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-BRP

April 4, 2018

Our file - Notre référence
CIDM# 1214061

Richard Dwyer
Manager of Licencing
Nunavut Water Board
P.O. Box 119
Gjoa Haven, NU, X0B 1J0

Re: Indigenous and Northern Affairs Canada's Technical Review of Sabina's Type A Water Licence application for water licence #2AM-BRP-----– Back River Project

Dear Mr. Dwyer,

Thank you for your February 23, 2018 letter indicating the timeline for technical review comments on the above referenced application.

The Water Resources Division of Indigenous and Northern Affairs Canada (INAC) examined the application and the results of our review are provided in the enclosed memorandum for the Nunavut Water Board's consideration. 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 (819) 953-8988 or by e-mail at ian.parsons@canada.ca.

Sincerely,

Ian Parsons
Regional Coordinator

Canada

Results of Review

INAC is satisfied with Sabina's responses to its completeness review. However INAC will revisit the responses provided by Sabina and may provide further commentary at the technical meeting. Further to this Sabina has committed to updating its load balance model to include total metals. The updated modelling will provide further evidence to Sabina's application. INAC looks forward to reviewing this updated model when it becomes available.

In our technical memorandum provided below, you will find no comments on security, this has been done intentionally. Our only update on this issue is that we are currently working with our consultants and other parties as well as Sabina in reaching an agreement on an amount before the Public Hearing.

Technical Review of Water Board Licence No. 2AM-BRP----

Indigenous and Northern Affairs Canada

Submission to Nunavut Water Board

April 04, 2018

EXECUTIVE SUMMARY

Indigenous and Northern Affairs Canada (INAC or the Department) is an interested party in the review of water licence applications processed by the Nunavut Water Board (NWB). The Department co-manages Nunavut's freshwater resources with the NWB based on its mandated responsibilities under the *Nunavut Agreement*, the *Nunavut Waters and Nunavut Surface Rights Tribunal Act* and its regulations, and the *Department of Indian Affairs and Northern Development Act*.

In addition to reviewing water licence applications, the Department reviews deliverables required by licence terms and conditions such as management plans and monitoring reports, and enforces licence conditions. It should be noted that the Minister of INAC is responsible for approving type A water licences issued by the NWB as well as accepting and holding reclamation security required under the water licences.

Within INAC's areas of interest, the Department has focused its Technical Review of Sabina's water licence application and supporting documents on the protection of freshwater quality, the quantity of water used and the wastes deposited resulting from the proposed Project. This includes the review of management and monitoring plans as well as infrastructure design. All phases of the Project were reviewed (i.e., construction, operation, closure, and post-closure).

Based on its review of the available documentation, INAC has identified twenty-seven (27) Technical Review Comments and recommendations for consideration by the Board and Sabina in preparation for the upcoming Technical Meeting. Summaries of each of these Technical Review Comments are provided as follows:

Water Management Program

1. **Water Management Diversions and Dams -** INAC's Completeness Review Comment #1, related to Sabina's Water Management Plan, requested that Figures A-11 and A-12 be revised to indicate the direction and flow of release points for all diversion berms. Unfortunately, some of the diversion berm directions of flow and discharge points presented by Sabina in their response to INAC-CR #1 remain unclear and need to be further clarified.

2. **Water Management at North Face of Tailings Storage Facility (TSF) Containment Dam -** Future (Phase 2) placement of tailings is proposed to occupy (and eliminate) the footprint of the Phase 1 TSF Containment Dam Embankment. This has the potential to compromise the water management function of the containment dam and result in increased water and sediment loads that are not accounted for in the design of the downstream TSF Diversion Berm.

3. **Water Management Facility Summaries are Incomplete -** Summary tables 6.3-1, 6.3-2 and 6.3-3 need to be expanded to include: (1) managed (pumped) water inflows into each facility that are in addition to gravity inflows and (2) destination of managed (pumped) outflows from each facility, (3) downstream infrastructure that would capture uncontrolled overtopping or breach flow. In addition, an assessment is needed to determine whether dam embankments should include overflow spillways.

4. **Design Criteria for Culverts and Diversion Berms -** Criteria presented in Table 6.2-3 for Diversion Berm Design Criteria, Table 6.2-4 for Culvert Design Criteria and Section 6.5, Culvert Sizing, include non-standard and/or un-referenced items that require clarification.

5. **Saline Water Migration -** Sub-permafrost groundwater is saline. The saline groundwater will be pumped to the Saline Water Pond. The Saline Water Pond will be unlined. The unlined pond has the potential to release saline water via infiltration into the active layer to the subsurface or nearby water bodies. The predicted chloride, and other parameters, concentration in the Saline Water Pond are sufficiently high to potentially impact permafrost, soil, water quality, vegetation and wildlife.

6. **Tailings Storage Facility Water Migration -** Water ponding in the Tailings Storage Facility (TSF) has the potential to seep out of the facility through the surrounding ridges and the TSF Containment Dam. If this water reaches nearby surface water bodies (i.e. Rascal Lake) there is the potential to impact down-gradient water quality and aquatic resources.

7. **Saline Soil Management -** A chloride diffusion model has been applied to predict pore water concentrations in soil within the Saline Water Pond. The prediction is that the pore water concentration will be 120 mg/L at closure. The water quality modelling predicts that the chloride concentration will reach nearly 30,000 mg/L in the pond. The management plan for the soil from the footprint of the Saline Water Pond at closure is to excavate and relocate chloride-contaminated soil to the TSF. Water quality predictions downgradient of the TSF apply the pore water value of 120 mg/L. If this value is not reasonable impacts to water quality downgradient may occur.

8. **Response Plan for Encountering Unforeseen Groundwater Flows -** Robust contingency plans are required for the management of potentially high volumes of groundwater flow that may result from the interception of High K zone, exploration holes etc. Such plans should also provide strategies for managing specific unexpected groundwater flow events.

9. **Water Management -** It is typical for the development of open pits located near lakes that the pit slopes require depressurization. The north wall of Goose Pit is located in close proximity to Goose Lake. Over time a hydraulic connection between Goose Lake and Goose Pit could form or be enhanced due to transient thermal conditions and pit wall exposure. This could result in greater flux to the open pit and potentially active wall depressurization. This in turn could impact the water balance and quality predictions.

Waste Management Program

10. **Landfill Settlement -** Both proposed landfills in the Umwelt WRSA and the TSF/TSF WRSA will be located within waste rock storage areas. There is a concern that there will be future settlement of the final cover once these areas are closed, especially if covered by additional waste rock, which may lead to surface runoff issues from the final surface.

11. **Alkaline and Carbon-Zinc Batteries Management -** Depending on the battery type, batteries will be allowed to be landfilled or need to be returned to a licenced recycler. There is potential for batteries to end up in the wrong waste stream, resulting in them being placed in the Umwelt WRSA and the TSF/TSF WRSA landfill sites.

12. **Landfill Siting Over Existing Drainage Streams -** The proposed landfills in the Umwelt WRSA and the TSF/TSF WRSA are planned to be placed directly over the top of existing drainage streams. There is a

concern that until permafrost is fully established below and into the waste mass at each of these landfill sites, preferential pathways for the flow of contaminants into these streams could be developed.

13. **Clarification of Landfill & Waste Management Plan Figures –** The cross-section details on Figures A-1 and A-2 are unclear and need to be clarified.

Mine Waste Management Program

14. **Waste Rock Placement in the TSF -** Additional information and supporting analyses are required on how the waste rock will be placed over the deposited tailings to ensure that local and/or global failures of the advancing waste rock placement do not occur.
15. **Tailings Storage Facility Design Basis -** INAC is concerned that the current Tailings Storage Facility (TSF) design may have Insufficient tailings storage capacity to accommodate the total volume of tailings to be directed to this facility.

16. **Potential Seepage through Fractured Bedrock Below the TSF -** Bedrock fractures found in some areas near the west abutment of the TSF dam may result in seepage through this fractured bedrock.

17. **TSF Site and Foundation Preparation -** Information is needed on the permeability value used by Sabina to determine when the foundation bedrock is considered to be highly permeable and unacceptable, thus requiring further excavation. This is important because the key trench needs to terminate on clean exposed bedrock to minimize or eliminate potential seepage through bedrock fractures found in some areas near the west abutment of the dam.

18. **TSF Performance Monitoring -** There is an apparent inconsistency in Figure A-07 of the Tailings Management Plan regarding the placement of the horizontal thermistor cables relative to the location of the key trench component of the dam foundation that requires clarification.

19. **Overburden Excavation and Handling -** The Mine Waste Rock Management Plan indicates that approximately 5.3 Mt of NPAG overburden will be produced during development of the Project. All of the overburden produced will be stored in engineered WRSAs located close to each of the open pits. Excavation of overburden from the footprints of much of the mine infrastructure (quarries, open pits, facilities etc.) may be challenging at times, particularly when excavation occurs in the summer months and in ice-rich materials.

20. **Mine Waste Management Segregation and Tracking -** The Mine Waste Rock Management Plan includes methods for the identification of PAG and NAG material, as well as the segregation of materials. However, the Plan does not include details on how the material volumes will be tracked. The management plan indicates expected volumes of PAG and NAG materials from each mine area, and verifying that these estimates are correct during construction and operations will be required to ensure that WRSAs are adequately designed for the Life of Mine.

Infrastructure and Access Management Program

21. **Expected Traffic on Ice Roads -** Sourcing, collecting and transporting snow to create the winter road in overland sections has the potential to disturb terrain and lead to increased erosion and sediment release. Similarly, obtaining fill material and constructing granular fill pads for areas with rough terrain and insufficient snow cover has the same potential.

22. **Ice Road Design and Operation -** The maximum loaded vehicle speeds presented in Sabina's Road Management Plan are higher than the maximum loaded vehicle speeds set for the most highly engineered, controlled and highest traffic ice road in the world, the Tibbitt to Contwoyto Winter Road (TCWR). This warrants reconsideration by Sabina.

Emergency Response Program

23. **Updates to Emergency Contact Information for Emergency Response Program Plans -** The emergency contact sections of each of the afore-mentioned plans need to be updated as necessary to facilitate efficient, timely and effective communications and responses to emergency and/or spill incidents prior to Project start-up.

24. **Risk Management & Emergency Response Planning -** Having a more focused Risk Management & Emergency Response Plan would facilitate more timely, efficient and effective responses to emergency incidents including incidents that may impact water resources.

25. **Deployment of Spill Containment Booms During Ship Bulk Fuel Transfer Operations -** Approximately 30 – 45 million litres of bulk fuel will be transferred from ships to the bulk fuel storage facility. Given the significant volume of bulk fuel to be transferred and the risk of leakage or spills posed by such operations, INAC wants to ensure that all reasonable preventive measures are implemented for all facets of the bulk fuel transfer operation.

General and Aquatic Effects Program

26. **Nearshore Marine Sediment Quality Sampling to Support Adaptive Management –** Nearshore marine sediment quality sampling should be undertaken as a component of the Marine Monitoring Plan to permit adaptive management actions to be implemented, as may be necessary, based on the future results of such sampling.

Interim Closure and Reclamation Program

27. **Incorporation of Active Revegetation into Closure Plan -** The proponent consistently states throughout the Interim Closure and Reclamation Plan (ICRP) and particularly in Closure Objective 2: Achieve Physical Stability that "*active revegetation of the Property as part of closure is not planned given the cold climate setting of the Project as well as the precedent established for mine closure in Nunavut*".
    INAC is unclear which precedent is being referred to with respect to revegetation and mine closure in Nunavut and considers active revegetation (e.g., through deliberate seeding and/or staking) to be a common reclamation practice even in northern environments. The inclusion of active revegetation in addition to more passive means that might serve to encourage natural revegetation provides a more comprehensive and robust approach to the restoration of areas that have been disturbed by mining activities.

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LIST OF ACRONYMS AND ABBREVIATIONS

AEMP	Aquatic Effects Management Plan
DEIS	Draft Environmental Impact Statement
DFO	Fisheries and Oceans Canada
ECCC	Environment and Climate Change Canada
EEM	Environmental Effects Monitoring
FEIS	Final Environmental Impact Statement
KIA	Kitikmeot Inuit Association
km/hr	Kilometres/hour
ICRP	Interim Closure and Reclamation Plan
INAC	Indigenous and Northern Affairs Canada
m	Metre
m^3	Cubic metre
mg/l	Milligrams per liter
MLA	Marine Laydown Area
MMER	Metal Mining Effluent Regulations
MT	Million Tonnes
NIRB	Nunavut Impact Review Board
NWB	Nunavut Water Board
NAG	Non-Acid-Generating (rock/tailings)
OPEP	Oil Pollution Emergency Plan
PAG	Potentially Acid-Generating (rock/tailings)
the Project	Back River Project
Proponent	Sabina Gold & Silver Corp.
Sabina	Sabina Gold & Silver Corp.
TCWR	Tibbitt to Contwoyto Winter Road
TF	Tailings Facility
TSF	Tailings Storage Facility
WRSA	Waste Rock Storage Area

1.0 BACKGROUND

The proposed Back River Gold Mine Project is situated in Nunavut's Kitikmeot region, approximately 400 km South of Cambridge Bay. The mine property is currently owned by Sabina Gold & Silver Corporation (Sabina or the Applicant). Following two rounds of NIRB review and final hearings, the NIRB issued its Revised Final Hearing Report on July 18, 2017.

On December 5, 2017, the NIRB received confirmation from the Minister's office that the responsible Ministers had accepted the NIRB's determination and indicated that Sabina could proceed to the regulatory phase of Project development.

In anticipation of a positive NIRB determination and Ministerial acceptance thereof, on October 5, 2017, the NWB received Sabina's Type "A" Water Licence and supporting documentation for the proposed Back River Project. Additional information was provided for clarity on November 27, 2017, following an initial internal Board review of the application package. This Application and associated documents replaced the initial water licence application package for the Back River Project, submitted to the NWB in 2012.

On December 8, 017, the Application was placed on the NWB's Public Registry and the Board began its initial process of seeking a preliminary completeness review of the Application and supporting documents by all interested parties. The Board received comments from various intervening parties including: Kitikmeot Inuit Association (KIA), Fisheries and Oceans Canada (DFO), Indigenous and Northern Affairs Canada (INAC), and Environment and Climate Change Canada (ECCC).

On February 5, 2018, Sabina provided responses to completeness review related comments made by all Interveners. On February 19, 2018, Sabina provided responses to additional completeness review related comments made by ECCC.

On February 23, 2018, The NWB determined that the Application can proceed to the detailed technical review and subsequent stages of the licensing process, subject to any outstanding pre-licensing considerations that may be associated with the Application.

2.0 REVIEW CONTEXT

Indigenous and Northern Affairs Canada (INAC or the Department) is an interested party in the review of water licence applications processed by the NWB. The Department co-manages Nunavut's freshwater resources with the NWB based on its mandated responsibilities under the *Nunavut Agreement*, the *Nunavut Waters and Nunavut Surface Rights Tribunal Act* and its regulations, and the *Department of Indian Affairs and Northern Development Act*.

In addition to reviewing water licence applications, the Department reviews deliverables required by licence terms and conditions such as management plans and monitoring reports, and enforces licence conditions. It should be noted that the Minister of INAC is responsible for approving type A water licences issued by the NWB as well as accepting and holding reclamation security required under the water licences.

Within INAC's areas of interest, the Department has focused its review on the protection of freshwater quality, the quantity of water used and the wastes deposited resulting from the proposed Project as presented in the water licence application. This includes the review of management and monitoring plans as well as infrastructure design. All phases of the Project were reviewed (i.e., construction, operation, closure, and post-closure).

- INAC's areas of primary interest include:
    - Environmental impact assessment methodology
    - Land contamination affecting or possibly affecting water
    - Surface water quality
    - Surface water quantity
    - Groundwater
    - Marine water quality only as affected from land (i.e., discharge from water impoundment area into marine environment; drainage at marine laydown site)
    - Permafrost
    - Waste management
    - Tailings Management
    - Closure Planning
    - Reclamation Cost Estimate
- Project components, activities, and plans related to INAC's areas of interest include, but are not limited to, the following:
    - Site water management and treatment (effluent, run-off, active-layer flow management, water balance, spring freshet management)
    - Infrastructure and engineering related to mine works (underground mine activity, water diversion structures, dams, tailings impoundments, waste rock storage, quarries, waste disposal sites, airstrips, roads, etc.)
    - Marine Laydown Area
    - Winter road corridor and any spurs
    - Mine tailings and waste rock management (i.e. acid rock drainage / metal leaching)
    - Hazardous material management

- Fuel Management
- Accidents and malfunctions
- Environmental management and protection plans

3.0 TECHNICAL REVIEW

In conducting the Technical Review for the proposed Back River Gold Mine Project INAC reviewed the following:

a. Sabina's Type A Water Licence Application

b. Main Application Document

c. Mandate-relevant Supporting Documents including management plans

d. Sabina's responses to the completeness review comments provided by the Parties to the review process

e. Any other relevant documentation deemed necessary for review.

4.0 TECHNICAL COMMENTS

4.1 General

INAC has conducted its Technical Review of the Application and all supporting management plans (plans) that fall within the Department's areas of primary interest.

As a result, INAC has determined that the following 27 Technical Review Comments should be addressed by Sabina in preparation for the upcoming Technical Meeting:

4.1.1 Water Management Program

Technical Review Comment	**INAC-TRC# 1**
Subject/topic	**Water Management Diversions and Dams**
References	• Water Management Plan • INAC Completeness Comment #1 • Sabina's Response to INAC Completeness Comment #1 • Figure A-11, General Arrangement Sheet 1 of 2, updated 2018-02-05 • Figure A-12, General Arrangement Sheet 2 of 2, updated 2018-02-05
Summary	INAC's Completeness Review Comment #1 related to Sabina's Water Management Plan requested that Figures A-11 and A-12 be revised to indicate the direction and flow of release points for all diversion berms. Unfortunately, some of the diversion berm directions of flow and discharge points presented by Sabina in their response to INAC-CR #1 remain unclear and need to be clarified.
Importance of Issue to Water Resources	Further clarifying and correcting these figures will allow reviewers to understand the intended diversion berm directions of flow and discharge points in the Water Management Plan.
Detailed Review Comment	The discharge location shown on updated Figure A-11 for Umwelt WRSA Diversion Berm appears to flow into the Umwelt WRSA. This is possibly in error since the purpose of the berm is understood to be to prevent the inflow of runoff into the WRSA from the upper basin area. Updated Figure A-12 does not show flow directions or discharge location for the TSF WRSA Diversion Berm.
Recommendation/Request	1. INAC requests that Figures A-11 and A-12 be further improved to clearly indicate directions of flow and release points for all diversions.

Technical Review Comment	**INAC-TRC# 2**
Subject/topic	**Water Management at north face of Tailings Storage Facility (TSF) Containment Dam**
References	• Water Management Plan • Water Management Plan Figures A-01 to A-08, (eight in total) • Water Management Plan Figures A-12
Summary	Future (Phase 2) placement of tailings is proposed to occupy (and eliminate) the footprint of the Phase 1 TSF Containment Dam Embankment. This has the potential to compromise the water management function of the containment dam and result in increased water and sediment loads that are not accounted for in the design of the downstream TSF Diversion Berm.
Importance of Issue to Water Resources	The future Phase 2 basin area draining to the TSF Diversion Berm and pumps need to be correctly delineated to properly design the water management facilities.
Detailed Review Comment	Figure A-01, titled Goose Property Catchments, presents watershed catchment areas that are the basis for sizing water management ponds and pumps. The present comment is concerned with Catchment TWD2, labelled "TSF WRSA Downstream Seepage Collection" with a small basin area of 0.14 km^2. The footprint of catchment TWD2 appears to correspond to the area between the crest of the TSF Containment Dam Embankment and the TSF WRSA Diversion Berm located below the toe of the dam embankment. Figure A-02, "Goose Property Pumping and Culvert Schematic" shows the dam embankment details and a pump (P14) at the TSF WRSA Diversion Berm. Figure A-03 (Phase 1 Construction) shows an outline of the TSF Containment Dam Embankment with no tailings present. Figure A-04 (Phase 2 Stage 1 TSF Operation) shows the same outline of the TSF Containment Dam Embankment, plus a footprint of "Active TSF" on the south (upstream) side of the Dam Embankment. The figure also shows a "Pumped Contact Water Pipeline" from the TSF Diversion Berm to the TSF WD Pond. The figures that follow, A-05 (Phase 2 Stage 2) through A-08 (Phase 4 Post-Closure) and Figure A-12 all show an altered footprint of waste rock storage that extends over the top of approximately ¾ of the longitudinal extent of the Phase 1 containment dam. This configuration suggests that much of the original dam will be covered with tailings and will not provide its original water management function after the Phase 2 Stage 1 operations have concluded. If the inference presented above is correct, the tributary basin to

	the TSF Diversion Berm may increase significantly in the latter stages of the project. In addition to increased flows, significant sediment loads could also be produced from tailings area runoff which could compromise the proper functioning of pumps that are relied upon to provide water management.
Recommendation/Request	1. INAC requests clarification of Sabina's plan for the proposed placement of tailings over the footprint of the Phase 1 TSF containment dam. 2. As appropriate, determine the future basin area draining to the TSF Diversion Berm and size pumps accordingly. Provide details on how initial sediment loads from the downstream face of the containment dam, and the higher sediment loads to be expected if the tailings are placed over the top of the dam embankment will be managed. 3. Please provide location of information on the seepage collection system that corresponds to the Figure A-01 label for catchment TWD2: "TSF WRSA Downstream Seepage Collection".

Technical Review Comment	**INAC-TRC# 3**
Subject/topic	**Water Management Facility Summaries are Incomplete**
References	• Water Management Plan • Section 6.3: Hydrologic Model • Tables 6.3-1, 6.3-2 • Section 6.4: Pond Sizing • Table 6.4-1 • Section 6.6: Diversion Berms and Containment Dams • Figures A-02, A-03
Summary	Summary tables 6.3-1, 6.3-2 and 6.3-3 need to be expanded to include: (1) managed (pumped) water inflows into each facility that are in addition to gravity inflows and (2) destination of managed (pumped) outflows from each facility, (3) downstream infrastructure that would capture uncontrolled overtopping or breach flow. In addition, an assessment is needed to determine whether dam embankments should include overflow spillways.
Importance of Issue to Water Resources	Additional water management information is needed to allow reviewers to understand inter-dependencies of the proposed water management facilities and to assess whether proposed design criteria are correctly developed and applied.
Detailed Review Comment	Table 6.3-1, Return Period Selection Criteria, identifies "contact water event ponds with additional water infrastructure downstream" but without a companion summary of how these criteria were applied.

	Table 6.3-2, Level of Risk for Each Item of Goose Infrastructure and Contributing Catchment Areas, does not account for pumped water between facilities. Table 6.4-1, Goose Property Pond Capacity and Pumping Rate Summary, is incomplete. No information is given for pumps P4, P5, or P14. Water Management Plan Section 6.3.2.1 Return Period Selection, presents return period criteria for each structure, qualitatively assessed using engineering judgement, risk of overtopping or breach, and other factors. For contact water event ponds, the level of risk is assumed to be high (100-year rainfall depth) unless there is "additional water infrastructure downstream" when the risk is reduced to medium (50-year) rainfall. The section continues with Table 6.3-2 which presents catchment areas and level of risk (low-medium-high) for each water management facility. There are two containment facilities – Primary Pond and East Echo Containment Dam – that are rated medium risk, presumably because of unspecified additional water infrastructure downstream. The above water management plan section does not provide sufficient information for INAC to review or confirm the assigned risk levels. Additional information is needed to understand which facilities are susceptible to a breach (dam break) failure, what if any downstream facilities would receive that water and whether those facilities have sufficient excess capacity to contain projected flows. INAC notes that facility water type (contact versus non-contact) needed for risk classification per Table 6.3-1 is presented later in Section 6.6, Diversion Berms and Containment Dams. The return period selection criteria consider "the qualitative level of risk associated with overtopping or breaching of the structure" but there is no further discussion of the risk or use of designated spillway sections to reduce the risk of a breach. Canadian Dam Association guidelines should be used to provide guidance on whether spillway would be recommended for the size of the impoundments proposed and the consequence of failure. Water Management Plan Section 6.4, Table 6.4-1, presents a summary of Pond Capacities and Pumping Rates, listed by Pump IDs under the column heading of "Pond ID" which is not found elsewhere. Figure A-02, Goose Property Pumping and Culvert Schematic, presents a list of 14 pumps, P1 to P14, and corresponding water management element. Figure A-03, Phase 1 Construction, shows pumped water pipelines including those from ponds to pits or other ponds, but the pumped water linkages connections are incomplete and unclear. Section 6.4 does not provide a complete list of pumps and pump capacities, and linkages are missing. Capacities of Pumps P4, P5, and P14 are not included in Table 6.4-1. Linkages between pumped

	facilities, such as from Umwelt WRSA Pond (Pump P2) to Umwelt Pit Sump (Pump P1) need to be clearly described. Inter-facility pumping will result in increased water flow to the downstream facility, possibly affecting the required storage capacity and pump rate compared to amounts computed solely based on gravity flows from tributary catchment areas.
Recommendation/Request	1. INAC requests that the facility summary be revised or amended to include the following elements: (1) outlet destination for pumped releases, (2) pumped inflows if any, (3) presence of an embankment which could potentially fail resulting in release of stored water, and (4) downstream water infrastructure in the flow path of an overtopping or breach event. 2. INAC requests that the need for dam embankment spillways be assessed considering Canadian Dam Association guidelines based on facility size and consequence of failure. 3. INAC requests that the Pumping Rate summary be expanded to include Pumps P4, P5, and P14 presently missing, and that storage capacities and pump rates be re-assessed for facilities that receive inter-facility pumped flow in addition to gravity flow from catchment areas.

Technical Review Comment	**INAC-TRC# 4**
Subject/topic	**Design Criteria for Culverts and Diversion Berms**
References	• Water Management Plan • Section 6.2: Hydrotechnical Design Criteria • Tables 6.2-2, 6.2-3, 6.2-4 • Section 6.5: Culvert Sizing • Table 6.5-1 • Figure A-01
Summary	Criteria presented in Table 6.2-3 for Diversion Berm Design Criteria, Table 6.2-4 for Culvert Design Criteria and Section 6.5, Culvert Sizing, include non-standard and/or un-referenced items that require clarification.
Importance of Issue to Water Resources	Reviewers need to understand the source or origin of the criteria presented and how they are being applied to design diversion berms and culverts
Detailed Review Comment	Water Management Plan Figure A-01, Goose Property Catchments, shows proposed culverts but corresponding catchment areas are not delineated. Water Management Plan Section 6.2, Hydrotechnical Design Criteria, presents criteria for designing diversion berms and culverts in Tables 6.2-3 and 6.2-4, respectively. In both tables, the criterion for conveyance capacity is the 24-hour total rainfall volume, plus snowmelt, in units of cubic metres of volume. This proposed criterion does not follow normal practice which is to design

	conveyance features for a peak flow rate (discharge) expressed in m^3/s or equivalent units. The tables identified in Section 6.2 should either be revised to indicate conventional units, or amended to include a detailed explanation if a non-standard approach is proposed. Water Management Plan Section 6.5, Culvert Sizing, presents additional design criteria not included in Table 6.2-4, specifically (1) The fish bearing crossings will be sized to keep maximum water velocities below 1.5 m/s for the average June flow, and (2) all culverts will be sized to meet a 0.3 m criterion for maximum water depth above the top of culvert. The plan also states that fish-bearing culverts will be embedded at depth and a "thin layer of streambed material" will be placed to promote fish passage and habitat suitability. The origins of the above criteria are not provided. DFO may wish to review the suggested criteria for fish passage design. INAC notes that the suggested maximum headwater depth may exceed standard practice for other northern projects and provides no factor of safety against possible ice or debris blockage of the culvert inlet. Table 6.5-1, Goose Property Culvert Characteristics, presents culvert characteristics (slope, diameter, embedment, etc.) and design storm hydraulic characteristics, including total discharge (m^3/s), depths and velocities. No information is given for catchment area size or fish passage criteria other than is inferred by a non-zero embedment depth. No information is given for hydraulic characteristics corresponding to the average June flow referenced in the criteria for sizing fish passage culverts. Of five culverts listed in Table 6.5-1, only the Gander Pond Culvert (C2) is designed with a non-zero embedment depth (0.4 m) indicating design for fish passage. Details for this culvert include a relatively steep slope of 3.6% and, for the 100-year storm event, supercritical flow conditions (normal depth less than critical) and an outlet flow velocity of 4.2 m/s. A proposed "thin layer of streambed material" through the culvert is unlikely to withstand such velocities.
Recommendation/Request	1. INAC requests that Water Management Plan Figure A-01 be amended or supplemented to show watershed areas draining to proposed culverts. 2. INAC requests clarification on whether conveyance capacity criteria for diversions and culverts is intended to be based on a peak flow (discharge) rate and if the tables showing conveyance capacity in volume units are in error. 3. INAC requests further information on the origin of proposed criteria that (1) fish bearing crossings be sized to keep maximum water velocities below 1.5 m/s for the average June flow, and (2) culverts meet a 0.3 m criterion for maximum

	water depth above the top of culvert. 4. For culverts being sized for fish passage, please provide results of hydraulic calculations for depths and velocities corresponding to the mean June flow identified in the criteria. Also, please review whether a proposed thin layer of substrate through the culvert(s) would withstand ordinary peak flows and/or if alternate measures should be considered to enhance fish passage and habitat.

Technical Review Comment	**INAC-TRC# 5**
Subject/topic	**Saline Water Migration**
References	• Water Management Plan • Section 8.1.8: Saline Water Pond • Section 9.4.2: Saline Water Management • Appendix B
Summary	Sub-permafrost groundwater is saline. The saline groundwater will be pumped to the Saline Water Pond. The Saline Water Pond will be unlined. The unlined pond has the potential to release saline water via infiltration into the active layer to the subsurface or nearby water bodies. The predicted chloride, and other parameters, concentration in the Saline Water Pond are sufficiently high to potentially impact permafrost, soil, water quality, vegetation and wildlife.
Importance of Issue to Water Resources	The salinity levels of the saline groundwater are sufficiently high to potentially impact permafrost, soil, water quality, vegetation and wildlife. Rehabilitation of chloride-impacted areas could be very challenging.
Detailed Review Comment	Umwelt Lake will be dewatered to construct the Saline Water Pond. To minimize surface flows towards the Saline Water Pond, it will be isolated by means of diversion berms. To manage saline groundwater and minimize potential associated impacts to permafrost, soil, surface water vegetation and wildlife, Sabina is committed to providing additional details reflecting any direction provided by the NIRB and NWB. Sabina proposes to include a Saline Water Management Plan as a component of the next revision to the Water Management Plan. Section 9.4.2 of the Water Management Plan states that the Saline Water Management Plan is: *expected to include monitoring of thermal conditions, monitoring of saline water at the Goose Property, and mitigation measures designed to address the potential for higher-than-predicted volumes of saline water inflows into the open pit and the underground mines, treatment, and disposal methods. This plan will include accurate characterization of saline water inflows into the underground mine workings.*

	The Water Management Plan identifies that sub-permafrost groundwater will be saline. Chloride concentrations will be upwards of 40,000 mg/L. The chosen management approach is to store the saline water in the former Umwelt lake (the Saline Water Pond). Water quality predictions show that the concentration of Chloride will reach approximately 30,000 mg/L in 2028. At closure the plan is to return the saline water to the underground, or pump it to the base of an open pit forming a meromictic lake. The Saline Water Pond is to be unlined. Saline water from the Pond has the potential to migrate into the environment through the groundwater. If this occurs the saline groundwater has the potential to migrate beyond the footprint of the Saline Water Pond and potentially impact permafrost, soil, water quality, vegetation and wildlife. Resulting impacts to the environment would be challenging to remediate. Currently the Water Management Plan contains no scope for monitoring or identifying if the water will be contained within the Saline Water Pond at all locations.
Recommendation/Request	1. INAC requests that it be demonstrated that hydraulic, geological or permafrost containment is present within the upland terrain around the Saline Water Pond. If it can be demonstrated that containment is present, please provide cross sections (including geology, permafrost, and active layer thickness) for critical sections of the Saline Water Pond. 2. INAC recommends that Sabina submit the Saline Water Management Plan to the NWB a minimum of 60 days prior to the start of preparations associated with development of the Saline Water Pond. This Plan should include shallow groundwater, active layer and permafrost monitoring components.

Technical Review Comment	**INAC-TRC# 6**
Subject/topic	**Tailings Storage Facility Water Migration**
References	• Water Management Plan • Section 8.2.6: Tailings Management Facilities • Appendix B
Summary	Water ponding in the Tailings Storage Facility (TSF) has the potential to seep out of the facility through the surrounding ridges and the TSF Containment Dam. If this water reaches nearby surface water bodies (i.e. Rascal Lake) there is the potential to impact down-gradient water quality and aquatic resources.
Importance of Issue to Water	Poor quality seepage water from the TSF has the potential to impact down-gradient water quality and aquatic resources.

Resources	
Detailed Review Comment	Section 8.2.6 of the Water Management Plan states that: *The Tailings Storage Facility (TSF) will store both tailings solids and supernatant water for the first two years of Operations. A seepage analysis of the TSF Containment Dam liner predicts that minor seepage through the TSF Containment Dam at an anticipated rate of 1,210 m^3/year is expected while it is an active tailings management facility. The TSF WRSA Diversion Berm, constructed downstream of the TSF, will collect surface runoff and sub-surface seepage through the active layer, which in turn will be pumped back into the TSF.* *Once the TSF is closed, the TSF WRSA Diversion Berm will collect runoff from the TSF WRSA, which will ultimately be captured in the active tailings management facility. No seepage or discharge from the TSF WRSA collection pond during active TSF operations or once the TSF becomes a WRSA will be released to environment unless discharge criteria are met.* *Seepage analysis for the TSF South Dyke was also completed during the FEIS process and flow is anticipated to be 92 m^3/year; this minimal seepage will be easily managed by intermittent pumping.* Water predicted to seep from the TSF that may not be captured has the potential to impact down-gradient groundwater and nearby surface water bodies. Groundwater may also leave the facility through the ridge lines surrounding the Tailings Storage Facility. The Water Management Plan does not appear to contain a scope for monitoring or identifying if the water will be contained within the Tailings Storage Facility at all locations. IF the impacted groundwater leaves the facility it has the potential to impact down-gradient water quality and aquatic resources.
Recommendation/Request	1. INAC requests that it be demonstrated that hydraulic, geological or permafrost containment is present within the ridges around the TSF year-round. If it can be shown that containment is present please provide cross sections (including geology, permafrost, and active layer thickness) at critical sections of the Saline Water Pond. 2. INAC requests that Sabina develop a plan for installing and monitoring instrumentation to confirm groundwater elevations and permafrost conditions around the TSF. 3. INAC also requests that a shallow groundwater monitoring plan be developed. This should include subsurface (active layer) monitoring locations close to the Tailings Storage Facility.

Technical Review Comment	**INAC-TRC# 7**

Subject/topic	**Saline Soil Management**
References	• Water Management Plan • Section 8.3.8: Saline Water Pond Closure
Summary	A chloride diffusion model has been applied to predict pore water concentrations in soil within the Saline Water Pond. The prediction is that the pore water concentration will be 120 mg/L at closure. The water quality modelling predicts that the chloride concentration will reach nearly 30,000 mg/L in the pond. The management plan for the soil from the footprint of the Saline Water Pond at closure is to excavate and relocate chloride contaminated soil to the TSF. Water quality predictions downgradient of the TSF apply the pore water value of 120 mg/L. If this value is not reasonable impacts to water quality downgradient may occur.
Importance of Issue to Water Resources	The current plan at closure is to remove the impacted sediments and place them in the Tailings Storage Facility. The quality of the pore water is critical as it has been used to make water quality predictions within the Tailings Storage Facility and downgradient of the facility. If the 120 mg/L value is not reasonable then the water quality predictions will need to be revisited.
Detailed Review Comment	A diffusion model has been used to predict pore water concentrations within the soil underlying the Saline Water Pond. It is unclear if this is the appropriate methodology for predicting pore water quality in sediment overlain by highly saline water (up to 30,000 mg/L Chloride). Given the transient deposition of water within the Saline Water Pond and the density difference between the pond water and pore water the application of an advective model which considers density dependent transport may be more appropriate. The outputs of an advective model would likely result in more appropriate but perhaps higher chloride concentrations than are currently being predicted by the diffusion model. This would have implications for current impact predictions and proposed mitigation measures.
Recommendation/Request	1. INAC requests that the chloride diffusion model used by Sabina be provided as well as the rationale for its use and the underlying assumptions used. 2. INAC recommends that Sabina provide a robust justification for the use of a diffusion model rather than other alternatives to evaluate predicted chloride concentrations in pore water within the soil underlying the Saline Water Pond. 3. INAC requests that a sensitivity analysis be performed on downgradient TSF water quality for various soil quantities and saline concentrations for soil originating from the Saline Water Pond.

Technical Review Comment	**INAC-TRC# 8**
Subject/topic	**Response Plan for Encountering Unforeseen Groundwater Flows**
References	• Water Management Plan • Section 6.1.4.2: Open Pit and Underground Workings Groundwater
Summary	Robust contingency plans are required for the management of potentially high volumes of groundwater flow that may result from the interception of High K zone, exploration holes etc. Such plans should also provide strategies for managing specific unexpected groundwater flow events.
Importance of Issue to Water Resources	The hydraulic properties of natural materials are highly variable, particularly in rock. Groundwater flow in rock is primarily through discontinuities in the rock mass. There is the potential that a highly-fractured zone, or other flow conduit may be intercepted during mining. If this occurs contingency plans need to be in place to manage the water as well as short term storage capacity otherwise unplanned discharges may result.
Detailed Review Comment	As stated in Section 6.1.4.2 of the Water Management Plan: *Umwelt Underground, Llama Underground, Llama Open Pit, and Goose Main Underground will all capture groundwater inflows These inflow quantities were included in the water and load balance.* Making predictions of groundwater flux is challenging as the material properties can be highly variable. A further complication is the transient nature of the mining process and groundwater response. This leads to uncertainty within the model predictions. One way to manage the uncertainty is to have robust water management contingency plans in place as well as excess storage capacity available to handle unforeseen events. By having a robust response plan in place as well as excess water storage capacity the likelihood of an uncontrolled water discharge is reduced. Uncontrolled discharges have the potential to negatively impact the water quality in surrounding water bodies.
Recommendation/Request	1. INAC requests that Sabina ensure that robust contingency plans will be put in place prior to commencing mining which will acknowledge uncertainties associated with water balance predictions. Additionally, these plans should contain methods to manage specific events (e.g. flowing exploration borehole underground, flowing fault zone in open pit). 2. INAC requests that Sabina demonstrate that the water balance model shows that sufficient capacity exists in the system to manage unforeseen, short duration, large groundwater flow events at all times of the mine life.

Technical Review Comment	**INAC-TRC# 9**
Subject/topic	**Water Management**
References	• Water Management Plan • Section 8.2.1: Open Pits and other Contact Water • Section 8.2.3: Underground Facilities
Summary	It is typical for the development of open pits located near lakes that the pit slopes require depressurization. The north wall of Goose Pit is located in close proximity to Goose Lake. Over time a hydraulic connection between Goose Lake and Goose Pit could form or be enhanced due to transient thermal conditions and pit wall exposure. This could result in greater flux to the open pit and potentially active wall depressurization. This in turn could impact the water balance and quality predictions.
Importance of Issue to Water Resources	It does not appear that that the water balance considers the possibility of active slope depressurization due to changing thermal conditions in Goose Pit. If active depressurization is required, the water balance may be impacted.
Detailed Review Comment	The transient nature of mining in the north can result in new or unexpected groundwater flow pathways being encountered or forming due to temperature fluctuations. This is observed in open pit walls when they are exposed to the atmosphere and cycle of warm and cold seasonal temperature fluctuations. When this occurs near a surface water body the groundwater flux can be greater than predicted. Additionally, a pit wall may need active depressurization to maintain slope stability, again resulting in more water requiring management. More water requiring management can impact the predicted water balance and water quality models.
Recommendation/Request	1. INAC requests that Sabina provide assurance that the Project has a plan to effectively implement active depressurization measures for the open pits if required.

4.1.2 Waste Management Program

Technical Review Comment	**INAC-TRC# 10**
Subject/topic	**Landfill Settlement**
References	• Landfill and Waste Management Plan • Section 6.3 • Page 6-2
Summary	Both proposed landfills in the Umwelt WRSA and the TSF/TSF WRSA will be located within waste rock storage areas. There is a concern that there will be future settlement of the final cover once these

	areas are closed, especially if covered by additional waste rock, which may lead to surface runoff issues from the final surface.
Importance of Issue to Water Resources	Differential settlement can lead to localized low spots where surface runoff on the final closed waste rock areas could pool and infiltrate at a higher rate than planned.
Detailed Review Comment	It is understood that the landfills, located within the waste rock storage areas, will be operated as industrial dry waste landfills and that the materials to be placed in these landfills will be largely inert. However, these landfilled materials will be heterogeneous in type and size and are significantly different from the surrounding materials, which are expected to experience considerably less settlement. During closure, the landfills will be covered with 5 m of NPAG waste rock as will the surrounding PAG waste rock. The concern is that due to the heterogeneous nature of the landfilled materials and the additional weight added at closure, there could be differential settlement at the landfill locations at the surface which could lead to potential ponding, reduction in surface runoff and increase in infiltration.
Recommendation/Request	1. INAC requests an explanation as to how future minimal settlement will be addressed during operations, closure and during post closure. 2. INAC recommends some overburden overfilling during closure above the landfill areas to allow for future settlement. 3. INAC recommends specific monitoring of these areas during post-closure.

Technical Review Comment	**INAC-TRC# 11**
Subject/topic	**Alkaline and Carbon-Zinc Batteries Management**
References	• Landfill and Waste Management Plan • Table B1 • Hazardous Materials Waste Management Plan • Section 6.1.12
Summary	Depending on the battery type, batteries will be allowed to be landfilled or need to be returned to a licenced recycler. There is potential for batteries to end up in the wrong waste stream, resulting in them being placed in the Umwelt WRSA and the TSF/TSF WRSA landfill sites.
Importance of Issue to Water Resources	Batteries classified to be Non-landfill batteries could end up in the Umwelt WRSA and the TSF/TSF WRSA landfill sites and have the potential for water contamination.

Detailed Review Comment	While Alkaline and Carbon-Zinc batteries can be landfilled as per the referenced guidelines, all other types of batteries are not permitted to be landfilled. Depending on the rigour to be applied when sorting the batteries into different streams, non-approved batteries could end up in the Umwelt WRSA and the TSF/TSF WRSA landfill sites. There they could pose a potential contamination risk to surface and groundwater.
Recommendation/Request	1. INAC recommends that waste battery management be simplified and that all batteries be backhauled to an acceptable off-site receiver. 2. INAC requests that more detail be provided on how Sabina intends to ensure that all batteries are directed into the correct waste management stream.

Technical Review Comment	**INAC-TRC# 12**
Subject/topic	**Landfill Siting Over Existing Drainage Streams**
References	• Landfill and Waste Management Plan • Figures A-01, A-02 and A-04
Summary	The proposed landfills in the Umwelt WRSA and the TSF/TSF WRSA are planned to be placed directly over the top of existing drainage streams. There is a concern that until permafrost is fully established below and into the waste mass at each of these landfill sites, preferential pathways for the flow of contaminants into these drainage streams could be developed.
Importance of Issue to Water Resources	The potential development of preferential pathways for contaminant flow from the proposed Umwelt WRSA and TSF/TSF WRSA landfills into these drainage streams is of concern to the water resources of these streams.
Detailed Review Comment	Sabina plans to landfill non-combustible, non-hazardous materials in approved on-site facilities within the Umwelt and TSF WRSAs. Water diversion and collection systems will be incorporated into the design of these landfills, which will be designed for the life of the Project. The landfills proposed for the Umwelt WRSA and the TSF/TSF WRSA are planned to be placed over the top of existing drainage streams. There is a concern that until permafrost is fully established below the landfills and into the waste mass to be placed in these landfill locations, preferential pathways for contaminant flow into these streams may develop. Based on Figures A-01 and A-02, it appears that an undefined barrier layer will be placed beneath each of the landfills and adjacent WRSA's. However, the existing flow pathways, especially if not blocked or diverted up-gradient of these drainage streams could lead to the development of preferential contaminant flow pathways.

Recommendation/Request	1. INAC recommends that Sabina modify the configuration of the landfills within the Umwelt WRSA and TSF/TSF WRSA to avoid placement immediately over the top of existing drainage streams.

Technical Review Comment	**INAC-TRC# 13**
Subject/topic	**Clarification of Landfill & Waste Management Plan Figures**
References	• Landfill and Waste Management Plan • Figures A-1 and A-2
Summary	The cross-section details on Figures A- 1 and A-2 are unclear and need to be clarified.
Importance of Issue to Water Resources	These figures indicate the presence of an un-defined layer located between the existing terrain surface and the landfill. Clarification of what this layer is, is needed to allow reviewers to comment on potential concerns associated with the presence of this layer.
Detailed Review Comment	On Figure A-1 and A-2 a 1.0 m thick layer is shown underneath the waste rock and landfill, but it is not detailed what this layer is. On Figure A-2, the label for existing ground appears to be incorrect. Clarification is needed to fully understand the drawing and comment on any concerns related to the proposed design.
Recommendation/Request	1. INAC requests that both Figures be updated with additional information.

4.1.3 Mine Waste Management Program

Technical Review Comment	**INAC-TRC# 14**
Subject/topic	**Tailings Management - Waste Rock Placement in the TSF**
References	• Tailings Management Plan • Section 4.1: Tailings Production and Storage
Summary	Additional information and supporting analyses are required on how the waste rock will be placed over the deposited tailings to ensure that local and/or global failures of the advancing waste rock placement do not occur.
Importance of Issue to Water Resources	Global and local stability of the tailings storage structure is an important consideration when placing waste rock over the tailings at the Tailings Storage Facility (TSF).
Detailed Review Comment	Referring to the following statement in the Tailings Management Plan: *After tailings deposition transitions from the TSF to the Umwelt TF in Year 2, the TSF will be converted to a waste rock storage area (namely, the TSF WRSA) and used to dispose of waste rock from the Goose Main Pit.* Have stability analyses been undertaken to assess the global and/or local stability of the waste rock as it is placed over the deposited tailings. The tailings may well be unfrozen, unconsolidated, saturated, very loose in nature and possibly subjected to undrained rapid loading by the overlying placed waste rock. As a result, the tailings could form a low strength deposit beneath the waste rock which could influence the local and/or global stability of the advancing waste rock placement.
Recommendation/Request	1. INAC requests additional information and supporting analyses on how the waste rock will be placed over the deposited tailings to ensure that potential local and/or global failures of the advancing waste rock placement do not occur.

Technical Review Comment	**INAC-TRC# 15**
Subject/topic	**Tailings Management - Tailings Storage Facility Design Basis**
References	• Tailings Management Plan • Section 4.2.1: Tailings Storage Facility Design Basis • Table 4.2-1: Tailings Storage Facility Design Basis Summary
Summary	INAC is concerned that the current Tailings Storage Facility (TSF) design may have Insufficient tailings storage capacity to accommodate the total volume of tailings to be directed to this facility.

Importance of Issue to Water Resources	INAC is concerned that the current TSF design may have insufficient tailings storage capacity to accommodate all of the tailings to be directed to this facility.
Detailed Review Comment	The Project is anticipated to produce about 19.8 million tonnes (Mt) of tailings over the 10-year operational mine life. Tailings to be directed to the TSF (approximately 3. 78 Mt) will dictate how water is managed at this facility. INAC is concerned that the current TSF design may have Insufficient tailings storage capacity to accommodate the total volume of tailings to be directed to this facility. The basic design assumption employed by Sabina is that both the subaerial and subaqueous tailings beach slope are 1%. It is generally accepted that subaqueous tailings beach slopes have a greater slope (~5%) than the subaerial tailings beach slope. This has implications for the sizing of the TSF and associated water management considerations
Recommendation/Request	1. INAC requests that Sabina provide justification for using the same tailings beach slope for both subaerial and subaqueous tailings beaches. 2. INAC requests that Sabina comment on what the impact would be on the tailings deposition plan and the TSF if the subaqueous tailings beaches were steeper – e.g. a more likely 5% slope.

Technical Review Comment	**INAC-TRC# 16**
Subject/topic	**Tailings Management – Potential Seepage through Fractured Bedrock Below the TSF**
References	• Tailings Management Plan • Section 4.2.3: Seepage Analysis
Summary	Bedrock fractures found in some areas near the west abutment of the TSF dam may result in seepage through this fractured bedrock.
Importance of Issue to Water Resources	Seepage through the zone of fractured bedrock near the west abutment would have implications for the management of water at this facility and potential impacts on the downstream water resources.
Detailed Review Comment	Section 4.2.3 of Sabina's Tailings Management Plan states that: *During the 2015 drill program, small zones of fractured bedrock (2 to 3 m thick) were found in some of the drill holes near the west abutment of the dam, which may provide a pathway for seepage through the foundation of the dam. However, the thickness of dam bulk fill present in this specific portion of the TSF Dam, as well as along most of the TSF Dam alignment, will far exceed the minimum thermal cover requirement to maintain the underlying*

	overburden materials in a frozen state; therefore, seepage is unlikely to occur. Based on the observations of the 2015 drill program INAC is concerned that if bedrock fractures found in some areas near the west abutment of the dam were ice filled or not. If the bedrock fractures found were not ice filled, INAC would question how the thermal cover would prevent seepage through this fractured bedrock.
Recommendation/Request	1. INAC requests that Sabina provide confirmation that the fractures in the bedrock were either ice filled or not. If they were not ice filled, please provide justification of how the thermal cover will prevent seepage through the fractured bedrock. 2. INAC requests that Sabina considers adding instrumentation to this west abutment area to monitor for the occurrence of seepage through the zone of fractured bedrock (i.e. additional thermistor cables).

Technical Review Comment	**INAC-TRC# 17**
Subject/topic	**Tailings Management - TSF Site and Foundation Preparation**
References	• Tailings Management Plan • Section 4.2.6: Tailings Storage Facility Embankment Construction
Summary	Information is needed on the permeability value used by Sabina to determine when the foundation bedrock is considered to be highly permeable and unacceptable, thus requiring further excavation. This is important because the key trench needs to terminate on clean exposed bedrock to minimize or eliminate potential seepage through bedrock fractures found in some areas near the west abutment of the dam.
Importance of Issue to Water Resources	Seepage through the zone of fractured bedrock near the west abutment would have implications for the management of water at this facility and potential impacts on the downstream water resources.
Detailed Review Comment	Section 4.2.6 of Sabina's Tailings Management Plan states that: *For the shallow bedrock foundation zone (Figure A-04), the key trench will terminate on clean exposed bedrock. If fractured rock is encountered, it will be examined and tested, and if deemed **highly permeable**, it will be excavated.* It is understood that the key trench will be excavated in the frozen overburden underlying the dam to a depth up to 4 m. For the shallow bedrock foundation zone, the intention is for the key trench to terminate on clean exposed bedrock. In the deep

	overburden foundation zones, the intention is for the key trench to terminate on frozen overburden soil. To meet the key trench design criteria for termination depth, INAC needs information on the permeability value that Sabina has used to determine when the foundation bedrock is considered to be "***highly permeable***" and unacceptable, thus requiring further excavation. INAC also needs more detail on the proposed method of in situ permeability testing to be completed by Sabina to determine permeability values in the field.
Recommendation/Request	1. INAC requests that Sabina provide the permeability value at which the foundation bedrock is considered to be "highly permeable" and unacceptable, thus requiring further excavation. 2. INAC requests that Sabina provide the procedure for determining the field permeability of the in-situ rock to define the final depth of the key trench.

Technical Review Comment	**INAC-TRC# 18**
Subject/topic	**Tailings Management – TSF Performance Monitoring**
References	• Tailings Management Plan • 4.2.6 Tailings Storage Facility Embankment Construction • Instrumentation (Text) v's Figure A-07
Summary	There is an apparent inconsistency in Figure A-07 of the Tailings Management Plan regarding the placement of the horizontal thermistor cables relative to the location of the key trench component of the dam foundation that requires clarification.
Importance of Issue to Water Resources	Temperature measurement within the tailings dam foundation is an important consideration as the dam foundation of the dam must be kept as cold as possible to limit the potential for thawed ground within the foundation of the dam.
Detailed Review Comment	Section 4.2.6 of Sabina's Tailings Management Plan states that: *Horizontal ground temperature cables will be placed within the liner cover zone along the upstream side of the key trench.* However, Figure A-07 indicates that the horizontal ground temperature cables will be placed within the liner cover zone on the downstream side of the key trench. Clarification of this apparent inconsistency is required.
Recommendation/Request	1. INAC requests Sabina to clarify the location of the horizontal ground temperature cables – are they upstream or downstream of the key trench.

Technical Review Comment	INAC-TRC# 19
Subject/topic	Overburden Excavation and Handling
References	• Mine Waste Rock Management Plan • Section 5: Planning and Implementation
Summary	The Mine Waste Rock Management plan focuses on the disposal of materials including overburden in the WRSA's but is silent on the management of the excavation of the overburden materials prior to them being deposited in the WRSA.
Importance of Issue to Water Resources	There is the potential for the release of sediment-laden water to the environment during excavation of overburden materials.
Detailed Review Comment	The Mine Waste Rock Management Plan indicates that approximately 5.3 Mt of NPAG overburden will be produced during development of the Project. All of the overburden produced will be stored in engineered WRSAs located close to each of the open pits. Excavation of overburden from the footprints of much of the mine infrastructure (quarries, open pits, facilities etc.) may be challenging at times, particularly when excavation occurs in the summer months and in ice-rich materials.
Recommendation/Request	1. INAC recommends that a section be added to the Waste Rock Management Plan that addresses the procedures needed to determine the characteristics (ice content and material type) of the overburden materials. 2. INAC recommends that a section be added to the Waste Rock Management Plan that addresses procedures to be utilized during overburden excavation to eliminate the potential for the release of sediment-laden water to the environment during its excavation and transport to the WRSAs.

Technical Review Comment	INAC-TRC# 20
Subject/topic	Mine Waste Management Segregation and Tracking
References	• Mine Waste Rock Management Plan • Section 5: Planning and Implementation • Section 6: Environmental Protection Measures
Summary	The Mine Waste Rock Management Plan includes methods for the identification of PAG and NAG material, as well as the segregation of materials. However, the Plan does not include details on how the material volumes will be tracked. The management plan indicates expected volumes of PAG and NAG materials from each mine area, and verifying that these estimates are correct during construction and operations will be required to ensure that WRSAs are

	adequately designed for the Life of Mine.
Importance of Issue to Water Resources	Increased volumes of PAG compared to estimates can result in the requirement for additional storage areas, and or handling and treatment of acidic or metalliferous leachate. Water management from PAG is different from water management of NAG.
Detailed Review Comment	The Mine Waste Management Plan includes estimates of expected waste rock volumes produced during construction and operation of the mine. There is an intention to identify and segregate the PAG and NAG materials so that they may be stored in the appropriate locations within the WRSAs. The Plan focuses on the identification of PAG and NAG for placement, and does not include a measure for tracking materials, and comparison to estimates of expected volumes of NAG and PAG. Increased volumes of PAG may require amendments to the design of WRSA's and associated water management infrastructure (ditches and ponds).
Recommendation/Request	1. INAC recommends that a section be added to the Waste Rock Management Plan that addresses the procedures to track and maintain records of quantities and locations of PAG and NAG waste rock from each mining area. 2. INAC recommends that a section be added to the Waste Rock Management Plan to address procedures to be utilized in the event that actual volumes of PAG encountered during mining are greater than those currently estimated.

4.1.4 Infrastructure and Access Management Program

Technical Review Comment	**INAC-TRC# 21**
Subject/topic	**Winter Ice Roads – Expected Traffic on Ice Roads**
References	• Road Management Plan • Section 4.2.2: Expected Traffic on Winter Ice Roads
Summary	Sourcing, collecting and transporting snow to create the winter road in overland sections has the potential to disturb terrain and lead to increased erosion and sediment release. Similarly, obtaining fill material and constructing granular fill pads for areas with rough terrain and insufficient snow cover has the same potential.
Importance of Issue to Water Resources	Overland winter ice road construction activities can lead to potential terrain disturbance, leading to increased erosion and sediment releases, thereby impacting water resources.
Detailed Review Comment	Section 4.2.2 of the Road Management plan states that: *Snow/ice thickness on land will be sufficient to prevent damage to soil and vegetation,* and

	Surface layers usually consist of compacted snow and/or ice where available. Ice-capped snow roads will be constructed for highway legal loads (e.g., B-trains). A discontinuous pad of granular fill may be required over short areas of rough terrain or where there is insufficient snow cover to create a smooth surface. If this is insufficient to provide an acceptable surface and gradient, additional grading effort may be required to create a road that meets the design criteria. Although Sabina currently does not anticipate any such locations, it is possible that operational requirements may require some fill. The surface conditions along the route consist of numerous areas where microtopography, including boulder fields may be difficult to level out with compacted snow. Additionally, some areas will likely blow clear of snow. This may require transporting snow from areas where it accumulates. Alternately, consideration may need to be given to artificially enhancing snow accumulation (e.g. using snow fencing). This must be accomplished in a manner that does not cause disturbance to the ground surface that could lead to erosion. In addition, the noted microtopography and lack of snow in some locations on the proposed route points to the likely need to construct pads of granular fill in some locations. Quarrying and pad construction brings with it the potential for additional sediment release into the environment.
Recommendation/Request	1. INAC recommends that the proposed winter road alignment be observed in early winter in a winter prior to the first winter road construction season to examine snow conditions and microtopography along the route. This will allow a better prediction of the requirements for and availability of snow along the route that can be used for winter road construction and/or the need to construct discontinuous granular fill pads in some locations. 2. INAC recommends that Sabina consider providing additional information in the Road Management Plan in regards to the procedures to be employed to obtain and transport snow from areas where it accumulates to the road alignment.

Technical Review Comment	**INAC-TRC# 22**
Subject/topic	**Winter Ice Roads - Ice Road Design and Operation**
References	• Road Management Plan • Section 4.2.3: Design Criteria for Winter Ice Roads • Second bullet

Summary	The maximum loaded vehicle speeds presented in Sabina's Road Management Plan are higher than the maximum loaded vehicle speeds set for the most highly engineered, controlled and highest traffic ice road in the world, the Tibbitt to Contwoyto Winter Road (TCWR). This warrants reconsideration by Sabina.
Importance of Issue to Water Resources	The higher maximum loaded vehicle speeds currently set for the Project winter ice road will pose greater risks to the vehicle operators and water resources due to vehicle incidents and the potential release of contaminants into waterbodies or onto the land.
Detailed Review Comment	Section 4.2.2 of the Road Management Plan lists the Design Criteria for Winter Ice Roads. Among the criteria presented, the maximum speed for loaded trucks (>50% of maximum load limit) is specified as 35 km/hr on ice and the maximum speed for loaded trucks on land is 40 km/hr. The suggested maximum speed on ice of 35 km/hr is higher than the maximum speed (25 km/hr) set on what is undoubtedly the most highly engineered, controlled and highest traffic ice road in the world, the Tibbitt to Contwoyto Winter Road (TCWR). Operating at higher speeds, particularly on the numerous small lakes of the proposed route will mean travelling at speeds closer to the critical speed. Failure of the floating ice sheet due to vehicles operating at speeds close to or at the "critical speed" could lead to vehicles breaking through the ice and spill incidents into water bodies. Similarly, the maximum speed on land portages for the TCWR is 30 km/hr. Vehicles travelling at higher speeds on land (portages) increases the risk of vehicle accidents on portages resulting in the potential release of contaminants on land with the potential for subsequent contaminated runoff into nearby streams or other waterbodies.
Recommendation/Request	1. INAC requests additional information and supporting analyses showing why the maximum operating speed on the Sabina Winter Road is higher than the busiest ice road (TCWR) operating in northern Canada. 2. INAC recommends that Sabina consider adopting the maximum loaded vehicle speeds specified for the TCWR.

4.1.5 Emergency Response Program

Technical Review Comment	**INAC-TRC# 23**
Subject/topic	**Updates to Emergency Contact Information for Emergency Response Program Plans**
References	• Risk Management & Emergency Response Plan • Fuel Management Plan • Spill Contingency Plan • Oil Pollution Emergency Plan • Emergency Contact Sections in each plan
Summary	The emergency contact sections of each of the afore-mentioned plans need to be updated as necessary to facilitate efficient, timely and effective communications and responses to emergency and/or spill incidents prior to Project start-up.
Importance of Issue to Water Resources	Timely, efficient and effective communications and response to emergency and/or spill incidents is important to assist in minimizing potential impacts to water resources.
Detailed Review Comment	To effectively respond to an emergency or spill incident, the emergency contact sections for each of the afore-mentioned plans will need to be completed and updated as necessary prior to Project start-up. This will help to ensure that all emergency response team members, contractors, key government contacts and external spill response contacts can be efficiently and effectively contacted as necessary to assist as may be required. These contacts and contact details should be updated on an annual basis or as necessary to reflect personnel, contractor and organizational changes.
Recommendation/Request	1. INAC recommends that all of Sabina's emergency and spill response plans be completed and updated as necessary prior to Project start-up, to ensure that the contact details for all emergency response team members, contractors, key government contacts and external spill response contacts are available in the event of an emergency and/or spill incident. 2. INAC recommends that these contacts and contact details be updated on an annual basis or as necessary to reflect personnel, contactor and organizational changes.

Technical Review Comment	**INAC-TRC# 24**
Subject/topic	**Risk Management & Emergency Response Planning**
References	• Risk Management & Emergency Response Plan • Section 7: Risk Assessment and Management
Summary	The Risk Management & Emergency Response Plan is intended to be an action-oriented focused plan. Although Section 7 of this Plan contains useful background information, INAC is of the view that

	most of this information would be better located in an Appendix to the Plan.
Importance of Issue to Water Resources	Having a more focused Risk Management & Emergency Response Plan would facilitate more timely, efficient and effective responses to emergency incidents including incidents that may impact water resources.
Detailed Review Comment	Section 7 of the Risk Management & Emergency Response Plan contains useful background information. However, INAC is of the view that most of this information would be better located in an Appendix to the Plan. This would result in the Plan being more focused on the Emergency Response components of the Plan. This would be of benefit to Sabina's Emergency Response Team in implementing more timely, efficient and effective responses to emergency incidents.
Recommendation/Request	1. INAC recommends that Section 7 of the Risk Management & Emergency Response Plan be relocated to an Appendix of the Plan.

Technical Review Comment	**INAC-TRC# 25**
Subject/topic	**Deployment of Spill Containment Booms During Ship Bulk Fuel Transfer Operations**
References	• Oil Pollution Emergency Plan (OPEP) • Section 11.3 Spill Prevention Measures – Bulk Fuel Transfer • Annex 5: Bulk Cargo Transfer Procedures
Summary	Approximately 30 – 45 million litres of bulk fuel will be transferred from ships to the bulk fuel storage facility. Given the significant volume of bulk fuel to be transferred and the risk of leakage or spills posed by such operations, INAC wants to ensure that all reasonable preventive measures are implemented for all facets of the bulk fuel transfer operation.
Importance of Issue to Water Resources	The effective deployment of spill containment booms during ship bulk fuel transfer operations would serve to assist in protecting the valued marine components of the area.
Detailed Review Comment	The total annual volume of the bulk fuel to be transferred from ships to the bulk fuel storage facility will be in the order of approximately 30 - 45 million litres, and will take place during the open shipping season between the months of late August through early October. The fuel transfer operations will involve the use of either a single or double four (4) inch floating hose with an approximate length of approximately 1,000 metres deployed between the vessel and the connecting flange on the shore. A six (6) inch steel pipeline will convey the fuel from the connecting flange to the bulk storage facility.

	Section 11.3 of the OPEP lists a number of preventive measures to be implemented to minimize risks of spills during bulk fuel transfer operations from ship to shore. Sabina notes that they have reviewed a copy of the Shipboard Oil Pollution Emergency Plan (SOPEP) that each ship is required to have to prevent and respond to spill incidents that may occur in relation their vessel's activities. Given the significant volume of bulk fuel to be transferred on an annual basis from ships to the bulk fuel storage facility and the risk of leakage or spills posed by such operations, INAC wants to ensure that all reasonable preventive measures are implemented for all facets of the bulk fuel transfer operation. In particular, to minimize potential impacts on the marine environment due to possible fuel leaks or spills associated with ship bulk fuel transfer operations, INAC is of the view that Sabina should commit to ensure that each ship involved in such operations deploy a spill containment boom below the point where the fuel transfer hose extends from the vessel to the sea surface, immediately adjacent to the vessel. The containment boom should be deployed prior to and for the duration of each fuel transfer operation. The effective implementation of this proactive protective measure would serve to contain any possible fuel leaks or spills at source, would facilitate subsequent fuel cleanup efforts and would assist in protecting the valued marine components of the nearshore area.
Recommendation/Request	1. INAC recommends that Sabina commit to ensure that each ship involved in such operations deploy a spill containment boom below the point where the fuel transfer hose extends from the vessel to the sea surface immediately adjacent to the vessel as an additional proactive, protective measure.

4.1.6 General and Aquatic Effects Program

Technical Review Comment	**INAC-TRC# 26**
Subject/topic	**Near Shore Marine Sediment Quality Sampling to Support Adaptive Management**
References	• Marine Monitoring Plan • Section 4.2: Sediment Quality • Aquatic Effects Management Plan • Section 1.1: Background
Summary	Near shore marine sediment quality sampling should be undertaken as a component of the Marine Monitoring Plan to permit adaptive management actions to be implemented, as may be necessary, based on the future results of such sampling.

Importance of Issue to Water Resources	Nearshore Marine sediment quality is an important component of the marine environment that should be incorporated into Sabina's Marine Monitoring Plan.
Detailed Review Comment	Section 4.2 of the Marine Monitoring Plan states that: *Sediment quality samples will be collected in 2017 to supplement baseline data collected for the Final Environmental Impact Statement and to support future adaptive management responses. Sediment samples will not be collected on an annual basis but will be collected as required if triggered by through adaptive management.* INAC is of the view that nearshore marine sediment quality sampling should be undertaken in the vicinity of the MLA/port area as a component of the Marine Monitoring Plan to permit adaptive management actions to be implemented, as may be necessary, based on the future results of such sampling. Consistent with Sabina's Aquatic Effects Management Plan (AEMP), the sampling frequency for the sediment sampling component of the Marine Monitoring Plan should be harmonized with the Metal Mining Effluent Regulations (MMER) and Environmental Effects Monitoring (EEM) requirements. These requirements call for sediment sampling every three (3) years. The incorporation of sediment sampling as a component of the Marine Monitoring Plan will facilitate the characterization of special and temporal variations and trends in marine sediment quality of the Marine Laydown/port area and provide the basis for adaptive management actions to be undertaken as and if determined to be necessary.
Recommendation/Request	1. INAC recommends that Sabina incorporate nearshore marine sediment quality sampling as a component of the Marine Monitoring Plan to permit adaptive management actions to be implemented, as may be necessary, based on the future results of such monitoring.

4.1.7 Interim Closure and Reclamation Program

Technical Review Comment	**INAC-TRC# 27**
Subject/topic	**Incorporation of Active Revegetation into Closure Plan**
References	• Interim Closure and Reclamation Plan
Summary	The proponent consistently states throughout the Interim Closure and Reclamation Plan (ICRP) and particularly in Closure Objective 2: Achieve Physical Stability – that: *active revegetation of the Property as part of closure is not*

	planned given the cold climate setting of the Project as well as the precedent established for mine closure in Nunavut. INAC is unclear which precedent is being referred to with respect to revegetation and mine closure in Nunavut and considers active revegetation (e.g., through deliberate seeding and/or staking) to be a common reclamation practice even in northern environments. The inclusion of active revegetation in addition to more passive means that might serve to encourage natural revegetation provides a more comprehensive and robust approach to the restoration of areas that have been disturbed by mining activities.
Importance of Issue to Water Resources	The exclusion of active revegetation as an option removes this as a potential mitigation measure to offset Project disturbances to terrestrial habitat and indirectly to water resources. While the natural recovery of arctic vegetation is slow following disturbance, it can be facilitated and encouraged by more deliberate revegetation practices such as seeding and/or staking.
Detailed Review Comment	Active revegetation as a reclamation option is common practice, even in northern locations. INAC is unclear which precedent is being referred to with respect to mine closure in Nunavut. The closure and reclamation guidance document prepared by the Mackenzie Valley Land and Water Board and Aboriginal Affairs and Northern Development Canada (2013) for mine sites in the Northwest Territories (which is applicable for sites in Nunavut as well) identifies how enhanced or active revegetation considerations can be incorporated into mine planning and design. While there are certainly drawbacks and limitations to active revegetation at northern sites compared to more southern locations, this should not preclude attempts to consider active revegetation as another option to site restoration. Including such a practice provides a more comprehensive approach to reclamation and offers another option that is compatible with the landscape and desired end land uses/objectives, such as the achievement of physical stability. The inclusion of active revegetation does not translate to it becoming the only reclamation option; it simply provides another alternative that can assist with land restoration following disturbance.
Recommendation/Request	1. INAC recommends that the Proponent include active revegetation (such as seeding and/or staking) as another potential reclamation option in the closure plan.

Conclusion

INAC has reviewed the water licence application package for Sabina's Back River Project and finds it is very well done. Although INAC has presented 27 Technical review comments, INAC doesn't think there are any issues/comments that cannot be resolved through the Nunavut Water Board Licence Review Process. INAC looks forward to reviewing Sabina's responses and resolving any outstanding comments at the technical meeting in May.