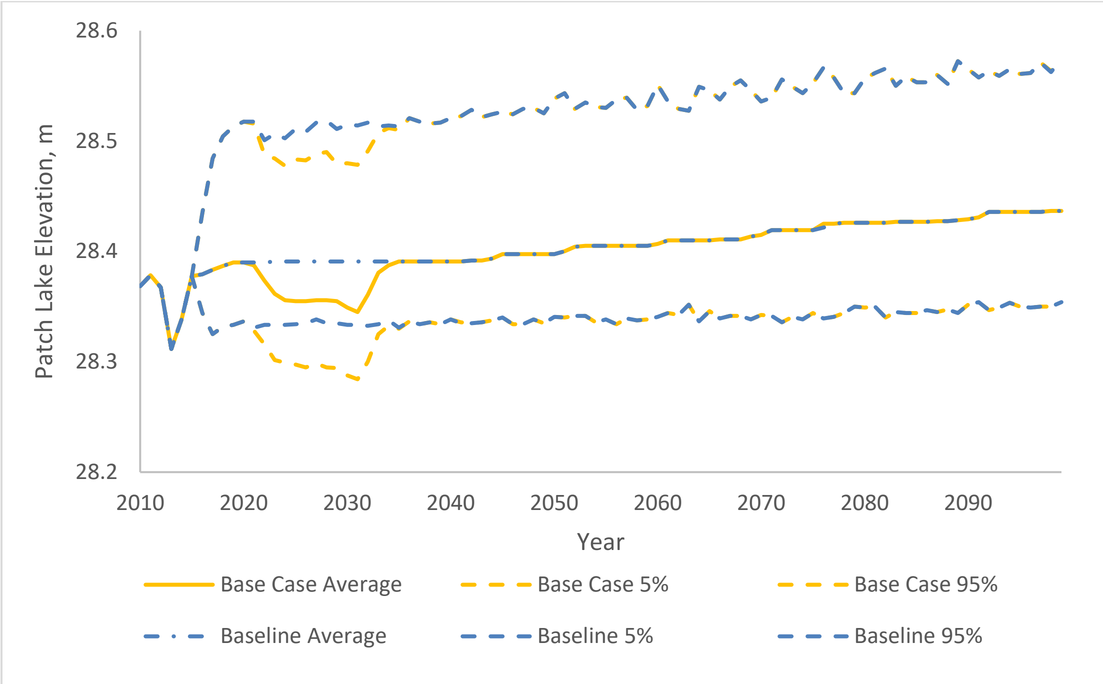


Figure 6-11: Annual Average Patch Lake Elevation Probabilities

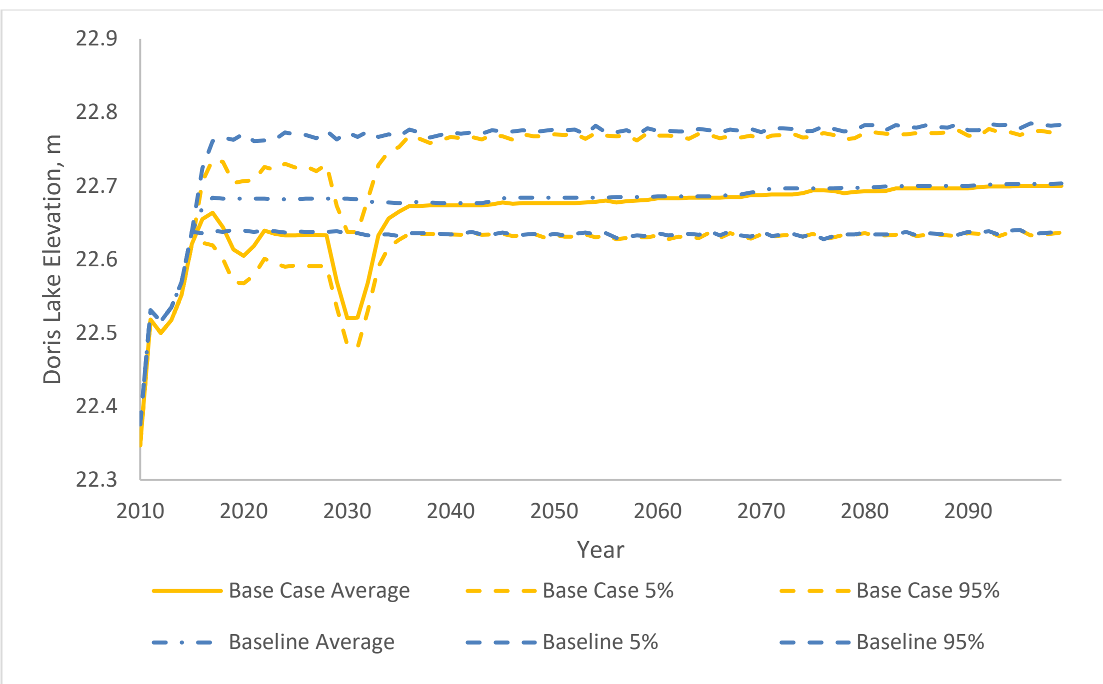


Figure 6-17: Annual Average Doris Lake Elevation Probabilities

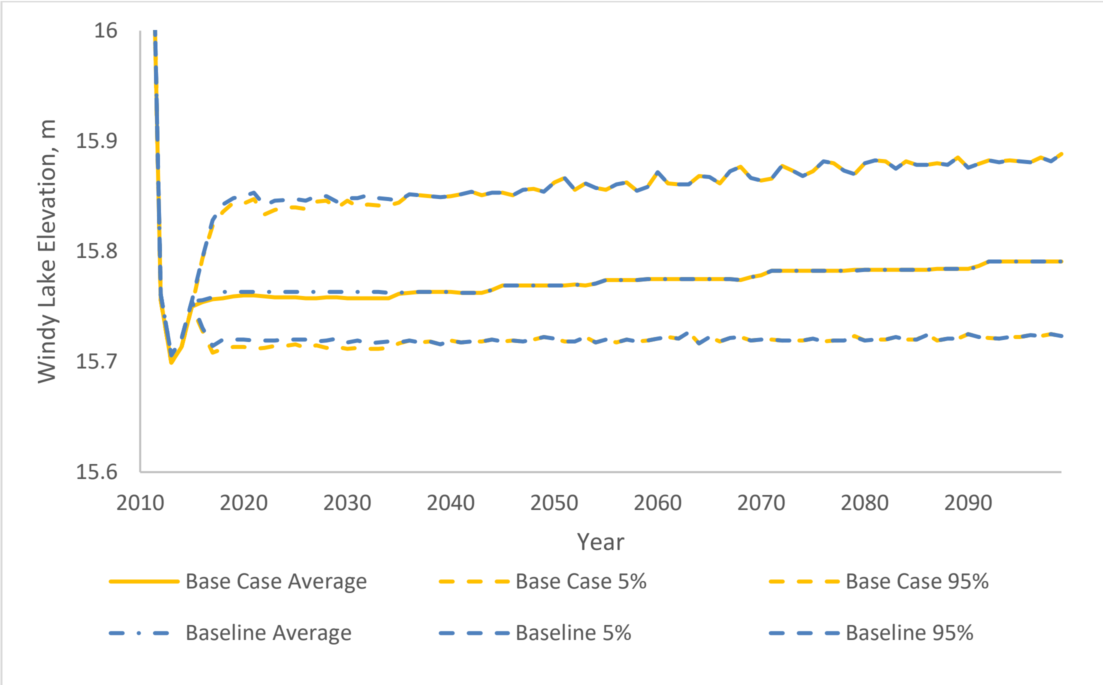


Figure 6-20: Annual Average Windy Lake Elevation Probabilities

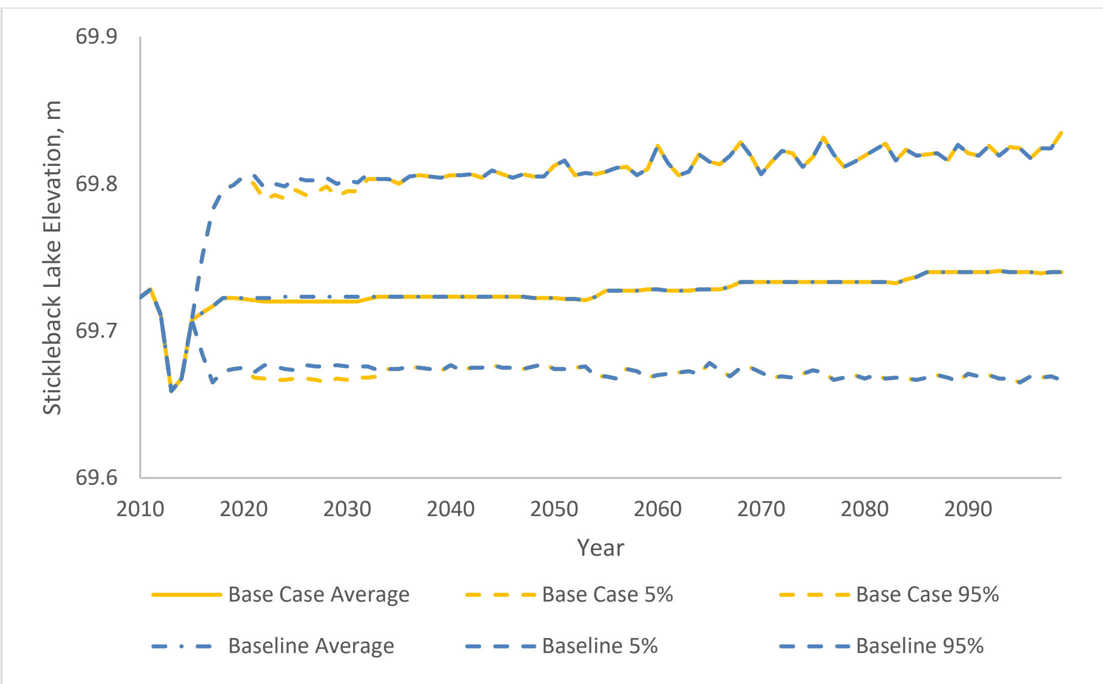


Figure 6-24: Annual Average Stickleback Lake Elevation Probabilities

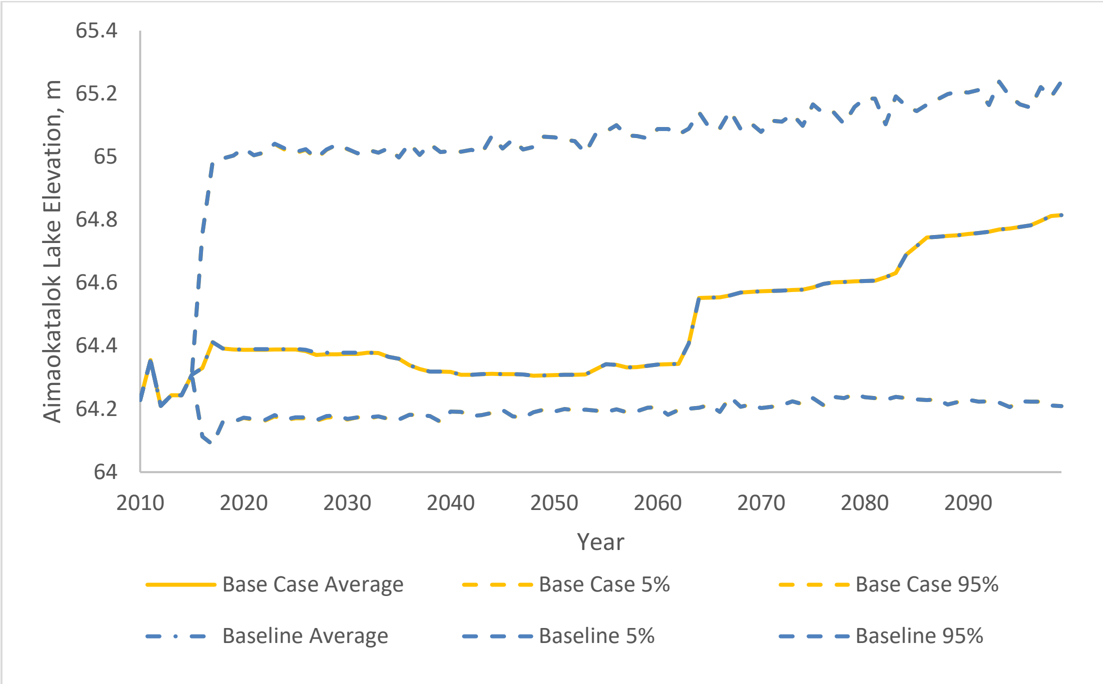


Figure 6-28: Annual Average Aimaokatalok Lake Elevation Probabilities

21. ID #KIA-IR21

21.1 SUBJECT/TOPIC

Water Balance Modelling – Seasonal fluctuation of baseline lake elevations (Palmer)

21.2 REFERENCES

- P5-4 Hope Bay Water Load Balance Report, Section 6, and Volume 5, Section 1, Surface Hydrology, Table 1.2-6

21.3 SUMMARY

No data on the seasonal fluctuations in lake elevation are included to provide context for the predicted drawdown.

21.4 DISCUSSION

21.4.1 Importance of Issue to the Impact Assessment Process

Including reference to the seasonal fluctuations in lake elevations provides context for the predicted drawdown and helps to determine whether these represent significant, long-lasting deviations from expected seasonal changes.

21.4.2 Detailed Review Comment

Reference to seasonal fluctuations in lake elevations is not provided in the interpretation of the predicted drawdown. The recorded baseline seasonal fluctuations are reported on Table 1.2-6 in Volume 5, Section 1, Surface Hydrology, only for Doris Lake and Windy Lake. Recorded baseline seasonal fluctuations are missing for Wolverine Lake, Imniagut Lake, Patch Lake, Stickleback Lake and Aimaokatalok Lake.

21.5 RECOMMENDATIONS/REQUEST

Please report baseline seasonal fluctuations recorded in Wolverine Lake, Imniagut Lake, Patch Lake, Stickleback Lake and Aimaokatalok Lake, in Volume 5, Section 1, Surface Hydrology, Table 1.2-6. Include reference to seasonal fluctuations in P5-4, Section 6, to support the interpretation of predicted drawdown.

21.6 TMAC RESPONSE

Table 1.2-6 in Volume 5, Section 1, of the FEIS shows recorded lake level fluctuation for the lakes monitored as part of the baseline monitoring program. Simulated baseline lake elevations at all assessment lakes under the average, 1-in-20-year dry, and 1-in-20-year wet conditions are presented in Appendix V5-1N of the FEIS.

22. ID #KIA-IR22

22.1 SUBJECT/TOPIC

Water Balance Modelling – Reduction in Imniagut Lake outflow (Palmer)

22.2 REFERENCES

- P5-4 Hope Bay Water Load Balance Report, Section 6.1.2.

22.3 SUMMARY

Reduction in outflow from Imniagut Lake associated with the project is not estimated.

22.4 DISCUSSION

22.4.1 Importance of Issue to the Impact Assessment Process

The maximum decline in lake elevation simulated at Imniagut Lake during the development of Madrid North is 176 cm, i.e. very significant. Such a significant decrease in elevation may be associated with a significant reduction in outflow from the lake.

22.4.2 Detailed Review Comment

It is understood that aerial photos of Imniagut Lake do not indicate a distinct outflow from the lake. It is possible that flow from Imniagut Lake to Patch Lake may occur at multiple locations and may therefore be difficult / not possible to measure with a reasonable level of accuracy. However, given the significant predicted decline in lake elevation induced by the project, it is not clear why the reduction in outflow from the lake was not estimated as the difference between the outflow simulated in baseline conditions and the outflow simulated with the project.

22.5 RECOMMENDATIONS/REQUEST

Please clarify why the reduction in outflow from Imniagut Lake was not estimated as the difference between the outflows simulated without (baseline) and with the project.

22.6 TMAC RESPONSE

The water and load balance model is based on monthly time-steps while the Imniagut Lake outflow is intermittent. The monthly model would simulate zero monthly outflows for both baseline and project affected conditions.

Field surveys of Imniagut Outflow indicate that it flows only seasonally (ERM 2015, 2017). The water and load balance model is based on monthly time-steps while the Imniagut Lake outflow is intermittent. The monthly model would simulate zero monthly outflows for both baseline and project affected conditions.

Although reductions in streamflow in Imniagut Outflow were not simulated in the water load and balance model, potential effects on fish and fish habitat associated with water reductions in Imniagut Outflow were considered as part of the FEIS. Table 6.5-13 (Volume 5, Chapter 6) assumes a 100% reduction from baseline flow and 21 years over the life of the Project with reduction in flow >10%. These assumptions are based on the simulated reduction in lake elevation from the water load balance model. The effects of reduction in streamflow on fish and fish habitat are described in Table 6.5-15 (Volume 5, Chapter 6) which provides total estimated permanent alteration or destruction of stream fish habitat as total habitat area (in m^2) based on the predicted water reduction over the life of the Project.

ERM. 2015. *Imniagut Lake Fisheries Assessment, Doris North Project, 2014*. Prepared for TMAC Resources Inc. by ERM Canada Ltd.: Yellowknife, NT.

ERM. 2017. *Hope Bay Project: 2017 Freshwater Fish and Fish Habitat Baseline Report*. Prepared for TMAC Resources Inc. by ERM Consultants Canada Ltd.: Yellowknife, NT

23. ID #KIA-IR23

23.1 Subject/Topic

Water Balance Modelling – Results for PO Lake (Palmer)

23.2 References

- P5-4 Hope Bay Water Load Balance Report, Section 6.1.3.

23.3 Summary

No water balance prediction results for PO Lake are presented.

23.4 Discussion

23.4.1 Importance of Issue to the Impact Assessment Process

PO Lake receives inflow from Patch Lake and may be affected by the predicted reduction in flow from Patch Lake to PO Lake. As such, it is important to estimate the effects on PO Lake is terms of changes in lake elevation and outflows.

23.4.2 Detailed Review Comment

No water balance predictions for PO Lake are presented. PO Lake receives inflow from Patch Lake, and the water balance predictions indicate that the project will lead to a reduction in outflow from Patch Lake. PO Lake may therefore be affected by the project because of reduced inflows.

23.5 Recommendations/Request

Please include the water balance prediction results for PO Lake.

23.6 TMAC Response

Flow predictions for all assessment nodes, including PO Lake Outflow, are presented in Appendix V5-1P of the FEIS. Lake level predictions for all assessment nodes, including PO Lake, are presented in Appendix V5-1Q of the FEIS. Summary table for maximum project effects are available in Appendix V5-1S of the FEIS.

24. ID #KIA-IR24

24.1 SUBJECT/TOPIC

Additional fish tissue metals data

24.2 REFERENCES

- P5-4 Hope Bay Water Load Balance Report, Section 6.1.5

24.3 SUMMARY

No water balance prediction results for Ogama Lake are presented.

24.4 DISCUSSION

24.4.1 Importance of Issue to the Impact Assessment Process

Ogama Lake receives inflow from Doris Lake and is affected by predicted reduction in flow from Doris Lake to Ogama Lake. As such, it is important to estimate the effects on Ogama Lake is terms of changes in lake elevation and outflows.

24.4.2 Detailed Review Comment

No water balance predictions for Ogama Lake are presented. Ogama Lake receives flow from Doris Lake, and the water balance predictions indicate that the project will lead to a reduction in outflow from Doris Lake. Ogama Lake may therefore be affected by the project because of reduced inflows.

24.5 RECOMMENDATIONS/REQUEST

Please include the water balance prediction results for Ogama Lake.

24.6 TMAC RESPONSE

Flow predictions for all assessment nodes, including Ogama Lake Outflow, are presented in Appendix V5-1P of the FEIS. Lake level predictions for all assessment nodes, including Ogama Lake, are presented in Appendix V5-1Q of the FEIS. Summary table for maximum project effects are available in Appendix V5-1S of the FEIS.

25. ID #KIA-IR25

25.1 SUBJECT/TOPIC

Water Balance Modelling – results for Glenn Lake (Palmer)

25.2 REFERENCES

- P5-4 Hope Bay Water Load Balance Report, Section 6.2.1

25.3 SUMMARY

No water balance prediction results for Glenn Lake are presented.

25.4 DISCUSSION

25.4.1 Importance of Issue to the Impact Assessment Process

Glenn Lake receives inflow from Windy Lake and is affected by predicted reduction in from Windy Lake to Glenn Lake. As such, it is important to estimate the effects on Glenn Lake is terms of changes in lake elevation and outflows.

25.4.2 Detailed Review Comment

No water balance predictions for Glenn Lake are presented. Glenn Lake receives flow from Windy Lake, and the water balance predictions indicate that the project will lead to a reduction in outflow from Windy Lake. Glenn Lake may therefore be affected by the project because of reduced inflows.

25.5 RECOMMENDATIONS/REQUEST

Please include the water balance prediction results for Glenn Lake.

25.6 TMAC RESPONSE

Flow predictions for all assessment nodes, including Glenn Lake Outflow, are presented in Appendix V5-1P of the FEIS.

Tables S-20 and S-21 in Appendix V5-1S of the FEIS show that the Project does not affect the Windy Lake outflow and lake level beyond natural variability. That is, the maximum outflow reduction is less than 10% and maximum lake level reduction is less than 1 cm. Glenn Lake is downstream of Windy Lake without any potential effects between the two lakes. Therefore, effects of the Project on Glenn Lake would be less than those of Windy Lake, and within the natural variability (see Table S-23 in Appendix V5-1S of the FEIS).

26. ID #KIA-IR26

26.1 SUBJECT/TOPIC

Groundwater Modelling – heat modelling and full talik development (Palmer)

26.2 REFERENCES

- P5-13 Groundwater characterization and modelling, 5.2.2.

26.3 SUMMARY

It is not clear why 1-D heat modelling results are used to conclude that mining will not lead to the development of a full talik.

26.4 DISCUSSION

26.4.1 Importance of Issue to the Impact Assessment Process

The development of full taliks because of mining may lead to significant irreversible permafrost degradation.

26.4.2 Detailed Review Comment

A 1-D heat model allows an estimation of the lateral thawing resulting from mining but does not allow the estimation of thawing in the three dimensions. As such, the model cannot support the conclusion that mining will not generate new open taliks. Extensive mining will occur throughout the entire depth of permafrost in both Madrid North and South, so it seems that taliks may likely develop.

26.5 RECOMMENDATIONS/REQUEST

Please clarify why the 1-D heat modelling results support the conclusion that mining will not lead to the development of open taliks.

26.6 TMAC RESPONSE

During summer months no heated air is pumped into the mine, and the resultant average air temperature in the mine is around -5^{o}C to -8^{o}C. During the winter, heated air is pumped into the mine, and the average temperature of the heated air being pumped underground is around -6^{o}C to -8^{o}C with the resultant effect of attaining an average air temperature in the mine of around -8^{o}C. Therefore, the air temperature in the mine is below freezing at all time.

The heat flow calculation presented in Supporting Document P5-13(Groundwater Characterization and Modelling, Hope Bay Project – SRK Consulting, November 2017) Section 5.5.2 illustrates the effect of constant heat of 5°C or 10°C being pumped into the mine as a means of illustrating that even under such extreme conditions mining has limited ability to induce a talik.

27. ID #KIA-IR27

27.1 SUBJECT/TOPIC

Groundwater Modelling – Sensitivity analysis with EPZs (Palmer)

27.2 REFERENCES

- P5-13 Groundwater characterization and modelling, 5.2.3.

27.3 SUMMARY

No sensitivity analysis of mine inflows to the presence of Enhanced Permeability Zones (EPZs) was conducted.

27.4 DISCUSSION

27.4.1 Importance of Issue to the Impact Assessment Process

The presence of EPZs that increase hydraulic connection with lakes would likely lead to much higher mine inflows than those simulated in Madrid North and South.

27.4.2 Detailed Review Comment

Enhanced Permeability Zones were identified in several northern Canada mines with similar settings to Madrid North and South. Although the available hydrogeological data do not provide evidence that these zones may be present in Madrid North and South, it would be nonetheless very valuable to conduct a sensitivity simulation based on the presence of EPZs, so to estimate a possible upper bound of mine inflows.

27.5 RECOMMENDATIONS/REQUEST

Please conduct a sensitivity run based on the presence of EPZs (similar to those identified in other mines) to estimate a possible upper bound for mine inflow.

27.6 TMAC RESPONSE

As summarised in Supporting Document P5-13(Groundwater Characterization and Modelling, Hope Bay Project – SRK Consulting, November 2017), Section 3.5.3, the entire Boston Mine will be in permafrost. As a result, there is no mine water inflow expected and therefore no need to run any sensitivity analysis including for enhanced permeability zones. Notwithstanding this, as documented in Supporting Document P4-6 (Hope Bay Project Groundwater Management Plan – TMAC Resources, December 2017), it is recognized that uncertainty exist, and as a result this plan provides triggers and mitigation measures should mine water be encountered.

28. ID #KIA-IR28

28.1 SUBJECT/TOPIC

Groundwater Modelling – Mine re-flood time estimation (Palmer)

28.2 REFERENCES

- P5-13 Groundwater characterization and modelling, 5.3.1.

28.3 SUMMARY

It is not clear why full re-flood is assumed to be achieved with a recovery to within 50 m of the pre-mining head..

28.4 DISCUSSION

28.4.1 Importance of Issue to the Impact Assessment Process

A reasonably accurate estimation of full re-flood in post-closure is required to determine when the groundwater regime will return to approximate pre-mining conditions.

28.4.2 Detailed Review Comment

Considering that the maximum drawdown at the end of mining is 785.8m and 635.8 m in Madrid South and North, respectively, a value of 50 represents approximately 6-8% of the maximum drawdown. A 5 m drawdown seems a more reasonable approximation a full mine re-flood.

28.5 RECOMMENDATIONS/REQUEST

Please explain why a recovery to within 50 m of the pre-mining head is considered an adequate approximation of full mine re-flood. Also, please estimate the re-flood time associated with a recovery to within 5 m of the pre-mining head

28.6 TMAC RESPONSE

The pre-mining heads correspond approximately to the levels of the lakes, therefore a recovery to within 50 m of the pre-mining head is equivalent to a 50 m deep groundwater table. SRK considered a recovery to within 50 m of the pre-mining head because the mine stopes and workings are estimated to remain in frozen ground above 50 mbgs and not collect any groundwater.

For reference, Table KIA-IR28.1 below compiles the estimated re-flood time associated with a recovery to within 5 m of the pre-mining head.

Table KIA-IR28.1: Estimated re-flood time associated with a recovery to within 5 m of the pre-mining head

Scenario	Parameters	Unit	Madrid South	Madrid North
All Cases	V_{mine}[1]	m^3	685,808	3,135,891
	Δh_r	m	5	5
	Δh_{eom}	m	785.8	635.8
Base Case	Q_{eom}	m^3/d	542	1164
	t_1 reflood	year	17.5	35.7
Low K Case	Q_{eom}	m^3/d	271	582
	t_2 reflood	year	35.0	71.5
high K Case	Q_{eom}	m^3/d	1847	5324
	t_3 reflood	year	5.1	7.8

Note:

[1] The deposition of backfill was assumed to be homogeneously distributed throughout the mine voids.

$$\Delta h_r(t) = \Delta h_{eom}\, e^{-t\frac{Q_{eom}}{V_{mine}}}$$

Where Q_{eom} is the flow rate at the end of mining, V_{mine} is the effective volume of the underground mine voids, Δh_{eom} is the drawdown at the end of mining, and t is the time since the mining stopped.

29. ID #KIA-IR29

29.1 SUBJECT/TOPIC

Groundwater Modelling – Inflow of mine-affected groundwater into lakes (Palmer)

29.2 REFERENCES

- P5-13 Groundwater characterization and modelling, 5.3.2

29.3 SUMMARY

An estimate of the unfrozen portion of mined-out areas in post-closure is not provided.

29.4 DISCUSSION

29.4.1 Importance of Issue to the Impact Assessment Process

The likelihood of unfrozen portions of the mined-out areas to intersect conductive fractures, which could act as conduit to transfer mine-affected groundwater to the adjacent lakes, increases with the extent of the unfrozen volume. It is therefore important to estimate the unfrozen volumes of mined-out areas that will likely be present in post-closure conditions.

29.4.2 Detailed Review Comment

An estimate of the volume of the mined-out areas that will remain unfrozen in post-closure was not conducted. It is considered that estimating this volume is important because greater unfrozen volumes would increase the likelihood to intersect conductive fractures, which would allow the transfer of mine-affected groundwater to adjacent lakes.

29.5 RECOMMENDATIONS/REQUEST

Please provide an estimate of the unfrozen volume of mined-out areas to be expected in post-closure in Madrid North and South.

29.6 TMAC RESPONSE

As previously discussed in KIA-IR26 the mining activity is not expected to have any effect on the permafrost because the air temperature in the mine will remain below freezing at all times. Therefore, post-mining the extent of permafrost and talik remain largely unchanged. In calculating the reflood times, all mine opening were assumed to be unfrozen which is a conservative approach and therefore specifically defining the remnant unfrozen zones in the mine will have no material effect on the predicted estimate of mine water flow to surrounding lakes post closure.

30. ID #KIA-IR30

30.1 SUBJECT/TOPIC

Groundwater Modelling – Inflow of mine-affected groundwater into lakes (Palmer)

30.2 REFERENCES

- P5-13 Groundwater characterization and modelling, 5.3.2.

30.3 SUMMARY

The estimated travel time of 1,000 years for mine-affected groundwater to flow from unfrozen mined-out areas to adjacent lakes does not consider the presence of conductive fractures.

30.4 DISCUSSION

30.4.1 Importance of Issue to the Impact Assessment Process

The travel times of mine-affected groundwater from unfrozen portions of the mined-out areas, which would be backfilled with tailings, to adjacent lakes, could be significantly less than 1,000 years in the presence of conductive fractures connecting the lakes and the unfrozen mined-out areas.

30.4.2 Detailed Review Comment

A complete assessment of the potential effects of the project on lake water quality in post-closure requires consideration of a scenario whereby portions of the mined-out areas, which will be backfilled with tailings and may remain unfrozen, may be hydraulically connected to adjacent lakes by conductive fractures. Under these conditions, mine-affected groundwater may take far less than 1,000 years to reach the lakes.

30.5 RECOMMENDATIONS/REQUEST

Please estimate the travel times required for mine-affected groundwater to flow from unfrozen portions of mined-out areas to adjacent lakes, considering the presence of conductive fractures that connect the mined-out areas and lakes.

30.6 TMAC RESPONSE

A detailed sensitivity analysis was completed to estimate the mine inflow rates, including presence of conductive fractures that connect mined-out areas and lakes. The results of this analysis is presented in Table 15 of Supporting Document P5-13 (Groundwater Characterization and Modelling, Hope Bay Project – SRK Consulting, November 2017). These results indicate that mine inflow could increase between about 25 and 100% of baseflow under such conditions. Therefore, once the mine refloods, it is reasonable to assume that this may result in the time for water to make its way from the mine to the lakes to increase no more than two times which will still imply a time period of at least 500 years.

31. ID #KIA-IR31

31.1 SUBJECT/TOPIC

Groundwater Modelling – Sensitivity to flow from exploration drill holes (Palmer)

31.2 REFERENCES

- P5-13 Groundwater characterization and modelling, 5.4.2

31.3 SUMMARY

Estimate increase in mine inflow due to the likely intersection with open drill holes in Madrid North.

31.4 DISCUSSION

31.4.1 Importance of Issue to the Impact Assessment Process

Based on the mine inflow estimate of 2,680 m3/day from an open drill hole connected to an adjacent lake, mine inflows in Madrid North, where there is 50% probability of intersecting two open drill holes, may increase significantly.

31.4.2 Detailed Review Comment

A mine inflow estimate of 2,680 m3/day from an open drill hole connected to an adjacent lake is provided. However, it is not clear whether this estimate can be used to infer the increase in mine inflow associated with the 50% likelihood that Madrid North may intersect two open drill holes. An estimate of the likely increase in mine inflow from open drill holes is missing.

31.5 RECOMMENDATIONS/REQUEST

Please provide an estimate of the likely increase in mine inflow from open drill holes intersecting Madrid North.

31.6 TMAC RESPONSE

Open drill holes connected to lakes are considered as a source of mine water inflow, and as described in Supporting Document P5-13 (Groundwater Characterization and Modelling, Hope Bay Project – SRK Consulting, November 2017), Section 5.4.2 the probability of intersecting open drill holes are estimated. However, such encounters are occasional and sporadic, and does not contribute towards continuous mine inflow. The Groundwater Management Plan (Supporting Document P4-6) provides specific triggers, responses and procedures for when open drill holes are encountered.

32. ID #KIA-IR32

32.1 SUBJECT/TOPIC

Groundwater Management – mine risk zone mapping (Palmer)

32.2 REFERENCES

- P4-6 Hope Bay Groundwater Management Plan, Section 3.1.

32.3 SUMMARY

A map of mine risk zones based on currently available information is not available

32.4 DISCUSSION

32.4.1 Importance of Issue to the Impact Assessment Process

Producing a mine risk map based on the currently available information helps determine the number and extent of high-risk zones, and therefore plan for an adequate level of intervention during mining.

32.4.2 Detailed Review Comment

The report states that mapping of mine risk zones, to identify where higher inflow may occur, will be carried out and updated during mining as more information is acquired. However, a risk zone map based on the currently available information is not available. A mine risk map based on the currently available information would help determine the number and extent of high-risk zones, and therefore plan for an adequate level of intervention during mining.

32.5 RECOMMENDATIONS/REQUEST

Please provide a mine risk zone map or explain why a map was not produced based on the currently available information.

32.6 TMAC RESPONSE

As stated in Section 3.1 of Supporting Document P4-6, Risk Zone Mapping is part of the official mine plan, managed by the mining department, and is a living document. For this reason, and as is the ongoing procedure at Doris Mine, TMAC does not include Risk Zone Mapping in the Groundwater Management Plan.

33. ID #KIA-IR33

33.1 SUBJECT/TOPIC

Groundwater Management – Inflow inspections and documentation (Palmer)

33.2 REFERENCES

- P4-6 Hope Bay Groundwater Management Plan, Section 7.1 and Module A and B

33.3 SUMMARY

A rationale is needed for selecting 250 m3/day as threshold for reporting in daily mining report and for triggering SPT level 1.

33.4 DISCUSSION

33.4.1 Importance of Issue to the Impact Assessment Process

Adequate thresholds for increase in mine inflow need to be set to ensure that adequate mitigation measures can be implemented on time when a flow increase occurs.

33.4.2 Detailed Review Comment

The threshold of 250 m3/day, which requires reporting in the daily mining report and triggers SPT level 1 (after flow persists for 3 days), corresponds to approximately 20% of the estimated mine inflow of 1,200 m3/day at Madrid North and approximately 50% of the estimated mine inflow of 550 m3/day at Madrid South. This threshold seems high, and such that it may not be possible to implement adequate and timely mitigation measures should an increase of this magnitude occur.

33.5 RECOMMENDATIONS/REQUEST

Please provide a rationale for why the threshold of 250 m3/day was selected for the daily mining reporting requirement and to trigger SPT level 1.

33.6 TMAC RESPONSE

Mine water from both Madrid North and Madrid South will be discharged to Roberts Bay. As a result, the mine water system from Madrid North and Madrid South form part of the existing Doris Mine water management system. Therefore, the pumping systems at Madrid North and Madrid South are being designed to be compatible with the larger Doris Mine inflow rates (3,000 m^3/day). The thresholds are set as a function of this system and therefore it is appropriate to match the Madrid thresholds to those at Doris.

34. ID #KIA-IR34

34.1 SUBJECT/TOPIC

Groundwater Management – Contingencies (Palmer)

34.2 REFERENCES

- P4-6 Hope Bay Groundwater Management Plan, Section 8.

34.3 SUMMARY

The volume of mined-out spaces and the filling time of these spaces based on the maximum predicted mine inflows is not provided.

34.4 DISCUSSION

34.4.1 Importance of Issue to the Impact Assessment Process

Adequate storage needs to be available to temporarily store significantly higher than expected mine inflows. Since mined-out space will be considered for temporary storage of higher than expected mine inflows, it is important to estimate the volume of this space.

34.4.2 Detailed Review Comment

An estimate of the storage volume provided by the mined-out space and of the time it would take to fill these spaces at the predicted maximum mine inflow is not provided. This estimate would help determine an upper bound for higher than expected mine inflows that could be stored temporarily.

34.5 RECOMMENDATIONS/REQUEST

Please estimate the storage volume of the mined-out spaces and the filling time of these spaces based on the maximum predicted mine inflows.

34.6 TMAC RESPONSE

The available storage volume in the mine will continuously change over time. Section 8 of Supporting Document P4-6 stipulates that as a last line of defense in case of unforeseen mine inflow, the available mine void space, at the time the inflow is encountered, can be used as storage. It should be noted no matter what void space is available, the maximum extent to which the mine could fill due to unforeseen and uncontrolled inflow is the elevation of the surrounding lakes which in all cases is well below the elevation of the portal. Therefore under no scenario is there a possibility of water spilling from the mine.

35. ID #KIA-IR35

35.1 Subject/Topic

Aquatic Effects Monitoring Plan – Lake elevation monitoring (Palmer)

35.2 References

- P4-18 Hope Bay Aquatic Effects Monitoring Plan, Section 2.1

35.3 Summary

No lake level monitoring is planned for Imniagut, Glenn, Ogama and PO Lake.

35.4 Discussion

35.4.1 Importance of Issue to the Impact Assessment Process

Glenn, Ogama and PO Lake receive flows from lakes that will be potentially be affected by the project. As such, these lakes may be affected, too. Although likely not hydraulically connected to other lakes, water balance predictions indicate that Imniagut Lake may experience a significant decline in lake level because of the project. It is therefore important to monitor lake levels in these lakes to determine any possible changes throughout the duration of the project.

35.4.2 Detailed Review Comment

Monitoring of lake levels at Imniagut, Glenn, Ogama and PO Lake is not planned as part of the Aquatic Effects Monitoring Plan.

35.5 Recommendations/Request

Please provide a rationale for why monitoring of lake levels at Imniagut, Glenn, Ogama and PO Lake is not planned as part of the Aquatic Effects Monitoring Plan.

35.6 TMAC Response

The project-related effects to lake levels will be considered as part of the assessment of potential fisheries productivity losses and associated development of a Fisheries Offsetting Plan. A Fisheries Offsetting Plan typically contains the design, implementation, and monitoring actions required to offset potential serious harm to CRA fisheries resulting from a project, as concluded by DFO and as per the guidance provided in DFO's Fisheries Protection Policy Statement (DFO 2013a). If deemed necessary by DFO through the

Fisheries Authorization (DFO 2013b) process, the FOP will eventually address all potential serious harm to CRA fish through mitigation and/or offsetting using methods from DFO's Fisheries Productivity Investment Policy: A Proponent's Guide to Offsetting (DFO 2013c) such as the restoration or enhancement of habitats or the creation of habitat elsewhere in the landscape. As indicated in the FEIS, TMAC will address DFO's Fisheries Protection Program (FPP) as required.

DFO. 2013a. *Fisheries Protection Policy Statement*. Fisheries and Oceans Canada: Ottawa, ON.

DFO. 2013b. *An Applicant's Guide to Submitting an Application for Authorization under Paragraph 35(2)(b) of the Fisheries Act.* http://www.dfo-mpo.gc.ca/pnw-ppe/reviews- revues/Applicant_Guide-Guide_autorisation-eng.pdf.

DFO. 2013c. *Fisheries Productivity Policy: A Proponent's Guide to Offsetting.* Ottawa, ON: Ecosystem Programs Policy, Fisheries and Oceans Canada

36. ID# KIA-IR36

36.1 SUBJECT

Climate characterization – Sublimation (Palmer)

36.2 REFERENCE

P5-2 Hope Bay Climate Hydrological Report

36.3 ISSUE SUMMARY

No discussion of sublimation as a component of the water balance is provided, and no estimates of sublimation are included in the report.

36.4 DISCUSSION

36.4.1 Importance of Issue

Given the extensive and permanent presence of snow cover in the project area, it is reasonable to assume that sublimation may represent a significant component of the water balance.

36.4.2 Detailed Review Comment

Sublimation is not discussed in the report. Given the extensive and permanent presence of snow cover in the project area, it is reasonable to assume that sublimation may represent a significant component of the water balance. Given the sparse dataset for snow pack and snow water equivalent, it is expected that sublimation records will not be available. However, sublimation could be modelled based on other climate parameters, similarly to snow pack and snow melt.

36.5 STATUS/CONCERN

Recommendation/Request:

Please provide a rationale for why sublimation was not discussed in the report.

36.6 TMAC RESPONSE

Sublimation is not directly discussed in P5-2 (Climate and Hydrological Parameters Summary Report, Hope Bay Project -SRK Consulting, November 2017), as sublimation is indirectly taken into account within the snowmelt model discussed in Section 4.

Similarly, the water and load balance takes sublimation into account within the run-off calibration. The Water and Load Balance considers hydrological inputs of total precipitation, temperature, lake evaporation and runoff. In the model, total precipitation is split into rain or snow depending on model temperature. Snow is added to the snowmelt model which melts based on model temperature. Rainfall and snowmelt are then combined to form total effective precipitation. Runoff coefficients which have been calibrated to the historical data set are then applied in the model to calculate the total yield from effective precipitation and to account for losses due to sublimation, evapotranspiration, soil storage, and infiltration.

The calibration method is considered to be the most suitable and realistic method of calculating the total effective precipitation . Independently calculating the sublimation (and other losses) based on functions of other climatic parameters and then subtracting from the total precipitation introduces further uncertainty and potential error.

37. ID# KIA-IR37

37.1 Subject

Assessment of Mercury in Discharge to Aimaokatolok Lake

37.2 Reference

Appendix V5-4E: Far Field Hydrodynamic Mixing Modelling for Discharges to Aimaokatolok Lake.

37.3 Issue Summary

Incorrect siting of CCME guidelines for predicted concentrations of Hg in discharge parameters. A more complete comparison and assessment of MeHg is required for protection of wildlife and humans in the consumption of fish.

37.4 Discussion

37.4.1 Importance of Issue

The parameters being used in Table 3.1 may underestimate the impact of mercury concentrations on wildlife and humans in the consumption of fish.

37.4.2 Detailed Review Comment

Table 3.1 Provides predicted concentrations of discharge parameters in Aimaokatolok Lake and associated CME guidelines. Predicted concentrations of Hg are compared to a CCME Guideline of 0.016 ug/L (16 ng/L) for Protection of Aquatic Life.

CCME (2003, Table 1) provides a freshwater guideline value of 26 ng/L for protection of aquatic life and 16 ng/L for protection of marine life but cautions:

"*The protocol does not address exposure through food or bioaccumulation to higher trophic levels. As such, aquatic life that are exposed to methylmercury primarily through food (e.g., piscivorous fish) may not be adequately protected. Moreover, these WQGs for mercury may not prevent the accumulation of methylmercury in aquatic life; therefore, through this process the tissue residue guideline (TRG; 33 µg MeHg·kg-1 ww) for the protection of wildlife that consume aquatic life may be exceeded (Environment Canada 2002). Thus, if the ultimate management objective for mercury is to protect high trophic level aquatic life and/or those wildlife that prey on aquatic life, more stringent site-specific application of these water quality guidelines may be necessary (see*

Additional Considerations). Use and derivation of site- and species-specific water quality objectives is provided by Environment Canada (Environment Canada 2003).

From conservative assumptions, concentrations of MeHg below 0.007 ng Hg·L-1 may be required to protect all wildlife species in Canada while concentrations above 0.2 ng Hg·L-1 may pose a risk to wildlife species. MeHg concentrations in water between these limits may be hazardous to some wildlife depending on their feeding habits (preferred prey items, and the trophic level and BAFs of these prey items). More specific information is given in the supporting document for these guidelines (Environment Canada 2003)."

37.5 STATUS/CONCERN

Recommendation/Request

1. Please cite the correct freshwater guideline value in Table 3.1.
2. Please complete a comparison and assessment that address MeHg and the protection of wildlife and human consumers of fish using a more protective guideline.

37.6 TMAC RESPONSE

1. Acknowledged. The freshwater CCME mercury guideline fro the protection of aquatic life is 0.00026 mg/L and therefore would require 6.5x dilution to meet the freshwater CCME guideline level in Aimaokatalok Lake.
2. This request is out of scope for this stage of the Type A Water Licence application completeness check and Information Request period and is better discussed as part of the technical review of the NIRB FEIS process.

38. ID# KIA-IR38

38.1 SUBJECT

Fisheries Offsetting (Palmer)

38.2 REFERENCE

Supplementary Information to Type A Water Licence – Appendix V5 – 6AA Conceptual Freshwater Fisheries Offsetting Approach for Madrid – Boston.

38.3 ISSUE SUMMARY

The Type A Water Licence indicates effects to fish and fish habitat and relies on the successful implementation of a Fisheries Offsetting Plan to mitigate potential residual effects resulting from Phase 2. However, both the Freshwater and Marine Conceptual Offsetting Plans only identify a procedural framework and potential offset options, should its development be deemed necessary by DFO. As offsetting is used as a key mitigation measure impacts and gains to fish habitat should be explicitly outlined.

38.4 DISCUSSION

38.4.1 Importance of Issue

In order to adequately understand whether habitat losses have been considered and accounted for through Offsetting, it is necessary to supporting documentation that the proposed mitigation measures will sufficiently counterbalance these losses. Although a final determination on fisheries offsetting as required under the *Fisheries Act* will be determined by DFO, it is important to outline sufficient details of the offsetting in the EIS, particularly as offsetting is used as a key mitigation measure

38.4.2 Detailed Review Comment

The successful implementation of a Fisheries Offsetting Plan to mitigate potential residual effects resulting from Phase 2 is necessary to offset losses to fish habitat. Both the Freshwater and Marine conceptual offsetting plans only identify a procedural framework and potential offset options for a Fisheries Offsetting Plan. The EIS notes that the requirement for an Offsetting Plan will be determined by DFO. Considering that offsetting is applied in the EIS as a key mitigation measure to avoid all residual effects to fish and fish habitat, there should be a commitment made at this stage to counterbalance the losses outlined in the FEIS, with corresponding detail on gains.

38.5 STATUS/CONCERN

Recommendation/Request

Please indicate whether a detailed fish Offsetting Plan including all rationale, will be provided for review by the KIA prior to DFO authorization and water use for the Project as this information is necessary to understand if Offset will adequately counterbalance losses to fish habitat.

38.6 TMAC RESPONSE

The objective of the fisheries offsetting plan (FOP) will be to compensate for the alteration or destruction of fish-bearing habitat by creating or modifying fish habitat elsewhere on the landscape should a *Fisheries Authorization* be deemed necessary for Madrid-Boston to proceed (see section 6.5.3.4 in the FEIS). As stated in Section *6.5.3.3*, TMAC will address DFO's Fisheries Protection Program (FPP) to develop a freshwater and marine offsetting plan commensurate with anticipated effects. All habitat losses related to the Madrid-Boston Project will be offset with the objective of maintaining the productivity of CRA species. The conceptual approach to fisheries offsetting proposed to balance all losses of fish habitat from Madrid- Boston Project infrastructure was included in Appendices V5-6AA and V5-10G. Discussion with DFO and other stakeholders will continue as the proposed Project moves through the various regulatory processes (e.g., NIRB and NWB).

39. ID# KIA-IR39

39.1 SUBJECT

Potential loss of fish habitat resulting from draw down (Water Balance Modelling – Results for Ogama Lake) (Palmer)

39.2 REFERENCE

P5-4 Hope Bay Water Load Balance Report, Section 6.1.5.

39.3 ISSUE SUMMARY

No water balance prediction results for Ogama Lake are presented.

39.4 DISCUSSION

39.4.1 Importance of Issue

Ogama Lake receives inflow from Doris Lake and is affected by predicted reduction in flow from Doris Lake to Ogama Lake. As such, it is important to estimate the effects on Ogama Lake is terms of changes in lake elevation and outflows.

39.4.2 Detailed Review Comment

No water balance predictions for Ogama Lake are presented. Ogama Lake receives flow from Doris Lake, and the water balance predictions indicate that the project will lead to a reduction in outflow from Doris Lake. Ogama Lake may therefore be affected by the project resulting from reduced inflows and potentially affect fish habitat within Ogama Lake.

39.5 STATUS/CONCERN

Recommendation/Request

Please include the water balance prediction results for Ogama Lake and indicate whether loss of fish habitat within the lake was considered for Offsetting

39.6 TMAC RESPONSE

Flow predictions for all assessment nodes, including Ogama Lake Outflow, are presented in Appendix V5-1P of the FEIS. Lake level predictions for all assessment nodes, including

Ogama Lake, are presented in Appendix V5-1Q of the FEIS. Summary table for maximum project effects are available in Appendix V5-1S of the FEIS.

Water in the Doris Watershed flows as follows (from upstream to downstream):

Patch Lake → Patch Outflow → PO Lake → PO Outflow → Ogama Lake → Ogama Outflow → Doris Lake → Doris Outflow → Little Roberts Lake → Little Roberts Outflow → Roberts Bay

The remainder of the reviewers request does not pertain to the Water Licence applications. As part of the submitted FEIS, Table 6.5-8 (Volume 5, Chapter 6) provides the list of lakes and outflows in which fish habitat may be impacted by water withdrawal and use effects. As described in Section 6.5.4.2 (Volume 5, Chapter 6), the list includes the lakes that may be directly affected through water withdrawal and use, as well as downstream outflow streams and lakes that may be indirectly affected by those same upstream lakes (e.g., reductions in lake volumes and surface elevations leading to reduced discharge in outflows). This includes Ogama Lake and its outflow. The potential effects on fish habitat from water withdrawal and use pathways listed in Table 6.5-8 were characterized using results of the *Hope Bay Project Water and Load Balance* (i.e., the water balance model; Package P5-4). Results of the water balance model include streamflow predictions at 13 assessment nodes, including Ogama Lake Outflow, during different phases of the Project (Appendix V5-1P), as well as surface elevation and lake volume predictions at nine lakes (including Ogama Lake) during different phases of the Project (Appendices V5-1Q (Elevations) and V5-1R (Volume)). Summary tables of maximum project effects are available in Appendix V5-1S of the FEIS.

For the purpose of the fish habitat VEC effects assessment in the FEIS, characterization of potential effects is described in Section 6.5.4.2 (Volume 5, Chapter 6) and includes potential effects of the Madrid-Boston Project in combination with Approved Projects (i.e., the Hope Bay Project) relative to baseline lake volume, lake surface elevation, and streamflow projections. This is consistent with the natural flow regime paradigm (Poff et al. 2010) and best practices for hydrologic effects assessments. This was applied to the fish habitat assessment to allow for consistent interpretation of potential effects on freshwater fish VECs relative to the surface hydrology VEC. Potential effects on fish habitat in Ogama Lake are assessed based on simulated changes in lake volume and lake surface elevation (Tables 6.5-9 and 6.510, respectively) and potential effects on fish habitat in Ogama Outflow are assessed based on simulated changes in streamflow (Tables 6.5-13 and 6.5-14). Estimated potential permanent alteration or destruction of fish habitat in Ogama Outflow is quantified in Table 6.5-15.

Poff, N. L., B. D. Richter, A. H. Arthington, S. E. Bunn, R. J. Naiman, E. Kendy, M. Acreman, C. Apse, B. P. Bledsoe, M. C. Freeman, J. Henriksen, R. B. Jacobson, J. G. Kennen, D. M. Merritt, J. H. O'Keeffe, J. D. Olden, K. Rogers, R. E. Tharme, and A. Warner. 2010. The ecological limits of hydrologic alteration (ELOHA): a new framework for developing regional environmental flow standards. *Freshwater Biology*, 55 (1): 147-70.

40. ID# KIA-IR40

40.1 SUBJECT

Potential loss of fish habitat resulting from draw down (Water Balance Modelling – results for Glenn Lake) (Palmer)

40.2 REFERENCE

P5-4 Hope Bay Water Load Balance Report, Section 6.2.1.

40.3 ISSUE SUMMARY

No water balance prediction results for Glenn Lake are presented.

40.4 DISCUSSION

40.4.1 Importance of Issue

Glenn Lake receives inflow from Windy Lake and is affected by predicted reduction in from Windy Lake to Glenn Lake. As such, it is important to estimate the effects on Glenn Lake is terms of changes in lake elevation and outflows. Decreased outflows could result in downstream losses to fish habitat.

40.4.2 Detailed Review Comment

No water balance predictions for Glenn Lake are presented. Glenn Lake receives flow from Windy Lake, and the water balance predictions indicate that the project will lead to a reduction in outflow from Windy Lake. Glenn Lake may therefore be affected by the project resulting from reduced inflows and potentially affect fish habitat in Glenn lake and outflows from this lake.

40.5 STATUS/CONCERN

Recommendation/Request

Please include the water balance prediction results for Glenn Lake and indicate whether loss of fish habitat was considered in Glenn Lake because of any potential water balance effects

40.6 TMAC RESPONSE

Flow predictions for all assessment nodes, including Glenn Lake Outflow, are presented in Appendix V5-1P of the FEIS.

Tables S-20 and S-21 in Appendix V5-1S of the FEIS show that the Project does not affect the Windy Lake outflow and lake level beyond natural variability. That is, the maximum outflow reduction is less than 10% and maximum lake level reduction is less than 1 cm. Glenn Lake is downstream of Windy Lake without any potential effects between the two lakes. Therefore, effects of the Project on Glenn Lake would be less than those of Windy Lake, and within the natural variability (see Table S-23 in Appendix V5-1S of the FEIS) and no further assessment is required.

Flow predictions for all assessment nodes, including Glenn Lake Outflow, are presented in Appendix V5-1P of the FEIS.

As part of the submitted FEIS, Table 6.5-8 (Volume 5, Chapter 6) provides the list of lakes and outflows which may be impacted by water withdrawal and use effects. As described in Section 6.5.4.2 (Volume 5, Chapter 6), the list includes the lakes that may be directly affected through water withdrawal and use, as well as downstream outflow streams and lakes that may be indirectly affected by those same upstream lakes (e.g., reductions in lake volumes and surface elevations leading to reduced discharge in outflows). However, as indicated above, further consideration of potential losses in Glen Lake and its outflow are unnecessary because predicted effects upstream in Windy Lake are limited (maximum outflow reduction is predicted to be less than 10% and maximum lake level reduction is less than 1 cm) and fall within natural variability and no further assessment is required.

41. ID# KIA-IR41

41.1 SUBJECT

Aquatic Effects Monitoring Plan – Lake elevation monitoring (Palmer)

41.2 REFERENCE

P4-18 Hope Bay Aquatic Effects Monitoring Plan, Section 3.0

41.3 ISSUE SUMMARY

No monitoring of changes to fish habitat is planned for Glenn, Ogama and PO Lakes despite potential draw downs. If habitat in these lakes have not been accounted for in the Fish Offsetting Plan,

41.4 DISCUSSION

41.4.1 Importance of Issue

Glenn, Ogama and PO Lake receive flows from lakes that will be potentially be affected by the project. As such, these lakes may be affected, too. If habitat in these lakes have not been accounted for in the fish habitat accounting for Offset, then monitoring of fish habitat in Glenn, Ogama, and PO lakes should be conducted to ensure no potential loss to these habitats.

41.4.2 Detailed Review Comment

It is assumed that habitat is not affected in Glenn, Ogama and PO lakes (Figure 6.5-1 and 6.5-2) in the FEIS and thus not accounted for as losses in the Fish Offset Plan. However, the potential for drawdown in these lakes could result from reduced inflows to these lakes resulting from the Project. Thus, changes to fish habitat should because of potential draw down due to decreased inflows should be monitored to ensure no effects to these habitats.

41.5 STATUS/CONCERN

Recommendation/Request

Please provide a rationale for why monitoring of fish habitat in Glenn, Ogama, and PO lakes is not planned as part of the Aquatic Effects Monitoring Plan.

41.6 TMAC RESPONSE

Similar to KIA-IR35, the project-related effects to aquatic habitat resulting from potential changes to lake levels will be considered during the development of Fisheries Offsetting in consultation with the interested parties.

42. ID# KIA-IR42

42.1 SUBJECT

Aquatic Effects Monitoring Plan –

42.2 REFERENCE

P4-18 Hope Bay Aquatic Effects Monitoring Plan, Section 3.2 Monitoring Components

42.3 ISSUE SUMMARY

No monitoring tissue metals concentrations in benthos or fish are included in the AEMP.

42.4 DISCUSSION

42.4.1 Importance of Issue

It is important to monitor changes in metals up the food web to assess risk to biota and human consumers.

42.4.2 Detailed Review Comment

Monitoring of metals in water and sediment has been proposed in the AEMP, however, no monitoring of metals up the food chain has been proposed. While it is acceptable to take the approach that if water quality meets guidelines at discharge then no effects are anticipated in the receiving environment, however this should be monitored in the environmental media in the receiving environment to inform potential risk to biota and consumer/users of biota.

42.5 STATUS/CONCERN

Recommendation/Request

Please provide a rationale for why monitoring of fish tissue and benthic tissue metals concentrations has not been proposed as part of the Aquatic Effects Monitoring Plan.

42.6 TMAC RESPONSE

Fish or benthic invertebrate tissue monitoring were not explicitly included within the draft Madrid-Boston AEMP as they are not currently monitored under the recently amended Doris AEMP, and fish tissue metal (mercury) concentrations will be monitored in Aimaokatalok Lake as per Schedule 5, Section 9c of the Metal Mining Effluent Regulations

(MMER). Further tissue sampling will be considered under the Aquatic Response Framework (AMF) as higher-level action items if statistically significant increases in water and/or sediment quality are determined. The AMF will be developed as part of the final Madrid-Boston AEMP in consultation with the interested parties.

43. ID# KIA-IR43

43.1 Subject

Landfill management plan (Zoetica)

43.2 Reference

Package P4 Environmental Management System, Section 2.8, and Page 2-8.

TMAC states:
"At present, there is no Landfill Management Plan for the Hope Bay Project as there is no existing landfill on the Project Site. In line with the NWB water licencing requirements, a Landfill Management Plan for the Hope Bay Project will be developed in consultation with interested parties six (6) months prior to the development of a landfill."

Package P4-4 Hope Bay Project Domestic Wastewater Treatment Management Plan, Section 2.4.1, Page 5.

TMAC states:
"Sludge is removed from the WTP and is transported directly to the TIA for disposal. TMAC will continue to explore alternative methods of sludge disposal which may include incineration of dried cake or disposal into the landfill once constructed."

43.3 Issue Summary

A detailed landfill management plan was not provided, and we concur that the NWB requirement is that it be developed 5 months prior to the development of a landfill. A conceptual plan with potential locations, however, would help in the review of this application.

43.4 Discussion

43.4.1 Importance of Issue

It is important to allow for review of potential impacts of major infrastructure considerations, including landfills, in the water licencing process.

43.4.2 Detailed Review Comment

Some of the application documents appear to contradict themselves as to whether or not, and when, there is going to be a landfill. Some portions imply/state there will be a landfill, which aligns with our understanding. However, other documents suggest there will/may not be. A landfill, or lack thereof, will pose different environmental impacts that can affect water quality and the terrestrial environment in the surrounding area differently. Ideally, the presence of absence, and potential location(s) of a landfill should be assessed and reviewed at a conceptual level as part of the project and water licence application.

Assuming a landfill will be used at a future date as for the project, the landfill management plan can then be developed 6 months prior to its development, which will include details including how wastes will be handled, management measures taken during periods of rainwater, closure and reclamation plans, and other aspects of management related to water quality, should be described in a landfill management plan.

43.5 STATUS/CONCERN

Recommendation/Request

Please indicate when a landfill will be used, and its potential location(s). Please also include information on what the impacts and mitigation will be for alternative waste disposal plans, prior it the landfill construction, and for how long those impacts and mitigation measures may be required. A conceptual landfill management plan would also be helpful for a fulsome review.

43.6 TMAC RESPONSE

TMAC confirms that a non-hazardous waste landfill is proposed to be constructed at Doris within Quarry 3 as approved under the existing water license 2AM-DOH1323 and at Boston within Quarry V as described in Supporting Document P5-28 (Hope Bay Project Boston Surface Infrastructure Preliminary Design – SRK Consulting, November 2017) Section 4.5 and shown on Drawing BC-11.

The potential locations for the landfills have been be assessed and reviewed as part of the previous, now approved, water license application for the Doris, Quarry 3 landfill and in this water licence application as described in Support Document P5-28 (Hope Bay Project Boston Surface Infrastructure Preliminary Design – SRK Consulting, November 2017), Section 4.5 and shown on Drawing BC-11.

TMAC has not committed to a specific timeline for construction of the landfill and this will be based on a operational requirement. Prior to landfill construction waste disposal plans will follow the existing practices currently implemented on site. No impacts are expected or currently observed for the currently implemented waste disposal practices.

A Landfill Management Plan for the Hope Bay Project will be developed six (6) months prior to the development of a landfill.

44. ID# KIA-IR44

44.1 SUBJECT

Wastewater treatment Doris (Zoetica)

44.2 REFERENCE

Package P4-4 Hope Bay Project Domestic Wastewater Treatment Management Plan, Section 2.3.1, Page 4.

TMAC states:
"Effluent samples are collected by the Environmental Coordinator as prescribed under the applicable licence or if there are suspected issues with the effluent quality based on daily monitoring conducted by the WTP operator. These samples are submitted for analysis at an accredited laboratory and compared to discharge criteria outlined in the water licence.
If water quality samples indicate the effluent is not compliant with these discharge criteria or if
monitoring activities conducted by the operators indicate there is an issue with the WTP system, discharge to the tundra is stopped until the cause of the issue is identified."

Package P4-4 Hope Bay Project Domestic Wastewater Treatment Management Plan, Module A: Doris, Section A3.2.1, Page A-9.

TMAS states:
"The potential does exist for isolated, short-term discharges of treated wastewater effluent that does not meet the discharge limits due to equipment malfunction or operator error."

44.3 ISSUE SUMMARY

Effluent quality will not be determined prior to its release, and effluent is being discharged onto the tundra.

44.4 DISCUSSION

44.4.1 Importance of Issue

It is important to ensure compliance with water quality standards and have a plan in place, which can react quickly to water quality issues.

44.4.2 Detailed Review Comment

The current plan calls for an effluent discharge to be stopped following a negative result. This will result in instances of poor water quality being released to the tundra, which could affect vegetation, soil, or wildlife. The ECCC also discussed this issue and recommended that wastewater be directed to the TIA.

44.5 STATUS/CONCERN

Recommendation/Request

How long of a time lag will, there be between sending a sample for laboratory testing and stopping wastewater discharge?

Now that directing wastewater to the TIA has been explored by TMAC, are there any solutions proposed that involve directing this water to the TIA rather than onto the tundra?

44.6 TMAC RESPONSE

The average time to receive results for a sample submitted for 3rd Party laboratory testing for the parameters outlined in Table A.1 of the Hope Bay Project Domestic Wastewater Treatment Management plan is 7-14 business days. However internal laboratory testing is performed on site on a daily basis by the WTP operator to ensure the treatment system is functioning within the acceptable operating range as per the manufacturer design. This includes monitoring of pH, dissolved oxygen, temperature, flow and settle ability of solids as described in Section A3.2 of the Hope Bay Project Domestic Wastewater Treatment Management plan. The WTP systems are designed to meet the applicable discharge criteria when functioning within the acceptable operating range for these parameters. The results of this daily monitoring are used to assess the performance of the system and make inferences about the effluent quality. If there were a concern that water might not meet water licence criteria, water would be directed to the TIA and not discharged to tundra until confirmatory results are obtained.

In the unlikely event that results of the daily monitoring indicate that effluent does not meet the discharge criteria outlined in Table A.1 and water discharge has commenced, the discharge to tundra would be stopped immediately and redirected to the TIA as outlined in Module A: Doris, Section A3.2.1 of the plan. Based on this approach, the lag time would typically be no more than a day before sampling would indicated a requirement to stop wastewater discharge. Steps would then be taken to return the system to acceptable operating parameters. In this case, effluent samples would be collected and submitted for 3rd Party laboratory testing to confirm effluent quality met the discharge criteria prior to recommencing discharge to tundra.

The 7-14 business days required for 3rd Party laboratory testing is dependent on the time required to ship the sample to the receiving laboratory and the time required by the laboratory to conduct the analytical analysis for the specified parameters. Results may be received sooner by requesting "same day" priority analysis from the laboratory in urgent situations where effluent quality could potentially exceed the discharge criteria. The minimum amount of time required to complete analysis is 5 business days (based on time required to complete analysis for BOD; other parameters can be available in less time).

45. ID# KIA-IR45

45.1 SUBJECT

Wildlife attraction to Wastewater discharge (Zoetica)

45.2 REFERENCE

Package P4-5 Hope Bay Project: Boston Sewage Treatment Operations and Maintenance Management Plan, Section 3.1, Page 6.

TMAC states:
"Under the existing Type B Water Licence 2BB-BOS1727, treated effluent from the Clementine STP can be discharged to tundra in an approved discharge location"

45.3 ISSUE SUMMARY

It is unclear as to whether monitoring will be done to determine whether treated effluent deposited to the tundra, with sewage sludge removed, will attract wildlife.

45.4 DISCUSSION

45.4.1 Importance of Issue

It is important to consider potential wildlife attractions with the project area.

45.4.2 Detailed Review Comment

Sewage sludge removal from effluent is noted as mitigation to limit attraction of wildlife. However, it is unclear if any monitoring for wildlife attraction to wastewater effluent, devoid of sludge, will be considered. At wastewater discharge points, novel smells may attract wildlife or be nutrient rich and cause more vegetation growth, which could attract wildlife.

45.5 STATUS/CONCERN

Recommendation/Request

Will wildlife attraction to these discharge sites be monitored?

45.6 TMAC RESPONSE

Wastewater has been discharged to the tundra at Doris Mine successfully for a number of years from locations within 1km of the mine site. During this period, the wastewater discharge locations have not been noted as a significant wildlife attractant during a number of wildlife safety audits. There is no reason to believe that similarly treated wastewater discharged at Boston would be perceived by wildlife in a differing manner.

46. ID# KIA-IR46

46.1 SUBJECT

Wastewater treatment Boston contingency (Zoetica)

46.2 REFERENCE

Package P4-5 Hope Bay Project: Boston Sewage Treatment Operations and Maintenance Management Plan, Section 6.1 Treatment Option Contingency

46.3 ISSUE SUMMARY

Boston wastewater treatment contingency plans are not as clearly described as for the Doris site.

46.4 DISCUSSION

46.4.1 Importance of Issue

It is important to ensure contingency plans are in place for both water treatment facilities.

46.4.2 Detailed Review Comment

The Doris wastewater treatment plant has two treatment plants operating plus a third in case of a failure at one of the plants. However, there is no indication of a back-up treatment plant at the Boston site.

46.5 STATUS/CONCERN

Recommendation/Request

Is there a back-up treatment plant at Boston? In addition, if not, why not?

46.6 TMAC RESPONSE

TMAC would like to note that the referenced Package 4-5 - Hope Bay Project: Boston Sewage Treatment Operations and Maintenance Management Plan is the existing management plan approved under the Boston Type B Water Licence 2BB-BOS1727, and was provided as part of the application to describe the existing facilities and sewage management at the current Boston Site. Details for the wastewater treatment at the proposed Phase 2 Boston Site are provided in Package 4-4: Hope Bay Project Domestic Wastewater Treatment Operations and Maintenance Plan.

Any redundancy at Doris is because staffing levels were not up to the level at which the plant can process. Communities, municipalities and industry do not build back up treatment plants. Rather, there is capacity to hold effluent due to equipment failure. Additionally, water management/reductions can be temporarily imposed to conserve water and reduce the amount going to the plant if the need arises.

47. ID# KIA-IR47

47.1 SUBJECT

Visual inspections of TIA and other water management structures (Zoetica)

47.2 REFERENCE

Package P4-7 Hope Bay Project Doris-Madrid Water Management Plan, Section 3.2.5, Page 19.

TMAC states:
"Visual inspections will consist of the following:
Water level in the pond should be measured weekly during the open water season, and more frequently during intensive rainfall or snowmelt periods."

Package P4-7 Hope Bay Project Doris-Madrid Water Management Plan, Section 5.4, Page 34.

Package P4-8 Hope Bay Boston Water Management Plan, Section 4.3, Page 14.

47.3 ISSUE SUMMARY

Visual inspections of the TIA could be enhanced by consideration of monitoring for wildlife use/attraction to the TIA at the same time.

47.4 DISCUSSION

47.4.1 Importance of Issue

It is important to monitor for wildlife interaction with the TIA to inform adaptive management. Routine visual inspections are occurring at set/frequent intervals, which could be used to efficiently collect signs and observations of wildlife attraction/use of the TIA.

47.4.2 Detailed Review Comment

Routine visual inspections of water management structures should also include an inspection of any wildlife interactions with ponds and larger water bodies. The inclusion of monitoring for wildlife interactions would be particularly relevant for the TIA. Wildlife could been exposed to the tailings water or be attracted to the water body itself, or to any salinity associated with ponds, or the TIA. There is also the possibility that wildlife may attempt to walk onto the sand-like tailings and be entrapped (i.e., quicksand effect), particularly as the amounts of beached tailings will increase during Phase II. Concurrent visual inspections of the TIA are an excellent opportunity to note apparent interactions with wildlife. If such issues are identified, adaptive management can be implemented quickly following observed issues.

47.5 STATUS/CONCERN

Recommendation/Request

Please include another point under visual inspections to check for any wildlife interactions that may be observable at the same time as the existing water management inspections.

47.6 TMAC RESPONSE

Monitoring of wildlife is comprehensively covered under the Hope Bay Project Wildlife Mitigation and Monitoring Plan. Under the Hope Bay Project Wildlife Mitigation and Monitoring Plan, any observation of wildlife or wildlife interaction on site is to be appropriately reported. This includes during inspection of the TIA. Duplication of wildlife monitoring to all other management plans is not required or practical.

48. ID# KIA-IR48

48.1 SUBJECT

Interim effluent and mine water management strategy (Zoetica)

48.2 REFERENCE

Package P4-7 Hope Bay Project Doris-Madrid Water Management Plan, Section 5.3.1., Page 33.

TMAC states:
"To discharge to Roberts Bay, the MMER requires that effluent not be acutely lethal to rainbow trout when tested in accordance with the applicable Reference Method. Currently, an alternate species acclimated to salt water is not permitted for use. Efforts are underway to amend the MMER to address this. To ensure it is in compliance with the MMER, TMAC has developed an interim effluent and mine water management strategy to be employed while the MMER is being amended."

48.3 ISSUE SUMMARY

MMER effluent requirements are geared to freshwater species, but the phase 2 project would discharge into the marine environment. As MMER is updated, an interim effluent and mine water management strategy has been developed by TMAC. However, they have not yet provided the strategy for review.

48.4 DISCUSSION

48.4.1 Importance of Issue

It is important to have complete information to ensure the protection of the marine environment compliance with the MMER, and agreement with best practices.

48.4.2 Detailed Review Comment

This interim effluent and mine water management strategy has not been provided for review. The interim strategy is needed to confirm compliance with the MMER and best practices. The interim strategy proposed by TMAC should be provided in the water management plan or cited appropriately, prior to effluent deposition.

48.5 STATUS/CONCERN

Recommendation/Request

Please provide the interim effluent and mine water management strategy.

48.6 TMAC RESPONSE

TMAC understands the issues pertaining to development of a toxicity test for saline tolerant test species is well underway and should be in place in Gazette 2 by May 2018, approximately 3 months from now. Following which TMAC intends to operate as per the stated water management strategy with discharge to Roberts Bay once construction of the pipeline is completed in open water of 2018. Mine water will be discharged to the TIA when not able to be discharged to Roberts Bay as per Supporting Document P4-7 (Hope Bay Project Doris-Madrid Water Management Plan – SRK Consulting, November 2017), Section 3.2.6. This includes the period prior to amendment of the MMER. The TIA has sufficient capacity to not require discharge in 2018 should there be delays in the amendment to MMER. As a result, there is no need to produce or adopt an interim water management plan as this scenario is covered under the existing plan.

49. ID# KIA-IR49

49.1 SUBJECT

Adaptive management during post-closure (Zoetica)

49.2 REFERENCE

Package P4-19 Hope Bay Project Boston Conceptual Closure and Reclamation Plan, Section 9.3, Page 30.
TMAC states:
"Adaptive management is discussed throughout this CCRP. Adaptive management includes:

- Continuation of post-closure monitoring beyond the stated durations if the closure objectives are not met or cannot be confirmed within the prescribed time period; and

Continuous monitoring of water quality during operations and updating of predictive models to refine closure requirements."

49.3 ISSUE SUMMARY

Examples are provided of monitoring, but not of potential actions that will be taken in response to problematic monitoring results.

49.4 DISCUSSION

49.4.1 Importance of Issue

Adaptive management is needed to ensure all closure objectives are met.

49.4.2 Detailed Review Comment

Adaptive management typically involves further actions to meet the project objectives once monitoring identifies an issue. The adaptive management examples provided only include monitoring, but no corresponding mitigation action. For example, if issues with water quality are identified associated with the TMA, barriers to prevent wildlife access such as fencing or floating water bird deterrents could be used.

49.5 STATUS/CONCERN

Recommendation/Request

Please expand on other adaptive management actions, following the findings of problematic monitoring results, which may be considered.

49.6 TMAC RESPONSE

If post-closure monitoring indicated that a project closure objective was not being met, an investigation would be undertaken to determine the cause and best course of action, specific to the issue identified and considering all the details identified during the investigation. Until those details are available it is ineffectual at this stage to forecast the potential issues given these are considered highly unlikely.

50. ID# KIA-IR50

50.1 SUBJECT

Road Management Plan Lacking

50.2 REFERENCE

Volume 1 Annex V1-7 Type A Water Licence Applications, Package P4 Environmental Management System, Section 9.4.10 Roads Management.

TMAC states: "*TMAC does not believe that a stand-alone plan is applicable or required*" [for roads management].

50.3 ISSUE SUMMARY

A stand-alone road management plan is needed for this project, as it adds a significant length of road, and traffic not included in the Doris North project. The road between Madrid and Boston also winds through some different topographical features that may create novel challenges for wildlife and road verge blind spots for drivers.

50.4 DISCUSSION

50.4.1 Importance of Issue

Not addressing all the potential issues related to roads, traffic and accidents presents a serious risk to employees and residents.

50.4.2 Detailed Review Comment

A stand-alone plan is required for roads management to address risks that are currently not being addressed in other plans, and that are different/greater than risks posed by the Doris North road and traffic rates. A road management plan is required for adequate risk management.

It is important that this road management plan be provided for review as part of this coordinated Water Licence/FEIS review process, such that commitments can be made during the review and hearing processes related to the contents of the plan, rather than a generic commitment being made to produce a plan that should have been provided. The road management plan should be provided prior to the final hearing to provide feedback on contents.

50.5 STATUS/CONCERN

Recommendation/Request

Please provide a stand-alone road management plan for review prior to final hearings.

50.6 TMAC RESPONSE

TMAC believes that the most effective fashion for addressing items related to road management is through consideration of environmental constraints in the design process and by addressing specific needs (i.e. wildlife) under existing plans. This is consistent with NIRB guideline 9.1 and based on this, TMAC does not require a stand alone management plan.

This position is further supported by the lack of connectivity of roads to any public network, the consideration of environmental constraints during the design process, and the fact that road management is already addressed under existing management plans (see Table below). Design considerations are outlined throughout the EIS, and include;

- the land tenure related to the proposed roads;
- public consultation undertaken with respect to the proposed Project;
- incorporation of TK in Project Design;
- land use of the Project area;
- consideration of Transport Canada's Navigable Waters Protection Program;
- projected traffic volumes and types and numbers of vehicles to be used;
- road design speed limits; and
- measures for preventing the permafrost degradation during construction and operation of ground transportation

Operational control measures employed at the Hope Bay Project related to roads are incorporated into various management plans and as summarized in the Table below.

Table Documents Outlining Management Measures Related to Roads

Plan	Relevance to Road Management
Surface Emergency Response Plan (P4-1)	Safety procedures and protocols for emergency events including accidents, accidents causing injuries, vehicle malfunction and emergency protocols
Wildlife Mitigation and Monitoring Plan (V8-3)	Mitigation measures and protocols to be implemented during construction and operations to mitigate potential impacts to wildlife, including explicit thresholds for mitigation of potential wildlife interactions, collisions and follow-up procedures

Air Quality Management Plan (V8-2)	Dust mitigation
Hope Bay Project Doris-Madrid Water Management Plan (P4-7) and Boston Water Management Plan (P4-8)	Measures to control surface runoff, sedimentation, and pooling of water during spring freshet or significant rain events, and mitigation actions such as snow clearing
Hope Bay Project Spill Contingency Plan (P4-3)	Emergency reporting and procedures for fuel/chemical spills
Closure and Reclamation Plans (P4-19 and P4-21)	Plans for site reclamation, including quarry sites and disposal of waste materials and options of final closure and reclamation, as well as consideration of potential future uses (e.g., potential public use)
Health and Safety Management Plan (V8-4)	Traffic Management

Furthermore TMAC would like to note that a stand alone Roads Management Plan is not a requirement under the Supplemental Guidelines for a Type A Water Licence application and is therefore out of the scope for this application.

51. ID# KIA-IR51

51.1 Subject

Kitikmeot Inuit involvement in environmental monitoring and management (SVS).

51.2 Reference

Volume 1 Annex V1-7 Type A Water Licence Applications, Package P2-2 Project Description Type A Water Licence Boston, Sections 5, 7, 8, 9 (regarding water and environmental monitoring plans).

51.3 Issue Summary

Kitikmeot Inuit residents (including employees and land and resource users) need to be directly involved in the environmental protection of their lands.

51.4 Discussion

1. *Gap/Issue*

Lack of indication of Kitikmeot Inuit involvement in environmental monitoring and management programs.

2. *Disagreement with WL information/ conclusion*

Project specific application of local Inuit Knowledge is imperative for meaningful and regionally relevant environmental stewardship.

3. *Reasons for disagreement*

Kitikmeot Inuit residents (including employees and land and resource users) need to be directly involved in the environmental protection of their lands.

51.5 Status/Concern

Recommendation/Request

Kitikmeot Inuit residents and employees need to be provided the capacity building resources to be directly involved in environmental monitoring and management programs both at a review level and on the ground in implementation. This needs to be made explicit in the licence application.

51.6 TMAC RESPONSE

TMAC disagrees that commitments related to Kitikmeot Inuit involvement in environmental monitoring and management need to be made explicit in this licence application.

As the KIA is fully aware, in March 2015, TMAC entered into a 20 year umbrella Framework Agreement with the KIA that includes a comprehensive Inuit Impact and Benefit Agreement (IIBA), Water and Wildlife Compensation Agreement and provision for annual, indexed payments to the KIA. The Framework Agreement is in place and implemented for the entire Hope Bay project including the Madrid Boston development currently subject to permitting.

Terms and conditions contained in the Framework Agreement and related documents provide Kitikmeot Inuit with resources and input into environmental monitoring and management programs both at the review level and on the ground at Hope Bay. As the Framework Agreement is an existing legally binding private contract between TMAC and the KIA, terms contained in these agreements relevant to licence application need not be replicated.

Examples of specific Framework Agreement commitments relevant to this Information Request include:

1. Framework Agreement Annual Payments – TMAC provides KIA with a substantial annual, indexed payment in consideration for Land Administration activities including inspection of TMAC facilities on Inuit Owned Land. To date, the KIA has elected to utilize Non-Inuit staff to undertake this work. However, the KIA may choose to utilize Kitikmeot Inuit to perform this task in the future in relation to Madrid Boston development and facilities.

2. Schedule D Hope Bay IIBA – TMAC is committed to Inuit specific training and education activities pursuant to this part of our IIBA. Examples of training initiatives include the completion and implementation of Career Development Plans for all Inuit workers including Site Environmental Staff. In 2017, TMAC completed the first annual Career Development Plans for Inuit staff, including Kitikmeot Inuit working for our Site Environment department. Inuit Environmental staff dedicated to the Madrid Boston development will have access to these resources.

3. Schedule E Hope Bay IIBA – TMAC is committed to preferentially hiring Inuit and to adhere to annual Inuit Employment Targets. Currently, 50-65% of TMAC Site Environmental Staff at Hope Bay are Kitikmeot Inuit. TMAC expects that for the Madrid Boston Development, we will be able to perform similarly to the past by hiring additional Kitikmeot Inuit in order to monitor and manage additional Hope Bay development.

4. Schedule F Hope Bay IIBA – TMAC is committed to preferentially contract with Kitikmeot Qualified Business in the area of Environmental Services.

5. Schedule I Hope Bay IIBA – TMAC is committed to establishing and utilizing an Inuit Environmental Advisory Committee (IEAC) made up of Kitikmeot Inuit to provide advice on environmental monitoring and management programs. TMAC is committed to paying the full costs of operating the IEAC. The IEAC was established in 2016 and is functioning; meeting an average of three times a year. The IEAC has already provided TMAC with valuable and actionable advice in relation to our Wildlife Monitoring and Mitigation Program (WMMP) and other environmental management programs. TMAC expects that the IEAC will continue to be in place and provide TMAC with the opportunity to benefit from Kitikmeot Inuit involvement in environmental matters related Madrid Boston activities.

52. ID# KIA-IR52

52.1 SUBJECT

Kitikmeot Inuit and resident employment/involvement in Environmental Management Systems (SVS).–

52.2 REFERENCE

Volume 1 Annex V1-7 Type A Water Licence Applications, Package P4 Environmental Management System, Section 1.2 and Table 1.1.

52.3 ISSUE SUMMARY

Kitikmeot Inuit residents (including employees and land and resource users) need to be directly involved in the environmental protection of their lands.

52.4 DISCUSSION

1. *Gap/Issue*

No indication of how Kitikmeot Inuit employees, residents, or land users will be involved in any aspect of these plans or programs.

2. *Disagreement with WL information/ conclusion*

Project specific application of local Inuit Knowledge is imperative for meaningful and regionally relevant environmental stewardship.

3. *Reasons for disagreement*

Kitikmeot Inuit residents (including employees and land and resource users) need to be directly involved in the environmental protection of their lands.

52.5 STATUS/CONCERN

Recommendation/Request

Kitikmeot Inuit residents and employees need to be provided the capacity building resources to be involved in environmental monitoring and management programs both at a review level and on the ground in implementation. This includes emergency response readiness and involvement.

The EMPs do not indicate how Inuit employees and citizens/land users will be involved in environmental protection, water and wildlife monitoring and/or be equipped with the capacity to be involved in emergency response. Please provide a description of how TMAC will ensure that Inuit residents and employees will be provided with training and roles to be involved in these management programs; specifically, for:

9.2 Environmental Protection Plan

9.4.1 Risk Management and Emergency Response

9.4.4 Site Water Monitoring and Management

9.4.16 Aquatic Effects Management Plan

9.4.17 Wildlife Mitigation and Monitoring Plan

52.6 TMAC Response

Similar to TMAC response to ID# KIA-IR51 above, TMAC disagrees that Kitikmeot Inuit involvement in environmental protection, water and wildlife monitoring and capacity building towards emergency response need to be made explicit in our various management programs.

As the KIA is fully aware, in March 2015, TMAC entered into a 20 year umbrella Framework Agreement with the KIA that includes a comprehensive Inuit Impact and Benefit Agreement (IIBA), Water and Wildlife Compensation Agreement and provision for annual, indexed payments to the KIA. The Framework Agreement and associated sub agreements are in place and implemented for the entire Hope Bay project including the Madrid Boston development currently subject to permitting.

Terms and conditions contained in the Framework Agreement and related documents provide Kitikmeot Inuit with resources and input into environmental monitoring and management programs both at the review level and on the ground at Hope Bay. As the Framework Agreement is an existing legally binding private contract between TMAC and the KIA, terms contained in these agreements relevant to licence application need not be replicated in site management documents.

Examples of specific Framework Agreement commitments relevant to this Information Request include:

1. Framework Agreement Annual Payments – TMAC provides KIA with a substantial annual, indexed payment in consideration for Land Administration activities including inspection of TMAC facilities on Inuit Owned Land. To date, the KIA has elected to utilize Non-Inuit staff to undertake this work. However, the KIA may

choose to utilize Kitikmeot Inuit to perform this task in the future in relation to providing input into our management plans.

2. Schedule D Hope Bay IIBA – TMAC is committed to Inuit specific training and education activities pursuant to this part of our IIBA. Examples of training initiatives include the completion and implementation of Career Development Plans for all Inuit workers including Site Environmental Staff. In 2017, TMAC completed the first annual Career Development Plans for Inuit staff, including Kitikmeot Inuit working for our Site Environment department. This would include relevant training and capacity building leading to Kitikmeot Inuit work progression related to implementation of site management plans.

3. Schedule E Hope Bay IIBA – TMAC is committed to preferentially hiring Inuit and to adhere to annual Inuit Employment Targets. Currently, 50-65% of TMAC Site Environmental Staff at Hope Bay are Kitikmeot Inuit. Going forward, TMAC fully expects to continue to preferentially hire Inuit to all Hope Bay roles, including those responsible for implement site management plans.

4. Schedule F Hope Bay IIBA – TMAC is committed to preferentially contract with Kitikmeot Qualified Business in the area of Environmental Services.

5. Schedule I Hope Bay IIBA – TMAC is committed to establishing and utilizing an Inuit Environmental Advisory Committee (IEAC) made up of Kitikmeot Inuit to provide advice on environmental monitoring and management programs. TMAC is committed to paying the full costs of operating the IEAC. The IEAC was established in 2016 and is functioning; meeting an average of three times a year. The IEAC has already provided TMAC with valuable and actionable advice in relation to our Wildlife Monitoring and Mitigation Program (WMMP) and other environmental management programs. TMAC expects that the IEAC will continue to be in place and provide TMAC with the opportunity to benefit from Kitikmeot Inuit knowledge and expertise in environmental matters related to future Hope Bay activities.

53. ID# KIA-IR53

53.1 SUBJECT

Lack of Road Management Plan/Human Safety (SVS)–

53.2 REFERENCE

P4-18 Hope Bay Aquatic Effects Monitoring Plan, Section 3.2 Monitoring Components

53.3 ISSUE SUMMARY

No monitoring tissue metals concentrations in benthos or fish are included in the AEMP.

53.4 DISCUSSION

53.4.1 Importance of Issue

It is important to monitor changes in metals up the food web to assess risk to biota and human consumers.

53.4.2 Detailed Review Comment

Monitoring of metals in water and sediment has been proposed in the AEMP, however, no monitoring of metals up the food chain has been proposed. While it is acceptable to take the approach that if water quality meets guidelines at discharge then no effects are anticipated in the receiving environment, however this should be monitored in the environmental media in the receiving environment to inform potential risk to biota and consumer/users of biota.

53.5 STATUS/CONCERN

Recommendation/Request

Please provide a rationale for why monitoring of fish tissue and benthic tissue metals concentrations has not been proposed as part of the Aquatic Effects Monitoring Plan.

53.6 TMAC RESPONSE

Fish or benthic invertebrate tissue monitoring were not explicitly included within the draft Madrid-Boston AEMP as they are not currently monitored under the recently amended Doris AEMP, and fish tissue metal (mercury) concentrations will be monitored in Aimaokatalok Lake as per Schedule 5, Section 9c of the Metal Mining Effluent Regulations

(MMER). Further tissue sampling will be considered under the Aquatic Response Framework (AMF) as higher-level action items if statistically significant increases in water and/or sediment quality are determined. The AMF will be developed as part of the final Madrid-Boston AEMP in consultation with the interested parties.

54. ID# KIA-IR54

54.1 SUBJECT

Monitoring and Adaptive Management for Social Issues Linked to Mining Employment (SVS)

54.2 REFERENCE

Volume 1 Annex V1-7 Type A Water Licence Applications, Package P4 Environmental Management System, Section 1.2 and Table 1.1: Socio-economic Management Plans.

54.3 ISSUE SUMMARY

The Application (Table 1.1) lists a variety of plans (HR, etc.,) that fall under the 'Socio-economic Management Plans' category. However there are no aspects of the socio-economic management plans that include monitoring and adaptive management of social issues inherently linked to mining employment and remote mine shift work (e.g., employment targets; training and capacity building; effectiveness indicators for Inuit / inter-cultural support systems; financial management; Inuit employee mental & cultural/spiritual health and wellbeing; spouse and family wellbeing; domestic violence etc.); A plan or commitment to developing these components of the socio-economic management plan is needed to address, mitigate and/or monitor these social impacts.

54.4 DISCUSSION

54.4.1 Importance of Issue

There are social impacts related to mining that need to be managed and monitored. They are not reflected in the current proposed socio-economic management plans and need to be so that adverse social impacts are mitigated, and potential positive socio-economic impacts are protected and enhanced.

54.4.2 Detailed Review Comment

1. *Gap/Issue*

There are no aspects of the socio-economic management plans that include monitoring and adaptive management of social issues inherently linked to mining employment and remote mine shift work (e.g., employment targets; training and capacity building; effectiveness indicators for Inuit/inter-cultural support systems; financial management; Inuit employee mental & cultural/spiritual health and wellbeing; spouse and family wellbeing; domestic violence etc.); A plan or commitment to developing these components of the socio-economic management plan is needed to address, mitigate and/or monitor these social impacts.

1. *Disagreement with WL information/ conclusion*

This omission creates a substantially grave risk to the individual, family and community health and well-being of Kitikmeot Inuit employees and residents.

2. *Reasons for disagreement*

Social impacts need to be more comprehensively addressed and managed.

54.5 STATUS/CONCERN

Recommendation/Request

Provide socio-economic management plans that include monitoring and adaptive management of social issues inherently linked to mining employment and remote mine shift work including employment targets; training and capacity building; effectiveness indicators for Inuit / inter-cultural support systems; financial management; Inuit employee mental & cultural/spiritual health and wellbeing; spouse and family wellbeing; domestic violence etc.). A plan or commitment to developing these components of the socio-economic management plan is needed to address, mitigate and/or monitor these social impacts.

54.6 TMAC RESPONSE

TMAC disagrees that a stand alone, socio-economic management plan for addressing, mitigating and/or monitoring for social impacts is appropriate for inclusion in water licence permitting.

In 2015, in accordance with Article 26 of the Nunavut Agreement, TMAC in good faith successfully concluded negotiations with the KIA to establish a 20 year term Inuit Impact and Benefit Agreement for the Hope Bay project including activities contemplated under this application.

This IIBA provides for a collaborative relationship between TMAC and the KIA in addressing, mitigating and/or monitoring for social impacts, primarily through quarterly joint IIBA Implementation Committee meetings. Both in 2016 and 2017, consecutive IIBA Evaluation Reports accepted by TMAC and the KIA indicate that this collaborative process is working to the satisfaction of the Parties. TMAC has no reason to believe this would change with expansion of activities at Hope Bay.

TMAC reminds the KIA that:

1. In Section 3.3(v) of the 2015 Hope Bay IIBA, the KIA has made covenants and agreed that it will not seek additional financial consideration, or economic or other consideration from TMAC in respect to the Hope Bay Belt Project for impacts on the rights of Inuit beneficiaries,

2. Schedule E of the Hope Bay IIBA (Employment) contains specific adaptive management provisions for all employee related issues indicated in Section 54.3 above,

3. Schedule G of the Hope Bay IIBA (Access to Facilities and Roads) contains specific adaptive management provisions related to Inuit access to the project area,

4. Schedule I of the Hope Bay IIBA (Inuit Environmental Advisory Committee) contains specific adaptive management provisions related to Inuit traditional use of the Project Area.

55. ID #ECCC-FEIS-01

55.1 SUBJECT/TOPIC

Sludge Management

55.2 REFERENCES

- Package 4-4: Hope Bay Project Domestic Wastewater Treatment Operations and Maintenance Plan
- Section 2.4.1 – Management Response
- Section A2.2.2 – Sludge Dewatering

55.3 SUMMARY

55.4 DISCUSSION

55.4.1 Importance of Issue to the Impact Assessment Process

55.4.2 Detailed Review Comment

Section 2.4.1 (Management Response) states that sludge is removed from the Waste Treatment Plant (WTP) and is transported directly to the Tailings Impoundment Area (TIA) for disposal.

However, Section A2.2.3 (Sludge Dewatering) states that sludge/press cake that will be disposed of in the TIA will be placed in bags and stored securely at the waste management facility in a manner that will prevent wildlife from accessing the sludge until such time that it can be disposed of in this location.

55.5 RECOMMENDATION/REQUEST

If bagged sludge is stored at the waste management facility prior to disposal in the TIA, ECCC recommends that TMAC employ secondary containment and conduct frequent inspections to mitigate against potential releases of sludge or leachate.

55.6 TMAC RESPONSE

TMAC would like to thank ECCC for pointing out this discrepancy. The sludge management described in Section 2.4.1 is the current practice at site. Sludge is removed from the WTP and sent directly to the Tailings Impoundment Area for disposal. As noted in the referenced plan, TMAC will continue to explore alternative methods for sludge disposal which may include incineration of dried cake or disposal into the landfill once constructed. TMAC are committed to managing sludge in a safe an responsible manner. This includes storing such materials in secondary containment located in regular inspected waste management areas.

56. ID #ECCC-FEIS-02

56.1 SUBJECT/TOPIC

Sludge Management

56.2 REFERENCES

- Package 4-4: Hope Bay Project Domestic Wastewater Treatment Operations and Maintenance Plan

56.3 SUMMARY

56.4 DISCUSSION

56.4.1 Importance of Issue to the Impact Assessment Process

56.4.2 Detailed Review Comment

As per Section A2.2.3 (Sludge Dewatering), TMAC will continue to explore alternative disposal methods for sludge/pressed cake generated from the sludge dewatering process which may include incineration or disposal into the landfill once constructed.

56.5 RECOMMENDATION/REQUEST

ECCC recommends that TMAC explore alternatives options to incineration as a means of managing sludge.

ECCC recommends that TMAC investigate options to replace the incineration of dewatered sludge with alternative practices which could conserve material for future reclamation activities. If landfilling is selected as a sludge disposal method, ECCC recommends the sludge be encapsulated.

56.6 TMAC RESPONSE

As per the existing Hope Bay Project Domestic Waste Water Treatment Operations and Maintenance plan (Package P4-4), TMAC will continue to explore alternative options for sludge disposal and will take ECCC recommendations into consideration. Should an alternative disposal method be chosen, this method would subsequently be included in an updated wastewater treatment management plan which would be submitted to the NWB for review.

57. ID #ECCC-FEIS-03

57.1 SUBJECT/TOPIC

Monitoring Station ST-9

57.2 REFERENCES

- Package 4-4: Hope Bay Project Domestic Wastewater Treatment Operations and Maintenance Plan

57.3 SUMMARY

57.4 DISCUSSION

57.4.1 Importance of Issue to the Impact Assessment Process

57.4.2 Detailed Review Comment

The current water licence describes monitoring station ST-9 as "Runoff from Wastewater Treatment Plant discharge - downstream of wastewater treatment plant discharge point and just prior to flow entering Doris Lake". However, Section A3.2 (Discharge Monitoring) of the Wastewater Treatment Management Plan describes ST-9 as located near the shore of Glenn Lake.

57.5 RECOMMENDATION/REQUEST

ECCC recommends clarification of the location of monitoring station ST-9.

57.6 TMAC RESPONSE

This is a typo in Schedule J Table 2 of the 2AM-DOH1323 amended water licence for station ST-9. The UTM coordinates for the monitoring station are 430798 7559290 as provided in the 2016 Annual Report for the 2AM-DOH1323 water licence. Refer to map on page 27 of P4-4 Hope Bay Domestic Wastewater Treatment Management Plan. Drainage in the area of the ST-8 discharge location flows towards Glenn Lake, not Doris Lake.

58. ID #ECCC-FEIS-04

58.1 Subject/Topic

Boston Sewage Treatment Plan

58.2 References

- Package 4-5 - Hope Bay Project: Boston Sewage Treatment Operations and Maintenance Management Plan
- Package P2-2 – Project Description Type A Water License Boston
- Section 5.5 – Sewage Treatment

58.3 Summary

58.4 Discussion

58.4.1 Importance of Issue to the Impact Assessment Process

58.4.2 Detailed Review Comment

The proposed development of the Boston Mine will require an increase in the camp's capacity to accommodate 300 people, therefore increasing the quantity of sewage effluent. The Boston Sewage Treatment Plan Operations and Maintenance Manual relates only to the requirements for sewage treatment under the existing Type B Bulk Sampling Licence associated with the 72 person camp. Given the application for a Type A Licence and development of the Boston Mine additional information relevant to the expansion of the camp will be required.

58.5 Recommendation/Request

ECCC recommends that TMAC provide an update to the Boston Sewage Treatment Operations and Maintenance Management Plan that accounts for the proposed changes and upgrades to the Boston Camp. The plan should include information on how increased sewage volumes may impact the existing plan and any upgrades that may be required for the sewage treatment system.

58.6 TMAC RESPONSE

TMAC would like to note that the referenced Package 4-5 - Hope Bay Project: Boston Sewage Treatment Operations and Maintenance Management Plan is the existing management plan approved under the Boston Type B Water Licence 2BB-BOS1727, and was provided as part of the application to describe the existing facilities and sewage management at the current Boston Site.

The approach to Management Plans that TMAC have adopted for the Madrid-Boston (phase 2) proposal and water licence applications is to have Belt Wide plans that provide an overview of how things are management across the Belt, with supporting modules in each Management Plan where applicable to describe the site specific management for Doris, Madrid and Boston sites. With that, TMAC would like to note that Package P4-4 Hope Bay Project Domestic Waste Water Management Plan was updated for the Madrid Boston Phase 2 application and it contains a Boston Module (Module D) which provides details for domestic waste water management for the proposed Phase 2 Boston site. With all management plans submitted as part of this application, these plans will be subject to annual review and will be updated as detailed engineering becomes refined throughout the permitting process.

59. ID #ECCC-FEIS-05

59.1 Subject/Topic

59.2 References

- Package 4-7 – Hope Bay Project Doris-Madrid Water Management Plan
- Section 5.3.1 – Mine water

59.3 Summary

59.4 Discussion

59.4.1 Importance of Issue to the Impact Assessment Process

59.4.2 Detailed Review Comment

The Water Management Plan discusses current efforts underway to develop a toxicity test for a saline tolerant test species and indicates that until such a time that this test is developed that TMAC will operate under an interim effluent and mine water management strategy. This interim effluent and mine water management strategy has not been presented in the Water Management Plan.

59.5 Recommendation/Request

ECCC recommends that TMAC provide the interim effluent and mine water management strategy and discuss the implications on the Water Management Plan. This could be provided as an appendix to the Water Management Plan until such a time that the interim water management strategy is no longer required.

59.6 TMAC Response

TMAC understands the issue pertaining to development of a toxicity test for saline tolerant test species is well underway and should be in place in Gazette 2 by May 2018, approximately 3 months from now. Following which TMAC intends to operate as per the stated water management strategy with discharge to Roberts Bay. Mine water will be discharged to the TIA when not able to be discharged to Roberts Bay as per Supporting P4-7 (Hope Bay Project Doris-Madrid Water Management Plan – SRK Consulting, November 2017), Section 3.2.6. This includes the period prior to amendment of the MMER. The TIA has sufficient capacity to not require discharge in 2018 should there be delays in the amendment to MMER. As a result, there is no need to produce or adopt an interim water management plan as this scenario is covered under the existing plan.

60. ID #ECCC-FEIS-06

60.1 SUBJECT/TOPIC

Water Management Plans

60.2 REFERENCES

- Package 4-7 – Hope Bay Project Doris-Madrid Water Management Plan Package 4-8 – Hope Bay Project Boston Water Management Plan

60.3 SUMMARY

60.4 DISCUSSION

60.4.1 Importance of Issue to the Impact Assessment Process

60.4.2 Detailed Review Comment

Overall, the Water Management Plans for Doris-Madrid and Boston are lacking in sufficient detail to adequately review.

60.5 RECOMMENDATION/REQUEST

ECCC recommends that the Water Management Plans for Doris, Madrid, and Boston be updated such that they clearly describe all water management actions for all sources during all stages of the project, additional information required includes the following:

- Maps depicting water sources and water management structures
- Identifying the proposed sampling locations in the plan for Boston and Madrid
- Clarify whether the plans refer only to existing Type B Licences for Madrid and Boston or if include all development as proposed in the Final Environmental Impact Statement (FEIS) and the Type A Water Licence application
- Describe water management for each source during Construction, Operations, Closure, and post-closure
- Identify contaminants of potential concern for each source
- List parameters tested for at each water management source

- Identify and describe treatment, where necessary
- Identify environmental protection measures, standard mitigations, and contingency options

60.6 TMAC RESPONSE

TMAC uses management plans as integral operational tools to allow site operations to be completed safely, efficiently and in accordance with required regulatory conditions. As a result TMAC prepares concise management plans focussed on providing operational staff with the information needed to complete their work. Detailed technical analysis and engineering design detail informing the management plans are therefore not repeated in the management plans as it makes those plans impractical for operational use; however relevant reference documents are listed so they can be readily consulted, if and when required. These are listed in Table 1-2 of Supporting Documents P4-7 and P4-8. The proposed management plans are consistent with the currently approved management plans for the Doris Type A Water licence.

All of the relevant additional detailed technical and engineering information that ECCC is requesting is available in the following Supporting Documents:

- P5-3 Hope Bay Project Contact Water Pond Berm Design
- P5-4 Madrid-Boston Project Water and Load Balance, Hope Bay Project
- P5-19 Hope Bay Project Madrid Water Management Design
- P5-24 Hope Bay Project Boston Water Management Design

TMAC also confirms that the Doris-Madrid Water Management Plans presented in the Water Licence application considers Phase 2 development of Madrid North and South, and not only the existing approved Bulk Sample Type B Water licence.

61. ID #ECCC-FEIS-07

61.1 Subject/Topic

Boston Water and Waste Rock/Ore Management Plan

61.2 References

- Package 4-12 – Hope Bay Project Water and Ore/Waste Rock Management Plan for Boston Site

61.3 Summary

61.4 Discussion

61.4.1 Importance of Issue to the Impact Assessment Process

61.4.2 Detailed Review Comment

The existing plan does not account for the proposed development of the Boston mine as outlined in the FEIS and instead only refers to management practices of the existing camp, roads, airstrip, and ore stockpiles. Additional information on the water and ore/waste rock management that will be required during Construction, Operations, Closure and post-closure of the Boston Mine is needed in order to assess potential effects and provide technical advice.

61.5 Recommendation/Request

ECCC recommends that TMAC update the Water and Ore/Waste Rock Management Plan for the Boston site to include information on management during Construction, Operations, Closure and post-closure of the proposed Boston Mine.

61.6 TMAC Response

Waste Rock and Ore Management at Doris, Madrid and Boston for the proposed Phase 2 development is addressed under Supporting Document P4-11 (Hope Bay Project Waste Rock, Ore and Mine Backfill). This is a combined management plan since ore and waste rock management principles across the entire Hope Bay Belt is consistent. This plan contains all the detailed information requested by ECCC.

Supporting Document P4-12 is the existing approved Boston Ore and Waste Rock Management Plan under the current Type B Water licence Application. As soon as Phase 2 development at Boston starts this plan will be superseded by P4-11.

62. ID #ECCC-FEIS-08

62.1 SUBJECT/TOPIC

Water and Load Balance

62.2 REFERENCES

- Package P5-4: Hope Bay Project – Water and Load Balance

62.3 SUMMARY

62.4 DISCUSSION

62.4.1 Importance of Issue to the Impact Assessment Process

62.4.2 Detailed Review Comment

The body of the Water and Load Balance report focuses only on parameters with authorized limits under the Metal Mining Effluent Regulations (MMER). It is possible that there are other potential contaminants of concern present in the effluent which are not further discussed in the body of the report. The appendices to the Water and Load Balance include results of modelling for the full suite of parameters. The information presented in the appendices should be interpreted and discussed in the body of the report, including identification of any additional contaminants that may require treatment or additional management.

62.5 RECOMMENDATION/REQUEST

ECCC recommends that TMAC include proposed discharge concentrations for the full suite of parameters modelled for the water and load balance. A discussion should be provided regarding the potential for impacts to aquatic life at end of pipe and in the receiving environment for parameters not authorized under MMER.

62.6 TMAC RESPONSE

The water and load balance is an iterative tool used to produce water quality predictions for the Hope Bay Project. Throughout the modelling process water quality predictions are compared to various end of pipe and instream water quality targets as described in

Sections 2.9 and 4.3 of P5-4: Hope Bay Project Water and Load Balance. If water quality objectives are exceeded, additional engineering mitigation measures are designed and subsequently included in the modelling. During this phase all parameters (69 in total) are evaluated at each model node. The water quality predictions for the final base case, for all parameters of concern are then assessed as described in Package 5.

The focus of the water and load balance is to ensure end of pipe targets where specific guidelines exist are met and to discuss parameters of concern. Comprehensive modeling results included in the Appendixes demonstrate that for all remaining parameters there are no exceedances in accordance with any of the stated guideline values and therefore there is no reason to provide additional discussion on those parameters as they have been demonstrated to have no environmental effects.

63. ID #ECCC-FEIS-09

63.1 Subject/Topic

Boston Effluent Discharge

63.2 References

- Package P5-4: Hope Bay Project – Water and Load Balance
- Section 7.1.3 – Boston Combined Discharge

63.3 Summary

63.4 Discussion

63.4.1 Importance of Issue to the Impact Assessment Process

63.4.2 Detailed Review Comment

Table 7-3 presents the Boston combined effluent base case and upper case water quality predictions, however, the only predicted concentrations presented in the table are for the post- closure phase of the project. In addition, only MMER parameters are discussed and compared to effluent quality criteria. Given the discharge from Boston will occur through life of mine into a freshwater environment, effluent quality predictions should be included for Operations and Closure for all modelled parameters, not just those with set limits under the MMER.

63.5 Recommendation/Request

ECCC recommends that TMAC provide effluent quality modelling for the Boston effluent discharge during Operations and Closure of the project. This should include all modelled parameters, not just those with set limits under the MMER.

63.6 TMAC Response

Appendix C-1 of Supporting Document P5-4 (Hope Bay Project – Water and Load Balance - SRK Consulting, November 2017) contains complete water balance results for Operations and Post-Closure conditions for the combined Boston effluent for all cases modelled and for all parameters. During operations and closure water treatment is required for all the Boston effluent streams and therefore the modelled Operations results represent closure conditions as well.

64. ID #ECCC-FEIS-10

64.1 Subject/Topic

Boston Combined Discharge Influent

64.2 References

- Package P5-4: Hope Bay Project – Water and Load Balance
- Section 7.1.3 – Boston Combined Discharge

64.3 Summary

64.4 Discussion

64.4.1 Importance of Issue to the Impact Assessment Process

64.4.2 Detailed Review Comment

The Boston Effluent discharge is derived from 3 separate effluent streams which are then combined and discharged together into Aimaokatalok Lake. These effluent streams include the Contact Water Treatment Plant, Process Water Treatment Plant, and the Sewage Treatment Plant. Unlike the description of the arsenic treatment at the Marine Mixing Box (Figure 7-2), the predicted influent concentrations for contaminants of potential concern at each treatment station is not described. Influent and effluent quality should be provided for each effluent stream to indicate expected efficacy of the selected treatment options.

64.5 Recommendation/Request

ECCC recommend that TMAC provide influent and effluent concentrations for parameters of potential concern at the Contact Water Treatment Plant, the Process Water Treatment Plant, and the Sewage Treatment Plant.

64.6 TMAC Response

The influent concentration for the Contact and Process Water Treatment Plants are provided in Table ECCC-FEIS-10.1. The treatment stages were not modeled separately and the effluent is reflective of combined process effluent. The influent concentrations represent average water quality over the course of operations and parameters unaffected by the process are not changed.

The Sewage Treatment Plant influent is not modeled, water is drawn from the respective lake and the sewage effluent is applied to the parameters affected by the camp use/process. All other parameters remain at the lake concentration.

Table ECCC-FEIS-10.1: Summary of influent water quality for the Contact and Process Water Treatment Plants

Parameter*	Units	MMER Maximum Authorized Monthly Mean Concentration		Contact Water Treatment Plant		Process Water Treatment Plant	
		Current	Proposed	Influent Value	Effluent Assignment	Influent Value	Effluent Assignment
TSS	mg/L	15	15	7.7	15	5.5	15
TDS	mg/L	-	-	1600	Calculated in Model	1200	Calculated in Model
Fluoride	mg/L	-	-	0.62	Influent	0.12	Influent
Chloride	mg/L	-	-	550	Influent	680	Influent
Free Cyanide	mg/L	-	-	-	Influent	-	Influent
Total Cyanide	mg/L	1	0.5	0.21	Influent	0.25	Influent
WAD Cyanide	mg/L	-	-	0.31	Influent	0.25	Influent
Cyanate	mg/L	-	-	25	Influent	20	Influent
Thiocyanate	mg/L	-	-	17	Influent	13	Influent
Ammonia	mg/L as N	-	Variable	12	Influent	15	10
Nitrate	mg/L as N	-	-	12	Influent	15	1
Nitrite	mg/L as N	-	-	0.2	Influent	0.25	30
Sulphate	mg/L	-	-	810	Calculated in Model	540	Calculated in Model
Alkalinity	mg/L	-	-	370	Influent	280	Influent
Hardness	mg/L	-	-	1400	Calculated in Model	720	Calculated in Model
Aluminum	mg/L	-	-	0.84	0.1	0.88	0.1
Antimony	mg/L	-	-	0.08	Influent	0.034	Influent
Arsenic	mg/L	0.5	0.1	***0.54***	0.01	0.084	0.01
Barium	mg/L	-	-	0.23	Influent	0.016	Influent
Beryllium	mg/L	-	-	0.02	Influent	0.016	Influent
Boron	mg/L	-	-	7.1	Influent	0.14	Influent
Cadmium	mg/L	-	-	0.0021	0.0001	0.00038	0.0001
Calcium	mg/L	-	-	600	0.0	510	520.2
Chromium	mg/L	-	-	0.024	Influent	0.0084	Influent
Cobalt	mg/L	-	-	0.026	Influent	0.0077	Influent
Copper	mg/L	0.3	0.1	0.036	0.001	0.018	0.001
Iron	mg/L	-	-	0.47	0.5	0.3	0.5

Parameter*	Units	MMER Maximum Authorized Monthly Mean Concentration		Contact Water Treatment Plant		Process Water Treatment Plant	
		Current	Proposed	Influent Value	Effluent Assignment	Influent Value	Effluent Assignment
Lead	mg/L	0.2	0.08	0.0039	Influent	0.0016	Influent
Lithium	mg/L	-	-	0.15	Influent	0.01	Influent
Magnesium	mg/L	-	-	170	Influent	97	Influent
Manganese	mg/L	-	-	0.5	Influent	0.06	Influent
Mercury	mg/L	-	-	0.000056	Influent	0.0000072	Influent
Molybdenum	mg/L	-	-	0.13	0.01	0.13	0.01
Nickel	mg/L	0.5	0.25	0.13	0.005	0.028	0.005
Selenium	mg/L	-	-	0.019	0.002	0.0083	0.002
Silver	mg/L	-	-	0.00096	Influent	0.00075	Influent
Sodium	mg/L	-	-	160	Influent	190	Influent
Thallium	mg/L	-	-	0.0011	Influent	0.00034	Influent
Uranium	mg/L	-	-	0.003	Influent	0.0016	Influent
Vanadium	mg/L	-	-	0.042	Influent	0.019	Influent
Zinc	mg/L	0.5	0.4	0.17	0.02	0.046	0.02

Source:
W:\01_SITES\Hope.Bay\1CT022.013_Phase_2_FEIS_Water_Licence_Submission\Water_Load_Balance\Model\Inputs\Water_Treatment\HopeBay_WBInputs_WTPEffluent_1CT022-013_R02_ajb

Note: * Dissolved metals are presented in this table, total metals are applied in the model based on Section 3.7.13 of Package P5-4: Hope Bay Project Water and Load Balance.

Current MMER exceedance shown in bold and Italics

Proposed MMER exceedance shown in grey highlight

65. ID #ECCC-FEIS-11

65.1 SUBJECT/TOPIC

Boston Tailings Management Area Runoff

65.2 REFERENCES

- Package P5-4: Hope Bay Project – Water and Load Balance

65.3 SUMMARY

65.4 DISCUSSION

65.4.1 Importance of Issue to the Impact Assessment Process

65.4.2 Detailed Review Comment

The information presented for the Boston Tailings Management Area (TMA) runoff only includes water quality predictions related to post closure. No information is provided on the quality of the runoff from the TMA during Operations and Closure.

In addition, TMAC states that during post-closure seepage and runoff from the TMA will enter Section 2b of Aimaokatalok Lake. The arsenic concentration in the runoff is modelled to be 0.081 mg/L, while the arsenic concentration in the seepage is modelled to be 3.8 mg/L. It is unclear what the arsenic concentration in this combined stream (runoff + seepage) will be.

65.5 RECOMMENDATION/REQUEST

ECCC recommends that TMAC provide water quality modelling for the Boston Tailings Management Area during Operations and Closure.

ECCC recommends that TMAC provide additional information on the total arsenic concentration expected in the combined runoff and seepage stream from the Tailings Management Area to Aimaokatalok Lake during post-closure.

65.6 TMAC RESPONSE

During operations and closure TMA runoff water is collected in Contact Water Pond 3, from where it is pumped to the Surge Pond. Here water is combined with other site contact water before being sent to a treatment plant before being discharged to Aimaokatalok Lake. The combined treated effluent water quality results during all stages of Operations (which is consistent with the closure period) and post-closure is presented in Appendix C-1 of Supporting Document P5-4 (Hope Bay Project – Water and Load Balance – SRK Consulting, November 2017).

The post-closure runoff water quality results from the TMA is presented in Table 7.3 and Figure 7.3 of Supporting Document P5-4 (Hope Bay Project – Water and Load Balance – SRK Consulting, November 2017), which includes total arsenic. This concentration ranges between 0.040 and 0.081 mg/L depending on the modelled case assessed.

66. ID #ECCC-FEIS-12

66.1 Subject/Topic

Sensitivity Analysis

66.2 References

- Package P5-4: Hope Bay Project – Water and Load Balance
- Section 8 – Sensitivity Analysis

66.3 Summary

66.4 Discussion

66.4.1 Importance of Issue to the Impact Assessment Process

66.4.2 Detailed Review Comment

All completed sensitivity analyses presented in the water and load balance relate to the Doris or Madrid Mine. These include changes to groundwater management (storage of groundwater in Doris TIA), Madrid Freshwater source (Windy or Patch Lake), and increased groundwater inflows into the Madrid Mine. No sensitivity analyses for implications to water management at Boston are presented for the proposed Boston Mine.

66.5 Recommendation/Request

ECCC recommends that TMAC provide a sensitivity analysis for implications to water management at the Boston Mine.

66.6 TMAC Response

The sensitivity analysis conducted for Doris-Madrid relate to two specific uncertainties that could materially impact the water and load balance, i.e. mine water intercepted by the mine and the use of different potable water sources, i.e. Doris and Windy Lakes. These uncertainties do not exist for Boston since there is a single potable water source and the mine is located entirely in permafrost and therefore will not intercept mine water.

67. ID #ECCC-FEIS-13

67.1 Subject/Topic

Boston Ore Processing

67.2 References

- Package P5-4: Hope Bay Project – Water and Load Balance
- Section 2.1 – Processing Options
- Section 9.0 – Conclusions

67.3 Summary

67.4 Discussion

67.4.1 Importance of Issue to the Impact Assessment Process

67.4.2 Detailed Review Comment

Two approaches for processing of Boston ore are presented in the water and load balance:

- All Boston ore is processed at the Boston process plant.
- A portion of ore from the Boston mine is processed at the Doris process plant and the remaining Boston ore is processed at the Boston concentrator.

The report indicates that at the time of modelling, TMAC had yet to decide where the Boston ore was processed and therefore the model was set up to simultaneously process ore at both the Boston process plant and Doris process plant.

67.5 Recommendation/Request

ECCC recommends that TMAC clarify whether a decision has been made on where the Boston ore is to be processed and request the documents be updated to reflect this.

67.6 TMAC RESPONSE

As stated in Volume 3, Project Description and Alternatives, Section 1 and illustrated on Figure 3.1-1a. Boston ore is to primarily be processed at Boston in a dedicated processing plant to be constructed at the Boston site. Mining at Boston is planned to begin prior to completion of the construction and commissioning of the Boston process plant. Ore mined at Boston which cannot be processed at the Boston process plant will be transported to Doris for processing in the Doris process plant.

To remain conservative in the assessment and engineering of infrastructure, it is assumed that both the Doris tailings impoundment area (TIA) and Boston tailings management area (TMA) are each independently filled to capacity. In the case of the TIA this assumption is based on extended transfer of ore (total of approximately 1.5 Mt) from Boston to Doris with all Doris process plant tailings being stored in the TIA. Similarly the TMA design and modelling assumes that all Boston ore is processed at Boston and stored in the TMA. The water and load balance modelling considers each of these scenarios independently. This is considered to be the most responsible and realistically conservative approach.

68. ID #ECCC-FEIS-14

68.1 SUBJECT/TOPIC

Nitrite – Boston Combined Effluent

68.2 REFERENCES

- Package P5-4: Hope Bay Project – Water and Load Balance
- Appendix C-1 (page C-1.6) Summary

68.3 DISCUSSION

68.3.1 Importance of Issue to the Impact Assessment Process

68.3.2 Detailed Review Comment

The concentration of nitrite (NO2-N) in treated combined effluent at Boston is modelled at concentrations up to 30 mg/L.

68.4 RECOMMENDATION/REQUEST

ECCC recommends that TMAC confirm whether nitrite concentrations are accurate and if not, provide/update the document to reflect the modelled concentration of nitrite in treated effluent.

68.5 TMAC RESPONSE

The nitrite concentration in the Boston effluent is based on concentrations provided by an RBC supplier. The concentration is a minimum process guarantee, however lower average operating concentrations are expected to be lower.

69. ID #ECCC-FEIS-15

69.1 SUBJECT/TOPIC

Aquatic Effects Monitoring Program Development

69.2 REFERENCES

- Package P4-18 Hope Bay Project Aquatic Effects Monitoring Plan

69.3 SUMMARY

69.4 DISCUSSION

69.4.1 Importance of Issue to the Impact Assessment Process

69.4.2 Detailed Review Comment

ECCC has reviewed the proposed Madrid-Boston Aquatic Effects Monitoring Plan (AEMP) and has identified a number of aspects which require clarification.

The study design descriptions make reference to MMER-EEM monitoring and non-MMER-EEM monitoring. It is not clear why the programs are not fully integrated and described in this document for clarity and completeness.

Non-MMER-EEM monitoring is going to use a Before-After-Control-Impact (BACI) study design and proposes to monitor and evaluate only parameters which have CCME guidelines for potential effects. The full suite of parameters should be evaluated for water and sediments, with focus subsequently shifting to parameters of potential concern if warranted based on monitoring data.

The MMER-EEM sites in Aimaokatalok Lake are set up as a multiple gradient study design, but for water quality it is not clear how the statistical analysis will be done. It appears to be set up as a Before-After comparison, but the gradient design would be suited to regression or ANCOVA analysis. Sampling stations for 1a and 1b are 50 m from the discharge, and the next sample stations are 250m then 750 m and 1500m from the diffuser in two directions. Plume delineation modeling should be referenced to support that spacing. A continuum of sampling stations is needed along the exposure gradient, and it is not clear that sampling will be done sufficiently close to the discharge to characterize effects in the near field.

In addition, the sediment and benthic samples to be collected from these sites are proposed to consist of a single grab sample (Section 3.2.4 Benthos) which will be used to evaluate potential changes in benthos. This sampling effort would not meet the guidance provided by the MMER-EEM program, nor would it be comparable to data collected previously or at other sites.

There are other details on monitoring and sampling methodology that raise questions. For example, ECCC has concerns with collection of three vs the recommended five sediment samples per station. Fish monitoring has been omitted from the AEMP and deferred to the MMER-EEM; this should be integrated and presented in both programs, as there may be different endpoints.

Monitoring results should be linked to a response framework which sets thresholds for change to trigger mitigation actions.

69.5 RECOMMENDATION/REQUEST

ECCC recommends that:

- TMAC further develop the details of the AEMP and include a Response Plan
- Both the AEMP and MMER-EEM monitoring programs should be harmonized to the extent possible, and details provided on the MMER-EEM program. Where there is overlap between the two programs, data should be combined for presentation (e.g. water sample data for two seasons under the AEMP with the additional two sampling times under the EEM) and evaluation. This will improve the characterization of variability and increase the dataset used for statistical analysis.
- For non-MMER-EEM monitoring, a full suite of parameters be evaluated for water and sediments, with the focus shifting to parameters of potential concern if warranted based on monitoring date.
- For MMER-EEM Sites in Aimaokatalok Lake clarity around how statistical analysis will be undertaken should be included. It is recommended that a continuum of sampling stations is needed along the exposure gradient, and that sampling will be done sufficiently close to the discharge to characterize effects in the near field
- Monitoring results be linked to a response framework which sets thresholds for change to trigger mitigation action.

69.6 TMAC RESPONSE

- Acknowledged. TMAC will update the Madrid-Boston AEMP with an Aquatic Response Framework similar to the approach taken for the Doris AEMP. The updated AEMP will be provided to parties prior to the May Hearing in Cambridge Bay.

- Acknowledged. TMAC will improve the harmonization between the AEMP and MMER programs in the updated Madrid-Boston AEMP.
- For non-MMER water and sediment quality parameters, the Madrid-Boston AEMP will take the approach as the approved Doris AEMP where CCME parameters and accompanying toxicity modifying factors are statistically evaluated for potential project effects. Several other non-CCME parameters (e.g., calcium, sodium, conductivity, total dissolved solids, sulphate, and other metals) will also be analyzed and will be reported in the appendices of the annual AEMP report. These parameters could be evaluated under the Aquatic Response Framework if deemed necessary.
- The updated Madrid-Boston AEMP will improve the clarity of the statistical approach regarding the MMER design in Aimaokatalok Lake and will revisit the sample sites within gradient design as informed by the hydrodynamic modelling carried out for the FEIS.
- Acknowledged. TMAC will update the Madrid-Boston AEMP with an Aquatic Response Framework with environmental thresholds that trigger further mitigation/information collecting similar to the approach taken for the Doris AEMP. The updated AEMP will be provided to the interested parties two weeks prior to the May Technical Meeting in Cambridge Bay.