Indigenous and Northern Affairs Canada | Affaires autochtones et du Nord Canada

Water Resources Division
Resource Management Directorate
Nunavut Regional Office
P.O. Box 100
Iqaluit, NU, X0A 0H0

Your file - Votre référence
2AM-DOH1323

June 22, 2016

Our file - Notre référence
CIDM#1074085

Ida Porter
Licensing Administrator
Nunavut Water Board
P.O. Box 119
Gjoa Haven, NU, X0B 1J0

Re: 2AM-DOH1323 – Review of Tailings Area Operations Maintenance and Surveillance Manual, Groundwater Management Plan and Aquatic Effects Monitoring Plan and Proposed Surveillance Network Program Revisions submitted by TMAC Resources Inc. for their Amendment Application – Doris North Gold Mine Project

Dear Ms. Porter,

Thank you for your June 2, 2016 invitation for written representations on the above referenced three documents.

The Water Resources Division of Indigenous and Northern Affairs Canada (INAC) retained the services of AMEC Foster Wheeler to conducted reviews of the Tailings Area Operations Maintenance and Surveillance Manual, the Groundwater Management Plan and Aquatic Effects Monitoring Plan and Proposed Surveillance Network Program Revisions submitted by TMAC Resources Inc. (TMAC). These are provided in three separate memoranda for the Nunavut Water Board's consideration and we have numbered the recommendations to facilitate tracking them. We are also providing a memorandum prepared by INAC with comments on the three documents as well as on the presentation of proposed revisions.

Comments have been provided pursuant to INAC's mandated responsibilities under the *Nunavut Waters and Nunavut Surface Rights Tribunal Act* and the *Department of Indian Affairs and Northern Development Act*.

INAC appreciates the opportunity to participate in this review. If there are any questions or concerns, please contact me at (867) 975-3876 or by e-mail at sarah.forte@aandc-aadnc.gc.ca.

Sincerely,

Canada

Sarah Forté
Water Management Coordinator

cc. Scott Burgess, Acting Manager, Water Resources Division, INAC
Erik Allain, Manager of Field Operations, INAC

MEMORANDUM

To	**David Abernethy, INAC** **Sarah Forte, INAC**	File no	**TV154011**
From	**Jane Doucette, Amec Foster Wheeler**	Copy	**Chris Milley, Amec Foster Wheeler**
Email			
Date	**June 21, 2016**		

Subject **Application for Amendment No. 1 to Nunavut Water Board Licence No. 2AM-DOH1323 and Nunavut Impact Review Board Project Certificate No. 003**
Technical Review and Evaluation of Tailings Management Plan Submission – Option 3
Doris North Project
Hope Bay, Nunavut

1.0 INTRODUCTION

Amec Foster Wheeler Environment & Infrastructure, a Division of Amec Foster Wheeler Americas Limited (Amec Foster Wheeler) was retained by Indigenous and Northern Affairs Canada (INAC) to carry out a technical review and evaluation of the Doris North Project Tailings Management Plan, submitted as part of the Application for Amendment No. 1 to the Nunavut Water Board (NWB) Licence No. 2AM-DOH1323 and the Nunavut Impact Review Board (NIRB) Project Certificate No. 003.

This work was carried out under Standing Offer Agreement 46-0000-1035, Call-up No. 1, Option 3. The scope of work is in accordance with the Statement of Work received from INAC (dated May 26, and Amec Foster Wheeler's quote dated May 30, 2016.

2.0 Background

The Doris North Project is owned by TMAC Resources Inc (TMAC). TMAC is applying to amend its NWB Type A Water Licence 2AM-DOH1323 and the NIRB Project Certificate 003. The amendment application will allow increased production rates, an increased mine size, changes to the management of tailings, the discharge of effluent reporting from the tailings impoundment area to the marine environment rather than to an approved creek, and other associated project changes.

Earlier phases in the amendment review process have included:

Completeness Review submission, September 9, 2015
This preliminary phase was carried out to determine if additional information would be required to carry out the Technical Review phase of the application. Amec Foster Wheeler technical experts

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reviewed the water licence amendment application and relevant documents, and generated Information Requests (IR's) that were considered necessary to complete sufficient analysis.

Technical Review submission, December 8, 2015
The Technical Review phase of the review process involved an assessment of information presented in the water licence amendment application and the Information Request (IR) responses submitted by TMAC was carried out. Amec Foster Wheeler technical experts carried out the assessment to determine whether the measures proposed would be sufficient to protect the quality and quantity of freshwater from the mining project activities.

Technical Meeting, January 28-29, 2016
Amec Foster Wheeler participated in a technical meeting to discuss outstanding issues with INAC, TMAC and other stakeholders. During the meeting, a list of commitments to resolve remaining issues were made, and which would be carried forward to the Final Hearing.

3.0 Scope of Work

Together with other deliverables, the overall goal of Option 3 work is to provide support to INAC's review of the Proponent's water licence amendment application, and:

- Determine if activities identified in the application include mitigation measures that will protect the quality and quantity of surrounding freshwater sources;
- Determine if commitments made by the Proponent during the application review process to date are sufficient for the protection of surrounding freshwater sources; and
- Identify any outstanding issues pertaining to water management that need to be addressed.

The scope of work for this portion of the assignment was to carry out a review of the Tailings Management Plan for the Doris North Project, which was submitted to INAC On June 02, 2016. The documents provided for this review are:

- 160601 2AM-DOH1323 Doris Amendment TIAOMS Manual 2 of 2-IAAE;
- 160601 2AM-DOH1323 Doris Amendment TIAOMS Manual 2 of 2-IAAE; and
- 160613 2AM-DOH1323 Amendment TIAOMS Manual Appendix A-IAAE.

This review included Amec Foster Wheelers' participation in a workshop (via teleconference) on June 6-8, 2016. The purpose of the workshop was to provide TMAC with an opportunity to present the Tailings Management Plan, and to be available to address questions or issues first hand.

Other tasks that were included in the work are:

- A review of the Groundwater Management Plan and related documents;
- A review of the Aquatic Effects Monitoring Framework, Freshwater Component and related documents;
- A review of the Interim Dike filter design trade-off study and detailed design of selected filtering method; and

- Preparation of a revised Reclamation Cost Estimate prepared by Amec Foster Wheeler Environment & Infrastructure in 2015.

Separate memos are being prepared for the other tasks.

4.0 Review of Tailings Management Plan (TMP)

4.1 General Comment

The document submitted by TMAC and presented in the workshop, is entitled the Tailings Impoundment Area Operations, Maintenance and Surveillance (OMS) Manual. It is understood that this document will also function as the Tailings Management Plan (TMP), which is required under the water licence. Its purpose is to outline the procedures that TMAC and their contractors will use for the safe construction, operation, maintenance and surveillance and closure of the Tailings Impoundment Area (TIA).

This document, together with the other studies and management plans submitted for the design, construction, and closure of the Project, form the Tailings Management Framework for the Doris North Project.

4.2 Review of Content

The document provides information in accordance with the guidance given in the Canadian Dam Association (CDA 2013) and the Mining Association of Canada (MAC 2011) for the development of an OMS Manual.

It is noted that TMAC has only provided a high level document. For example, a detailed description of the construction of the North Dam is not included, since there is a library of "as-built documentation" available. Furthermore, individual roles and responsibilities are defined only at the Vice President, Manager and Superintendent levels, with the intent that more detailed information about other staff member roles and responsibilities is contained in the mine site Standard Operating Procedures. It has also noted that the Emergency Preparedness and Response Plan for the TIA will be included in the Surface Emergency Response Plan, which is currently being prepared by TMAC.

INAC R1 While the use of multiple documents to support a high level OMS manual is acceptable, it is recommended that at the end of each section of the OMS include a reference to where detailed information can be found.

4.3 Review for Outstanding Issues

The tailings management design system was evaluated during earlier phases of the water licence amendment application review (the completeness review and technical review). During the earlier review phases, information requests (IR's) and technical comments (TC's) were generated. The IR's and TC's, and the submittals made in response to them, have been tracked throughout the review process.

The tracking table had been reviewed prior to the workshop to determine if there were any outstanding responses to IR's or TC's. The status of INAC TC11 required an update to the TMP to include details regarding the use of environmentally suitable chemical dust suppressants.

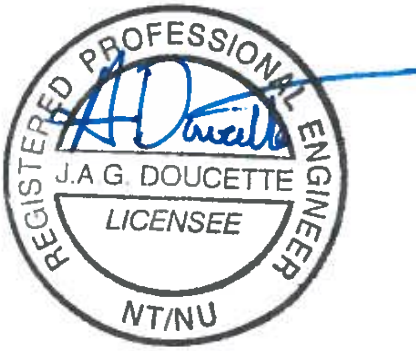
As part of the updated TMP, TMAC submitted Appendix A - Summary of Currently Available Dust Control Products. Each of the three dust control suppressants presented in the Appendix are considered environmentally safe. Details on application rates will depend on material-specific testing (of the tailings).

Based on the updated TMA submission this issue is considered to be resolved.

5.0 Summary

Amec Foster Wheeler has reviewed the Tailings Management Plan, and offers the following:

- The activities identified in the application include acceptable mitigation measures that will protect the quality and quantity of surrounding freshwater sources;
- Information should be provided within each section of the OMS providing cross-reference to where detailed information can be found in other related TMAC documents;
- Reasonable commitments have been made by the Proponent during the application review process to date, and these are sufficient for the protection of surrounding freshwater sources; and
- Amec Foster Wheeler has not identified any further outstanding issues pertaining to the Tailings Management Plan that should be addressed at this time.



MEMORANDUM

To	**David Abernethy, INAC** **Sarah Forte, INAC**	File no	**TV154011**
From	**Tracy Cochrane, Amec Foster Wheeler** **Jane Doucette, Amec Foster Wheeler**	Copy	**Chris Milley, Amec Foster Wheeler**
Email			
Date	**June 21, 2016**		

Subject **Application for Amendment No. 1 to Nunavut Water Board Licence No. 2AM-DOH1323 and Nunavut Impact Review Board Project Certificate No. 003 Technical Review and Evaluation of *Groundwater Management Plan* Submission – Option 3**
Doris North Project
Hope Bay, Nunavut

1.0 INTRODUCTION

Amec Foster Wheeler Environment & Infrastructure, a Division of Amec Foster Wheeler Americas Limited (Amec Foster Wheeler) was retained by Indigenous and Northern Affairs Canada (INAC) to carry out a technical review and evaluation of the Doris North Project Groundwater Management Plan, submitted as part of the Application for Amendment No. 1 to the Nunavut Water Board (NWB) Licence No. 2AM-DOH1323 and the Nunavut Impact Review Board (NIRB) Project Certificate No. 003.

This work was carried out under Standing Offer Agreement 46-0000-1035, Call-up No. 1, Option 3. The scope of work is in accordance with the Statement of Work received from INAC dated May 26, 2016, and Amec Foster Wheeler's quote dated May 30, 2016.

2.0 Background

The Doris North Project is owned by TMAC Resources Inc (TMAC). TMAC is applying to amend its NWB Type A Water Licence 2AM-DOH1323 and the NIRB Project Certificate 003. The amendment application will allow increased production rates, an increased mine size, changes to the management of tailings, the discharge of effluent reporting from the tailings impoundment area to the marine environment rather than to an approved creek, and other associated project changes.

Earlier phases in the amendment review process have included:

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Completeness Review submission, September 9, 2015
This preliminary phase was carried out to determine if additional information was required to carry out the Technical Review phase of the application. Amec Foster Wheeler technical experts reviewed the water licence amendment application and relevant documents, and generated Information Requests (IR's) that were considered necessary to complete sufficient analysis.

Technical Review submission, December 8, 2015
The Technical Review phase of the review process involved an assessment of information presented in the water licence amendment application and the Information Request (IR) responses submitted by TMAC was carried out. Amec Foster Wheeler technical experts carried out the assessment to determine whether the measures proposed would be sufficient to protect the quality and quantity of freshwater from the mining project activities.

Technical Meeting, January 28-29, 2016
Amec Foster Wheeler participated in a technical meeting to discuss outstanding issues with INAC, TMAC and other stakeholders. During the meeting, a list of commitments to resolve remaining issues were made, and which would be carried forward to the Final Hearing.

3.0 Scope of Work

Together with other deliverables, the overall goal of Option 3 work is to provide support to INAC's review of the Proponent's water licence amendment application, and:

- Determine if activities identified in the application include mitigation measures that will protect the quality and quantity of surrounding freshwater sources;
- Determine if commitments made by the Proponent during the application review process to date are sufficient for the protection of surrounding freshwater sources; and
- Identify any outstanding issues pertaining to water management that need to be addressed.

The scope of work for this portion of the assignment was to carry out a review of the Groundwater Management Plan for the Doris North Project, which was submitted to INAC in June 2016. The digital name of the document is 160602 2AM-DOH1323 Doris Amendment Groundwater Management Plan IAAE.

This review also included Amec Foster Wheeler's participation in a workshop (via teleconference) on June 6-8, 2016. One of the goals of workshop was to afford TMAC an opportunity to present the Groundwater Management Plan, and to be available to address questions or issues.

Other tasks that are included in the work for Option 3 include:

- A review of the Tailings Management Plan and related documents;
- A review of the Aquatic Effects Monitoring Framework, Freshwater Component and related documents;
- A review of the Interim Dike filter design trade-off study and detailed design of selected filtering method; and

- Preparation of a revised Reclamation Cost Estimate prepared by Amec Foster Wheeler Environment & Infrastructure in 2015.

Separate memos are being prepared for the other tasks.

4.0 Review of Groundwater Management Plan (GWMP)

4.1 General Comment

The Groundwater Management Plan (GWMP) was developed for the portions of the mine that will result in groundwater inflow. It is an adaptive response plan for managing underground mine water. The objectives of the GWMP are to: (i) minimize the influence of mining on the Doris Lake water levels; and (ii) characterize the mine flow discharge and water quality. The document provides an overview of the hydrogeology and water management plans, the basis for the adaptive management trigger points (also called specific performance thresholds), monitoring, evaluation, specific responses to the trigger points, and the adaptive response plan for managing underground mine water.

4.2 Review of Content

The GWMP provides a concise description of TMAC's approach to managing groundwater, including adaptive management and contingencies. However, given the uncertainty associated with groundwater inflow estimates, it is recommended that more detail be provided regarding contingency plans in the event that flow rates exceed 3,000 m^3/day. While the total volume of the mine is provided in the GWMP, mine inflow rates are estimated to be high by the end of the first year of mining. Therefore, mine inflow rates could potentially exceed 3,000 m^3/day relatively early in mine development and the contingency plan in the GWMP should provide greater detail on the contingency plans for this possibility.

INAC R2

Furthermore, it is recommended that the monitoring of mine inflow water quality be modified. The GWMP states that during periods of mine water discharge, mine water samples will be tested weekly for only chloride, total dissolved solids and nitrate. The list of parameters should be increased to include all those listed on page 12 of the GWMP, which include: total ammonia-N, nitrite-N, pH, EC, ICPMS metals, alkalinity, acidity, sulphate, total and WAD cyanide.

INAC R3

Amec Foster Wheeler has identified no other concerns with the content of the GWMP at this time.

4.3 Review for Outstanding Issues

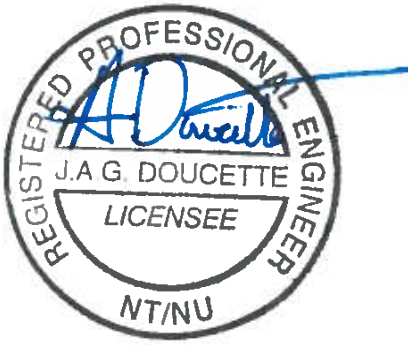
There are no outstanding issues related to the GWMP.

5.0 Summary

Amec Foster Wheeler's review of the Doris North Project Groundwater Management Plan, (submitted in June 2016 as part of the Application for Amendment No. 1 to the Nunavut Water

Board (NWB) Licence No. 2AM-DOH1323) identified two issues which should require further attention. It is recommended that:

1. More detailed contingency plans for possible groundwater flows rates in excess of 3,000 m^3/day be included in the GWMP; and
2. During periods of mine water discharge, mine water discharge testing should be expanded to include total ammonia-N, nitrite-N, pH, EC, ICPMS metals, alkalinity, acidity, sulphate, total and WAD cyanide.



MEMORANDUM

To	**David Abernethy, INAC** **Sarah Forte, INAC**	File no	**TV154011**
From	**Jane Doucette, Chris Milley, Tracy Cochrane, Amec Foster Wheeler**	Copy	
Email			
Date	**June 21, 2016**		

Subject **Application for Amendment No. 1 to Nunavut Water Board Licence No. 2AM-DOH1323 and Nunavut Impact Review Board Project Certificate No. 003 Technical Review and Evaluation of *Aquatic Effects Management Plan*, Freshwater Component, and Proposed *Surveillance Network Program* Revisions – Option 3**
Doris North Project
Hope Bay, Nunavut

1.0 INTRODUCTION

Amec Foster Wheeler Environment & Infrastructure, a Division of Amec Foster Wheeler Americas Limited (Amec Foster Wheeler) was retained by Indigenous and Northern Affairs Canada (INAC) to carry out a technical review and evaluation of the Doris North Project Aquatic Effects Management Plan – Freshwater Component, and the Surveillance Network Program (SNP) for the Doris North Project submitted as part of the Application for Amendment No. 1 to the Nunavut Water Board (NWB) Licence No. 2AM-DOH1323 and the Nunavut Impact Review Board (NIRB) Project Certificate No. 003.

This work was carried out under Standing Offer Agreement 46-0000-1035, Call-up No. 1, Option 3. The scope of work is in accordance with the Statement of Work received from INAC (dated May 26, and Amec Foster Wheeler's quote dated May 30, 2016.

2.0 Background

The Doris North Project is owned by TMAC Resources Inc (TMAC). TMAC is applying to amend its NWB Type A Water Licence 2AM-DOH1323 and the NIRB Project Certificate 003. The amendment application will allow increased production rates, an increased mine size, changes to the management of tailings, the discharge of effluent reporting from the tailings impoundment area to the marine environment rather than to an approved creek, and other associated project changes.

Earlier phases in the amendment review process have included:

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Fax +1 (506) 468-1314 www.amecfw.com

Completeness Review submission, September 9, 2015
This preliminary phase was carried out to determine if additional information would be required to carry out the Technical Review phase of the application. Amec Foster Wheeler technical experts reviewed the water licence amendment application and relevant documents, and generated Information Requests (IR's) that were considered necessary to complete sufficient analysis.

Technical Review submission, December 8, 2015
The Technical Review phase of the review process involved an assessment of information presented in the water licence amendment application and the Information Request (IR) responses submitted by TMAC was carried out. Amec Foster Wheeler technical experts carried out the assessment to determine whether the measures proposed would be sufficient to protect the quality and quantity of freshwater from the mining project activities.

Technical Meeting, January 28-29, 2016
Amec Foster Wheeler participated in a technical meeting to discuss outstanding issues with INAC, TMAC and other stakeholders. During the meeting, a list of commitments to resolve remaining issues were made, and which would be carried forward to the Final Hearing.

3.0 Scope of Work

Together with other deliverables, the overall goal of Option 3 work is to provide support to INAC's review of the Proponent's water licence amendment application, and:

- Determine if activities identified in the application include mitigation measures that will protect the quality and quantity of surrounding freshwater sources;
- Determine if commitments made by the Proponent during the application review process to date are sufficient for the protection of surrounding freshwater sources; and
- Identify any outstanding issues pertaining to water management that need to be addressed.

The scope of work for this portion of the assignment was to carry out a review of the Aquatic Effects Monitoring Plan (AEMP) for freshwater discharge, and the Surveillance Network Program (SNP) for the Doris North Project, which was submitted to INAC in June 2016. The documents provided for this review are:

- 2AM DOH1323 Doris Aquatic Monitoring Workshop Pres 20160606
- 150301 2AM-DOH1323 2014 AEMP Report Apr 2015 Part1-IACE
- 150301 2AM-DOH1323 2014 AEMP Report Apr 2015 Part2-IACE
- 150301 2AM-DOH1323 2014 AEMP Report Apr 2015 Part3-IACE
- 150301 2AM-DOH1323 2014 AEMP Report Apr 2015 Part4-IACE
- 150301 2AM-DOH1323 2014 AEMP Report Apr 2015 Part5-IACE
- 150301 2AM-DOH1323 2014 Seepage Appendix A_1of 3-IACE
- 150301 2AM-DOH1323 2014 Seepage Appendix A_2of 3-IACE
- 150301 2AM-DOH1323 2014 Seepage Appendix A_3of 3-IACE
- 150301 2AM-DOH1323 2014 Seepage Appendix B-IACE

- 150301 2AM-DOH1323 2014 Seepage Report-IACE
- 150505 2AM-DOH1323 2014 AEMP Report Apr 2015 Part1-IMLE
- 150505 2AM-DOH1323 2014 AEMP Report Apr 2015 Part2-IMLE
- 150505 2AM-DOH1323 2014 AEMP Report Apr 2015 Part3-IMLE
- 150505 2AM-DOH1323 2014 AEMP Report Apr 2015 Part4-IMLE
- 150505 2AM-DOH1323 2014 AEMP Report Apr 2015 Part5-IMLE
- 150505 2AM-DOH1323 Cover letter AEMP and Seepage Mon Report-IMLE
- 150505 2AM-DOH1323 Seepage2014_AppendixA_1 of 3-IMLE
- 150505 2AM-DOH1323 Seepage2014_AppendixA_2 of 3-IMLE
- 150505 2AM-DOH1323 Seepage2014_AppendixA_3 of 3-IMLE
- 150526 2AM-DOH1323 Email Distro 2014 AEMP and Seepage Monitoring Report-OACE
- 160601 2AM-DOH1323 A 1 Doris AEMP-IAAE
- 160601 2AM-DOH1323 Doris proposed SNP revisions w notes-IAAE

This review included Amec Foster Wheeler's participation in a workshop (via teleconference) on June 6-8, 2016. The purpose of the workshop was to afford TMAC an opportunity to present the Aquatic Effects Management Plan, Freshwater Component and proposed revisions to the SNP , and to be available to address questions or issues.

Other tasks that are included in the work for Option 3 include:

- A review of the Groundwater Management Plan and related documents;
- A review of the updated Tailings Management Plan and related documents;
- A review of the Interim Dike filter design trade-off study and detailed design of selected filtering method; and
- Preparation of a revised Reclamation Cost Estimate prepared by Amec Foster Wheeler Environment & Infrastructure in 2015.

Separate memos are being prepared for the other tasks.

4.0 Review of Aquatic Effects Monitoring Plan (AEMP) for Freshwater Discharge

4.1 General Comment

The document submitted to, and presented by TMAC at the workshop is entitled the Hope Bay Project, Doris Aquatic Effects Monitoring Plan (AEMP), June 2016. This plan is required as a submission under Part 7, Item K of the water licence.

As a result of the proposed changes under the licence amendment application, all mine and groundwater will be discharged into the marine environment. Proposed revisions to the AEMP for marine discharge were discussed in the Environmental Effects Assessment package of the water licence amendment No. 1 application.

Based on the results of discussions in an Aquatic Monitoring Workshop (AMW) held in March 2016, a revised AEMP for freshwater discharge was developed. The purpose of the revised plan is to assess the potential effects of Doris Mine activities on the freshwater environment, as the

proposed changes to the scope of the mining project will see expansion of the underground mine into the talik under Doris Lake.

4.2 Review of Content

The AEMP document provides information on the proposed changes to the mine plan. The document also presents potential changes to environmental effects as a result of the changes to the mine plan, and defines how these effects will be handled in terms of monitoring and surveillance, reporting requirements and response / alert levels.

Based on the review of the revised AEMP, Amec Foster Wheeler offers the following observations and recommendations:

INAC R4

1. **Downstream monitoring**: Under the revised AEMP, the Proponent proposes to eliminate water quality monitoring downstream from Doris Lake. However, the Proponent also states that water will be discharged directly into Doris Creek if the mine enters into Care and Maintenance, and the water quality meets minimum standards. In this situation there would be no water quality monitoring of effluent if the downstream monitoring points are removed. It is therefore recommended that the downstream monitoring points be maintained as part of a robust AEMP.

INAC R5

2. **Cross referencing with SNP Report:** It is recommended that the results from the two Doris Creek sample locations included in the SNP (TL-2 and 3) be included in the AEMP report with a discussion of temporal trends.

INAC R6

3. **Sediment sampling:** The proponent has removed sediment sampling in the revised AEMP. Considering that dust from mine tailings, roads and other aspects of mine operation will settle into the lake, it is recommended that sediment sampling be continued as an integral activity in the AEMP.

INAC R7

4. **Testing parameters:** It is recommended that all water samples be tested for sulphate and major ions in solution. Although these parameters are not typically regulated parameters, analysis of the major ions (e.g. Ca, Na, Cl) provides an opportunity to assess the quality of the data and identify potential matrix interferences that may not be noticeable otherwise (i.e., quality control). Sulphate analysis is recommended since it provides an indicator for sulphide oxidation.

INAC R8

5. **Reference point monitoring**: The proponent has removed the reference stations from the revised AEMP. While it is understood that reference lakes have provided some historical baseline information, removing the use of reference lakes undermines the potential for determining effects resulting from widespread environmental changes. It is, therefore, recommended that TMAC continue to use reference lakes as an integral activity in the AEMP.

4.3 Review for Outstanding Issues

Based on the earlier review phases of the amendment application documents (the completeness review and technical review), information requests (IR's) and technical comments (TC's) were generated. The IR's and TC's, and the responses provided by TMAC, have been tracked throughout the review process. The tracking table has been reviewed to determine if any IR's or TC's were outstanding:

TC4 – This technical comment stated the need for reviewing post-closure monitoring requirements for water flowing from Tail Lake to Doris Lake. However, the current water licence expires in 2023, prior to closure. It was noted that monitoring discharge to the freshwater environment after closure is a matter which should be addressed at the time of water licence renewal.

Based on the updated TMAC submission this issue is considered to be resolved.

5.0 Review of Surveillance Network Program (SNP)

Amec Foster Wheeler has reviewed the materials presented at the June 2016 workshop and offers the following observations and comments at this time:

1. The overall rationale for changing the SNP has not been fully explained. The proposed changes reduce the overall sampling strategy without providing sufficient detail on why sample sites have been removed or sampling frequency reduced.

2. Sampling at TL-5, ST-1, ST-2 has been eliminated – TMAC indicated that sampling in regard to the load balance model calibration it is being conducted under the Water Management Plan, but it has not been included in the June 2015 version of the WMP. TMAC has committed to providing a new WMP in Sept. 2016. It is not possible to determine the appropriateness of the sampling strategy at this time without the updated WMP.

3. TL-1 and 2: TMAC has reduced sampling to the construction phase only, and have removed sampling during operation and closure.
    a. Sampling should be required post-closure sometime before TIA water is discharged to Doris Creek. It is recommended that to ensure completeness in the monitoring strategy, sampling should be conducted at these locations should the project enter into Care and Maintenance.
    b. There is some concern that the removal of TL-1 during operations will reduce the robustness of the sampling strategy. It is important that sampling be conducted at the point where water can enter the marine outflow box before discharge to environment.

4. TL-3: Post-closure sampling frequency is only annual. It is recommended that sampling be conducted more frequently (several times per year) before and for a few years after TIA discharge to Doris Creek restarts.

INAC R9

INAC R7

5. TL-12: TMAC has removed this sample from the SNP and included it into the GWMP. Under this plan mine water will be sampled weekly for only 3 parameters (Cl, TDS, NO_3). It is recommended that sampling parameters be expanded as noted in our GWMP review memorandum.

INAC R10

6. It is recommended that all water samples submitted for inorganic testing include analyses for sulphate and major ions in solution. This provides an opportunity to assess the quality of the data and identify potential matrix interferences that may not be noticeable otherwise (i.e., quality control). Sulphate is an indicator for sulphide oxidation.

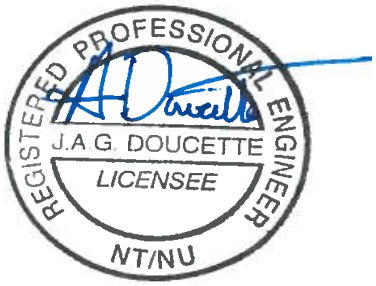
6.0 Summary

With respect to the review of the Aquatic Effects Monitoring Plan (AEMP) for Freshwater Discharge, the following conclusions are that:

- The activities identified in the application include acceptable monitoring measures that will facilitate protection of the quality and quantity of surrounding freshwater sources;
- In general, reasonable commitments have been made by the Proponent during the application review process, however for the protection of surrounding freshwater sources these commitments can be enhanced by additional attention to downstream monitoring, sediment sampling and cross referencing samples with a reference lake; and
- Amec Foster Wheeler has not identified any further outstanding issues pertaining to the AEMP that should be addressed at this time.

With respect to the review of the Surveillance Network Program (SNP), the following conclusions are that:

- Greater detail of the rationale for changes to the number of sampling sites and frequency of sampling in the revised SNP should be provided.
- The number of parameters analysed from samples should be increased to include sulphate and major Ions in solution for TL-12 and sites where samples are analysed for inorganic testing.
- Sampling of sites on Doris Creek should be conducted under Care and Maintenance and Post closure.



Technical Review Memorandum

To: Ida Porter, Licensing Administrator, Nunavut Water Board

From: Amjad Tariq, Regulatory and Science Advisor, Water Resources Division, INAC
Sarah Forté, Water Management Coordinator, Water Resources Division, INAC

Date: June 22, 2016

Re: Review of Tailings Area Operations Maintenance and Surveillance Manual, Groundwater Management Plan and Aquatic Effects Monitoring Plan and Proposed Surveillance Network Program Revisions for Type A Water Licence 2AM-DOH1323 Amendment Application

Applicant: TMAC Resources Inc.
Projects: Doris North Gold Mine
Region: Kitikmeot

A. BACKGROUND

On June 2, 2016, the Nunavut Water Board (NWB or Board) provided notification of TMAC Resources Inc.'s (TMAC or the licensee) submission of a *Tailings Area Operations Maintenance and Surveillance Manual*, a *Groundwater Management Plan* and an *Aquatic Effects Monitoring Plan* and *Proposed Surveillance Network Program Revisions*, dated June 2016. This submission by TMAC forms part of their amendment application for Type A water licence 2AM-DOH1323.

On June 6 to 8, 2016, TMAC and Indigenous and Northern Affairs Canada (INAC) held meetings at the Nunavut Regional Office, Iqaluit, Nunavut. TMAC introduced the plans and discussed the outstanding issues for water licence amendment application. The shared information during the meeting has been considered in this review.

The NWB requested interested parties review the three documents and make representations by June 22, 2016.

B. RESULTS OF REVIEW

On behalf of INAC Water Resources, the following comments and recommendations are provided for the Board's consideration. The three documents reviewed are discussed in separate sections and a fourth section is included for proposed revisions to the surveillance network program, which were provided as a presentation.

1. TAILINGS IMPOUNDMENT AREA OPERATIONS, MAINTENANCE AND SURVEILLANCE MANUAL

1.1 Surface emergency response plan

Reference:

- Hope Bay Project, Doris Tailings Impoundment Area Operations, Maintenance, and Surveillance Manual – Hope Bay, Nunavut, TMAC Resources Inc., June 2016, Section 1.5 & Table 3

Comment:
The list of documents related to the manual includes a Surface Emergency Response Plan which is in preparation. The plan is to replace the current Emergency Response Plan.

Recommendation:
(INAC R11) INAC recommends that the licensee provide the Surface Emergency Response Plan within 30 days of licence issuance.

1.2 Tailing impoundment area responsible persons

Reference:

- Hope Bay Project, Doris Tailings Impoundment Area Operations, Maintenance, and Surveillance Manual – Hope Bay, Nunavut, TMAC Resources Inc., June 2016, Section 2.1 & Table 4
- Spill Contingency Plan – Hope Bay, Nunavut, TMAC Resources Inc., April 2016, page II

Comment:
The list of personnel to contact contains many positions for which the people are yet to be determined. It is understood that not all positions would be filled at this stage in the project, however the list does not seem to be up to date.

The list of Hope Bay emergency phone numbers in the Spill Contingency Plan includes contact names and numbers for the positions of Manager of Mining, Surface Manager and Environmental Coordinator, and these do not appear in Table 4 of the Doris Tailings Impoundment Area Operations, Maintenance, and Surveillance Manual (TIA OMS Manual). Additionally, no contact information is provided for Andy Mortimore, the Mill Manager.

Recommendation:
INAC recommends that the licensee update Table 4 of the TIA OMS Manual, the list of tailings impoundment area (TIA) responsible persons.

1.3 Tailings cover design at closure

Reference:

- Hope Bay Project, Doris Tailings Impoundment Area Operations, Maintenance, and Surveillance Manual – Hope Bay, Nunavut, TMAC Resources Inc., June 2016, Section 3.1
- Doris North Mine, Interim Closure and Reclamation Plan – Hope Bay, Nunavut, TMAC Resources Inc., June 2015, Sections 2.9 & 3.7

Comment:
The TIA OMS Manual states:

> *"Upon closure, the tailings surface will be covered with a nominal 0.3 m thick run of quarry (ROQ) cover. The function of the cover is to prevent aeolian and hydraulic erosion of the tailings."*

INAC is concerned the 0.3 m thick ROQ cover may be insufficient to prevent tailings erosion. The rationale behind the design should be provided. It is not included in the Interim Closure and Reclamation Plan, which provides even less detail on the cover design.

Recommendation:
(INAC R12) INAC recommends that the licensee provide the cover design to be applied at closure. The design should ensure long-term physical and chemical stability of the TIA.

1.4 Interim dyke/filter

Reference:
- Hope Bay Project, Doris Tailings Impoundment Area Operations, Maintenance, and Surveillance Manual – Hope Bay, Nunavut, TMAC Resources Inc., June 2016, Section 3.4.3

Comment:
The project proposal as it was evaluated by the Nunavut Impact Review Board (NIRB) involved three structures in the TIA; North Dam, South Dam and Interim Dyke. This is the project that must be executed unless proposed changes are vetted by NIRB.

INAC has concerns with the fact the Interim Dyke now appears as a possibility amongst others. Section 3.4.3 states:

> *"Tailings will be deposited between the South Dam and the North Dam, with a filter in place to reduce total suspended solids in the Reclaim Pond thus ensuring Reclaim Pond water is suitable both for reuse in the mill and compliant discharge to Roberts Bay. This Interim Filter will be comprised of one of several options. The current preferred option is the Interim Dike, described below. Other options for the Interim Filter may include a silt curtain, a modified dike structure, or a combination thereof."*

Recommendation:

(INAC R13) INAC recommends that the licensee be required to modify its TIA OMS Manual so that the Interim Dyke is an integral feature.

1.5 Geochemical characterization of tailings deposited in impoundment area

Reference:

- Hope Bay Project, Tailings Impoundment Area Operations, Maintenance, and Surveillance Manual – Hope Bay, Nunavut, TMAC Resources Inc., June 2016, Section 3.6.2

Comment:

The project will produce two types of tailings; detoxified and flotation tailings. Static and humidity cell tests indicate that the flotation tailings, which will be stored in the TIA, are non-potentially acid generating (PAG).

The assumption that flotation tailings are non-PAG is important as it impacts the reclamation at closure. The TIA OMS manual does not describe what measures and tests will be done to confirm that flotation tailings remain non-PAG throughout all of the ore body being mined.

Recommendation:

(INAC R14) INAC recommends that the licensee be required to include measures, tests and a schedule used to characterize the flotation tailings as non-PAG throughout the mine life.

1.6 South Dam as water retaining structure

Reference:

- Hope Bay Project, Doris Tailings Impoundment Area Operations, Maintenance, and Surveillance Manual – Hope Bay, Nunavut, TMAC Resources Inc., June 2016, Sections 3.8, 3.9 & 4.8, Table 6, Figure 9

Comment:

The design parameters for the South Dam are presented in Table 6 and include:

- Active use period as water retaining structure: 1 year
- Design basis as active water retaining structure: 5 years

According to Figure 9, active tailings deposition from the South Dam will continue into Year 3 of the project. It is not clear why active water retention would not be required throughout the period during which tailings will be deposited from the dam. Given the frequency at which projects start up more slowly than planned, the design basis of 5 years as a water retaining structure also seems rather brief.

The freeboard requirement section states: "*once the tailings beach develops at South Dam, there will not be any water adjacent to the structure.*" Water is therefore expected when tailings are deposited from spigots located on the dam. According to the dam break analysis, a breach of the South Dam would result in release of tailings solids into

Ogama Lake, so presumably water filtering through the South Dam would also enter this lake.

It is essential that all tailings water be contained within the TIA.

Recommendation:
(INAC R15) INAC recommends that TMAC clarify why the planned active use period for the South Dam as a water retaining structure is of 1 year and provide assurances that both as it is planned, and if it runs a few years behind schedule, the project would not cause the release of tails or tailing dewatering water through the South Dam.

1.7 Surface emergency response plan

Reference:

- Hope Bay Project, Doris Tailings Impoundment Area Operations, Maintenance, and Surveillance Manual – Hope Bay, Nunavut, TMAC Resources Inc., June 2016, Section 3.8, Table 6

Comment:
The annual exceedance probability (AEP) for earthquake design ground motion for the Interim Dyke is listed as 1/100 in the table and 1/2475 in the notes.

Recommendation:
(INAC R16) INAC recommends that the licensee provide a single consistent value for the AEP for earthquake design ground motion.

1.8 Mitigation strategy for load balance concern

Reference:

- Hope Bay Project, Doris Tailings Impoundment Area Operations, Maintenance, and Surveillance Manual – Hope Bay, Nunavut, TMAC Resources Inc., June 2016, Section 4.2, Table 7

Comment:
When discussing operating constraints, water unsuitable for reclaim or discharge is listed as a possible load balance concern. The operations and preventative maintenance consideration for this case is to: "*retain water provided capacity is available*". The mitigation strategy is to: "*develop strategy to treat water*".

Recommendation:
(INAC R17) INAC recommends that if water treatment becomes necessary, the licensee provide a plan for review with the treatment method they propose to implement.

1.9 Dust suppressants

Reference:

- Hope Bay Project, Doris Tailings Impoundment Area Operations, Maintenance, and Surveillance Manual – Hope Bay, Nunavut, TMAC Resources Inc., June 2016, Section 4.4 & Appendix A

Comment:
The primary dust control measure in the TIA will be water. Chemical dust suppressants will only be used if water proves to be ineffective. Three chemical dust suppressants are listed in Appendix A as examples of suitable currently available products.

The wording of the TIA OMS Manual is such that other chemical dust suppressants might be used since "*specific suitable products will be sought at that time*".

Recommendation:
(INAC R18) INAC recommends that the licensee modify the TIA OMS Manual to use one of the three products proposed or to seek approval from the Board prior to using any other chemical dust suppressant.

1.10 Shoreline erosion monitoring transects

Reference:
- Hope Bay Project, Doris Tailings Impoundment Area Operations, Maintenance, and Surveillance Manual – Hope Bay, Nunavut, TMAC Resources Inc., June 2016, Section 5.3.1

Comment:
One of the maintenance tasks associated with shoreline erosion protection is inspecting, surveying and maintaining four shoreline erosion monitoring transects.

It would be helpful to have these transects drawn on one of the figures in the manual to ensure monitoring is done in the same locations and so that outside parties can also inspect these transects.

Recommendation:
(INAC R19) INAC recommends that the licensee include the shoreline erosion monitoring transects on one of the figures included in the TIA OMS Manual.

1.11 Discharge of TIA water to Doris Creek

Reference:
- Hope Bay Project, Doris Tailings Impoundment Area Operations, Maintenance, and Surveillance Manual – Hope Bay, Nunavut, TMAC Resources Inc., June 2016, Section 4.2, Table 7
- Water Management Plan – Hope Bay, Nunavut, TMAC Resources Inc., June 2015, Section 4, Table 4

Comment:

There appears to be an inconsistency between the TIA OMS Manual and the Water Management Plan regarding possible discharge of TIA water to Doris Creek. An adaptive management solution to malfunctioning discharge pipeline to Roberts Bay in the Water Management Plan is: "*Excess water management in the TIA that meets water quality and discharge criteria as described in the water license will be discharged to Doris Creek during the open water season*."

This possibility is not in the TIA OMS Manual, where operational and preventative maintenance considerations and maintenance strategies for three different pipeline malfunction scenarios are discussed.

Recommendation:
(INAC R20) INAC recommends that the updated version of the Water Management Plan correct an apparent inconsistency regarding discharging TIA water into Doris Creek.

1.12 Detoxified tailings management

Reference:

- Hope Bay Project, Doris Tailings Impoundment Area Operations, Maintenance, and Surveillance Manual – Hope Bay, Nunavut, TMAC Resources Inc., June 2016
- Doris North Project, Tailings Management System Design, SRK Consulting (Canada) Inc., May 2015, Section 3.3

Comment:
The TIA OMS Manual was provided in lieu of a Tailings Management Plan. It is understood that detoxified tailings which have been exposed to cyanide are not discussed in the Manual as they will not be sent to the TIA but rather be disposed of in an area of the underground mine in permafrost.

An outline of the deposition of detoxified tailings underground is included in the Tailings Management System Design, but details on their management needs to be provided.

Recommendation:
(INAC R21) INAC recommends that TMAC provide details on the management of detoxified tailings in the appropriate management plan.

2. GROUNDWATER MANAGEMENT PLAN

Developing a Groundwater Management Plan was one of the commitments made by TMAC at the NIRB final hearing. At that time, INAC Impact Assessment provided a framework with a list of items the plan had to address. Subsequently, TMAC shared a memorandum dated March 15, 2016 entitled Doris Project – Groundwater Management Plan (GWMP) Framework – Final. The Groundwater Management Plan provided was compared to both these documents to see if all points had been addressed.

During the June 6-8, 2016 meetings in Iqaluit and in a follow-up email sent by Sharleen Hamm on June 14, 2016, TMAC explained that the response to some of the commitments were found in documents other than the Groundwater Management Plan. We are including comments for those commitment items not found in the Plan to facilitate tracking of these items, as well as newly generated comments.

2.1 Demonstration of robustness of management plan with numerical analysis

Reference:

- Hope Bay Project, Groundwater Management Plan – Hope Bay, Nunavut, TMAC Resources Inc., June 2016, Sections 2.1 & 2.3.1
- 5MN047 Doris Amendment: Groundwater Management Plan Commitment, available from the NIRB ftp site: http://ftp.nirb.ca/03-MONITORING/05MN047-DORIS%20NORTH%20GOLD%20MINE/01-PROJECT%20CERTIFICATE/03-AMENDMENTS/AMENDMENT%20No.1/8-TECHNICAL%20REVIEW/06-COMMITMENTS/160211-05MN047-Supplemental%20Information%20Re%20GMP%20Framework-IA2E.pdf
- P6-3 Groundwater Inflow and Quality Model: Hydrogeological Modeling of the Proposed North Project, Hope Bay, Nunavut, SRK Consulting (Canada) Inc., June 2015, Section 4.4

Comment:

This comment is a further discussion of recommendation 2 made by AMEC Foster Wheeler.

Item 3b from the Commitment is to: "*Provide numerical analysis to show the robustness of the water management plan to various possible scenarios (i.e. more water in underground, poorer quality water in underground, longer discharge to tailings impoundment etc.)*"

TMAC has responded that this is addressed in Section 4.4 of the Groundwater Inflow and Quality Model (Document P6-3), which consists of a sensitivity analysis. The conclusion is that: "*predictions of inflows are sensitive to the hydraulic conductivities of volcanic rock and lake sediment, and not sensitive to the surface water elevation in Doris Lake nor to the hydraulic conductivity of the diabase*." For the analysis, the hydraulic conductivity of the lake bed sediment and the volcanic rock were increased by one order of magnitude and the relative % change to mine inflow were +160% and +183% respectively.

An increase in hydraulic conductivity of one order of magnitude is quite possible given the uncertainty in measuring this property and the difficulty in scaling up packer and pumping test-scale measurements to model-scale.

The Groundwater Management Plan states the maximum inflow rates are estimated to be less than 3000 m^3/day and that a maximum pumping rate of 3000 m^3/day is considered sufficient. The maximum mine inflow rate predicted by the model is 2650

m^3/day, therefore 3000 m^3/day is only a 13% increase in inflow. The contingency plan for excess inflow is emergency storage of water in the mine.

The sensitivity analysis does not include effects on water quality. Nor is there a discussion of effects of longer discharge to tailings impoundment.

During the June 6-8 meetings, TMAC stated that impacts of pumping rates greater than 3000 m^3/day were not investigated because they may not be economically feasible. If greater pumping rates proved necessary, TMAC would have to stop and reconsider the costs of the operation as a whole.

Recommendation:
(INAC R22) INAC recommends that the licence limit the allowable pumping rate for groundwater to 3000 m^3/day because impacts of pumping at a higher rate have not been assessed.

2.2 Contingencies for poor groundwater quality

Reference:

- Hope Bay Project, Groundwater Management Plan – Hope Bay, Nunavut, TMAC Resources Inc., June 2016, Sections 2.2.1 & 8
- 5MN047 Doris Amendment: Groundwater Management Plan Commitment, available from the NIRB ftp site: http://ftp.nirb.ca/03-MONITORING/05MN047-DORIS%20NORTH%20GOLD%20MINE/01-PROJECT%20CERTIFICATE/03-AMENDMENTS/AMENDMENT%20No.1/8-TECHNICAL%20REVIEW/06-COMMITMENTS/160211-05MN047-Supplemental%20Information%20Re%20GMP%20Framework-IA2E.pdf
- P6-6 Roberts Bay Discharge System: Water Management Options, SRK Consulting (Canada) Inc., June 11, 2015, Section 5
- Hope Bay Project, Doris Tailings Impoundment Area Operations, Maintenance, and Surveillance Manual – Hope Bay, Nunavut, TMAC Resources Inc., June 2016, Section 4.2, Table 7

Comment:
Item 4c from the Commitment is to describe: "*contingencies for unforeseen conditions of low flow, poor quality*" groundwater.

TMAC has responded that this is addressed in Sections 8 and 2.2 of the Groundwater Management Plan. Section 8 speaks to unexpectedly high inflows but does not mention unexpectedly poor water quality. Section 2.2.1 offers a management response: "*If mine water discharge water quality exceed Metal Mining Effluent Regulations (MMER) criteria, discharge to Roberts Bay occurs via the TIA and/or with treatment."*

Our understanding of the comments made by TMAC on this topic, when it was discussed during the June 6-8, 2016 meetings, is that according to their models, groundwater of unexpectedly poor quality could still be discharged to Roberts Bay,

through the TIA. Different water quality discharge alternatives are discussed in the Roberts Bay Discharge System: Water Management Options, however, the alternatives discussed are different proportions of groundwater and TIA water. For groundwater parameters, values used are based on the median concentrations of all sample depths and mixed concentration from hydrogeological modelling, according to the note below Table 6. Median concentrations would not qualify as unexpectedly poor quality.

INAC was seeking assurances that if groundwater of poor quality was pumped to the surface, adequate mechanisms were in place to dispose of the water. TMAC's response to TC-6 demonstrates satisfactorily that should the water require treatment before discharge, the TIA has sufficient capacity to store excess water during the development and implementation of a water treatment method.

2.3 Schematic of water storage and removal facilities

Reference:

- Hope Bay Project, Groundwater Management Plan – Hope Bay, Nunavut, TMAC Resources Inc., June 2016
- Doris Project – Groundwater Management Plan (GWMP) Framework – Final, SRK Consulting (Canada) Inc., March 15, 2016, Section 4.3

Comment:

The framework outlines what is to be included in the Groundwater Management Plan. One of the items in the framework which is not found in the Plan is: "*A description of the facilities installed and/or on site to be used in the management of groundwater entering the mine. This will include general schematics of water storage and removal facilities*."

The explanation given by TMAC during the June 6-8 meetings for the lack of description and schematics was that this was going to be included in standard operating procedures (SOPs) instead of being in the plan. TMAC also mentioned that other relevant information could be found in Table 1 of the Plan.

INAC is satisfied with this answer, provided TMAC indicates where, on site, the plans are located, so they may be reviewed by INAC staff, if required.

2.4 Remedial stage actions for management of mine inflow

Reference:

- Hope Bay Project, Groundwater Management Plan – Hope Bay, Nunavut, TMAC Resources Inc., June 2016
- Doris Project – Groundwater Management Plan (GWMP) Framework – Final, SRK Consulting (Canada) Inc., March 15, 2016, Section 4.6

Comment:

Under Mine Inflow Management Considerations, the framework states:

"Remedial stage actions may include:

- *Modifying and/or adjusting the mine plan to avoid areas of concern;*
- *Facilities and actions to arrest inflow from open exploration drill holes and enhanced permeability zones; and*
- *Isolation of mining sections as a means to control or minimize mine inflow."*

The Groundwater Management Plan discusses grouting as an action to arrest inflow and states that emergency storage of water in the mine could be undertaken as a contingency measure. The remedial actions of the first and second bullets are not discussed explicitly in the plan.

Recommendation:
(INAC R23) INAC recommends that the licensee explicitly list all remedial stage actions for managing mine inflow in the updated version of the Groundwater Management Plan.

2.5 Mine discharge management

Reference:

- Doris Project – Groundwater Management Plan (GWMP) Framework – Final, SRK Consulting (Canada) Inc., March 15, 2016, Section 4.6
- Water Management Plan – Hope Bay, Nunavut, TMAC Resources Inc., June 2015, Section A4.1
- Hope Bay Project, Groundwater Management Plan – Hope Bay, Nunavut, TMAC Resources Inc., June 2016, Section 2.2.1

Comment:
The framework states that mine discharge management will be covered by the Surface Water Management Plan. It states further: "*This chapter will outline and refer to the SOP's anticipated to be required to properly operate these facilities, including installation and operation of sumps, piping, sump pumps, main mine pumps, etc."*

The Water Management Plan submitted in June 2015 contains inconsistencies with the Groundwater Management Plan submitted a year later. According to the Water Management Plan, "*Groundwater will be intercepted in underground sumps and pumped to the mill building and discharged to Roberts Bay. Intercepted groundwater will be discharged to Roberts Bay year round via a diffuser.*" This appears inconsistent with the Groundwater Management Plan, which states that if water quality exceeds MMER criteria, discharge will occur via the TIA and/or with treatment.

Additionally, the Water Management Plan does not refer to SOPs for operating the facilities used to manage water on the surface.

Recommendation:

(INAC R24) INAC recommends that the updated version of the Water Management Plan correct an apparent inconsistency regarding the discharge of groundwater to Roberts Bay and refer to SOPs for operating facilities used to manage water.

2.6 Source of increased inflow

Reference:

- Hope Bay Project, Groundwater Management Plan – Hope Bay, Nunavut, TMAC Resources Inc., June 2016, Section 2.2

Comment:

When discussing mine inflow chemistry, the argument is made that: "*As geological structures in the Doris Mine area have been observed to be sub-vertical, the increased flow will likely originate from the lake.*" This has a large impact on the chemistry of mine inflow water since the lake has fresher water than the connate water coming from the rock mass, and the resultant mixed inflow water would have lower concentrations of chloride and other parameters.

The hydrogeological model includes two sources of inflow other than Doris Lake; the open talik base and the mine lithologies themselves. Since the open talik base would also be intersected by geological structures in the sub-vertical direction, it is not clear why it should not also contribute to increased flow.

Recommendation:

(INAC R25) INAC recommends that the updated version of the Groundwater Management Plan better explain why increased mine inflow rates would likely originate from the lake.

3. AQUATIC EFFECTS MONITORING PLAN

The modified Aquatic Effects Monitoring Plan (AEMP) submitted in June 2016 proposes cutting back monitoring in the freshwater environment because discharge of mine, process and contact water would be in the marine environment under an amended licence and no effects have been measured to date, through the most intensive construction period.

INAC is cognisant of the lack of measured effects to date but is of the opinion that the AEMP needs to remain robust in order to assess potential effects of planned activities which have yet to occur such as milling and associated tailings transfers, increased mining and truck traffic, and mine dewatering. The AEMP, with modifications as proposed by TMAC, therefore appears insufficient for adequate monitoring.

3.1 Sampling station locations on Doris Lake

Reference:

- Hope Bay Project, Doris Aquatic Effects Monitoring Plan, TMAC Resources Inc., June 2016
- Doris North Gold Mine Project: Aquatic Effects Monitoring Plan, Rescan Environmental Services Ltd., February 2010

Comment:
Two water sampling station locations are proposed on Doris Lake: ST-7, a surveillance network program (SNP) station at the water intake on the west shore and at Doris Lake North, an existing AEMP site in deep water at the north end of the lake. Water quality is to be measured monthly at ST-7 and ice thickness, temperature and dissolved oxygen are to be measured once a year, in April, at Doris Lake North. At the June 6-8 meetings, TMAC stated that Doris Lake was well mixed and the data available demonstrated that water chemistry at the ST-7 and Doris Lake North sites was equivalent.

Given the size of Doris Lake, more than one station should be used to characterise its water chemistry. Keeping a near shore shallower station and a deep water station further from potential sources would help identify any changes due to mining activity. Though the water chemistry at both sites is said to be equivalent, this may longer be the case should a point source locally alter certain parameter concentrations.

Water quality measurements in the 2010 version of the AEMP also included Secchi depths and conductivity measurements, as well as the temperature and dissolved oxygen included in the present plan. Keeping these simple field parameters will help characterise the water and confirm that the lake remains well mixed.

Recommendation:
(INAC R26) INAC recommends that water chemistry sampling be continued at both stations ST-7 and Doris Lake North at least four times a year. Profile of temperature, dissolved oxygen and conductivity should be collected at Doris Lake North at least twice a year, as well as ice thickness or Secchi depth according to the season.

3.2 Biological monitoring

Reference:
- Hope Bay Project, Doris Aquatic Effects Monitoring Plan, TMAC Resources Inc., June 2016
- Doris North Gold Mine Project: Aquatic Effects Monitoring Plan, Rescan Environmental Services Ltd., February 2010

Comment:
No biological monitoring is included in the modified AEMP, in contrast with the 2010 version which included plankton, benthic invertebrate, fish population and fish tissue monitoring. At the June 6-8 meetings, TMAC () stated that chlorophyll *a* was not included because no effect had been measured to date and, since there shouldn't be differences in chlorophyll *a* if the nutrients remained constant, analysing for nutrients should be sufficient.

Monitoring can be either stressor-based or effects-based, and both should be used to adequately characterise a system. The AEMP as it is presented, focusing solely on water quality parameters, has only stressor-based monitoring. Given the complexity of biological systems effects-based monitoring is also relevant, should be included as the name of the plan indicates.

INAC is of the opinion that measuring chlorophyll *a* should be continued as, in arctic systems, these populations can sometimes be used to measure changes in water quality that nutrient analyses do not pick up because of detection limits. Characterizing algal assemblages can also be helpful in detecting changes.

Recommendation:
(INAC R27) INAC recommends biota sampling be continued to include effects-based monitoring in the Aquatic Effects Monitoring Plan. This is a precautionary approach for the plan to include two monitoring methods, increasing the chances of detecting changes to the aquatic environment by using both water quality parameters and biological indicators.

3.3 Monitoring during care and maintenance

Reference:

- Hope Bay Project, Doris Aquatic Effects Monitoring Plan, TMAC Resources Inc., June 2016, Section 3.1

Comment:
The AEMP states: "*Should the site re-enter a phase of care and maintenance, the program will be carried out once every third year using data collected from ST-7 during months of water use.*"

This schedule would be insufficient to react in a timely manner should changes be occurring.

Recommendation:
(INAC R28) INAC recommends that sampling be conducted at least twice a year during care and maintenance to adequately monitor the site and any potential effects of infrastructure, ore and waste rock piles as well as tailings.

4. PROPOSED SURVEILLANCE NETWORK PROGRAM REVISIONS

TMAC submitted a presentation where Table 2 from Schedule J of water licence 2AM-DOH1323 is presented with proposed modifications marked in red. Below each slide a rational for the change is included.

There was quite a bit of back and forth when proposed changes were discussed at the June 6-8, 2016 meetings, so the following comments are mostly to state INAC's understanding at the end of the conversation but also to raise points on which we disagree with proposed changes.

4.1 Measurement units for Fecal Coliform

Reference:

- Aquatic Working Group Meeting: Proposed Surveillance Network Program Revisions for Water Licence 2AM-DOH1323 – presentation, TMAC Resources Inc., June 6, 2016, Slide 3

Comment:

In the table of analytical parameters for different monitoring groups, measurement units for Fecal Coliform are modified from "*CFU/100 mL (colony forming units)"* to "*CFU or MFU/100 mL"*. It was understood that MFU was a mistake and should be MPN (most probable number), so that the measurement units would read "*CFU or MPN/100 mL"*.

4.2 Station at the TIA discharge pump (TL-1)

Reference:

- Aquatic Working Group Meeting: Proposed Surveillance Network Program Revisions for Water Licence 2AM-DOH1323 – presentation, TMAC Resources Inc., June 6, 2016, Slide 7
- Hope Bay Project, Doris Tailings Impoundment Area Operations, Maintenance, and Surveillance Manual – Hope Bay, Nunavut, TMAC Resources Inc., June 2016, Section 4.5
- Nunavut Water Board Water Licence 2AM-DOH1323, Nunavut Water Board, August 16, 2013

Comment:

This comment adds to what is presented in point 3 of section 5.0 of the AMEC Foster Wheeler review memorandum on the AEMP and SNP revisions.

Station TL-1 in the present licence is described as "TIA at the Reclaim Pump Barge Depth 1.5 m below surface" and TMAC proposes to change the description to "TIA at the Discharge Pump". They also suggest restricting sampling to the construction period during discharge to fresh water.

Characterising water in the TIA is important so that in event of spills from the pipelines or malfunctions, regulators are aware of the characteristics of the water TMAC is dealing with. During the June 6-8, 2016 meetings, TMAC stated that TIA water would be monitored during operations for operational purposes, so keeping this station in the licence ensures that the data will be clearly identified and reported in the annual report.

According to the TIA Operations, Maintenance and Surveillance Manual: "*During operations, in addition to tailings slurry, the following sources of mine contact water may be pumped to the TIA: underground mine water, pollution control pond water, sedimentation pond water, landfill sump water, bulk fuel storage sump water, treated sewage effluent, and any other industrial contact water collected at site from various locations.*" The addition of treated sewage makes it appropriate to include monitoring for biological parameters, as suggested by TMAC. The addition of bulk fuel storage sump water and other industrial contact water makes it appropriate to include monitoring of petroleum hydrocarbons, as Total Oil & Grease or some other form.

Recommendation:
(INAC R29) INAC recommends that sampling at station TL-1 be required during operations and closure, in addition to during construction. Sampling at the pump could not continue post-closure, but would be necessary in an adjacent location.

We agree with the addition of biological parameters in the list to be tested and recommend petroleum hydrocarbon parameters be included as well.

(INAC R30) INAC recommends that the updated Water Management Plan explicitly specify how all mine contact water will be handled. The TIA OMS Manual states that some waters **may** be pumped to the TIA, implying they could be sent elsewhere. All possible contact water disposal locations need to be identified.

4.3 Doris Creek monitoring stations (TL-2, TL-3, TL-4)

Reference:

- Aquatic Working Group Meeting: Proposed Surveillance Network Program Revisions for Water Licence 2AM-DOH1323 – presentation, TMAC Resources Inc., June 6, 2016, Slides 8, 9 & 10
- Nunavut Water Board Water Licence 2AM-DOH1323, Nunavut Water Board, August 16, 2013

Comment:
In the present licence, three stations are located on Doris Creek. TL-2 (Doris Outlflow Creek – upstream (at the flow monitoring station adjacent to the bridge)), TL-3 (Doris outflow Creek (~80 m downstream of the base of the waterfall), and TL-4 (TIA Dischage End of Pipe (taken at a valve at the discharge end of the transfer pump pipeline). TMAC proposes restricting sampling to the construction period during discharge to fresh water for TL-2, changing sampling phases at TL-3 to construction and post-closure, and removing TL-4 since it will be equivalent to TL-1.

INAC agrees that station TL-4 would bring no new information. We are of the opinion that at least one station on Doris Creek needs to be monitored throughout all phases of the project. This would provide downstream monitoring of any potential effects from dust deposition on Doris Lake, seepage from the TIA through North Dam, and unforeseen events on site.

Recommendation:
(INAC R31) INAC recommends keeping a monitoring station on Doris Creek during construction, operation, closure and post-closure.

4.4 Water component of tailings discharged into TIA (TL-5)

Reference:

- Aquatic Working Group Meeting: Proposed Surveillance Network Program Revisions for Water Licence 2AM-DOH1323 – presentation, TMAC Resources Inc., June 6, 2016, Slide 11
- Water Management Plan – Hope Bay, Nunavut, TMAC Resources Inc., June 2015
- Nunavut Water Board Water Licence 2AM-DOH1323, Nunavut Water Board, August 16, 2013

Comment:
TMAC proposes removing station TL-5 (Tailings Discharged into TIA (Water Component) taken from valve in the mill at the discharge end of the mill tailings pumps) on the grounds that: "*Characterization of waters discharged into the TIA for the purposes of Water and Load balance model calibration will be outlined in the Water Management Plan*."

As mentioned in point 2 of section 5.0 of the AMEC Foster Wheeler review memorandum on the AEMP and SNP revisions, this was not found in the June 2015 Water Management Plan. Keeping SNP station TL-5 will ensure that sampling which will be done in any case for operations is reported in the annual report.

Recommendation:
(INAC R32) INAC recommends that station TL-5 be kept in the licence and that the updated version of the Water Management Plan include how the waters discharged into the TIA will be characterized.

4.5 Sampling station TL-9 – barren bleed solution

Reference:

- Aquatic Working Group Meeting: Proposed Surveillance Network Program Revisions for Water Licence 2AM-DOH1323 – presentation, TMAC Resources Inc., June 6, 2016, Slide 15
- Nunavut Water Board Water Licence 2AM-DOH1323, Nunavut Water Board, August 16, 2013

Comment:
TMAC proposes removing station TL-9 (Barren Bleed Solution sent to tailings taken from a sampling valve within the mill) because the amended project will no longer use this process. During the June 6-8 meetings, TMAC stated there was no analogous

process under the revised processing, but that they would look into if there was any liquid along the cyanide process that could be analysed to see how successful the sulphur dioxide-oxygen cyanide destruction process was.

Recommendation:
(INAC R33) INAC recommends that station TL-9 be modified to a location where it can serve to monitor the efficacy of the cyanide destruction process.

4.6 Underground mine water (TL-11 and TL-12)

Reference:

- Aquatic Working Group Meeting: Proposed Surveillance Network Program Revisions for Water Licence 2AM-DOH1323 – presentation, TMAC Resources Inc., June 6, 2016, Slides 17 & 18
- Hope Bay Project, Groundwater Management Plan – Hope Bay, Nunavut, TMAC Resources Inc., June 2016, Section 5.2
- Nunavut Water Board Water Licence 2AM-DOH1323, Nunavut Water Board, August 16, 2013

Comment:
TMAC proposes removing stations TL-11 and TL-12 because "*groundwater will either be discharged directly to the ocean, or to the TIA and then to the ocean"* and *"groundwater seepage will be monitored under the Groundwater Management Plan*".

INAC is of the opinion that groundwater monitoring should be kept in the SNP so that sampling, which will be done in any case for operations, is reported in the annual report. The results can provide helpful information for understanding where the water is coming from and verifying model predictions.

Parameters which should be tested are discussed in INAC R7 from AMEC Foster Wheeler review memo on the Groundwater Management Plan, point 4 of section 4.2 and AMEC Foster Wheeler review memo on the AEMP and SNP revisions, point 5 of section 5.0.

Recommendation:
(INAC R34) INAC recommends that a station to monitor underground water to be discharged on the surface be included in the SNP, and that parameters tested include those listed in INAC R7.

4.7 Discharge from sedimentation and pollution ponds (ST-1 and ST-2)

Reference:

- Aquatic Working Group Meeting: Proposed Surveillance Network Program Revisions for Water Licence 2AM-DOH1323 – presentation, TMAC Resources Inc., June 6, 2016, Slides 20 & 21

- Nunavut Water Board Water Licence 2AM-DOH1323, Nunavut Water Board, August 16, 2013

Comment:
TMAC proposes removing stations ST-1 and ST-2 because water will be discharged into the TIA.

INAC is satisfied that if the possibility of discharging to the tundra is removed, these stations can be as well.

4.8 Discharge from sumps (ST-3, ST-4, ST-5, ST-6, ST-11 and ST-13)

Reference:
- Aquatic Working Group Meeting: Proposed Surveillance Network Program Revisions for Water Licence 2AM-DOH1323 – presentation, TMAC Resources Inc., June 6, 2016, Slides 22 to 25, 31 and 33
- Nunavut Water Board Water Licence 2AM-DOH1323, Nunavut Water Board, August 16, 2013

Comment:
Six stations are related to discharging from sumps: ST-3 (Discharge from Non-hazardous Landfill pollution control sump), ST-4 (Discharge from Landfarm sump), ST-5 (Discharge from the Plant Site Fuel Storage and Containment Area Sump), ST-6 (Discharge from the Roberts Bay Fuel Storage and Containment Area Sumps), ST-11 (Discharge from the Reagent and Cyanide Storage Facility Sumps) and ST-13 (Discharge from Sedimentation Pond (for pad U)). In the present licence, discharge sampling is prescribed once before any discharge and **daily** when discharging onto the tundra.

In their submitted presentation, TMAC proposed changing the frequency to once before any discharge and **once** when discharging onto the tundra. The volume of the sumps was discussed during the June 6-8 meetings. TMAC stated that the Non-hazardous Landfill pollution control sump might contain approximately 500 m^3 of water when emptied and the Roberts Bay Fuel Storage and Containment Area Sumps might collect approximately 275 m^3 per year.

A single sample collected prior to discharge could be sufficient to properly characterize water contained in a small sump.

Recommendation:
(INAC R35) INAC recommends the licensee demonstrate with data they collect from discharging sumps that water quality does not change during discharge and all the water in the sump can be accurately characterized by a reduced number of samples.

4.9 Runoff from sediment controls (ST-10)

Reference:

- Aquatic Working Group Meeting: Proposed Surveillance Network Program Revisions for Water Licence 2AM-DOH1323 – presentation, TMAC Resources Inc., June 6, 2016, Slide 30
- Nunavut Water Board Water Licence 2AM-DOH1323, Nunavut Water Board, August 16, 2013, Part D and Schedule D

Comment:

TMAC proposes removing station ST-10 (Site Runoff from Sediment Controls) because "*rock is used solely for construction on site in accordance with the construction technical specifications*". During the June 6-8 meetings, TMAC added that since the construction section of the water licence had monitoring requirements, removing this station would not remove monitoring requirements for constructions zones.

Including ST-10 as an SNP station allows a more precise description of the monitoring prescribed in Part D and schedule D of the water licence. This station is also broader than just construction and requires monitoring of all sediment control measures throughout the life of the project.

Recommendation:

(INAC R36) INAC recommends keeping station ST-10 as in the SNP.