

**LEGEND** 

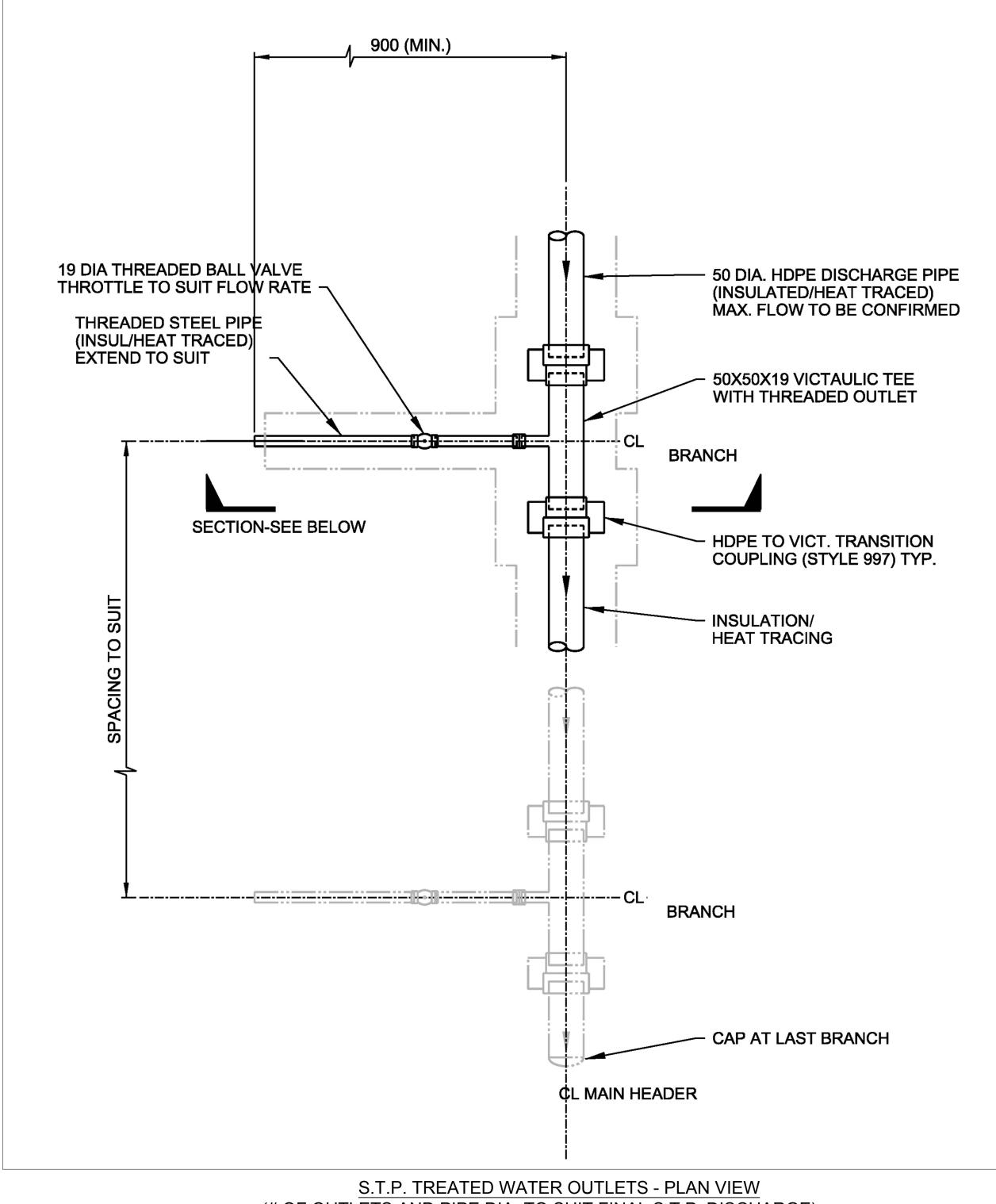
TWS— TREATED EFFLUENT WATER DISCHARGE

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

## REFERENCE(S)

 BASE DRAWING OBTAINED FROM SRK CONSULTING. FILE NAME: 1CS020.011\_WMP\_FIGURE\_A-20.DWG. RECEIVED DATE: 2017-06-02.

ISSUED FOR PERMITTING



# (# OF OUTLETS AND PIPE DIA. TO SUIT FINAL S.T.P. DISCHARGE)

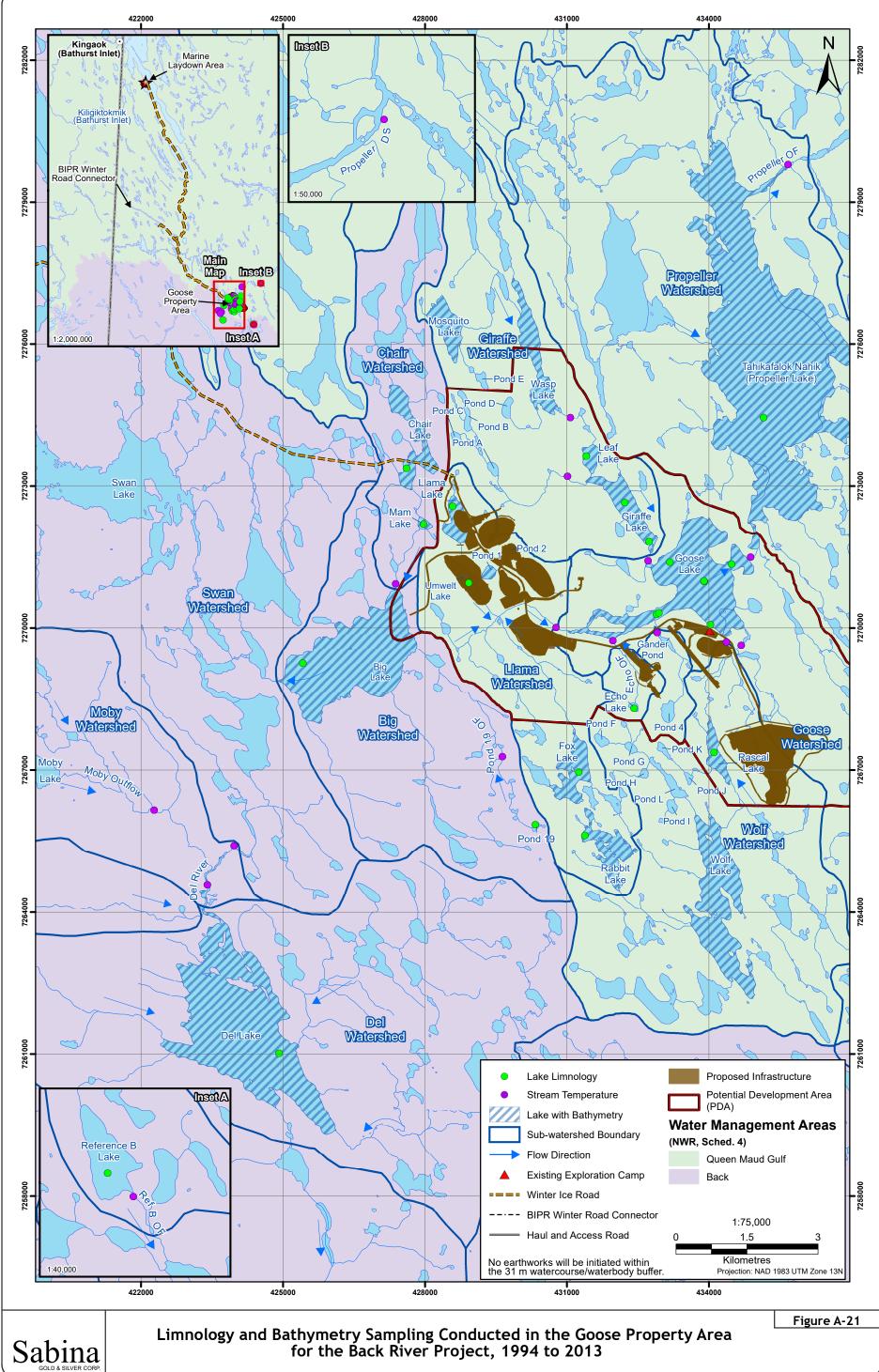
YYYY-MM-DD 2017-10-03 DESIGNED PREPARED CONSULTANT EA/AF REVIEWED

BACK RIVER PROJECT WATER LICENCE PHASE NUNAVUT, CANADA

S.T.P. TREATED WATER DISCHARGE PLAN AND SECTION

Golder Associates SIGNED AND SEALED

PROJECT NO. FIGURE REV. 1776921 A-20



Limnology and Bathymetry Sampling Conducted in the Goose Property Area for the Back River Project, 1994 to 2013

## Appendix B. Water Quality Monitoring

All water on the Project is categorized into three types: contact water (i.e., impacted by mine workings), non-contact water (i.e., undisturbed areas runoff), and saline water (i.e., groundwater). Only non-contact water will be diverted off-site without treatment.

Each type of water will be managed separately throughout each Project Phase.

#### **Construction Phase**

The following monitoring activities are proposed during the Construction Phase:

- Visual inspections to confirm that mitigation measures identified in this document and other relevant management plans (i.e., the Environmental Management and Protection Plan [SD-20], Borrow Pits and Quarry Management Plan [SD-03]) are implemented satisfactorily.
- o Visual inspections to monitor the effectiveness of sediment and erosion control and runoff collection measures on a regular basis (daily or weekly as appropriate).
- Monitor treated sewage effluent discharges on a weekly basis for key indicators (i.e., TSS and ammonia), and monthly sampling using laboratory analysis for the parameters listed in Table B-01.
- Periodically sample runoff at active construction fronts for the parameters listed in Table B-03.
- o Monitoring of runoff from quarries and borrow pits in relation to the quarry runoff criteria identified in Table 7.5-1.
- Monitoring of runoff at the Umwelt WRSA Pond and the Ore Stockpile Pond for compliance with MMER limits.
- Recording daily and monthly water consumption.
- o Monitoring of waste and water management aspects including remediated soil, oily water, and landfill seepage.
- o Monitoring of water quantity and quality will occur during all dewatering activities. The volume of water transferred will be measured on a continuous basis using appropriate flow meters.
- o Field turbidity and TSS will be monitored daily. As data becomes available, a TSS and turbidity curve will be generated to manage dewatering activities. Water transferred during dewatering activities will meet a TSS or turbidity threshold discharge criteria. The trigger level to suspend dewatering activities will be 90% of the limit to avoid releasing water above the threshold. Clean lake water will be transferred and monitored until the trigger level is reached. When the TSS trigger level is reached, lake water will be treated for TSS through the WTP before discharge into Goose Lake.
- o If released volumes of water change stream base flows or water levels by greater than 10% of baseline, then water transfer rates will be adjusted as required.
- O During Construction, the emphasis of monitoring will be on the implementation and success of mitigation at construction areas. Toward the end of Construction, Operations Phase monitoring activities will be implemented and monitoring will shift to include the relevant aspects of Operation Phase monitoring. Operations Phase activities beginning before the end of the Construction Phase will include the installation of Operations Phase water management facilities, milling, pre-stripping and mining of open pits and underground facilities, and the development of WRSAs.

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#### **Operations Phase**

In addition to the above efforts during Construction, the following is proposed for monitoring during the Operations Phase:

- Recording daily and monthly water consumption;
- o Regular visual monitoring of Operations Phase water management facilities;
- o Visual inspections and monitoring of construction areas as described in Section 8.4 of the Environmental Management and Protection Plan (SD-20);
- o Daily monitoring of the tailings discharge and the supernatant water level within the TSF;
- o Monitoring of effluents prior to discharge in relation to the criteria identified for various effluents within the tables of Section 7.5:
- Underground mine inflows will be sampled to verify water quantity predictions and verify storage requirements;
- o Monitoring of desalination discharge water to Bathurst Inlet to ensure that the salinity of the water remains within natural variability or CCME guidelines in sensitive marine areas;
- o Monitoring of mine contact water effluent discharges as prescribed by a study design developed under the MMER; and
- o Implementation of the future AEMP to monitor effects to downstream aquatic environments.

During Operations, the emphasis will be on inspecting and monitoring construction fronts as aspects of construction will be ongoing throughout the mine life. The Operations Phase monitoring program will also incorporate the monitoring of mining activities and water management systems associated with the active tailings management facilities, pits, WRSA ponds, and the Saline Water Pond.

#### Closure Phase

The following is proposed for monitoring during Closure:

- Regular inspections to confirm that closure activities are being undertaken as identified in the final approved Mine Closure and Reclamation Plan;
- Construction-type monitoring is undertaken during decommissioning activities as described above;
- o TSF/TF water quality monitoring until water quality objectives are met;
- Water quality monitoring of water being discharged from pits and the WRSAs to confirm all meet water quality objectives; and
- Water quality monitoring in Goose Main TF to confirm treatment is progressing as planned such that the discharge schedule may go ahead.

Due to the relatively long Closure Phase, there will be sufficient opportunities to conduct post-closure monitoring of the closed-out Project features. The WRSAs will be substantively closed in Year 6, and Llama Pit, Umwelt Pit, and Echo Pit will be closed out by Project Year 14; this will allow for a number of years of post-closure monitoring during the Passive Closure Stage. Closure monitoring at receiving waters will be measured against water quality objectives.

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#### Post-Closure Phase

Post-Closure monitoring is expected to be required for five years after completion of closure activities and the completion of water treatment in Goose Main TF. This is consistent with mine reclamation at other northern sites and is believed to be a reasonable monitoring period given the amount of verification monitoring that can performed during the Operations and Closure phases. Post-Closure monitoring is expected to include:

- Water quality sampling at mine contact water discharge locations in accordance with water quality objectives; and
- o Final Environmental Effects Monitoring studies in accordance with the water quality objectives needed to obtain status as a recognized closed mine from ECCC.

#### Sampling Plan

The sampling plan has been designed to consider the various phases of the Project but updates will be made as based on advancement of the Project and outcome of monitoring results.

Environmental monitoring station locations are shown on Figure B-01 and Figure B-02 for the Goose Property and MLA, respectively. In addition, Table B-01 and Table B-02 summarizes proposed water quality and flow monitoring of the Project during the Construction, Operations, Closure phases, and includes monitoring station location, monitoring type, description, purpose, mine phase, parameters grouping, and sample frequency for each location. The list of constituents in each parameter group is provided in Table B-03. It is anticipated that some locations will be initiated in Construction and maintained through Post-Closure, while other locations will come on-line in Operations once water is present. Proposed locations will be confirmed in the field.

To the extent practical, water samples will be analyzed for the same suite of constituents as analyzed for the AEMP. This will aid interpretation of AEMP results and linkages to mine related effects.

Figures and details regarding physical, chemical, and biological parameters in the AEMP sampling program are provided in the AEMP (SD-21); full details regarding marine monitoring are provided in the Marine Monitoring Plan (SD-23).

Sabina committed to developing a stand-alone marine monitoring plan (Term and Condition FA-ECCC-T-1). While, marine monitoring is outside the jurisdiction of the NWB, details on marine monitoring can be found in the Marine Monitoring Plan (SD-23).

#### Sample Collection

Field measurements of specific conductivity, pH, and temperature will be recorded whenever samples are collected using a multi-meter (e.g., YSI 6-Series Multimeter), along with measurements of total water depth, and sample collection depth.

Water quality samples will be collected from specific sampling stations (coordinates still to be confirmed) using a grab sampler or directly into bottles provided by an accredited analytical laboratory. Water quality samples will be analyzed by an accredited laboratory at detection limits less than aquatic life guidelines or as appropriate for site contact water type samples. The specific limits will be provided once the analytical laboratory has been selected.

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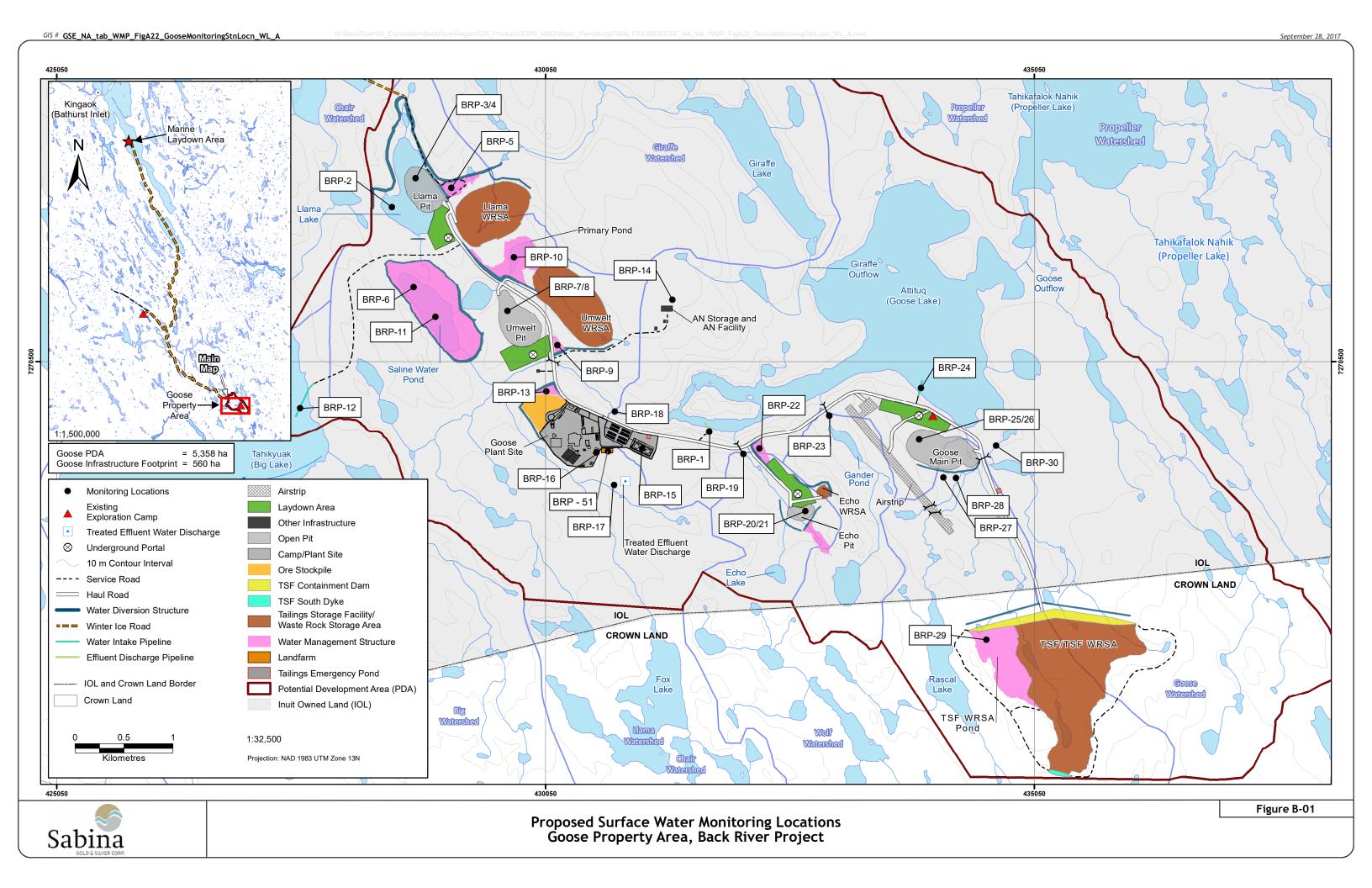
### **Quality Assurance and Quality Control**

Samples will be collected following standard sampling protocol (e.g., see the Quality Assurance and Quality Control Plan [SD-24]) by qualified personnel using suitable sampling equipment. Water samples for laboratory analysis will be filtered and preserved (as required), and stored in a cool environment before shipping to the laboratory. Quality control samples (i.e., blanks and duplicates) will be collected at a quantity of 10% of all samples collected.

#### Reporting

Results collected in any given year will be included in the annual report. Descriptive summary statistics will be calculated and results will be analyzed by comparison to Water Licence criteria and aquatic life guidelines (CCME 1999) or baseline conditions, as appropriate.

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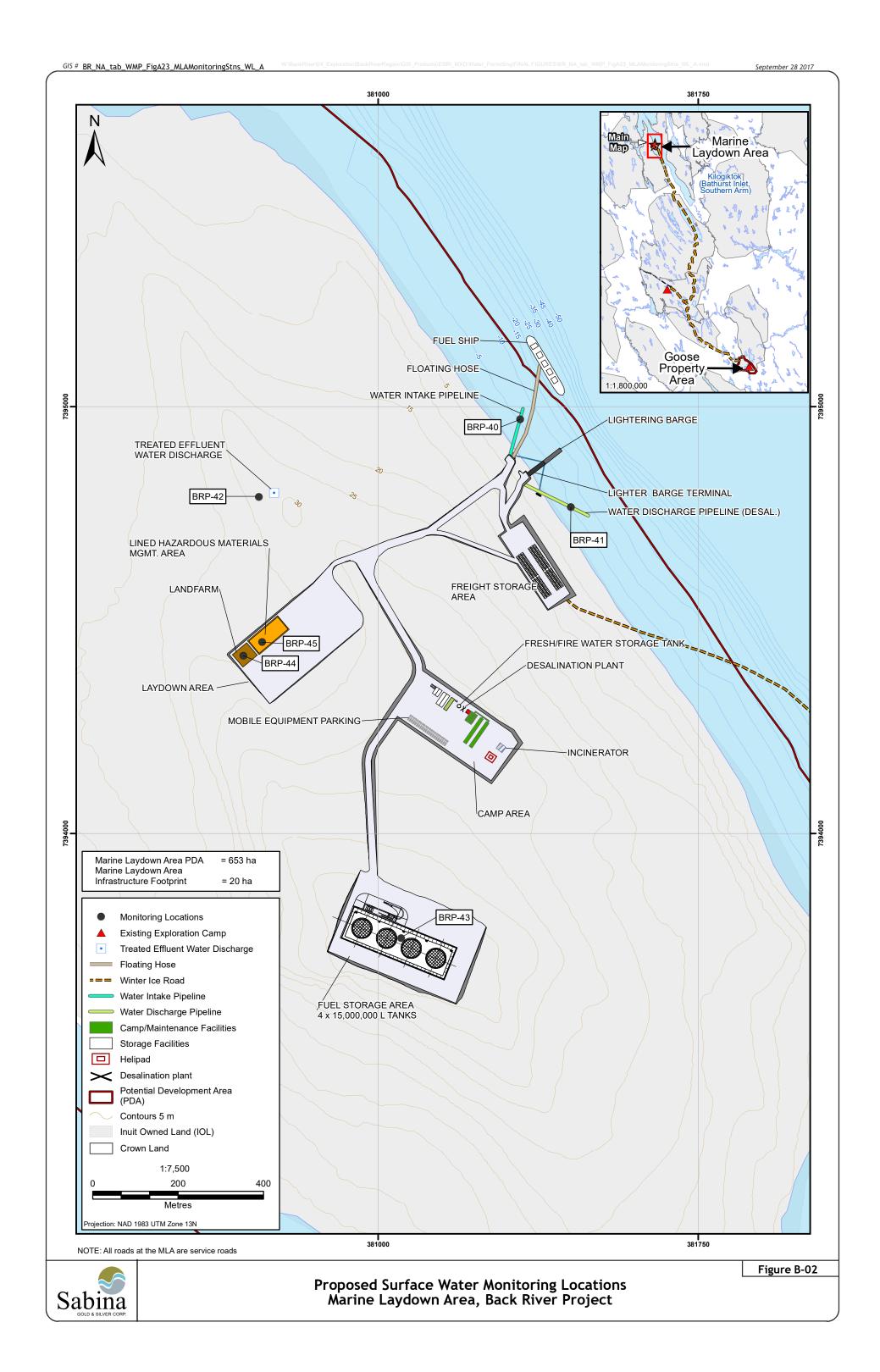


Table B-01. Proposed Water Quality Monitoring for the Project during Construction, Operations, and Closure in Goose Property Area

Monitoring Location Number	Monitoring Type	Description	Purpose	Mine Phase	Parameter Group Code <sup>5</sup>	Frequency
BRP-G-01 to BRP-G-TBD	Regulated Monitoring <sup>1</sup>	General Site Runoff including Quarries - both Goose and MLA	Applies anywhere on the site; monitoring for erosion and sedimentation	Construction	С	Weekly if flow enters a waterbody
	Regulated Discharge to Good Monitoring <sup>2</sup> treatment)		Test of dewatering discharge (i.e., effluent), at final point of control. If water does not meet TSS discharge criteria, water will be treated prior to release <sup>2</sup> .	Construction	A, B, G	Weekly during dewatering
BRP-01		Discharge to Goose Lake (after			D	Four times during dewatering, at the same time as the weekly samples
		treatment)			Н	Once per month during dewatering, at the same time as groups D and F
					I	One time during dewatering, at the same time as groups D and F
BRP-02	General Monitoring	Llama Lake Dewatering (prior to treatment) if required	If treatment is required, this station will test pretreated water. When paired with results from BRP-01 this will be used to evaluate treatment efficiency.	Construction	C (TSS only)	Weekly if treatment is required; no sample if treatment is not required
BRP-03	Verification Monitoring	Llama Pit	Pit water quality prior to transfer to a tailings facility	Operations (Stage 1) to Operations (Stage 2)	A, G	See note <sup>6</sup>
BRP-04	General Monitoring	Llama Pit Lake	During pit flooding and before overflow to the downstream environment	Closure to Post- closure	A, D	Twice per year
BRP-05	Verification Monitoring	Llama WRSA Pond	Test quality of drainage water from Llama WRSA	Operations (Stage 1) to Closure	A, G	See note <sup>6</sup>

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Table B-01. Proposed Water Quality Monitoring for the Project during Construction, Operations, and Closure in Goose Property Area (continued)

Monitoring Location Number	Monitoring Type	Description	Purpose	Mine Phase	Parameter Group Code <sup>5</sup>	Frequency	
BRP-06	General Monitoring	Umwelt Lake Dewatering (prior to treatment) if required	If treatment is required, this station will test pretreated water. When paired with results from BRP-01 this will be used to evaluate treatment efficiency.	Construction	C (TSS only)	Weekly if treatment is required; no sample if treatment is not required	
BRP-07	Verification Monitoring	Umwelt Pit  Pit water quality prior to transfer to a tailings facility; Umwelt underground water directed to Saline Pond and not Umwelt Pit  Construction to Operations (Stage 2)  A, G		A, G	See note <sup>6</sup>		
BRP-08	General Monitoring	Umwelt Pit Lake	During pit flooding and before overflow to the downstream environment	Closure to Post- closure	A, D	Twice per year	
BRP-09	Verification Monitoring	Umwelt WRSA Pond  Test quality of drainage water from Umwelt WRSA. A landfill is located in this WRSA. Appropriate landfill parameters will be tested for; see the LWMP (SD-10) for details.  Construction to Closure (early)		A, G	See note <sup>6</sup>		
BRP-10	Verification Monitoring	Primary Water Pond	Test quality of water in pond for industrial water use	Construction to Closure (early)	A, D	See note <sup>6</sup>	
BRP-11	Verification Monitoring	Saline Water Pond	Test quality of water in pond; Formerly Umwelt Lake; different than station 3; monitoring at 14 does not overlap with monitoring at 3	Construction (late) to Closure (early)	A, D	See note <sup>6</sup>	
BRP-12	General Monitoring	I Rig Lake Intake∙	Source intake water quality for potable and industrial use	Construction to Closure	A, D	Four times per year	
					В	Weekly	
BRP-13	Verification Monitoring	Ore Stockpile Pond  Test quality of drainage water from Ore stockpile  Construction to Closure (early)			A, D	See note <sup>6</sup>	
BRP-14	Verification Monitoring	ANFO Plant	Test quality of runoff water in the ANFO plant containment area	Construction to closure	A, E	See note <sup>6</sup>	

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Table B-01. Proposed Water Quality Monitoring for the Project during Construction, Operations, and Closure in Goose Property Area (continued)

Monitoring Location Number	Monitoring Type	Description Purpose Mine Phase		Mine Phase	Parameter Group Code <sup>5</sup>	Frequency
BRP-15	Regulated Monitoring <sup>3</sup>	Goose Fuel Tank Farm	Test quality of runoff water in the Fuel Tank Farm containment area	Construction to closure	Α, Ε	Prior to discharge or transfer of water
BRP-16	Regulated Monitoring <sup>3</sup>	Goose Hazardous Waste Mgmt Area	Test quality of runoff water in the Hazardous Waste Management containment area	Construction to closure	Α, Ε	Prior to discharge or transfer of water
BRP-17	Regulated Monitoring <sup>4</sup>	Treated sewage discharge to land	Test quality of sewage effluent discharge water quality	Construction to closure	Α, Ε	Prior to discharge or transfer of water
BRP-18	General Monitoring	Llama Watershed Outflow (PN04 from water and load balance)	Test quality of non-contact water runoff from the "Llama" watershed	Construction to closure	A, D	Once during freshet
BRP-19	General Monitoring	Echo Outflow (PN09 from water and load balance)	Test quality of non-contact water runoff from the "Echo" watershed	Operations (Stage 1) to Closure	A, D	Once during freshet
BRP-20	Verification Monitoring	Echo Pit	Pit water quality prior to transfer to a tailings facility; Echo underground water is always directed to the TSF	Operations (Stage 2)	A, G	See note <sup>6</sup>
BRP-21	General Monitoring	Echo Pit Lake	During pit flooding and before overflow to the downstream environment	Closure to Post- closure	A, D	Twice per year
BRP-22	Verification Monitoring	Echo WRSA Pond	Test quality of drainage water from Echo WRSF	Operations (Stage 2) to Closure (early)	A, G	See note <sup>6</sup>
BRP-23	General Monitoring	Gander Pond Outflow (PN07 from water and load balance)	Test quality of non-contact water runoff from the "Gander" watershed	Operations (Stage 1) to Closure	A, D	Once during freshet
BRP-24	General Monitoring	Goose Lake Intake  Source intake water quality; for operations (Stage 2) to Closure (early)  B  B		В	Weekly	
BRP-25	Verification Monitoring	Goose Pit Pit water quality prior to transfer to a tailings facility; underground (saline) water directed to Saline Water Pond 2) Operations (Stage 1) to Operations (Stage 2)		A, G	See note <sup>6</sup>	

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Table B-01. Proposed Water Quality Monitoring for the Project during Construction, Operations, and Closure in Goose Property Area (completed)

Monitoring Location Number	Monitoring Type	Description	Purpose	Mine Phase	Parameter Group Code <sup>5</sup>	Frequency
BRP-26	General Monitoring	Goose Pit Lake	During pit flooding and before overflow to the downstream environment	Closure to Post- closure	A, D	Twice per year
BRP-27	Verification Monitoring	Goose Main TF Intake; collected at "inlet" to treatment facility	Pretreatment quality	Operations (Stage 3) to Closure	A, G	See note <sup>6</sup>
BRP-28	Verification Monitoring	Goose Main TF Discharge into Goose Main TF (after treatment); collected at "outlet" of treatment facility; no discharge to the receiving environment	Post-treatment quality to confirm treatment efficiency	Operations (Stage 3) to Closure	A, G	See note <sup>6</sup>
BRP-29	Verification Monitoring	TSF WRSA Pond	Test quality of drainage water from TSF; A landfill is located in this WRSA. Appropriate landfill parameters will be tested for; see the LWMP (SD-10) for details.	Operations (Stage 1) to Closure	A, G	See note <sup>6</sup>
BRP-30	General Monitoring	Goose Southeast Inflow (PN06 from water and load balance)	Test quality of non-contact water runoff from the "TSF" watershed	Operations (Stage 1) to Closure	A, D	Once during freshet
BRP-51	Regulated Monitoring <sup>3</sup>	Goose Landfarm	Test quality of runoff water in the Landfarm containment area	Construction to Closure	E	Prior to discharge or transfer of water

Notes BRP = Back River Project; MLA = Marine Laydown Area

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<sup>1)</sup> See Table 7.5-2 (Dewatering Discharge Criteria) in the Water Management Plan

<sup>2)</sup> See Table 7.5-1 (Site Runoff Discharge Criteria) in the Water Management Plan

<sup>3)</sup> See Table 7-5.3 (Discharge to Land Criteria) in the Water Management Plan

<sup>4)</sup> See Table 7.5-4 (Treated Sewage Effluent Criteria) in the Water Management Plan

<sup>5)</sup> See Table B-03 for parameters in each monitoring group

<sup>6)</sup> Monitoring parameters and frequency at the discretion of Sabina as results from the verification stations are used for operational and management purposes

Table B-02. Proposed Water Quality Monitoring for the Project during Construction, Operations, and Closure in Marine Laydown Area

Monitoring Location Number	Monitoring Type	Description	Purpose	Mine Phase	Parameter Group Code <sup>4</sup>	Frequency
BRP-G-01 to BRP-G-TBD	Regulated Monitoring <sup>1</sup>	General Site Runoff including Quarries - both Goose and MLA	Applies anywhere on the site; monitoring for erosion and sedimentation	Construction	С	Weekly if flow enters a waterbody
BRP-40	General	Bathurst Inlet Intake (pre-	Source intake water quality for potable	Construction to	A, D	See note 5
DRP-40	Monitoring	treatment)	and industrial use	Closure	В	See note 5
BRP-41	General Monitoring <sup>1</sup>	Bathurst Inlet Discharge (post treatment)	Test quality at final point of control	Construction to Closure	A, J	See note <sup>5</sup>
BRP-42	Regulated Monitoring <sup>2</sup>	MLA Treated Effluent Discharge Location to land (greywater)	Confirm quality of greywater before release	Construction to Closure	A, F	Prior to discharge or transfer of water
BRP-43	Regulated Monitoring <sup>3</sup>	MLA Fuel Tank Farm	Test quality of runoff water in the Fuel Tank Farm containment area	Construction to closure	Α, Ε	Prior to discharge or transfer of water
BRP-44	Regulated Monitoring <sup>3</sup>	MLA Landfarm	Test quality of runoff water in the Landfarm containment area	Construction to closure	Α, Ε	Prior to discharge or transfer of water
BRP-45	Regulated Monitoring <sup>3</sup>	MLA Hazardous Waste Mgmt Area	Test quality of runoff water in the Hazardous Waste Management containment area	Construction to closure	Α, Ε	Prior to discharge or transfer of water

Notes BRP = Back River Project; MLA = Marine Laydown Area

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<sup>1)</sup>Marine Discharge Criteria not required for the Water Licence

<sup>2)</sup> See Table 7.5-4 (Treated Sewage Effluent Criteria) in the Water Management Plan

<sup>3)</sup> See Table 7.5-3 (Discharge to Land Criteria) in the Water Management Plan

<sup>4)</sup> See Table B-03 for parameters in each monitoring group

<sup>5)</sup> Monitoring parameters and frequency at the discretion of Sabina as results from the verification stations are used for operational and management purposes

Table B-03. List of Constituents in Each Parameter Group

Parameter Group	Parameter Group Code	Specific parameters
Field Chemistry	Α	pH, specific conductivity, and temperature.
Flow	В	Flow datalogger, calculated volume
General Surface runoff	С	Total Suspended Solids (TSS), Oil and Grease, pH
General Chemistry	D	Conventional: turbidity, hardness, alkalinity, calcium, chloride, fluoride, magnesium, potassium, sodium, sulphate, total dissolved solids, TSS, total cyanide, free cyanide, and weak acid dissociable (WAD) cyanide.  Nutrients: ammonia, nitrate, nitrite, total phosphorus (TP), and dissolved organic carbon.  Total and dissolved metals: aluminum, arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, molybdenum, nickel, selenium, silver, strontium, thallium, uranium, and zinc  Other: radium-226, Escherichia coli, and Total coliforms, when required
Secondary Containment	E	TSS, pH, ammonia, total arsenic, total copper, total lead, total nickel, total zinc, benzene, toluene, ethylbenzene, xylene, Oil and Grease
Sewage	F	Biochemical Oxygen Demand (5-day), TSS, Fecal coliform, ammonia, phosphorus, Oil and Grease, pH, Acute toxicity (Rainbow Trout and Daphnia magna)
MMER deleterious substances	G	TSS, total cyanide, total arsenic, total copper, total lead, total nickel, total zinc, and radium-226
MMER toxicity	Н	Acute toxicity (Rainbow Trout and Daphnia magna)
MMER sublethal toxicity	I	Sublethal toxicity (Fathead Minnow or Rainbow Trout, Ceriodaphnia dubia, Lemna minor, Pseudokirchneriella subcapitata)
Discharge to Marine	J	Salinity, total metals (aluminum, arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, molybdenum, nickel, selenium, silver, strontium, thallium, uranium, and zinc), oil and grease

Note: Detection limits may vary for site monitoring and for downstream receiving environment monitoring

#### **REFERENCES**

- 1985. Fisheries Act. R.S.C. 1985, c. F-14.
- 1988. Environmental Protection Act. RSNWT (Nu) 1988, c E-7.
- 1993. Nunavut Agreement Act. S.C. 1993, c. 29.
- CCME (Canadian Council of Ministers of the Environment). 1999 (with updates to 2017). Canadian Environmental Quality Guidelines for the Protection of Aquatic Life Summary Table. Available at: http://st-ts.ccme.ca/.

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