Final Submission Regarding
TMAC Resources Inc.'s
Water Licence Applications for Hope Bay Phase2
New Type A – 2AM-BOS----
& 2AM-DOH1323 Amendment#2

Crown-Indigenous Relations and Northern Affairs Canada

Final Submission to the Nunavut Water Board

September 28, 2018

EXECUTIVE SUMMARY

Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC) has participated in the ongoing review of the TMAC Resources Inc.'s (TMAC) water licence applications for the Hope Bay Phase 2 project, which includes mines at four sites. The first application is for amendment #2 of its existing Type A Nunavut Water Board water licence 2AM-DOH1323 for the operating Doris North gold mine, to incorporate production at two other gold mines, Madrid North and Madrid South. The second application is a for a new type A licence 2AM-BOS----, for a gold mine at the Boston site. This project is situated on Roberts Bay off Melville Sound in Nunavut's Kitikmeot region.

During the technical review, topics discussed were:

- Scope of Licences
- Terms of Licences
- Water Supply
- Water Management
- Waste Management
- Management Plans and Reports
- Monitoring Program
- Closure and Reclamation Planning

Most of the issues have been resolved through discussion with TMAC. Our outstanding issues relate to the scope of licences and the reclamation cost estimate. CIRNAC is submitting a revised reclamation cost estimate and is engaging in discussions on this topic with TMAC and the Kitikmeot Inuit Association.

ᓇᐃᓚᒋᐊᕐᓗᒍ ᐅᓂᒃᑲᖅ

To be provided.

ATANGUYAIT NAINAGHIMAYOT ONIPKAGIYAIT

To be provided.

TABLE OF CONTENTS

INTRODUCTION

Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC) has participated in the ongoing review of the TMAC Resources Inc.'s (TMAC) applications their Hope Bay Phase 2 project which includes amendment #2 of Type A water licence 2AM-DOH1323 and new Type A water licence 2AM-BOS----.

On March 29, 2018, CIRNAC submitted a technical review of the applications. Our review included both recommendations (R) and information requests (IR). We then participated in a Technical Meeting on May 14 and 15, 2018 in Cambridge Bay. A Pre-Hearing Conference was held by teleconference on July 31, 2018, following which the Nunavut Water Board (Board) distributed the Pre-Hearing Conference Decision on August 22, 2018 inviting interested parties to submit final written submissions.

The scope of the Phase 2 project includes work activities and undertaking at four sites[1]:

- Doris North Site
    - expansion of accommodations (400-person capacity);
    - increasing the capacity for sub-aerial deposition at the existing Doris Tailings Impoundment Area to 18 million tonnes by raising the existing south dam by eight (8) metres (m) and constructing a five (5) m high west dam to support belt-wide activities associated with the Project;
    - increases to the volume of water used for domestic and industrial purposes from Windy Lake and Doris Lake, respectively;
    - construction of a Windy Lake North freshwater intake;
    - construction of two (2) wind turbines;
    - upgrading the existing all-weather road between Doris North and Madrid North sites; and
    - use of other existing facilities at the Doris North site, including the 7.5 million litre (ML) fuel storage facility and explosives magazines; waste rock and ore storage facilities and laydown area, solid waste management facilities and water management infrastructure (including contact water ponds and water treatment facilities), site roads and airstrip, and explosives storage facilities.
- Madrid North Site
    - underground mining and surface mining (crown pillar recovery) to access the ore deposits at Madrid North;
    - construction of a 1,200 tonne-per-day (tpd) concentrator;
    - incremental expansion of surface infrastructure at Madrid North to accommodate production mining, including laydown areas;
    - construction of two (2) wind turbines;
    - hauling of concentrate and excess mined ore to the existing processing plant at Doris North for gold extraction;

[1] Nunavut Impact Review Board, Final Hearing Report, Phase 2 Hope Bay Belt Project, TMAC Resources Inc., NIRB File No. 12MN001, June 2018

- storage of ore and waste rock on dedicated pads;
- construction and operation of site roads and an all-weather access road and tailings pipeline from Madrid North to the south end of the Doris North Tailings Impoundment Area;
- establishment of quarries for construction and for use as backfill material;
- trucking of domestic waste to existing waste management facilities at the Doris North site;
- construction and operation of site water management infrastructure (including contact water ponds);
- construction of maintenance facilities and other buildings necessary to support mining activities;
- construction of a bulk fuel storage facility (4.5 ML capacity);
- construction of other infrastructure necessary to support ongoing exploration activities, including helipads;
- water use for domestic and industrial purposes from Windy Lake and Doris Lake, respectively; and
- installation and operation of three (3) 1.2 megawatt (MW) power plants and a standby/emergency plant.

- Madrid South Site
  - underground mining and surface mining (crown pillar recovery) to access ore deposits at Madrid South;
  - construction and operation of site roads and a 4.7 km extension of the Doris-Windy all-weather road to the Madrid South site;
  - haulage of mined ore for processing at the Madrid North plant and the existing Doris North processing plant;
  - establishment of quarries for construction and for use as backfill material;
  - incremental expansion of surface infrastructure, including laydown areas, at Madrid South to accommodate production mining;
  - storage of ore and waste rock on dedicated pads;
  - construction of maintenance facilities and other buildings necessary to support mining activities;
  - construction and operation of site water management infrastructure, including contact water ponds;
  - water use for domestic and industrial purposes from Windy Lake and Doris Lake, respectively;
  - trucking of domestic waste to existing waste management facilities at the Doris North site; and
  - installation and operation of two (2) 725 kilowatt power plants and a standby/emergency plant.

- Boston Site
  - underground mining and surface mining (crown pillar recovery) to access ore deposits at Boston;
  - storage of ore and waste rock on dedicated pads;
  - construction and operation of site access and haul roads and quarry sites;

- haulage of mined ore to a new 2,400 tpd processing plant at the Boston site;
- haulage of some ore and concentrate to the existing plant at Doris North for processing and gold extraction;
- construction and operation of a dry-stack Tailings Management Area (storage capacity of 5.1 million tonnes);
- construction of all infrastructure necessary to support mining and processing activities at Boston, including construction of a new accommodation (300 person-capacity) facility and associated support facilities (sewage treatment, incinerator, water supply), ore and waste rock pads, explosives storage facility, reagent pad, laydown area, and maintenance facilities;
- construction and operation of site water management infrastructure, including contact water ponds;
- construction of two (2) wind turbines;
- construction and operation of a power plant and a 7.5 ML fuel tank farm;
- construction and operation of a two (2) km all-weather airstrip;
- water use for domestic and industrial purposes from Aimaokatalok Lake;
- establishment and operation of a wastewater treatment plant with a discharge outfall to Aimaokatalok Lake;
- construction and operation of solid waste management facilities;
- construction of other infrastructure necessary to support ongoing exploration activities, including helipads; and
- installation and operation of eight (8) 1.2 MW power plants and a standby/emergency plant.

The NWB has provided a list of topics to be discussed at the public hearing. The topics have been used as headings in this document to organize the comments we made.

Comments in this submission are made in the context of CIRNAC policy and mandated responsibilities under the *Nunavut Waters and Nunavut Surface Rights Tribunal Act* and the *Department of Indian Affairs and Northern Development Act*. Comments are structured as issues and supported by observations made during the course of the application review and recommendations are made directly to the Board.

TECHNICAL COMMENTS

Exchanges and discussion with TMAC at the technical meeting and in follow-up correspondence have allowed CIRNAC to clarify most of the concerns we had regarding the proposed project. The remaining issues are principally administrative.

Different comments submitted by CIRNAC have been assigned to one of the topics in the Board's list, but we note that several comments could be assigned to more than one heading.

1. Scope of Licences

Presently TMAC hold four water licences regulating their activities in the Hope Bay belt: an exploration licence (2BE-HOP1222), two bulk sample licences (Boston>2BB-BOS1727 and Madrid>2BB-MAE1727), and a type A water licence for the Doris mine (2AM-DOH1323). CIRNAC submitted one comment on this topic as presented in Table 1.

Table 1 Status of comment pertaining to scope of licences

Comment #	Issue	Status
IR1, R16	Water licences for Hope Bay belt	Unresolved

Water licences for Hope Bay belt: We have had several exchanges as to what activities should be regulated in which licences when considering the possible addition of a type A licence at Boston (2AM-BOS----) and the amendment of the Doris type A (2AM-DOH1323) to include Madrid. **IR1** sought clarification on whether TMAC wished to keep its 2BB-MAE1727 licence in addition to a possible amended type A incorporating Madrid, and they confirmed they do. **R16** was regarding the incorporation of the scope of 2BB-BOS1727 into any new type A for Boston.

TMAC's latest submission regarding the scope of water licences is a memo to the Board dated July 25, 2018, in which they re-iterate their justifications for requesting 5 water licences, should the applications under considerations be successful. We note that in the changes of scope requested for the type A licences at Doris-Madrid (Table 1) and Boston (Table 2), the industrial water treatment plants for removal of arsenic, cadmium and ammonium are not included. This appears to be an omission.

The principle arguments used by TMAC for keeping their 2BB licences alongside type A licences covering mining activities at the same location is to maintain procedural flexibility of type B licences and to do bulk samples and production mining in parallel.

CIRNAC is of the opinion that licences should cover distinct undertakings with as little overlap as possible for clarity on the proponent's authorizations, obligations and responsibilities. Our arguments are:

- Issuing both type B and type A licences for similar activities at the same location will make it difficult for Inspectors to determine what activities are occurring under which licences. In the event of non-compliance issues, the overlapping authorizations could lead to mining work being continued under their bulk sample or production licence if work was stopped under the other licence.
- There would be some physical overlap between the existing 2BB-BOS1727 infrastructure and different infrastructure proposed for 2AM-BOS----, in particular the vent raise and air strip. This raises complications for closure and reclamation which could be avoided by incorporating the 2BB-BOS1727 licence into a type A.
- Including the scope of the 2BB licences in the type A licences would allow for bulk samples to be taken, and incorporating the extra water sources in the type A would help keep some of the operational flexibility. Should areas outside those defined at Boston, Madrid North and Madrid South become targets for further bulk samples, an application or amendment for a type B licence would be required anyway.
- The 2BE-HOP1222 exploration licence covers the Hope Bay belt and allows for surface exploration across the belt, including the watersheds where 2BB-MAE1727 and 2BB-BOS1727 are located.

CIRNAC recommends the scope of 2BB-BOS1727 be incorporated into any new 2AM-BOS---- licence in order to cancel the type B when the type A comes into effect. Likewise, we recommend the scope of 2BB-MAE1727 be incorporated into an amended 2AM-DOH1323 licence in order to cancel the type B when the type A comes into effect.

Draft water licences: TMAC submitted draft water licences, which the Board circulated and requested comments on. We are still having discussions between the different divisions of CIRNAC on the drafts and will present our recommendations at the public hearing.

2. Terms of Licences

During the technical meeting, TMAC requested the longest term possible, 25 years, but stated they would leave the term duration to the Board's discretion.

CIRNAC recommends that the licence terms match the duration of activities scheduled to occur under the licences. However, we consider the duration of post-closure monitoring proposed by TMAC to be inadequate. Lengthening the duration of post-closure monitoring would require those activities to be carried out after the project schedule presented by TMAC.

3. Water Supply

TMAC is requesting authorization for use of 120 m^3/day from Windy lake for potable water and 7 270 m3/day from Doris Lake for industrial water use under an amended Doris water licence. For the Boston water licence, the request is for 1323 m^3/day from Aimaokatalok Lake for both potable and industrial uses.

CIRNAC submitted a single comment regarding water supply, as summarised in Table 2. It has been resolved.

Table 2 Status of comment pertaining to water supply

Comment #	Issue	Status
IR9	Requested water volumes	Resolved

Requested water volumes: IR9 was to sort out water quantities which seemed inconsistent between different parts of the application. TMAC clarified that the maximum camp size proposed for Doris is 400 people and the maximum daily withdrawal from Doris Lake is 7 270 m^3/day.

4. Water Management

Water Management infrastructure includes contact water ponds on all four sites (Doris, Madrid North, Madrid South, and Boston), the tailings impoundment area (TIA), and pipelines. Saline groundwater is expected at all mines except Boston, and will be discharged to the marine environment in Roberts Bay. Five comments were provided and they are resolved, as presented in Table 3.

Table 3 Status of comment pertaining to water management

Comment #	Issue	Status
IR3	Water & load balance model validation	Resolved
IR6	Contact water pond design	Resolved
IR12	Mine water at Boston	Resolved
IR13, R19	Madrid mine water transport	Resolved
IR15	Effect of saline water in tailings impoundment area on frozen core dam	Resolved

Water & load balance model validation: IR3 asked what data were used to validate the water and load balance model, since it was not clear if the same data had been used for both calibration and validation. TMAC specified that although the calibration and validation data span the same periods, data from different measurement locations were used.

Contact water pond design: IR6 asked for more information on the overburden thickness at the planned locations for contact water ponds, since the pond design relies on the low permeability of a sufficiently thick layer of marine clays and silts. TMAC does not yet have the information, but proposed three mitigation strategies, should overburden thicknesses be insufficient.

Mine water at Boston: IR12 was for contingency measures should groundwater be encountered in the Boston mine. The current model predicts the Boston mine will be located entirely within permafrost; however the model was created with limited data and required localized modifications, increasing the uncertainty. TMAC responded they would seal any point sources and use any water encountered in the mine. Should greater volumes be encountered, the water would be trucked to Doris for disposal in the TIA or Roberts Bay.

Madrid mine water transport: IR13 and **R19** were regarding groundwater at the Madrid mines. Volumes of 1 180 m3/day and 550 m3/day are predicted for the Madrid North and Madrid South mines respectively. The water management proposed is disposal in Roberts Bay, either directly or via the TIA, but insufficient information had been provided on the method of transport between the Madrid mines and the bay. TMAC explained the groundwater would be trucked to the Doris site until ingress volumes are sufficient to warrant building a pipeline. They have updated the Groundwater Management Plan to refer to both methods of transport.

Effect of saline water in tailings impoundment area on frozen core dam: IR15 was to verify if the design of the North Dam of the TIA took into account the thermal effects of retaining saline groundwater in the TIA. TMAC confirmed saline groundwater storage would not alter the dam's performance.

5. Waste Management

Waste in water will be managed with two sewage treatment plants (Doris & Boston), two industrial water treatment plants (Doris & Boston) and through ocean discharge. As well, flotation tailings will be disposed of in a TIA at Doris and a tailings management area (TMA) at Boston, whereas detoxified tailings will be disposed of in the mines' permafrost zones. The mine workings will also be used for disposal of waste rock and hydrocarbon impacted soils. Two landfills are proposed (Doris & Boston) for non-hazardous waste.

As outlined in Table 4, all CIRNAC's comments are considered resolved, with one requiring follow-up.

Table 4 Status of comment pertaining to waste management

Comment #	Issue	Status
R11	Water treatment plant effluent quality	Resolved
IR10	Waste rock volumes in relation to void	Resolved

	volumes	
IR11	Detoxified tailings deposition at Madrid	Resolved
IR14, R20	Non-hazardous waste disposal	Resolved. Follow-up required.

Water treatment plant effluent quality: R11 is about the water treatment process proposed for the Boston industrial water treatment plant to remove arsenic and cadmium. The treated effluent arsenic concentration assumed (0.01 mg/L) is highly optimistic for a field scale plant and it was used in the water and load balance model for Aimaokatalok Lake. The examples of plant effluent concentrations from other sites cited by TMAC did not provide sufficient confidence they could achieve the target. TMAC chose to use a 0.1 mg/L treated effluent target, which is more achievable and meets the *Metal and Diamond Mining Effluent Regulations* requirements. They also revised their hydrodynamic mixing model using the new effluent discharge concentrations and found arsenic concentrations in Aimaokatalok Lake to be protective of aquatic life.

Waste rock volumes in relation to void volumes: IR10 aimed to verify that sufficient space would be available in the mine workings, since they will be used as permanent disposal sites for waste rock, detoxified tailings and industrial water treatment plant sludge. TMAC stated where they had provided most of the information requested and gave estimates of the yearly sludge production.

Detoxified tailings deposition at Madrid: IR11 is about the availability of permafrost zones in the Madrid mine for disposal of detoxified tailings underground. TMAC confirmed the mine plan was such that there would always be space available in permafrost zones.

Non-hazardous waste disposal: IR14 asked about the expected timing of the landfill construction at Boston, and TMAC replied it would be early in the Boston mine life. **R20** suggested that operational details for the landfills be incorporated into the Non-Hazardous Waste Management Plan, which TMAC has committed to.

CIRNAC recommends that the licence include a timeline for approval of the revised plan.

6. Management Plans and Reports

Management plans describe how concepts and strategies will be implemented. Table 5 lists all the comments and their status

Table 5 Status of comment pertaining to management plans and reports

Comment #	Issue	Status
R12	Backfill materials	Resolved
R15	Release of saline minewater to the tundra	Resolved

IR2, R17	Industrial water treatment plant at Doris	Resolved. Follow-up required.
IR7	Cyanide testing	Resolved
IR8	Maximum camp size at Doris	Resolved
IR16	Crown pillar recovery at Doris North	Resolved

Backfill materials: R12 asked for rational for using quarried rock instead of filtered flotation tailings to fill in the mine workings voids. TMAC explained that the filtered tailings do not have the strength characteristics required for structural backfill.

Release of saline minewater to the tundra: R15 requested an evaluation of failure modes of saline groundwater during its transport from Madrid to Doris, and consequences of accidental discharge to the tundra. TMAC provided a memo with the requested information and a proposed mitigation measure.

Industrial water treatment plant at Doris: IR2 is about the Doris industrial water treatment plant to remove arsenic from contact water, on which insufficient information had been provided. TMAC responded with the information requested, and following **R17**, they will integrate the relevant information in the Doris-Madrid Water Management Plan.

CIRNAC recommends that the licence include a timeline for approval of the revised plan.

Cyanide testing: IR7 pertained to cyanide testing described in the Quality Assurance and Quality Control Plan. TMAC provided clarifications which they committed to integrating in the next version of the Plan.

Maximum camp size at Doris: IR8 sought clarification on two possible maximum camp sizes for Doris contained in the application materials, and the capacity of the wastewater treatment plant. TMAC confirmed the maximum camp size is 400 people and there will be sufficient sewage treatment capacity.

Crown pillar recovery at Doris North: IR16 asked about missing information of the excavation necessary for crown pillar recovery at Doris. TMAC replied it was no longer being considered for this application.

7. Monitoring Program

Monitoring allows us to check that management measures are performing as planned and the project is not having any unintended consequences. A single comment was submitted, as presented in Table 6, and it has been deferred.

Table 6 Status of comment pertaining to monitoring program

Comment #	Issue	Status
IR4, IR5, R18	Aquatic effects monitoring plans	Deferred. Follow-up required.

Aquatic effects monitoring plans: Two Aquatic Effect Monitoring Plans (AEMP) were submitted, one for each Madrid-Doris and Boston. **IR4** asked for more information on methodology used for hydrological measurements, and **IR5** was about the duration of "before" water quality analyses for Before-After Control-Impact analysis. TMAC provided satisfactory responses for both of these. **R18** was for a single AEMP integrated both projects, with some specific suggestions. TMAC has deferred producing the AEMP until after the public meeting.

CIRNAC recommends that the licence include a timeline for approval of the revised plan.

8. Closure and Reclamation Planning

The Doris Interim Closure and Reclamation Plan has been updated to include proposed amendments, and a Conceptual Closure and Reclamation Plan has been provided for Boston. These describe how the sites will be cleaned up after the mining has finished, and they were used to develop reclamation cost estimates. Table 7 lists the comments on this topic and their status.

Table 7 Status of comment pertaining to closure and reclamation planning

Comment #	Issue	Status
R1, R2	Doris Tailings Impoundment Area	Resolved
R3, R4, R5, R6	Boston Tailings Management Area seepage	Resolved
R7, R8, R9, R10	Closure planning and requirements	Resolved
R13, R14	Long-term climate change effects	Resolved
R21	Reclamation cost estimate	Unresolved

Doris Tailings Impoundment Area: R1 and **R2** are about plans for closure of the Doris TIA. The first was about the site specific water quality objectives (SSWQO) TMAC was proposing to use after closure, and this issue has been deferred to the Aquatic Effects Monitoring Plan. The second recommendation was for field trials of the proposed cover design for closure to confirm that none of the potential issues identified would compromise its performance. TMAC has provided a discussion of potential performance issues and concluded deficiencies could be covered by the 20% contingency of the reclamation cost estimate.

Boston Tailings Management Area seepage: R3, **R4**, **R5** and **R6** are all related to the Boston TMA closure plan which includes cover of a geomembrane under 1 m of aggregate. **R3** is on the effect on arsenic loading from a 1% geomembrane failure, as will occur in the future, likely in between 100-500 years. TMAC provided a memo with modelling results of arsenic loading calculations demonstrating that even at 10% cover failure, concentrations would remain below criteria. The last three recommendations covered: the anticipated design life of the TMA components; post-closure mitigation actions that could be taken in event of non-compliant seeps; and field trials of the proposed cover design. These were addressed in TMAC's discussion of potential performance issues with mitigation measures.

Closure planning and requirements: Though adequate for the current level of project definition, the Boston Conceptual Closure and Reclamation Plan and the Doris-Madrid Interim Closure Plan do not follow many of the requirements in the *Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites in the Northwest Territories* (MVLWB & AANDC, 2013). The recommendations were about: following the applicable closure planning guidance (**R7**), establishing a stakeholder working group for closure planning (**R8**), defining long term post-closure maintenance and monitoring requirements (**R9**), and specifying post-closure land uses (**R10**). TMAC provided a closure design and performance uncertainties table detailing different failure modes and concluded there would be no post-closure maintenance requirements, addressing **R9**. They also committed to considering the other recommendations in future plan updates.

Long-term climate change effects: R13 sought confirmation that the geochemical source terms used to assess project impacts accounted for anticipated climate change effects, which TMAC provided. **R14** was for a sensitivity analysis projecting climate change effects 200 years post-closure using predicted climate data for 2100, because permafrost response to climate change can be delayed until cumulative thresholds are reached. TMAC stated the model response past 2100 would remain unchanged, which is due to simplifications in the thermal model used.

Reclamation cost estimate (R21): CIRNAC developed two estimates for the closure plans at Doris-Madrid and at Boston. Following discussions with TMAC and the Kitikmeot Inuit Association, we have revised the estimate. Our current reclamation costs are in Table 8 for Doris-Madrid and in Table 9 for Boston. The detailed RECLAIM spreadsheets will be submitted with this document.

Table 8 Reclamation cost estimate for Doris-Madrid

Cost Category	Total Cost ($)	Land		Water	
		%	Cost ($)	%	Cost ($)
Capital Costs					
Underground	312 868	98	306 351	2	6 517
Tailings Facility	18 850 158	50	9 425 079	50	9 425 079
Rock Pile	170 371	100	170 371	0	-
Buildings and equipment	13 641 928	91	12 346 309	9	1 295 619
Chemicals and Contaminated Soil Mgmt	2 873 934	50	1 436 967	50	1 436 967
Surface and Groundwater Mgmt	660 059	0	-	100	660 059
Interim Care and Maintenance	5 597 400	0		100	5 597 400
Subtotal: Capital Costs	***42 106 717***	*56*	***23 685 077***	*44*	***18 421 640***
Indirect Costs					
Mobilization/Demobilization	9 180 540	56	5 164 064	44	4 016 476
Post-Closure Monitoring and Maintenance	1 855 177	56	1 043 539	44	811 638
Engineering	2 105 336	56	1 184 254	44	921 082
Project Management	2 105 336	56	1 184 254	44	921 082
Contingency	8 421 343	56	4 737 015	44	3 684 328
Sub-Total: Indirect Costs	***23 667 732***	*56*	***13 313 126***	*44*	***10 354 605***
Total Costs	**65 771 118**		**36 998 203**		**28 776 246**

Table 9 Reclamation cost estimate for Boston

Cost Category	Total Cost ($)	Land		Water	
		%	Cost ($)	%	Cost ($)
Capital Costs					
Underground	60 847	100	60 847	0	-
Tailings Facility	15 195 574	50	7 597 787	50	7 597 787
Rock Pile	57 143	100	57 143	0	-
Buildings and equipment	5 313 366	95	5 070 137	5	243 229
Chemicals and Contaminated Soil Mgmt	636 123	50	318 061	50	318 061
Surface and Groundwater Mgmt	46 772	0	-	100	46 772
Interim Care and Maintenance	4 786 320	0		100	4 786 320
Subtotal: Capital Costs	***26 096 144***	*50*	***13 103 974***	*50*	***12 992 170***
Indirect Costs					

Mobilization/Demobilization	5 041 005	50	2 531 301	50	2 509 704
Post-Closure Monitoring and Maintenance	1 577 877	50	792 318	50	785 558
Engineering	1 304 807	50	655 199	50	649 609
Project Management	2 105 336	50	655 199	50	649 609
Contingency	5 219 229	50	2 620 795	50	2 598 434
Sub-Total: Indirect Costs	***14 447 725***	*50*	***7 254 812***	*50*	***7 192 913***
Total Costs	**40 543 869**		**20 358 786**		**20 185 083**

We are still in discussions on three aspects of the estimates.

1) Costs: The biggest differences between the CIRNAC and TMAC estimates are because of the duration of interim care & maintenance and post-closure monitoring. CIRNAC is looking to standardize the duration of interim care & maintenance to 5 years and post-closure monitoring to 25 years, as described in the guideline in Annex A. Since the current Doris water licence has a 1.5 year interim care & maintenance period, we are using 3 years as a transition.

   Our discussion with TMAC on costs is ongoing, and the difference between our estimates is approximately 10%.

2) Land-water split: The Kitikmeot Inuit Association is looking to hold security for what they consider predominantly land liabilities, which would leave CIRNAC to hold water related liabilities. There are significant differences between the Kitikmeot Inuit Association's and CIRNAC's land-water allocations, principally due to how the tailings reclamation costs are distributed. Rational for the land-water split used by CIRNAC is provided in Annex B.

   If the site were to be abandoned, CIRNAC's reclamation efforts would be in collaboration with the Kitikmeot Inuit Association. Security would be accessed following the *Mine Site Reclamation Policy for Nunavut* (INAC, 2002).

   Discussions are also ongoing with the Kitikmeot Inuit Association regarding the land-water split.

3) Phased bonding: TMAC has proposed posting security in phases for both projects. The current proposal has 6 phases for Boston and 15 for Doris-Madrid. Some concerns we are presently discussing with TMAC are:
   - There are too many phases. With the current project schedule 1-4 phases would be posted each year, with the possibility for more. This is an administrative burden and might lead to re-evaluations of security more frequently than necessary as different people handle the file. We would recommend limiting changes to posted security once per year by lumping together phases in that year's workplan, and believe this would not pose undue constraints given the advanced planning necessary for each phase.

- Mobilization, interim care & maintenance, and post-closure monitoring costs need to be in the first phase for each licence. These costs will be necessary almost in their entirety once the project is started, so it is not logical to distribute them proportionally.
- Dividing the tailings reclamation costs according to the tonnage deposited as proposed would require further work. For the Boston TMA, we have spoken about how the stacking of tailings could be done in cells or areas, so that only the proportion of the footprint for which security was held was being used. This would require modifying the Boston Tailings Management Area – Operations, Maintenance and Surveillance Manual and possibly the Conceptual Closure and Reclamation Plan, as well as clearly delineating the areas on the ground so Inspectors could identify them. Similarly, at Doris, markers allowing Inspectors to assess what surface area extent of the TIA was secured were discussed.

CIRNAC agrees with the principle of phased bonding and continuing discussions should allow us to come to an agreement.

Annex A

Guidelines for duration of interim care & maintenance and post-closure monitoring in mine site closure & reclamation plan cost estimates for Nunavut

Guidelines for duration of interim care & maintenance and post-closure monitoring in mine site closure & reclamation plan cost estimates for Nunavut

When developing a closure and reclamation plan cost estimate for mine sites in Nunavut, the reference document is the *Mine Site Reclamation Policy for Nunavut* (INAC, 2002). It provides principles for mine site reclamation and some considerations but does not get into details. As more mines are developed in Nunavut, the need for more detailed guidelines is arising in order to ensure a consistent approach protective of the environment and coherent with what would occur, should a mine be abandoned.

Further guidance can be found in documents which Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC) helped develop for the Northwest Territories including the *Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites in the Northwest Territories* (MVLWB/AANDC, 2013) and the *Guidelines for Closure and Reclamation Cost Estimates for Mines* (MVLWB/INAC/GNWT, 2017). The *Abandoned Military Site Remediation Protocol* (INAC, 2008) developed by CIRNAC's Contaminated Sites Program also contains relevant information.

Two components of mine site closure and reclamation plan cost estimates which have been the topic of repeated deliberations are: the duration of interim care & maintenance, and the duration of post-closure monitoring. The following discussion presents CIRNAC's current default position. It is not a determination that the durations presented will be the same for every site. A case-by-case assessment will allow for the durations to be extended or shortened, should evidence be presented for a change.

Interim care & maintenance

Without getting into a long description, interim care & maintenance is basically a period of temporary closure, after which a mine site could resume operations or begin reclamation. The *Policy* states an element of any mine closure & reclamation plan is "*a list of contingency measures for temporary closure of the mine, outlining specific actions and their scheduling, to be taken during temporary closure.*" The *Guidelines for Closure and Reclamation Cost Estimates for Mines* offers more details, specifying the legal processes described in the "Insolvencies" section of the *Policy* would take place during a period of care & maintenance.

Should a mine operator abandon its site, the period of interim care & maintenance would need to include time necessary for the activities listed below. They are presented

in the order in which they would occur, and would have to occur sequentially for the most part.

1. Site assessment and inventory;
    - One summer season visit would be required to assess conditions on site and inventory such things as fuel, equipment, volumes of contaminated soil, volumes of hazardous wastes, and quantities of tailings and waste rock to be moved or covered.
    - *Duration: up to one year*
2. Participation in proceedings to sell assets of the insolvent company;
    - As stated in the *Policy*, these attempts would include non-conventional transactions.
    - *Duration: 1-3 years.*
3. Finalizing the closure & reclamation plan;
    - Though the water licences require interim closure & reclamation plans, the final plan is not typically completed until 12 months prior to closure and would likely not be done in event of a site abandonment. Information gathered in step 1 would be used finalize the plan.
    - *Duration: 3-6 months*
4. Issuing a contract for the reclamation work;
    - To ensure a transparent and fair process, the department would work with Public Works, prepare a tender, go out to tender, evaluate submissions and issue a contract.
    - *Duration: 6-7 months*
5. Obtaining and transferring the necessary permits and authorizations;
    - The reclamation work would already have been evaluated and approved for the mine site. However, it would be necessary to for the entity doing reclamation to get land use permits and a water licence. If the finalized closure plan included components, methods or elements not in the interim plan, these would have to be evaluated.
    - *Duration: 4-6 months.*
6. Mobilizing equipment and materials to site in the appropriate season.
    - Equipment, a camp and materials will have to be mobilized to site in order to carry out the reclamation work. Given that winter roads or barges are the only means to transport this quantity of material to most mine sites in Nunavut, it could be necessary to wait for the correct season.
    - *Duration: up to one year*

These activities produce a range of total durations between 2.5 and 6.5 years. Using a conservative scenario, but not the very worst case, a 5 year interim care & maintenance period will be used for making reclamation cost estimates.

This is in line with recent experience at an abandoned mine site in Nunavut, where the period between site abandonment and site stabilization lasted 5 years.

The need for a discussion between all landowners, including regional Inuit associations has not been included in the list of activities but would certainly have to occur should an abandoned mine site be situated on land owned by multiple owners. Presumably this would occur concurrently with other activities.

Post-closure monitoring

Again without getting into a long discussion, basically post-closure monitoring is monitoring that is necessary to verify that the reclaimed structures are performing as intended and demonstrates that the site has reached physical and chemical stability. It is also an element of closure & reclamation plans according to the *Policy*, and "*the duration of the required monitoring phase will be reviewed and confirmed at the time of closure and will depend on the risks associated with the potential impacts to the environment.*" Though the duration will be reviewed after closure, it is helpful to have a standard to start with and adjust according to site conditions.

The *Abandoned Military Site Remediation Protocol* sets out three phases of long term monitoring, applicable to four types of landfills in northern settings. The approach was developed using data from landfills at reclaimed military sites. Phase I involves site visits every two years (Years 1, 3, 5) an focuses on assessing the landfill's thermal state. After review of Phase I results and if warranted, monitoring frequency can be reduced for Phase II, with a suggested schedule of Years 7, 10, 15, 25. Another review of results is necessary at the end of Phase II to determine what further monitoring is necessary.

Mine sites typically have landfills, however the principal sources of environmental risk on site after reclamation will be associated with tailings and waste rock disposal. If these are at the surface, CIRNAC's experience with landfill monitoring at reclaimed military sites in the arctic is relevant because the principles of encapsulation using granular cover and permafrost aggradation used for landfills are also applied to tailings and waste rock disposal areas at the surface. There is precedence in other jurisdictions such as Alaska, for using the same duration of post-closure monitoring for alternate encapsulation methods for permanent disposal of tailings and waste rock including in underground mine workings or underwater.

A 25 year post-closure monitoring program will be used for making reclamation cost estimates. The monitoring event frequency will be determined by considerations such

as the encapsulation method chosen, the nature of tailings and waste rock, and site characteristics. Frequency will be higher initially and can be reduced after analysis of monitoring data demonstrates site stability.

Most of the reclamation costs are associated with reclamation work, so once a mine has past the closure stage, the majority of security posted under a water licence is returned to the operator. An example of security remaining for a closed mine that is at year 13 of their 25-year post-closure monitoring in Nunavut, indicates that appropriately only 5% of the total amount posted when the mine was operating remains furnished or 95% of security has been returned to the operator, at this point in time, in this case..

Annex B

Hope Bay Phase 2 Closure and Reclamation – Comment on Land/Water Liability Split of Financial Security

MEMO

ARCADIS Design & Consultancy for natural and built assets

To:
Ian Parsons – CIRNAC
Sarah Forte - CIRNAC

Copies:

Arcadis Canada Inc.
121 Granton Drive, Suite 12
Richmond Hill, Ontario L4B 3N4
Tel 905 764 9380
Fax 905 764 9386
www.arcadis.com

ENVIRONMENT

From:
Charles Gravelle, M.Sc.E., P.Eng.

Date:
September 26, 2018

ARCADIS Project No.:
702774-000

Subject:
Hope Bay Phase 2 Closure and Reclamation –
Comments on Land/Water Liability Split of Financial Security

Tables 1 and 2 presents Arcadis Canada Inc.'s (ACI) proposed Land/Water split of the Boston and Doris-Madrid closure and reclamation costs respectively. The split in Land and Water liability assignments has been amended from the split provided in our Version 5 of the RECLAIM model (17 September 2018) to reflect some of the comments provided by SRK and TMAC in their document dated 28 August 2018 (Hope Bay Phase 2 Closure and Reclamation Cost Estimate – August 2018) relating to the split in liabilities. The updated RECLAIM models (Version 6) for the respective mine sites will be provided to Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC) in a separate email (sent 26 September 2018).

For ease of discussion the headers used in the RECLAIM software have been used herein to discuss how the liability percentage splits were derived.

<u>For the Boston Mine Site</u>

- **Underground** – Capital costs have been 100% assigned to Land as the work relates entirely to the reclamation of land-based concerns.

- **Tailings Facility** – Capitals costs have been split 50/50 as there is both a risk to land and water associated with this liability and as such this cost category cannot be easily divided any other way as one risk is no more important than the other. Furthermore, in order to remove the liability in its entirely all the work outlined in the reclamation and closure plan needs to be executed and as such both liability security amounts are required to mitigate the risks associated with the tailings management area.

- **Rock Pile** – Given that the final grading of the waste rock areas will not significantly change the migration or quality of the surface water, and it has been assumed acid generating rock will not be exposed during the grading work, the potential for an impact to the water environment is minimal and as such the capital costs for this liability have been assigned entirely to Land.

- **Buildings and Equipment** - In general the capital costs associated with this cost category are related to Land liabilities in particular the demolition of buildings and grading out of roads and related infrastructure pads. The costs associated with the decommissioning of the fuel tank farm, however, does have a water related liability given that if the work is not done there is a potential risk to the water regime and as such the capital costs associated with this particular work have been split 50/50 between Land and Water. This results in an overall 95/5 percentage split between Land and Water.

- **Chemical and Contaminated Soil Management** – Given the nature of the work under this cost category the liability has been split 50/50 as the impacts are related to both soil and water where if the soil impacts are not removed they have the potential to impact the water regime in the area of the mine. As with the Tailings Facility category costs the reclamation work in this regard needs to be done in its entirety in order to mitigate the risks to the environment included herein.

- **Surface and Groundwater Management** – The RECLAIM model defaults any costs under this category as a Water Liability and as such this assignment has not been amended.

- **Interim Care and Maintenance** - The RECLAIM model defaults any costs under this category as a Water Liability and as such this assignment has not been amended.

- **Indirect Costs** – The RECLAIM model defaults the liability split for indirect costs as a function of the capital cost splits. Given the changes in the Capital Cost liability splits between the Revision 5 and Revision 6 models the liability percentage are reflective of the latest model (i.e. 50% to each liability).

Doris-Madrid Mine Sites

- **Underground** – In general the only reclamation work item that has the potential to impact the water regime relates to the management of explosives and as such the capital cost associate with this task has been split 50/50 between land and water. The balance of the work has been assigned to Land as the work relates entirely to the reclamation of land-based concerns. The next result is a 98/2 split between Land and Water respectively.

- **Tailings Facility** – Capitals costs have been split 50/50 as there is both a risk to land and water associated with this liability and as such this cost category cannot be easily divided any other way as one risk is no more important than the other. Furthermore, in order to remove the liability in its entirely all the work outlined in the reclamation and closure plan

needs to be executed and as such both liability security amounts are required to mitigate the risks associated with the tailings impoundment area.

- **Rock Pile** – Given that the final grading of the waste rock areas will not significantly change the surface water and it has been assumed acid generating rock will not be exposed the potential for an impact to the water environment is minimal and as such the capital costs for this liability have been assigned entirely to Land.

- **Buildings and Equipment** - In general the capital costs associated with this cost category are related to Land liabilities in particular the demolition of buildings and grading out of roads and related infrastructure pads. The costs associated with the decommissioning of the fuel tank farm, however, do have a water related liability given that if the work is not done there is a potential risk to the water regime and as such the capital costs associated with this work have been split 50/50 between Land and Water.

  The removal of bridges and culverts have also been considered partially water related liabilities and as such the costs for these reclamation tasks have also been split 50/50. On aggregate a percentage split of 91/9 has been assigned for Land and Water respectively.

- **Chemical and Contaminated Soil Management** – Given the nature of the work under this cost category the liability has been split 50/50 as the impacts are related to both soil and water where if the soil impacts are not removed they have the potential to impact the water regime in the area of the mine. As with the Tailings Facility category costs the reclamation work in this regard needs to be done in its entirety in order to mitigate the risks to the environment included herein.

- **Surface and Groundwater Management** – The RECLAIM model defaults any costs under this category as a Water Liability and as such this assignment has not been amended.

- **Interim Care and Maintenance** - The RECLAIM model defaults any costs under this category as a Water Liability and as such this assignment has not been amended.

- **Indirect Costs** – The RECLAIM model defaults the liability split for indirect costs as a function of the capital cost splits. Given the changes in the Capital Cost liability splits between the Revision 5 and Revision 6 models the liability percentage are reflective of the latest model (i.e. 56% Land and 44% Water liability).

We trust the comments provided herein are helpful and meet your current needs. Should you require any additional comments or review please don't hesitate to contact our Mr. Charles Gravelle.

HOPE BAY PHASE 2 LAND/WATER SECURITY ALLOCATION

Table 1 Proposed Land/Water Liability Split for Boston Mine Site

Cost Category	Total Cost	Land		Water		Comment
		%age	Cost	%age	Cost	
Capital Costs						
Underground	$ 60,847	100%	$ 60,847	0%	$ -	no explosives to be managed at this site as part of the reclamation works (see Doris-Madrid)
Tailings Facility	$ 15,195,574	50%	$ 7,597,787	50%	$ 7,597,787	Given that the potential for the tailings to impact land, air and water should the closure of the TMA not be done correctly cost of the reclamation work is considered a shared cost between water and land liabilities.
Rock Pile	$ 57,143	100%	$ 57,143	0%	$ -	The final grading of the waste rock areas may impact overland flow, however it is assumed that the exposed water rock is not acid generating and as such not a potential threat to the local water bodies.
Buildings and equipment	$ 5,313,366	95%	$ 5,070,137	5%	$ 243,229	Demolition related activites except those related to fuel tank farm reclamation are set at 100% land liability. Fuel tank farm reclamation is split 50/50 given the nature of the materials contained within the tank farm. Grading of pads and the like are set at 100% land. No bridge or culvert removal work under this reclamation plan and as such no costs assigned to Water for reclamation of roads.
Chemicals and Contaminated Soil Mgmt	$ 636,123	50%	$ 318,061	50%	$ 318,061	Given that chemical impacts can impact both soil and water and in most cases you cannot mitigate water issues without managing the soil concerns liabilities associated with this Cost Category have been split 50/50.
Surface and Groundwater Mgmt	$ 46,772	0%	$ -	100%	$ 46,772	RECLAIM model default is 100% Water Liability
Interim Care and Maintenance	$ 4,786,320	0%	$ -	100%	$ 4,786,320	RECLAIM model default is 100% Water Liability
Subtotal: Capital Costs	$ 26,096,144	50%	$ 13,103,974	50%	$ 12,992,170	
Indirect Costs						
Mobilization/Demobilization	$ 5,041,005	50%	$ 2,531,301	50%	$ 2,509,704	Split set by RECLAIM model on the basis of the assessment of liabilities within the Capital Cost portion of the model. From the split of liabilities outlined above the Land/Water split would be 50/50 respectively.
Post-Closure Monitoring and Maintenance	$ 1,577,877	50%	$ 792,318	50%	$ 785,558	
Engineering	$ 1,304,807	50%	$ 655,199	50%	$ 649,609	
Project Management	$ 1,304,807	50%	$ 655,199	50%	$ 649,609	
Health and Safety Plans/Monitoring/QA/QC	$ -	0%	$ -	0%	$ -	
Bonding.Insurance	$ -	0%	$ -	0%	$ -	
Contingency	$ 5,219,229	50%	$ 2,620,795	50%	$ 2,598,434	
Market Price Factor Adjustment	$ -	0%	$ -	0%	$ -	
Sub-Total: Indirect Costs	$ 14,447,725		$ 7,254,812		$ 7,192,913	
Total Costs	**$ 40,543,869**		**$ 20,358,786**		**$ 20,185,083**	

HOPE BAY PHASE 2 LAND/WATER SECURITY ALLOCATION

Table 2 Proposed Land/Water Liability Split for Doris-Madrid Mine Site

Cost Category	Total Cost	Land		Water		Comment
		%age	Cost	%age	Cost	
Capital Costs						
Underground	$ 312,868	98%	$ 306,351	2%	$ 6,517	The Water portion is related to a 50/50 split in costs associated with management explosives that could impact water courses if left in place.
Tailings Facility	$ 18,850,158	50%	$ 9,425,079	50%	$ 9,425,079	Given that the potential for the tailings to impact the local water courses should the closure of the TIA not be done correctly cost of the reclamation work is considered a shared cost between water and land liabilities.
Rock Pile	$ 170,371	100%	$ 170,371	0%	$ -	The final grading of the waste rock areas may impact overland flow, however it is assumed that the exposed water rock is not acid generating and as such not a potential threat to the local water bodies.
Buildings and equipment	$ 13,641,928	91%	$ 12,346,309	9%	$ 1,295,619	Demolition related activites except those related to fuel tank farm reclamation are set at 100% land liability. Fuel tank farm reclamation is split 50/50 given the nature of the materials contained within the tank farm. Grading of pads and the like are set at 100% land however the removal of culverts and bridges has been split 50/50 as these liabilities have the potential to impact the surface water movement within the footprint of the mine site.
Chemicals and Contaminated Soil Mgmt	$ 2,873,934	50%	$ 1,436,967	50%	$ 1,436,967	Given that chemical impacts can impact both soil and water and in most cases you cannot mitigate water issues without managing the soil concerns liabilities associated with this Cost Category have been split 50/50.
Surface and Groundwater Mgmt	$ 660,059	0%	$ -	100%	$ 660,059	RECLAIM model default is 100% Water Liability
Interim Care and Maintenance	$ 5,597,400	0%	$ -	100%	$ 5,597,400	RECLAIM model default is 100% Water Liability
Subtotal: Capital Costs	**$ 42,106,717**	**56%**	**$ 23,685,077**	**44%**	**$ 18,421,640**	
Indirect Costs						
Mobilization/Demobilization	$ 9,180,540	56%	$ 5,164,064	44%	$ 4,016,476	Split set by RECLAIM model on the basis of the assessment of liabilities within the Capital Cost portion of the model. From the split of liabilities outlined above the Land/Water split would be 56/44 respectively.
Post-Closure Monitoring and Maintenance	$ 1,855,177	56%	$ 1,043,539	44%	$ 811,638	
Engineering	$ 2,105,336	56%	$ 1,184,254	44%	$ 921,082	
Project Management	$ 2,105,336	56%	$ 1,184,254	44%	$ 921,082	
Health and Safety Plans/Monitoring/QA/QC	$ -	0%	$ -	0%	$ -	
Bonding.Insurance	$ -	0%	$ -	0%	$ -	
Contingency	$ 8,421,343	56%	$ 4,737,015	44%	$ 3,684,328	
Market Price Factor Adjustment	$ -	0%	$ -	0%	$ -	
Sub-Total: Indirect Costs	**$ 23,667,732**	**56%**	**$ 13,313,126**	**44%**	**$ 10,354,605**	
Total Costs	**$ 65,771,118**		**$ 36,998,203**		**$ 28,776,246**	