# BACK RIVER PROJECT
# Tailings Management Plan

November 2020

# BACK RIVER PROJECT

# TAILINGS MANAGEMENT PLAN

## Table of Contents

## List of Tables



## List of Appendices

# Revision Log

| Date | Section | Page | Revision |
|---|---|---|---|
| November 2015 | All | All | Supporting Document for Final Environmental Impact Statement; submitted to Nunavut Impact Review Board (NIRB). |
| October 2017 | All | All | Supporting Document for Type A Water Licence Application; submitted to Nunavut Water Board (NWB). |
| November 2020 | All | All | Revisions to address requirements and commitments of Project Certificate, No. 007, and Water Licence, 2AM-BRP1831 and updated to reflect Type A Water Licence Amendment Application to the NWB. |

# Acronyms

| | |
|---|---|
| ARD | acid rock drainage |
| CDA | Canadian Dam Association |
| FEIS | Final Environmental Impact Statement |
| GCL | geosynthetic clay liner |
| HDPE | high-density polyethylene |
| ICRP | Interim Closure and Reclamation Plan |
| MAC | Mining Association of Canada |
| MDMER | Metal and Diamond Mining Effluent Regulations |
| ML | metal leaching |
| Mt | million tonnes |
| NIRB | Nunavut Impact Review Board |
| NPAG | non-potentially acid generating |
| NWB | Nunavut Water Board |
| OMS | Operation, Maintenance, and Surveillance |
| PAG | potentially acid generating |
| PGA | peak ground accelerations |
| Project | Back River Project |
| ROM | run-of-mine |
| Sabina | Sabina Gold & Silver Corp. |
| TF | Tailings Facility |
| TMP or Plan | Tailings Management Plan |
| TSF | Tailings Storage Facility |
| TSM | Towards Sustainable Mining |
| WRSA | Waste Rock Storage Area |

# Executive Summary

This Tailings Management Plan describes Sabina's approach to managing tailings that will be produced in the development and operation of the Project. The main environmental concerns related to tailings storage are the potential for dust to spread to the surrounding land and water, as well as potential effects of runoff and seepage on local water quality. This plan ensures that: 1) potential adverse environmental effects are identified and promptly mitigated 2) mitigation measures are proven successful, and 3) relevant laws and regulations are complied with. This plan does not address discharge from the tailings storage facilities which will occur at Project Closure; those activities are addressed in other plans.

# Uyaraktaqnikut Aulatauni Parnaut (TMP) Ataniqnut Nainaqhimayuq

Una parnaut unniqtuqtai Sabina-kut pityuhi aulaninut kuviraqvit hanayauyukhat atuqtitlugu tamna pivaliatitni aulatauni taphuma Havaguhia. Tamna aturniqhaq avatiliqutit piyai turangani kuviraqviknut tutqumavia atuqtitlugu una pivikha pityutaulat puyuqnut hiamaknia avatigiyainut nunat immatlu tapkualuttauq aktualaqni kuukviunit maqinitlu nunagiyaini imaq nakuunai. Una parnaut hugiangitai kuvititauni talvanga kuviraqviuyuq tutqumavik havagutai tapkuat atuqniat talvani Havaguhia Umikniq; tahapkuat huliniit hugiaqtauyut ahiini parnautit. Una Parnaut atuqpiaqtai tapkuat 1) ihuityutaulat avatiliqutinut aktuanit naunaiqtauyut qilamiklu ihuaqhigiaqtauyut 2) ihuaqhigiaqni piyauyut naunaiqtauyutlu atuttiaqni tamnalu 3) turangayut maligait maligauyutlu katitauyut tapkununga.

# TMP ᐃᓱᒪᑕᐅᓂᕐᓂᑦ ᓇᐃᓈᖅᓯᒪᔪᖅ

ᐸᕐᓇᐅᑎ ᐅᕐᑲᐅᓯᕐᑲᖅᑐᖅ ᓴᐲᓇᒃᑯᑦ ᐊᑐᖅᑕᖕᒐᓐᓂᒃ ᐊᐅᓚᑦᑎᓂᕐᒧᑦ ᕿᒪᒃᑎᑦᑐᓂᒃ ᐱᑕᕐᑲᓕᕐᑲᑦᑕᖅᑐᑦ ᐱᕙᓪᓕᐊᓂᕐᑲᖅᑎᓪᓗᒋᑦ ᐊᒻᒪ ᐊᐅᓛᖅᑎᑦᑎᓂᕐᑲᖅᑎᓪᓗᒋᑦ ᐱᓕᕆᐊᕐᒥᑦ. ᐊᕙᑎᓕᕆᓂᕐᒧᑦ ᐃᓱᒪᓘᑕᐅᓗᐊᖅᑐᖅ ᕿᒪᒃᑎᑦᑐᑦ ᑐᖅᑯᖅᑕᐅᓯᒪᓂᖏᓐᓄᑦ ᒫᓇᐅᔪᖅ ᐳᔪᕐᑲᓛᒃ ᓯᐊᕐᒪᑐᐃᓐᓇᓐᓇᐊᕐᑲᕐᓂᖓ ᕐᑲᓂᑕᖕᒐᓄᑦ ᓄᓇᒧᑦ ᐊᒻᒪ ᐃᒪᕐᒧᑦ ᐊᒻᒪ ᕐᑲᓄᐃᖓᓕᖅᑎᑦᑎᓂᐅᔪᓐᓇᖅᑐᑦ ᑯᕕᔪᓂᒃ ᕐᑲᓂᑦᑐᒥᑦ ᐃᒪᐅᑉ ᕐᑲᓄᐃᓐᓂᖕᒐᓄᑦ. ᐸᕐᓇᐅᑎ ᐱᓕᕆᐊᕐᑲᖕᒋᑦᑐᖅ ᑯᕕᔪᓂᒃ ᕿᒪᒃᑎᑦᑐᓄᑦ ᑐᖅᑯᖅᓯᓯᒪᕝᕕᖕᓂᑦ ᑕᐃᒪᐅᕐᑲᑦᑕᕐᓂᐊᖅᑐᖅ ᐱᓕᕆᐊᖅ ᐅᒃᑯᐊᖅᑎᓪᓗᒍ; ᕐᑲᓄᐃᓕᐅᕈᑕᐅᔪᑦ ᐊᓯᖏᓐᓂᑦ ᐸᕐᓇᐅᑎᓃᑦᑐᑦ. ᐸᕐᓇᐅᑎ ᐃᒪᓐᓇᐃᑎᑦᑎᔪᖅ 1) ᐊᖏᔪᒥᒃ ᐊᒃᑐᖅᓯᓂᐅᔪᓐᓇᖅᑐᑦ ᐊᕙᑎᒧᑦ ᕐᑲᐅᔾᔭᐅᓗᑎᒃ ᐊᒻᒪ ᐊᖏᓗᐊᖏᕆᐊᖅᑎᑕᐅᓗᑎᒃ 2) ᐊᖏᓗᐊᖏᕆᐊᖅᑎᑦᑎᓂᕐᒨᖓᔪᑦ ᓇᓗᓇᐃᖅᓯᔾᔪᑕᐅᔪᑦ ᐱᐊᓂᑦᑎᐊᖅᓯᒪᓂᕐᒧᑦ ᐊᒻᒪ 3) ᑕᒪᒃᑯᓄᙵ ᒪᓕᒐᐅᔪᑦ ᐊᒻᒪ ᒪᓕᒐᕋᓛᑦ ᒪᓕᒃᑕᐅᓗᑎᒃ.

# 1. Introduction

The Back River Project (the Project) is a gold project owned by Sabina Gold & Silver Corp. (Sabina) within the West Kitikmeot region of southwestern Nunavut. It is situated approximately 400 kilometres (km) southwest of Cambridge Bay, 95 km southeast of the southern end of Bathurst Inlet, and 520 km northeast of Yellowknife, Northwest Territories. The Project is located predominantly within the Queen Maud Gulf Watershed (Nunavut Water Regulations, Schedule 4).

The Project is comprised of two main areas with interconnecting winter ice roads; the Goose Property and the Marine Laydown Area (MLA). The majority of annual Project resupply will be completed via sealift using the MLA situated along the western shore of southern Bathurst Inlet, which is connected seasonally to Goose Property by an approximately 160-km long Winter Ice Road. Both the Goose Property and the MLA make use of a local networks of all-weather roads.

The Tailings Management Plan (Plan or TMP) outlines the approach for managing and monitoring tailings produced at the Goose Property. No tailings will be generated at the MLA.

The Plan has been constructed in consideration of all applicable guidelines and requirements, including those of the Type A Water Licence, 2AM-BRP1831, and Project Certificate, No. 007 as well as the Metal and Diamond Mining Effluent Regulations (MDMER). This plan will be reviewed and updated as needed to reflect changes in regulatory requirements, facility operation and/or technology, approach, monitoring results, management reviews, incident investigations, best practice updates or other Project specific protocols.

Any updates to this plan will be filed with the Nunavut Water Board (NWB) and the Nunavut Impact Review Board (NIRB) as per the requirements of the Project Certificate, No. 007 and Water Licence, 2AM-BRP1831.

It should be noted that the scope of this plan prescribed by the NWB overlaps with the scope and content of a future Operation, Maintenance, and Surveillance (OMS) Manual that Sabina will develop as a member of the Mining Association of Canada (MAC) and in consideration of the requirements of the International Cyanide Management Code. It is Sabina’s preference to replace this plan with a future OMS Manual that is compliant with MAC requirements as well as any relevant requirements of the Type A Water Licence, 2AM-BRP1831. This future OMS Manual will be provided 60 days prior to operation of any tailings management facility.

# 2. Scope and Objectives

This Plan is one of the documents that forms part of Sabina's overall Waste Management Program developed for the Project. This plan describes Sabina's approach to managing tailings that will be produced in the development and operation of the Project. This Plan includes details on the Back River Projects Tailings Management Facilities: the Tailings Storage Facility (TSF), and the Llama Tailings Facility (TF). This Plan includes where and how tailings will be stored and managed, tailings characteristics, and details related to the TSF design, operation, closure, and monitoring. This Plan does not address runoff from the TSF following facility closure. This runoff and associated monitoring are addressed in Sabina's Water Management Plan and closure approach is addressed in Sabina's Closure and Reclamation Plan.

The Plan applies to the Construction and Operations phases of the Project during which time tailings will be produced and has relevance to the Closure/Post-Closure phases as tailings will be permanently disposed of on the Property. The purpose of the Plan is to document the tailings management approach for the Project so that potential adverse environmental effects are identified and promptly mitigated, mitigation measures are proven successful, and relevant laws and regulations are complied with. Closure and reclamation of the tailings management facilities are addressed in detail in the Interim Closure and Reclamation Plan (ICRP).

The main environmental concerns related to tailings storage are the potential for dust to spread to the surrounding land and water, as well as potential effects of runoff and seepage on local water quality. The measures identified in this plan are intended to protect groundwater and permafrost, and the Project's Valued Ecosystem Components including air quality, surface water, water quality, sediment quality, aquatic habitat, fish, migratory birds, and terrestrial mammals.

## 2.1 RELATED PLANS AND STUDIES

This Plan is to be implemented in conjunction with various other Sabina management, mitigation, and monitoring plans. Plans that have relevance to this Plan include:

- Environmental Management and Protection Plan;
- Water Management Plan;
- Waste Rock Management Plan;
- Interim Closure and Reclamation Plan;
- Aquatic Effects Management Plan;
- Air Quality Monitoring and Management Plan; and
- Thermal and Geotechnical Monitoring Plan (*in prep.).*

The following reports and studies have also informed the development of this Plan:

- Tailings Management System Design Report (Sabina 2017a, Appendix F-4);
- Waste Rock Storage Area (WRSA) Design Report (Sabina 2017a, Appendix F-3);
- Geochemical Characterization Report (Sabina 2017a, Appendix E-3);

- Water and Load Balance Report (Sabina 2017a, Appendix E-2);
- Site Wide Water Management Report (Sabina 2017a, Appendix F-1);
- Multiple Accounts Analysis, submitted during FEIS Information Requests (Sabina 2016);
- Back River Project: Considering Climate Change in Tailings Storage Facility and Waste Rock Storage Areas Closure Strategy (Sabina 2017b, Appendix V4-3D); and
- Peer Review of the Back River Project Waste Rock and Tailings Closure Strategy (Sabina 2017b, Appendix V4-3E).

This plan is based on the tailings management system design report submitted as part of the Water Licence submission package (Sabina 2017a, Appendix F-4), which includes the following design details:

- Site Description, including topography, geology, climate, permafrost, hydrology, hydrogeology, and seismicity;
- Tailings Management System Concept, including storage requirements, and tailings physical and geochemical properties;
- TSF Containment Dam Design Criteria, including dam hazard classification, design life, tailings beach slope, stability criteria, inflow design flood, wave run-up, and freeboard and earthquake design;
- TSF Containment Dam Design, including foundation conditions, containment concept, geomembrane liner choice, and containment dam geometry;
- TSF Containment Dam components, including construction material specifications, seepage collection, and monitoring instrumentation;
- TSF Design Studies and considerations, including stability analysis, seepage analysis, thermal analysis, consolidation analysis, settlement, deformation (creep), dam break, and TSF water balance;
- Construction of TSF Containment Dam and South Dyke, including equipment, scheduling, material quantities and material geochemistry;
- Operation of the TSF and mined-out open pits used as TF, including a tailings deposition plan for the TSF; and
- Closure and reclamation of the Tailings Management Facilities.

# 3. Applicable Legislation and Guidelines

The TMP has been prepared to comply with existing regulations and follow the applicable guidelines provided by the federal government and the Government of Nunavut. The applicable regulations include:

- *Fisheries Act* (1985), including the *Metal and Diamond Mining Effluent Regulations* (SOR/2002-22);
- *Nunavut Environmental Protection Act* (1988);
- *Nunavut Land Claim Agreement Act* (1993);
- *Nunavut Waters and Nunavut Surface Rights Tribunal Act*, S.C. 2002, c 10 (Canada 2002); and
- *Nunavut Waters Regulations* (2013).

The Project is also bound by the requirements of Project Certificate, No. 007 and Type A Water Licence, 2AM-BRP1831.

In addition, Sabina commits to meeting the requirements of the Towards Sustainable Mining (TSM) Initiative. A component of the TSM Initiative is adherence to the TSM Tailings Management Protocol, which includes the following elements:

- Development of a tailings management policy and commitment (either as a stand-alone policy or as part of an overall environmental policy);
- Development of a tailings management system;
- Assignment of accountability and responsibility for tailings management;
- Conducting an annual tailings management inspection; and
- Preparation of an OMS Manual.

Sabina will also refer to the following Guidance Documents during Project development:

- TSM Tailings Management Protocol (MAC 2019a);
- A Guide to the Management of Tailings Facilities (MAC 2019b);
- A Guide to Audit and Assessment of Tailings Facility Management (MAC 2011c);
- 2013 Canadian Dam Safety Guidelines (Canadian Dam Association [CDA] 2013);
- 2014 Application of Dam Safety Guidelines to Mining Dams (CDA 2014); and
- Developing an Operation, Maintenance, and Surveillance Manual for Tailings and Water Management Facilities (MAC 2011d).

# 4. Roles and Responsibilities

The General Manager is ultimately responsible for the success of the Tailings Management Plan and approves all relevant policies and documents, auditing, action planning, and the verification process.

The General Manager along with his/her direct reports is responsible for specifics of this Plan including:

- Overall management and execution of the Plan;
- Operational aspects; and
- Internal reporting.

The Environmental Superintendent along with his/her direct reports is responsible for:

- Monitoring;
- External reporting; and
- Verifying compliance and adaptive management.

Further definition of the site management structure, organizational chart, and a list of designated personnel responsible for aspects of this Plan will be provided in future revisions of the Plan or a replacement OMS Manual in compliance with MAC requirements.

# 5. Planning and Implementation

## 5.1 TAILINGS PRODUCTION AND STORAGE

Approximately 12.4 Mt of tailings will be produced over the 12-year life of mine. All tailings will be deposited as slurry. Initially, tailings will be deposited in the TSF, which is the only purpose-built tailings management facility on-site. Tailings deposition will transition Llama Open Pit once mining operations have ceased in that location (called Llama TF). As permitted under Water Licence 2AM-BRP1831, other site effluent will also be directed to these facilities, including effluent from the WRSAs, the Ore Stockpile, and the ANFO Plant and Primary Water Pond water, as well as sewage and effluent from other facilities that do not meet their discharge criteria.

The Operations Phase is described in stages according to the tailings storage and water management plans, as follows:

- Stage 1 – Tailings Storage Facility – For the first five years of Operations (Years 1 to 5), a purpose-built TSF will be utilized; and
- Stage 2 – Llama Tailings Facility (Llama TF) – From Year 5 onward, tailings will be disposed of in the mined-out Llama Open Pit.

The tailings management strategy has been developed based on the principle of maximizing the use of open pits for tailings storage. To that end, tailings will be stored in mined-out open pits as soon as the pits are available for tailings deposition. The purpose-built TSF is located on Crown land and in the area of a natural depression about 2 km south of Goose Main Open Pit. Containment will be achieved with construction of a frozen foundation dam with a geosynthetic clay liner (GCL) on the northern end of the facility (TSF Containment Dam), and a small control structure at the south end of the facility (TSF South Dyke). Three small streams and four ponds are located within the footprint of the TSF and will be covered by the facility as shown on 2020 Modification Package Appendix A, Figure 3. A plan view of the TSF Containment Area is shown in Figure A-01.

Tailings deposition will begin in the TSF at the start of Operations for approximately five years. Tailings deposition will then transition from the TSF to in-pit deposition in the mined-out Llama Pit for the remaining seven years of the mine life. A summary of the Tailings Management System storage requirements is outlined in Table 5.1-1.

**Table 5.1-1. Back River Property Tailings Management System Storage Requirements**

| Location | Period (Year and Quarter) | Tailings (Mt) | Tailings ($Mm^3$*) |
|---|---|---|---|
| TSF** | Y1 Q1 to Y5 Q1 | 4.4 | 3.8 |
| Llama TF | Y5 Q2 to Y12 Q4 | 8.0 | 6.7 |
| Total Project | Y1 Q1 to Y10 Q2 | 12.4 | 10.3 |

**The tailings density is 1.2 $t/m^3$.*

***this could occur as early as Y-1 Q4.*

After tailings deposition transitions from the TSF to the Llama TF in Year 5, 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. Potentially acid-generating (PAG) waste rock will be placed over the tailings and eventually covered with a non-potentially acid generating (NPAG) waste rock cover for closure (Figure A-02 and A-08). Placement of waste rock over the tailings will provide protection of the tailings from the active layer and promote permafrost aggredation into the tailings.

### 5.1.1 Tailings Physical Characteristics

Physical properties of the tailings include the following:

- Solids Content: 49% solids (by weight);
- Tailings Solids Specific Gravity: 2.9;
- Settled Density: 1.2 t/m$^3$;
- Plasticity: non-plastic; and
- Particle size ($P_{80}$): approximately 50 μm.

### 5.1.2 Tailings Geochemical Characteristics

Tailings geochemical characterization confirms that tailings will be PAG and metal leaching (ML) (Sabina 2017b, Appendix E-3). The projected lag to onset of acid generation in mixed Goose Main and Llama tailings deposited in the TSF is anticipated to be greater than 10 years in site-specific conditions; nonetheless, tailings will be managed to reduce the potential for acid rock drainage (ARD) and manage ML. Process water discharged as supernatant water with the tailings has the potential to contain elevated metal concentrations, including arsenic (As), copper (Cu) and iron (Fe). There is currently no planned discharge of tailings supernatant water during Operations. Should a controlled discharge be required during Operations the requirements for doing so will include the development of a Temporary Tailings Effluent Discharge Plan to be submitted 120 days prior to release as required by Part F, Item 16 of the Licence and discussed in Section 8.

Exposed tailings beaches may be an ongoing source of sulphate and arsenic leaching; pH changes may result in increased concentrations of other trace elements if tailings are left exposed for an extended period of time (estimated to be decades). However, the development of acidic conditions is expected to be delayed considerably by the cold temperatures, with the alkalinity from the deposition of fresh tailings helping to maintain neutral pH conditions. In addition, exposed tailings beach runoff accounts for approximately 8 to 11% of the water entering the tailings supernatant pond, and therefore it is expected to have a relatively small effect on pond water quality. At Closure, NPAG waste rock will be used to cover tailings material in the purpose-built TSF. The resulting aggradation of permafrost will minimize infiltration and development of ML/ARD conditions. Tailings in the Llama TF will be deposited sub-aqueously and flooded with a permanent water cover at Closure, which will prevent acidic conditions from developing.

Sabina commits to test a mixture of tailings and water treatment plant sludges to evaluate the potential for remobilization of arsenic from this material. Tests will be conducted in the first year that water treatment plant sludges are produced. Sabina commits to provide their proposed testing method to the KIA for review and approval prior to initiating these tests, and will provide the results of the testing in the annual monitoring report.

## 5.2 TAILINGS STORAGE FACILITY

### 5.2.1 Tailings Storage Facility Design Basis

The design of the TSF has incorporated the following requirements:

- Applicable Legislation and Guidelines;
- Permanent storage of tailings solids within an engineered disposal facility;
- Control, collection, and recovery of tailings process water and runoff water from within the TSF for recycling to the Process Plant as reclaim water;
- Minimizing seepage losses from the TSF, conducting seepage monitoring, and constructing a seepage collection system downstream of the TSF Dam to minimize adverse downstream water quality impacts;
- Integration of the tailings management facilities into the overall mine site water management requirements;
- Designing for closure;
- The inclusion of freeboard allowance for ice entrainment, storm water management, wave run-up, potential embankment settlement, and other contingencies such as varying tailings deposition slopes; and
- The inclusion of monitoring features for all aspects of the facility.

The design basis is summarized in Table 5.2-1.

**Table 5.2-1. Tailings Storage Facility Design Basis Summary**

| Component | Criteria |
|---|---|
| Dam Hazard Classification | High |
| Design Life:<br>Active use period as water retaining structure<br>Use as active water retaining structure<br>Total life until breach | <br>5 years<br>7 years<br>12 years |
| Dam staging | None |
| Tailings production rate | Ramp up period, with a maximum rate of 3,000 t/d |
| Tailing slurry content | 49% solids (by weight) |
| Tailings solids specific gravity | 2.9 |
| Tailings settled density | 1.2 t/$m^3$ |
| Tailings storage requirement:<br>By Mass<br>By Volume | <br>4.4 Mt<br>3.8 $Mm^3$ |
| Ice entrainment allowance:<br>Percentage of tailings capacity<br>By Volume | 20%<br>0.73 $Mm^3$ |
| Contact water storage requirement | Average during operations 0.8 $Mm^3$<br>95$^{th}$ percentile during operations 1.1 $Mm^3$<br>Maximum at TSF closure 0.174 $Mm^3$ (1:100-year) |

| Component | Criteria |
| --- | --- |
| Total TSF storage requirement (tailings, ice entrainment, and contact water) | Average during operations 5.1 $Mm^3$<br>95th percentile during operations 5.4 $Mm^3$ |
| Tailings beach slope | |
| Subaerial tailings | 1% |
| Subaqueous tailings | 1% |
| Tailings deposition method | Single point spigot subaerial discharge (five locations over the life of facility) |
| Maximum design earthquake | 1:2,475 year recurrence event; PGA* of 0.036 g |
| Inflow design flood | probable maximum precipitation depth, approx. 221 mm |
| Freeboard requirement: | |
| Wind Setup and Wave run-up allowance | 1.2 m |
| Probable maximum flood storage allowance | 0.6 m |
| Total freeboard (sum of above) | 1.8 m |
| Stability Factors of Safety (Static) | 1.3 during construction<br>1.5 during operation and closure |
| Stability Factors of Safety (Pseudo-Static) | 1.0 |

**PGA = peak ground accelerations*

### 5.2.2 Dam Hazard Classification

The design, construction, operation, and monitoring of dams, including tailings dams, will be completed in accordance with appropriate Provincial and Federal regulations and industry best management practices. The primary industry guidance documents as developed by the CDA, including the 2013 Canadian Dam Safety Guidelines (CDA 2013), and the dam safety guidelines specific to mining dams (CDA 2014), were used by Sabina in defining a Dam Hazard Classification for the TSF Containment Dam.

Assessment of the dam hazard classification was carried out to determine the appropriate design earthquake and flood events for the TSF. Selection of the design earthquake is based on the classification criteria provided by the CDA and summarized in Table 5.2-2. The TSF Dam classification was carried out by considering the potential incremental consequences of an embankment failure. The incremental consequences of failure were defined as the total damage from an event with dam failure minus the damage that would have resulted from the same event had the dam not failed. Three categories of losses were considered: loss of life; environmental and cultural values; and infrastructure and economics, as shown on Table 5.2-2.

The Property is located in an extremely remote area with no major development other than those associated with the Project itself. The potential for loss of life due to a dam failure is therefore very low. A Dam Classification of “High” has been selected for the TSF based on the impact to environmental and cultural values (i.e., expected loss or deterioration of fish or wildlife habitat where restoration or compensation in kind is highly possible).

**Table 5.2-2. Tailings Storage Facility Dam Classification**

| Dam Class[2] | Population at Risk | Incremental Losses[1] Loss of Life[3] | Environmental and Cultural Values | Infrastructure and Economics |
|---|---|---|---|---|
| Low | None | 0 | Minimal short-term loss.<br>No long-term loss. | Low economic losses; area contains limited infrastructure or services. |
| Significant | Temporary only | Unspecified | No significant loss or deterioration of fish or wildlife habitat.<br>Loss of marginal habitat only.<br>Restoration or compensation in kind highly possible. | Losses to recreational facilities, seasonal workplaces, and infrequently used transportation routes. |
| High | Permanent | 10 or fewer | Significant loss or deterioration of *important* fish or wildlife habitat.<br>Restoration or compensation in kind highly possible. | High economic losses affecting infrastructure, public transportation, and commercial facilities. |
| Very High | Permanent | 100 or fewer | Significant loss or deterioration of *critical* fish or wildlife habitat.<br>Restoration or compensation in kind is possible but impractical. | Very high economic losses affecting infrastructure or services (e.g., highway, industrial facility, storage facilities for dangerous substances). |
| Extreme | Permanent | More than 100 | Major loss of *critical* fish or wildlife habitat.<br>Restoration or compensation in kind impossible. | Extreme losses affecting critical infrastructure or services (e.g. hospital, major industrial complex, major storage facilities for dangerous substances). |

*1) Reproduced from Table 2-1 of the Canadian Dam Association's Dam Safety Guidelines (CDA 2013).*
*2) Definitions for Population at Risk:*
***None** - There is no identifiable population at risk, so there is no possibility of loss of life other than through unforeseeable misadventure.*
***Temporary** – People are only temporarily in the dam-breach inundation zone (e.g., seasonal cottage use, passing though on transportation routes, participating in recreational activities).*
***Permanent** – The population at risk is ordinarily located in the dam-breach inundation zone (e.g., as permanent residents); three consequence classes (High, Very High and Extreme) are proposed to allow for more detailed estimates of potential loss of life (to assist in decision-making if the appropriate analysis is carried out).*
*3) Implications for Loss of Life:*
***Unspecified** - The appropriate level of safety required at a dam where people are temporarily at risk depends on the number of people, the exposure time, the nature of their activity, and other conditions. A higher class could be appropriate, depending on the requirements. However, the design flood requirement, for example, might not be higher if the temporary population is not likely to be present during the flood season.*

Inflow Design Flood

The selection of an Inflow Design Flood is governed by the dam classification. Based on the dam hazard classification of High, the guidelines (CDA 2014) recommend the use of an operational inflow design flood of 1/3 between the 1:1,000 return period 24-hour duration precipitation event and the probable maximum precipitation for this region. Notwithstanding this criterion, the TSF has been conservatively designed to maintain a minimum freeboard below the top of the liner to contain 100% of the probable maximum precipitation depth of 221 mm. The TSF Dam crest has also been designed to maintain freeboard that accounts for wind setup and wave run-up, which is an additional 1.2 m. The total freeboard allowance is 1.8 m and has been designed to avoid the requirement of a constructed permanent spillway for a facility with such a short lifespan. Figure A-06 and A-07 show the required freeboard for the TSF above the pond full supply level.

Design Earthquake

Based on the dam hazard classification of High for the TSF, the Dam Safety Guidelines (CDA 2013, 2014) recommend the seismic stability analysis be completed assuming the peak ground accelerations (PGA) for 1:2,475 year event, which resulted in a PGA of 0.036 g. Further details on seismic analysis can be found in Appendix F-4 of the Type A Water Licence Application (Sabina 2017a).

### 5.2.3 Seepage Analysis

The water retention capability of the TSF Containment Dam relies on the GCL being keyed into the permafrost foundation or competent bedrock. Thermal modeling indicates that the foundation of the dam will remain frozen, thus the seepage through the foundation is expected to be negligible.

Sabina commits to a quality assurance/quality control (QA/QC) program during liner installation. Properly installed liner combined with swelling of the bentonite in the liner as it is hydrated is expected to seal most defects such that seepage is controlled by the hydraulic conductivity of the GCL. A comprehensive calculation of the seepage through the liner was completed, and with the TSF at full supply level (FSL), seepage is estimated to be up to 1,210 $m^3$/year; this equates to seepage rates of $10^{-5}$ $m^3/s$ (Sabina 2017a, Appendix F-4). Seepage is expected to decrease as the supernatant pond is removed.

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.

Sabina commits to undertake an infill geotechnical program that will include drillholes to further characterize foundation conditions at the TSF Containment Dam, as well as areas where fractured bedrock zones were identified in the west abutment of the dam, and along the western ridge of the facility that will constrain tailings. It is intended that drillholes will recover frozen overburden core and extend sufficiently to characterize bedrock; a subset of the core will be collected for geotechnical analysis. Packer testing will also be completed in select drillholes to evaluate bedrock hydraulic conductivity. This information will be used to inform updated seepage analyses and thermal modelling along critical cross-sections of the TSF Containment Dam, and, if appropriate, the western ridge; this infill geotechnical program is in accordance with NIRB PC T&C 13 and 18.

Where the results of this program show the potential for seepage, Sabina commits to the establishment of a monitoring program with the capability of determining that contaminants are being contained within the facility. Sabina will provide sufficient justification where the program results determine that additional monitoring is not required beyond what is currently planned for the TSF.

### 5.2.4 Stability Analyses

A comprehensive stability analysis was carried out to confirm whether the TSF meets the appropriate design requirements outlined above. The stability assessment took into consideration the location and layout of the GCL as the potential weakest element of the dam associated with upstream slope stability.

Analysis was completed on two models; the first (Model A) assumed the TSF was empty (i.e. immediately following construction), and the second (Model B) considered the TSF operations phase with the pond at the full supply level. Both static and pseudo-static scenarios were assessed for each model using a PGA of 0.036g (1:2,475 year seismic event). The results indicate that in all cases the design Factor of Safety complies with the minimum required (Sabina 2017a, Appendix F-4).

As precedent, both the Meliadine Project and the Diavik Mine are located in the same low-seismicity central part of Canada and have completed the comparable level of seismic analysis of their tailings storage facilities. A site-specific seismic assessment was not considered to be required for those facilities. Based on the TSF design completed to date, no further site-specific stability assessment is considered to be required.

### 5.2.5 Climate Change

Climate change considerations were incorporated into the design of the Project, including the TSF and TF (Sabina 2017a, Appendix F-3 and Appendix F-4). The life of the Project is relatively short such that climate change impacts will be most relevant to these project components in the Post-Closure Phase.

The TSF cover consisting of 5 m of NPAG waste rock is expected to promote permafrost aggredation into the tailings and PAG waste rock, and to maintain frozen conditions in the tailings even under conservative climate change models (Sabina 2015, Appendix V4-3B). For additional information refer to FEIS Addendum Volume 4, Appendix V4-3D and Appendix V4-3E (Sabina 2017b).

Other climate change impacts such as increased precipitation, are not expected to meaningfully impact the Tailings Management Facilities in the Post-Closure Phase.

### 5.2.6 Tailings Storage Facility Embankment Construction

<u>Construction Schedule</u>

The TSF Dam will be constructed prior to the Goose Process Plant starting production. The key trench excavation and backfill will be completed in the winter to eliminate potential issues caused by thawing of the soft overburden soils in the TSF Dam foundation. The horizontal liner below the upstream portion of the dam, and a minimum of 2 m of the dam bulk fills, will also be placed in the winter to provide a thermal blanket to protect permafrost in the foundation.

Site and Foundation Preparation

Prior to construction of the TSF, some preparation work is necessary, specifically the foundations of the TSF embankments. Organic material will be stripped and disposed of in a WRSA. Excavation of the key trench must be completed in the winter when the ground is completely frozen. This is necessary to keep the foundation as cold as possible to limit the potential for thawed ground within the dam foundation. Drill and blast methods will be required to excavate the key trench, and due to the possible high ice content and nature of the soils, a tight drill pattern and high blast load factor is expected to be required. The excavated material will be hauled away and disposed of in a WRSA.

Figure A-03 shows a plan and profile of the TSF including foundation conditions and zones of expected shallow and deep bedrock.

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. In the deep overburden foundation zones (Figure A-05), the key trench will terminate on frozen overburden soil; however, should any massive ice or high interstitial ice zones (more than 10% visible ice or greater than 30% water content) be encountered, the key trench will be deepened until the massive ice has been removed.

Tailings Storage Facility foundation preparation will require establishing sediment and erosion control best management practices throughout the construction area. Other preparation work will include the construction of a downstream berm, seepage collection and recycling measures, and TSF access roads.

Embankment Components

The figures in Appendix A present plan views and typical cross sections of the TSF. The main components of the TSF embankments are as follows:

- Key Trench:
  - 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 key trench will terminate on clean exposed bedrock. In the deep overburden foundation zones, the key trench will terminate on frozen overburden soil.
- Pony Wall:
  - In the shallow bedrock foundation zone, a reinforced concrete pony wall will be cast to attach the GCL to bedrock. The pony wall will be doweled to the bedrock to provide a good bond and will span the length of the shallow foundation zone.
- Geosynthetic Clay Liner:
  - The GCL will be the low permeability element of the dam and will be placed into the frozen foundation key trench to provide a continuous low permeability cut-off. The top edge of the GCL will be terminated in an appropriately sized anchor trench within the dam bulk fills and covered with 1 m of fill.
  - Where the pony wall is present, the GCL will be attached to the pony wall with a metal strip and anchor bolts.
  - In the base of the key trench, the GCL will be placed directly onto the prepared and clean foundation, with imperfections filled with granular bentonite.

  - In all other areas, the GCL will be sandwiched between two compacted layers of crushed gravel (pea gravel size).

- Dam Bulk Fill:

  The bulk fill of the TSF Dam, including the key trench, will consist of run-of-mine (ROM) waste rock. The waste rock will be well graded and have a maximum particle size of 600 mm.

- Transition Zone:

  - The GCL is protected using a fine crushed gravel (pea gravel) produced from ROM waste rock. To provide filter compatibility, a transition zone of 150 mm minus crushed ROM waste rock will be placed between the liner bedding and dam bulk fill zones.

- Bedding Layer:

  - The GCL will be sandwiched between two 0.3 m-thick compacted layers of bedding material for protection. This material will be crushed ROM waste rock. The gravel will be pea gravel size.

- Upstream Dam Shell:

  - The upstream dam shell will be constructed using the same ROM waste rock as the dam bulk fill. Consideration will be given to using more uniformly graded material on the upstream face, with less fines to reduce the potential for erosion.

- South Dyke:

  - A small retaining dyke is required along the southern end of the TSF to contain the tailings within the TSF and the Potential Development Area. This structure will be a saddle dyke built of ROM waste rock with a length of approximately 200 m, a maximum height of just over 3 m, and a crest width of 6 m.
  - No key trench is planned for this structure and no impermeable liner is planned because tailings will be deposited against the dyke and are expected to push the water away from the structure and direct it downstream towards the north end of the facility. Careful deposition, including active monitoring, will be conducted during initial tailings deposition adjacent to the South Dyke to confirm the structure is performing as designed.

Borrow material and aggregate for embankment construction will be sourced from waste rock storage areas, local borrow pits, the Airstrip Quarry, or the Umwelt Quarry. Refer to the Borrow Pits and Quarry Management Plan for additional detail.

Instrumentation

A series of ground temperature cables will be installed at the TSF Containment Dam to monitor the thermal regime in the dam, key trench, and foundation under the Thermal and Geotechnical Monitoring Program. Vertical ground temperature cables will be installed in bore holes drilled through the dam fill after the completion of the dam and will extend through the downstream side of the key trench and through the foundation soils. Horizontal ground temperature cables will be placed within the liner cover zone along the upstream side of the key trench. Survey prisms will be installed on the dam crest and downstream slope to monitor deformation.

The instrumentation will assess embankment performance and help identify if conditions differ from those assumed during design and analysis. Amendments to the designs and/or remediation work can be implemented to respond to changed conditions, should the need arise. Refer to Section 7 for monitoring requirements, and Section 8 for contingencies, mitigation and adaptive management.

### 5.2.7 Tailings Storage Facility Operations

Tailings water from the TSF supernatant pond will be recycled and reused in the Process Plant as reclaim water, with no planned discharge from the TSF during Operations. Should a controlled discharge be required during Operations, all effluent will meet relevant regulations or site specific water quality objectives. The tailings distribution system is designed for a daily production rate of 3,000 tonnes per day. Water will be reclaimed from the TSF through the reclaim barge at an average rate of 2,100 $m^3$/d. The water balance is presented in the Water Management Plan.

To address the concern of potential seepage from the TSF, a seepage collection system will be constructed downstream of the TSF Dam. The seepage collection system includes a downstream berm with a low permeability liner keyed into the permafrost. Depending on the water quality, seepage may be directed to sumps, from where it will be pumped back into the TSF.

The design of the TSF has incorporated a freeboard allowance for ice entrainment, storage of the inflow design flood and wind setup in addition to the operating pond. Construction of the TSF Dam is planned to be completed in one stage with the supernatant water progressively reclaim through the Process Plant until end of Operations. As such, the TSF is only expected to be near its design capacity for a short period of time immediately prior to transitioning to the next tailings facility.

For additional details on operational monitoring, refer to Section 7.

<u>TSF Tailings Deposition Plan</u>

The TSF tailings deposition plan proposes discharge from multiple points within the TSF over the life of the facility, representing multiple periods in the deposition and tailings beach development. As part of this deposition plan, tailings will be deposited from the crest of the South Dyke to fill in the southern end of the TSF, which will create a sloped surface that will direct the tailings and the water away from this structure. Tailings discharge locations can be seen in Figure A-01.

### 5.2.8 Tailings Storage Facility Closure

Closure approach and activities are described in the Interim Closure and Reclamation Plan. In general, Closure of the TSF will begin as progressive reclamation while the facility is still in operation. PAG and NPAG waste rock from open pit developments will be used to cover the tailings surface. This entire covered surface, whether PAG waste rock or tailings, will receive a final NPAG waste rock cover at least 5 m thick (Figures A-02 and A-08). This cover is expected to promote permafrost aggredation into the tailings, and to maintain frozen conditions in the tailings in the long term. The majority of the NPAG waste rock cover will be placed by Year 6, and then waste rock placement will pause, with material being stockpiled within the footprint of the TSF, until the supernatant pond is fully reclaimed through the Process Plant in Year 12. The small outstanding portion of NPAG waste rock cover will then be moved into final placement at the TSF WRSA. The Project phases and stages, along with waste rock disposal scheduling, is outlined in the ICRP.

### 5.2.9 Tailings Management Alternatives

Using the Guidelines for the Assessment of Alternatives for Mine Waste Disposal (ECCC 2011), Sabina completed a multiple accounts analysis for tailings locations and disposal technologies. The chosen TSF location was selected based on proximity to the plant site and local topography, foundation conditions, and input from the landowners. The assessment also concluded that the most appropriate tailings deposition method is conventional slurry tailings. Details of the assessment are found in the Integrated Mine Waste Disposal Alternatives Assessment that was submitted February 2016 as part of the FEIS

Information Request Response Package (Sabina 2016). Sabina received notice that the Schedule 2 listing required under the MDMER for the Tailings Storage Facility was completed in June, 2020.

## 5.3 TAILINGS FACILITIES IN OPEN PITS

The exhausted Llama Open Pit will be converted into a TF and be used for the storage of tailings when the TSF has ceased operations .

### 5.3.1 Tailings Facility Construction and Operation

The open pits will be readily convertible to store tailings and will operate similarly to conventional above-ground tailings storage facilities.

Tailings will be deposited subaqueously in the mined-out open pits by using a single spigot discharge point. This discharge location within the TF will be changed over the life of deposition so that a near struck tailings surface is created. A reclaim barge will be located within each TF during its operation; water (supernatant) contained in the TF will be reclaimed and reused in the Process Plant.

Water from the Llama TF will be treated year-round during the Operations phase beginning in Year 5; this treated water will be withdrawn from Llama TF and discharged back into Llama TF. Based on the Water and Load Balance Report, water treatment is not required in the Closure Phase to meet discharge water quality objectives for the external receiving environment. See the Water Management Plan for additional details.

The TF will be filled to a maximum of 5 m below their overflow elevations to provide sufficient storage for water to passively accumulate in the TF to form a permanent water cover.

Details on water storage capacity of TF, and water treatment can be found in the Water Management Plan.

### 5.3.2 Tailings Facility Closure

Closure approach and activities are described in the Interim Closure and Reclamation Plan. The Llama TF will be closed once tailings deposition in this location ceases. The closure will entail a permanent water cover of 5 m which is deemed sufficient to limit resuspension of tailings solids due to wave action, surge following storm events, and ice scour. Water treatment is expected to only be necessary during Operations. The Llama TF may also be used to store non-hazardous waste from the final mine closure activities; further details can be found in the ICRP.

# 6. Environmental Protection Measures

## 6.1 MANAGEMENT OF SEEPAGE FROM THE TAILINGS STORAGE FACILITY

The overburden soils downstream of the TSF Dam are not considered conducive to constructing seepage collection ditches or drains. Therefore, seepage collection will be completed by constructing a berm downstream of the dam. The berm will incorporate a low permeability liner keyed into the permafrost. Depending on the quality of seepage water, it may be directed to sumps from where it will be pumped back into the TSF. Additional details on ditches and berms can be found in the Water Management Plan.

The above described seepage management process will continue, as required, into the Closure Phase but seepage is expected to significantly reduce over time with the cessation of tailings deposition and removal of the supernatant pond. In addition, placement of waste rock over the tailings will promote the aggradation of permafrost into the tailings over time. The TSF will be instrumented to monitor foundation temperatures below the TSF Dam, within the tailings, and within the final waste rock cover (see Section 7).

## 6.2 EFFLUENT DISCHARGES

Supernatant water contained in the TSF and the TF will be reclaimed and reused in the Process Plant. Discharges from the TSF and TF are not planned while they are operational, and supernatant will be removed from the TSF prior to it being converted into a WRSA. Discharges from the TF are not possible until the pits have passively filled as part of intended closure.

Water treatment details, reclaim rates, discharge criteria, and Post-Closure discharges from the TF are discussed in the Water Management Plan and the ICRP.

## 6.3 DUST MANAGEMENT

The possible sources of dust related to tailings management during the construction, operation, and closure of the tailings management facilities include:

- TSF Dam foundation construction prior to placement of tailings;
- Wind erosion of fine particles from the TSF surface;
- Vehicle traffic dislodging fine particles from the TSF/TF associated service and haul roads; and
- Placement of closure and capping layers.

Dust suppression measures typical of the current mine practices (i.e., Meliadine Project and Meadowbank Mine), and consistent with best management practices, will be considered through the Construction, Operations, and Closure phases of the Project to control dust.

Minimal site preparation is required for TSF construction; therefore, dust is not expected to be problematic during the Construction Phase. While the TSF is in operation, dust is not expected to have a significant impact; however, dust will be monitored and managed to the best extent possible through Sabina's Air Quality Management and Monitoring Plan (AQMMP). While a supernatant pond will cover a portion of the tailings surface, a tailings beach will be exposed that can generate wind-blown tailings. Dust related to TSF operation during the winter season is expected to be minimal due to snow cover over the tailings and a frozen crust over areas that are not near the active deposition. The summer season is expected to have the highest potential for dust generation, and will be managed by limiting the volume of tailings surface not under water. Dust mitigation measures will be applied as identified in the AQMMP.

After the operational life of the TSF, the supernatant pond will be progressively reclaim through the Process Plant until the end of Operations. Waste rock will also begin being placed over tailings while the TSF is in use; this waste rock cover will limit the amount of time the tailings beach will be susceptible to wind erosion. The TSF will be fully covered by early Closure to prevent further wind erosion of the tailings. The need for dust control during cover placement will be further evaluated during closure activities.

Dust in not expected to be an issue during the operation and closure of the Llama TF as the facility will maintain a permeant water cover during Operations and Closure, and as such, no wind erosion is anticipated at these facilities.

# 7. Monitoring Program

Routine inspections of the TSF during the construction and operations of the facility will include:

- Regular monitoring of the tailings disposal and tailings beach formation;
- Regular monitoring of the tailings supernatant water level;
- Visual inspections of the tailings embankment including seepage, during periods of flow, etc.;
- Grab sampling of tailings and treatment sludges as they are produced to confirm the potential for remobilization of arsenic from these materials remains within predicted levels; and
- An annual third-party geotechnical inspection of all earthworks including the TSF and TF is included under the Thermal and Geotechnical Monitoring Plan.

All testing will be completed in a certified laboratory and appropriate quality assurance/quality control measures will be applied.

A Field Characterization Program will also be conducted prior to the construction of the TSF dam. The information from the field characterization will ensure that the design meets the required intent of managing seepage through both the foundation and the body of the TSF Dam. If, based on this additional characterization, Sabina believes that there remain areas where seepage could occur, Sabina will install the necessary monitoring instrumentation to confirm the performance of the TSF Dam and the TSF WRSA Diversion Berm. This program will include an infill geotechnical characterization program of the western ridge adjacent to the TSF Containment Dam to determine the extent of the fractured bedrock contact zone and apply proposed mitigation as necessary. This will include permeability testing, seepage analysis, and planning for thermal monitoring of the western ridge, where appropriate. Percolation testing will include a series of shallow drillholes (approximately 10 m deep) which are completed using a blast hole drill at close spacing (about 25 m) along both the upstream and downstream extent of the key trench. The drill cuttings from each of the drill holes are collected, logged, sampled. In addition, select samples are tested for salinity and water content (which indicates ice content). Next, a falling head hydraulic conductivity test is completed on each drill hole, using heated water if conditions require it. This is a standard construction procedure for any frozen dam and the information collected in this fashion confirms foundation excavation depth.

A portion of the initial infill geotechnical drilling targeting the western ridge and the TSF Containment Dam has already been completed. The remaining infill geotechnical drill program will be completed as part of further characterization carried out immediately prior to TSF Dam construction.

Geotechnical and thermal monitoring instrumentation installed in the TSF Dam embankment and foundation (ground temperature cables and survey prisms) over the life of the Project will be conducted under the Thermal and Geotechnical Monitoring Plan. The instrumentation will be monitored to assess embankment thermal and stability performance, and to identify if conditions differ from those assumed during design and analysis. Amendments to the designs and/or remediation work can be implemented to respond to the changed conditions, should the need arise. A monitoring response framework will be developed as part of the Operation, Maintenance, and Surveillance Manual that will include quantitative performance objectives (threshold values, required actions, and personnel responsibilities).

Additional details on monitoring frequency, inspection plans, mine site water quality monitoring and receiving water quality monitoring can be found in the Water Management Plan, Appendix B.

Runoff water quality monitoring will be conducted as described in the Water Management Plan and prescribed in the Type A Water Licence. For details on TSF monitoring during Closure, please refer to the ICRP.

# 8. Contingencies, Mitigation, and Adaptive Management

The mine design, including the Tailings Management Facilities' designs, has been carefully prepared taking into consideration the vast database of site characterization data gathered for the Project, coupled with rigorous engineering analysis. Where data was limited, conservative assumptions were consistently applied. There is therefore a high level of comfort that the plans are viable and realistic. It is however understood that mining activities by nature have inherent uncertainty. Additional mitigation or adaptive management may be required as an outcome of conditions observed during the monitoring activities described in Section 7. This may include changes to TSF or TF operation as a result of operational, engineering, and environmental monitoring.

Possible tailings scenarios that could be encountered during Operations, and possible contingency strategies to address are outlined Table 8-1. Additional details on TSF WRSA closure and waste rock management contingency strategies can be found in the Mine Waste Rock Management Plan.

**Table 8-1. Tailings Management Contingency Strategies**

| Possible Scenario | Contingency Strategy |
|---|---|
| The total volume of tailings might be greater than expected. | There is contingency built into the TSF capacity and additional capacity is available in the open pits to accommodate greater volumes of tailings. |
| The slope of the tailings beach might be different than expected. | Additional tailings discharge (spigot) points may be considered. |
| The tailings dry density may be different than expected. | Less dense tailings will occupy more space; however the TSF has contingency storage and additional capacity is available in the open pits. |
| The total volume of seepage might be greater than expected. | Larger return pumps may be considered. The tailings deposition plan may be modified to push the pond away from the TSF Dam to reduce seepage. |
| The impact to the underlying permafrost might be greater than expected from thermal modelling. | Retroactive design changes to the TSF Dam could include tailings deposition upstream of the dam, placement of GCL over original ground upstream of the dam to lengthen the seepage path through the foundation, and/or installation of vertical thermosiphons. |
| The tailings material might oxidize faster than expected. | Some additional water treatment may be required until the tailings freeze. |

Should contingency measures be implemented in the form of using other open pits as TFs (i.e., Llama and Echo pits), Sabina intends to provide the NWB at least 60 days' notice prior to the disposal of waste in the TFs and will present the following information: waste disposal quantities, volumes, disposal timing, maximum pit capacity, effects to pit closure, and appropriate mitigation and monitoring plans.

Should temporary discharge be required from a tailings facility to the environment for any reason, a Temporary Tailings Effluent Discharge Plan would be submitted to the NWB at least 120 days prior to this discharge, as required by Part F, Item 16 of the Licence. This plan would include the following: justification for temporary discharge; volume, rate, and quality of discharge; final discharge point and characteristics of the receiving environment; proposed effluent quality limits; and mitigation options to avoid future discharges.

# 9. Environmental Reporting

Monitoring results will be reported in the annual reports filed with the NIRB and the NWB. Results of water quality or waste monitoring required under the Water Licence will be reported monthly and/or annually to the NWB, in accordance with the requirements of Water Licence 2AM-BRP1831.

As required by Part D, Item 4, of the Licence, the results of the infill geotechnical characterization program as discussed during permitting of the Project will also be reported. This submission shall include a description of the necessary monitoring instrumentation to confirm performance of the TSF Dam.

# 10. 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.

CDA (Canadian Dam Association). 2013. Dam Safety Guidelines 2007, 2013 edition.

CDA. 2014. Technical Bulletin: Application of Dam Safety Guidelines to Mining Dams. 2014.

ECCC (Environment and Climate Change Canada). 2011. Guidelines for the Assessment of Alternatives for Mine Waste Disposal. Available at: http://www.ec.gc.ca/pollution/default.asp?lang=En&n=125349F7-1&offset=2&toc=show

MAC (Mining Association of Canada). 2011c. *A Guide to Audit and Assessment of Tailings Facility Management*. Available at: http://www.mining.ca/site/index.php/en/towards-sustainable-mining/performance-measures-a-protocols.html.

MAC. 2011d. *Developing an Operation, Maintenance, and Surveillance Manual for Tailings and Water Management Facilities*. ISBN 0-921108-25-7. Available at: http://www.mining.ca/site/index.php/en/towards-sustainable-mining/performance-measures-a-protocols.html.

MAC. 2019a. *Towards Sustainable Mining Tailings Management Assessment Protocol – February 2019*. Available at: https://mining.ca/wp-content/uploads/2019/03/Tailings-Management-Protocol_2019-final.pdf.

MAC. 2019b. *A Guide to the Management of Tailings Facilities, Version 3.1 – February 2019*. Available at: https://mining.ca/wp-content/uploads/2019/03/MAC-Tailings-Guide_2019.pdf

NIRB (Nunavut Impact Review Board). 2013. *Guidelines for the Preparation of an Environmental Impact Statement for Sabina Gold & Silver Corp.'s Back River Project*. NIRB File No. 12MN036).

NWB (Nunavut Water Board). 2010a. Mining and Milling Supplemental Information Guideline (SIG) for Mine Development (MM3). February 2010.

NWB. 2010b. Miscellaneous Supplemental Information Guideline (SIG) for General Water Works (including crossings, flood control, diversions, and flow alterations) (M1). February 2010.

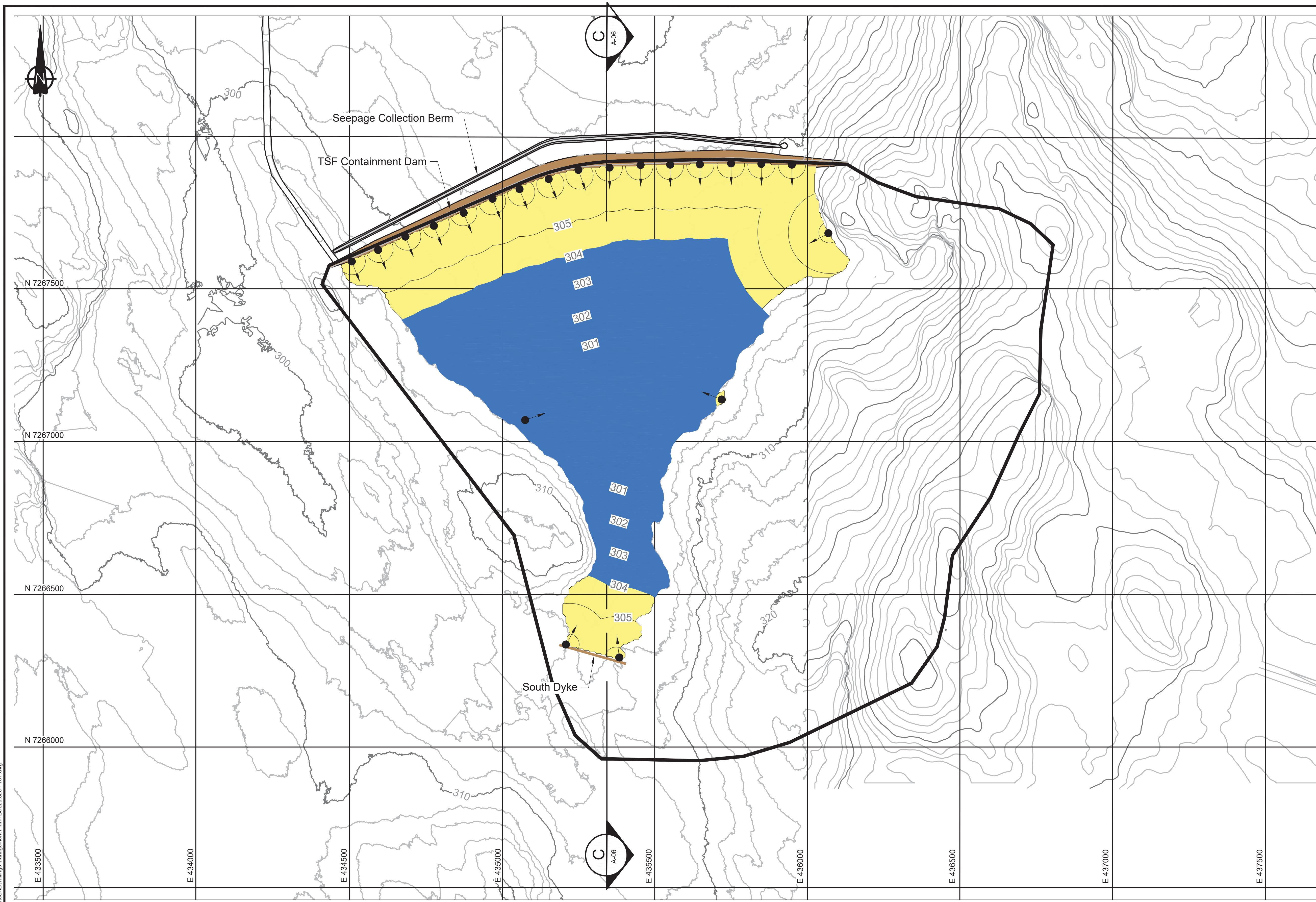
Sabina (Sabina Gold & Silver Corp.). 2015. The Back River Project, Final Environmental Impact Statement. Submitted to the Nunavut Impact Review Board. November 2015.

Sabina. 2016. Back River Project FEIS Information Request Responses – Part 2, Appendix O. February 2016.

Sabina. 2017a. Revised Type A Water Licence Application for Sabina Gold & Silver Corp. Back River Project. Submitted to the Nunavut Water Board. October 4, 2017.

Sabina. 2017b. Final Environmental Impact Statement Addendum. Submitted to Nunavut Impact Review Board. February 2017.

# Appendix A. Figures




**LEGEND**

- Tailings Deposition Point
- TSF Catchment Boundary
- Seepage Collection Berm
- TSF Containment Dam
- Tailings Surface
- Water Elev. (304.0m)

0m 100 200 300 400 500

| DRAWING NO. | DRAWING TITLE | NO. | DESCRIPTION | CHK'D | APP'D | DATE | NO. | DESCRIPTION | CHK'D | APP'D | DATE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | C | ISSUED FOR PERMIT | CP | JBK | 20/11/27 |
| | | | | | | | B | ISSUED FOR PERMIT | CP | EMR | 17/08/29 |
| - - | - - | - - | - - | - - | - - | - - | A | ISSUED FOR PERMIT | CP | EMR | 16/05/26 |

REFERENCE DRAWINGS | REVISIONS

PROFESSIONAL ENGINEERS STAMP

srk consulting

DESIGN: CP | DRAWN: TAH | REVIEWED: JBK
CHECKED: CP | APPROVED: JBK | DATE: 2020/11/27
FILE NAME: 1CS020.020 - TSF.dwg

Sabina GOLD & SILVER CORP.

BACK RIVER PROJECT

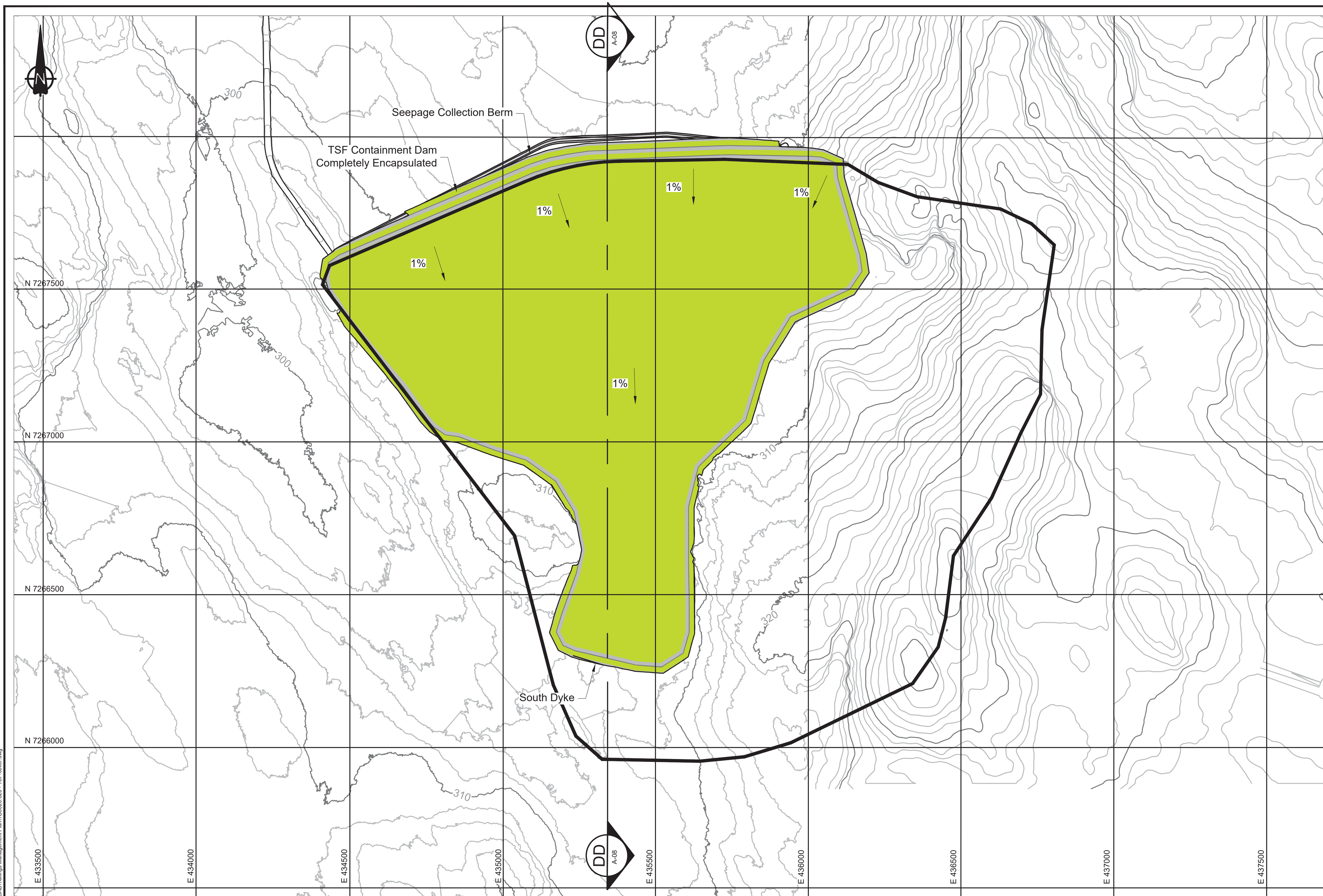
SRK JOB NO.: 1CS020.020

TAILINGS MANAGEMENT PLAN

DRAWING TITLE:
TSF Containment Area
Plan View (Year 5)

REVISION NO. C | SHEET 1 OF 8 | FIGURE NO. A-01

P:\Projects\01_SITES\Back River\1040_AutoCAD\Tailings Management Plan\1CS020.020 - TSF.dwg




**LEGEND**

- TSF Catchment Boundary
- Seepage Collection Berm
- PAG with NPAG Cover

0m 100 200 300 400 500

| DRAWING NO. | DRAWING TITLE |
|---|---|
| - - | - - |

REFERENCE DRAWINGS

| NO. | DESCRIPTION | CHK'D | APP'D | DATE |
|---|---|---|---|---|
| C | ISSUED FOR PERMIT | CP | JBK | 20/11/27 |
| B | ISSUED FOR PERMIT | CP | EMR | 17/08/29 |
| A | ISSUED FOR PERMIT | CP | EMR | 16/05/26 |
| - - | - - | - - | - - | - - |

REVISIONS

PROFESSIONAL ENGINEERS STAMP

srk consulting

| | | |
|---|---|---|
| DESIGN: CP | DRAWN: TAH | REVIEWED: JBK |
| CHECKED: CP | APPROVED: JBK | DATE: 2020/11/27 |

FILE NAME: 1CS020.020 - TSF-cover.dwg

Sabina GOLD & SILVER CORP.

BACK RIVER PROJECT

SRK JOB NO.: 1CS020.020

TAILINGS MANAGEMENT PLAN

DRAWING TITLE:

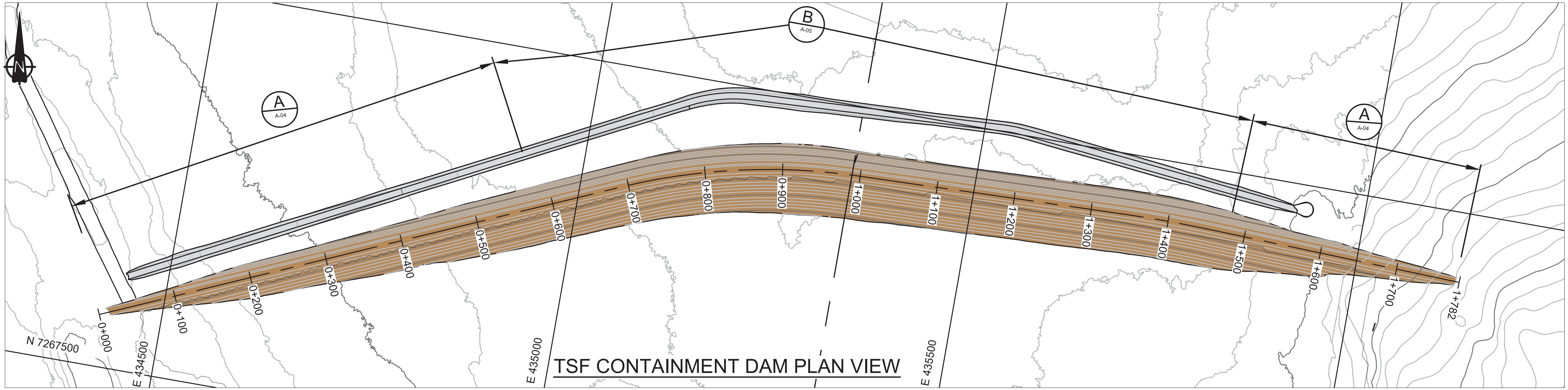
TSF Containment Area Plan View (Year 13)

REVISION NO. C

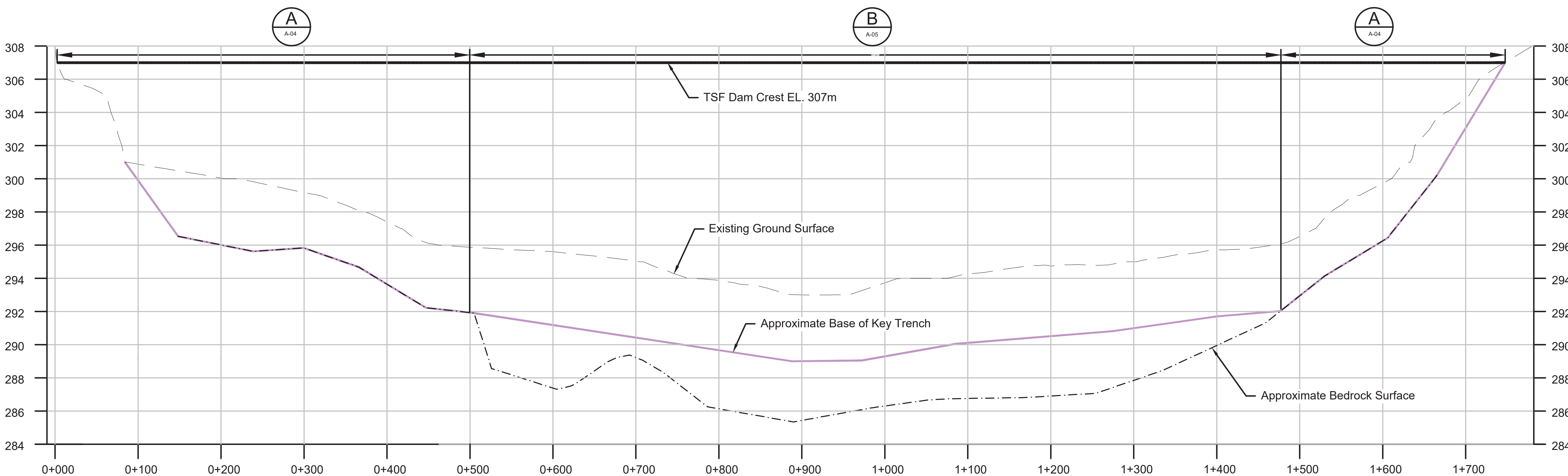
SHEET 2 OF 8

FIGURE NO. A-02

P:\Projects\01_SITES\Back River\1040_AutoCAD\Tailings Management Plan\1CS020.020 - TSF-cover.dwg




TSF CONTAINMENT DAM PLAN VIEW




CENTRELINE TSF CONTAINMENT DAM PROFILE VIEW

20x Exaggeration

**LEGEND**

TSF Containment Dam

0m 50 100 150 200

| DRAWING NO. | DRAWING TITLE | NO. | DESCRIPTION | CHK'D | APP'D | DATE | NO. | DESCRIPTION | CHK'D | APP'D | DATE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | C | ISSUED FOR PERMIT | CP | JBK | 20/11/27 |
| | | | | | | | B | ISSUED FOR PERMIT | CP | EMR | 17/08/29 |
| -- | -- | -- | -- | -- | -- | -- | A | ISSUED FOR PERMIT | CP | EMR | 16/05/26 |

REFERENCE DRAWINGS

REVISIONS

PROFESSIONAL ENGINEERS STAMP

srk consulting

DESIGN: CP
DRAWN: TAH
REVIEWED: JBK
CHECKED: CP
APPROVED: JBK
DATE: 2020/11/27
FILE NAME: 1CS020.020 - TSF - prf.dwg

Sabina GOLD & SILVER CORP.

BACK RIVER PROJECT

SRK JOB NO.: 1CS020.020

TAILINGS MANAGEMENT PLAN

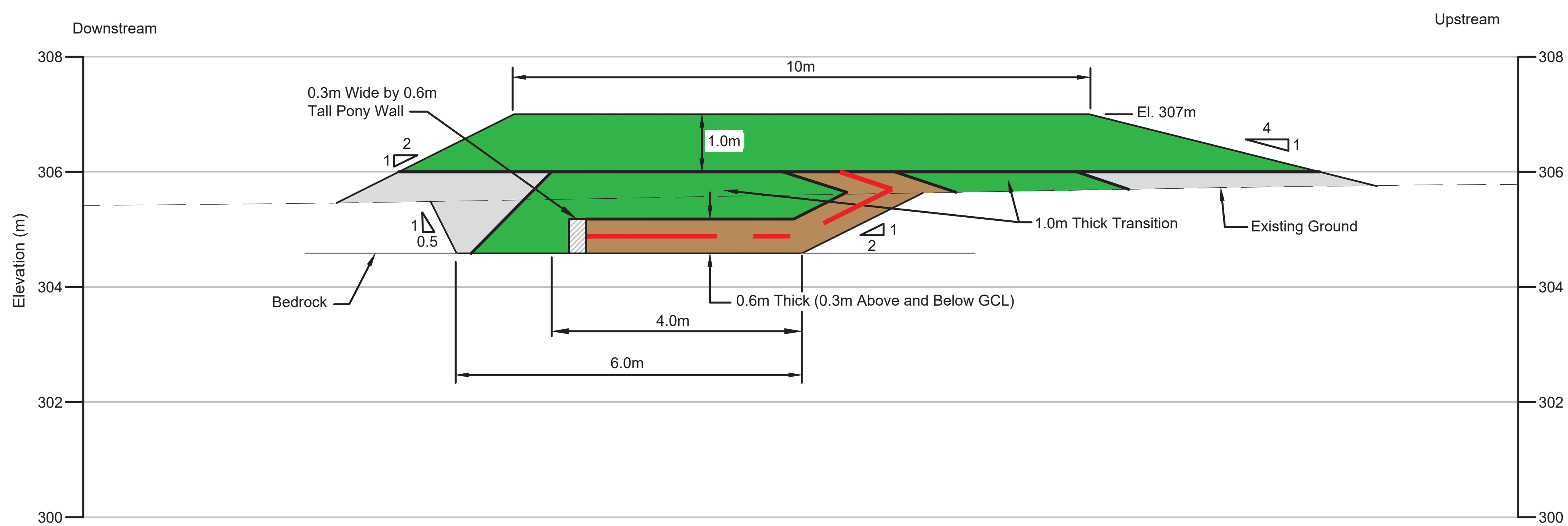
DRAWING TITLE:
TSF Containment Dam
Plan View and Profile View

REVISION NO. C
SHEET 3 OF 8
FIGURE NO. A-03

P:\Projects\01_SITES\Back River\1040_AutoCAD\Tailings Management Plan\1CS020.020 - TSF - prf.dwg

**LEGEND**

- GCL Liner
- Bulk Fill (ROM)
- Transition Fill
- Bedding Fill
- Ground Surface




A
A-03
TYPICAL CROSS-SECTION - SHALLOW BEDROCK

0m 1 2 3 4

| DRAWING NO. | DRAWING TITLE | NO. | DESCRIPTION | CHK'D | APP'D | DATE | NO. | DESCRIPTION | CHK'D | APP'D | DATE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | C | ISSUED FOR PERMIT | CP | JBK | 20/11/27 |
| | | | | | | | B | ISSUED FOR PERMIT | CP | EMR | 17/08/29 |
| - - | - - | - - | - - | - - | - - | - - | A | ISSUED FOR PERMIT | CP | EMR | 16/06/26 |

REFERENCE DRAWINGS | REVISIONS

PROFESSIONAL ENGINEERS STAMP

srk consulting

DESIGN: CP | DRAWN: TAH | REVIEWED: JBK
CHECKED: CP | APPROVED: JBK | DATE: 2020/11/27
FILE NAME: 1CS020.020 - TSF- xs.dwg

Sabina GOLD & SILVER CORP.

BACK RIVER PROJECT

SRK JOB NO.: 1CS020.020

TAILINGS MANAGEMENT PLAN

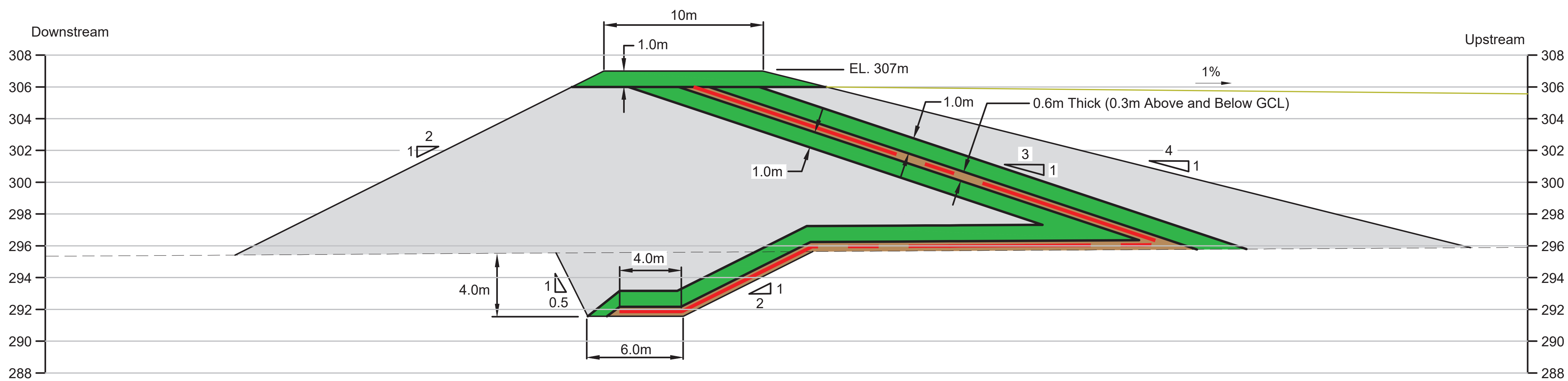
DRAWING TITLE: TSF Containment Dam Typical Cross Section A - Shallow Bedrock (Year 1)

REVISION NO. C | SHEET 4 OF 8 | FIGURE NO. A-04

P:\Projects\01_SITES\Back River\!040_AutoCAD\Tailings Management Plan\1CS020.020 - TSF- xs.dwg

**LEGEND**

- GCL Liner
- Bulk Fill (ROM)
- Transition Fill
- Bedding Fill
- Ground Surface
- Tailings Surface




B (A-03) TYPICAL CROSS-SECTION - DEEP OVERBURDEN

0m 3 6 9 12

| DRAWING NO. | DRAWING TITLE | NO. | DESCRIPTION | CHK'D | APP'D | DATE |
|---|---|---|---|---|---|---|
| - - | - - | - - | - - | - - | - - | - - |

REFERENCE DRAWINGS

| NO. | DESCRIPTION | CHK'D | APP'D | DATE |
|---|---|---|---|---|
| C | ISSUED FOR PERMIT | CP | JBK | 20/11/27 |
| B | ISSUED FOR PERMIT | CP | EMR | 17/08/29 |
| A | ISSUED FOR PERMIT | CP | EMR | 16/06/26 |

REVISIONS

PROFESSIONAL ENGINEERS STAMP

srk consulting

DESIGN: CP | DRAWN: TAH | REVIEWED: JBK
CHECKED: CP | APPROVED: JBK | DATE: 2020/11/27
FILE NAME: 1CS020.020 - TSF- xs.dwg

Sabina Gold & Silver Corp.

BACK RIVER PROJECT

SRK JOB NO.: 1CS020.020

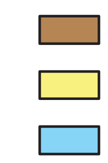
TAILINGS MANAGEMENT PLAN

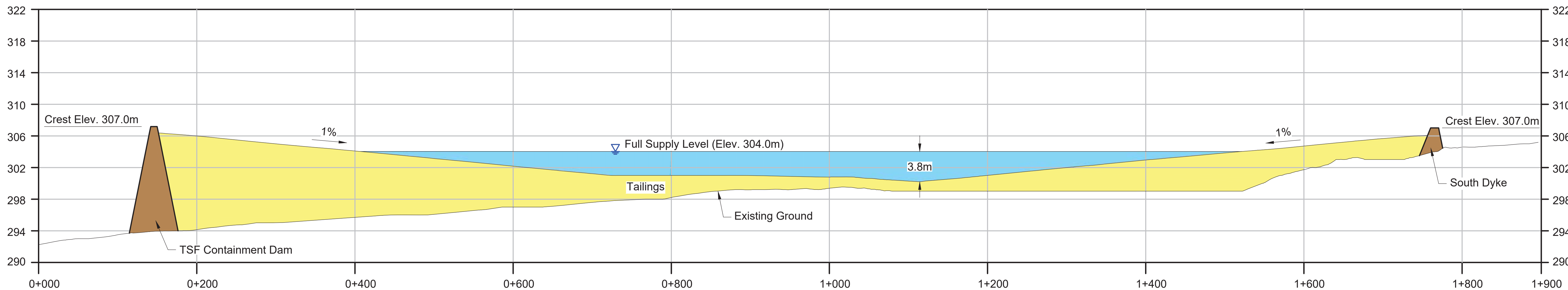
DRAWING TITLE: TSF Containment Dam Typical Cross Section B - Deep Overburden (Year 1)

REVISION NO. C | SHEET 5 OF 8 | FIGURE NO. A-05

P:\Projects\01_SITES\Back River\1040_AutoCAD\Tailings Management Plan\1CS020.020 - TSF- xs.dwg

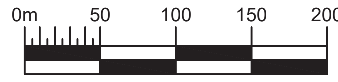
**LEGEND**




CC A-01 TYPICAL TSF CROSS SECTION

10x Exaggeration




| REFERENCE DRAWINGS | | REVISIONS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DRAWING NO. | DRAWING TITLE | NO. | DESCRIPTION | CHK'D | APP'D | DATE | NO. | DESCRIPTION | CHK'D | APP'D | DATE |
| | | | | | | | C | ISSUED FOR PERMIT | CP | JBK | 20/11/27 |
| | | | | | | | B | ISSUED FOR PERMIT | CP | EMR | 17/08/29 |
| - - | - - | - - | - - | - - | - - | - - | A | ISSUED FOR PERMIT | CP | EMR | 16/06/26 |

PROFESSIONAL ENGINEERS STAMP

srk consulting

DESIGN: CP | DRAWN: TAH | REVIEWED: JBK
CHECKED: CP | APPROVED: JBK | DATE: 2020/11/27
FILE NAME: 1CS020.020 - TSF- xs.dwg

Sabina GOLD & SILVER CORP.

BACK RIVER PROJECT

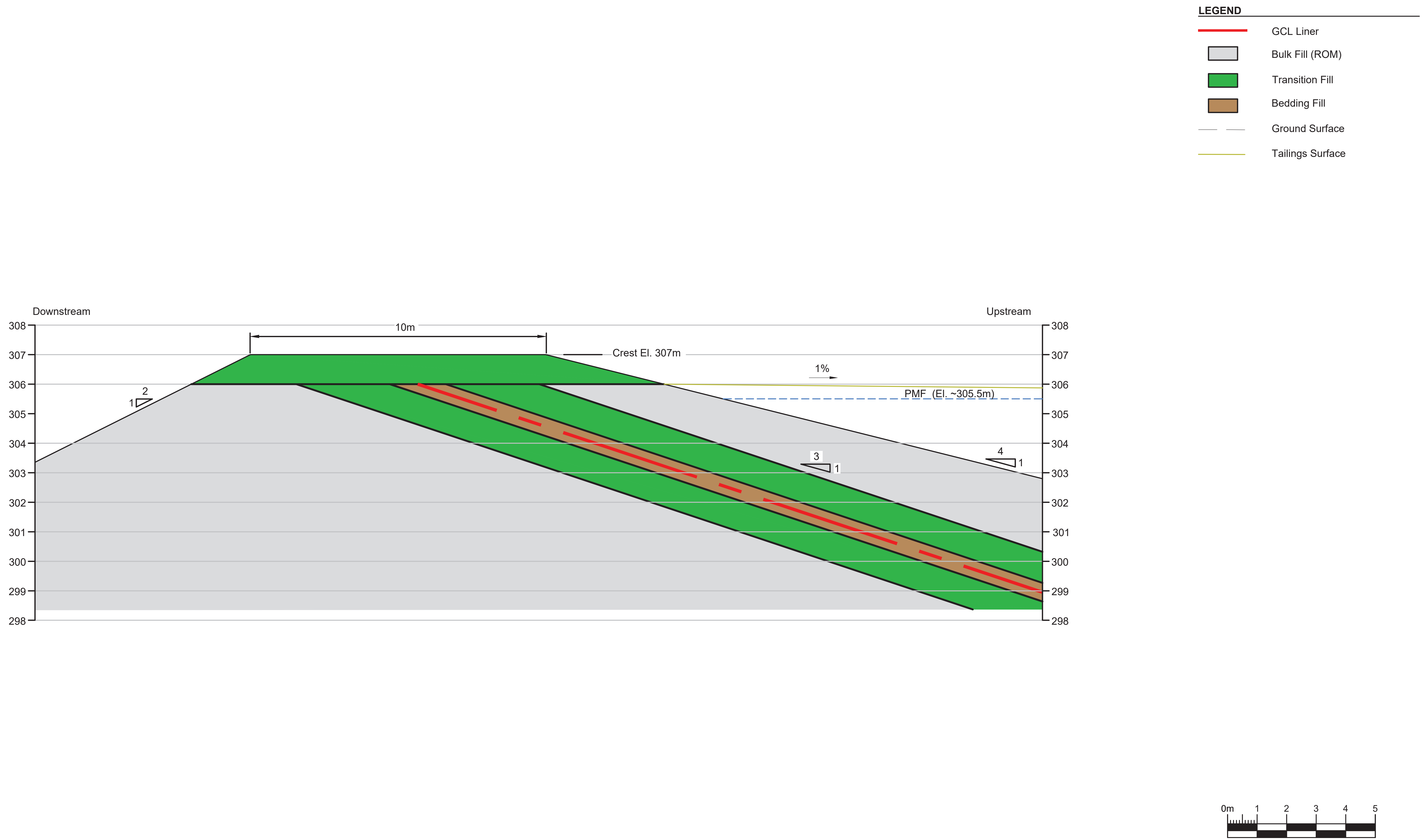
SRK JOB NO.: 1CS020.020

TAILINGS MANAGEMENT PLAN

DRAWING TITLE: TSF Typical Cross Section with Full Supply Level

REVISION NO. C | SHEET 6 OF 8 | FIGURE NO. A-06

P:\Projects\01_SITES\Back River\!040_AutoCAD\Tailings Management Plan\1CS020.020 - TSF- xs.dwg




| DRAWING NO. | DRAWING TITLE |
|---|---|
| - - | - - |

REFERENCE DRAWINGS

| NO. | DESCRIPTION | CHK'D | APP'D | DATE | NO. | DESCRIPTION | CHK'D | APP'D | DATE |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | C | ISSUED FOR PERMIT | CP | JBK | 20/11/27 |
| | | | | | B | ISSUED FOR PERMIT | CP | EMR | 17/08/29 |
| - - | - - | - - | - - | - - | A | ISSUED FOR PERMIT | CP | EMR | 16/06/26 |

REVISIONS

PROFESSIONAL ENGINEERS STAMP

srk consulting

| | | |
|---|---|---|
| DESIGN: CP | DRAWN: TAH | REVIEWED: JBK |
| CHECKED: CP | APPROVED: JBK | DATE: 2020/11/27 |

FILE NAME: 1CS020.020 - TSF- xs.dwg

Sabina GOLD & SILVER CORP.

BACK RIVER PROJECT

SRK JOB NO.: 1CS020.020

TAILINGS MANAGEMENT PLAN

DRAWING TITLE: TSF Containment Dam Typical Freeboard Cross Section

REVISION NO. C | SHEET 7 OF 8 | FIGURE NO. A-07

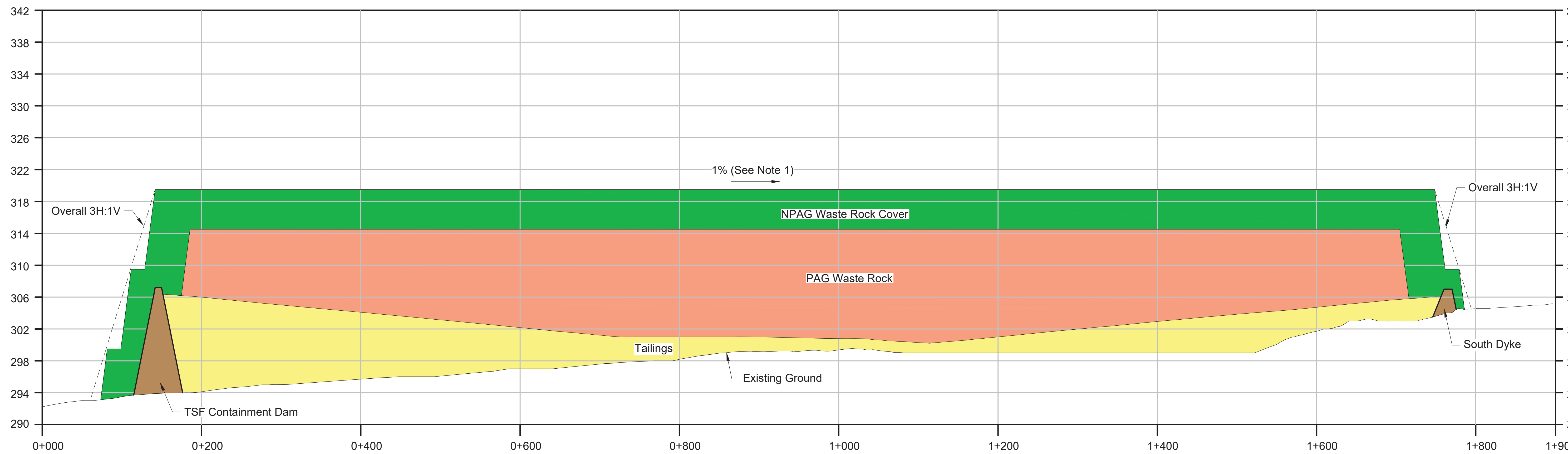
P:\Projects\01_SITES\Back River\!040_AutoCAD\Tailings Management Plan\1CS020.020 - TSF- xs.dwg

## LEGEND

- TSF Containment Dam
- Tailings
- PAG Waste Rock
- NPAG Waste Rock Cover

## NOTES

1. Top surface will be sloped to the south at 1% away from the TSF Containment Dam; slope not shown in section.




DD
A-02

# TYPICAL TSF WRSA CROSS-SECTION

10x Exaggeration

0m 50 100 150 200

| DRAWING NO. | DRAWING TITLE | NO. | DESCRIPTION | CHK'D | APP'D | DATE |
|---|---|---|---|---|---|---|
| - - | - - | - - | - - | - - | - - | - - |

REFERENCE DRAWINGS

| NO. | DESCRIPTION | CHK'D | APP'D | DATE |
|---|---|---|---|---|
| C | ISSUED FOR PERMIT | CP | JBK | 20/11/27 |
| B | ISSUED FOR PERMIT | CP | EMR | 17/08/29 |
| A | ISSUED FOR PERMIT | CP | EMR | 16/06/26 |

REVISIONS

PROFESSIONAL ENGINEERS STAMP

srk consulting

DESIGN: CP | DRAWN: TAH | REVIEWED: JBK
CHECKED: CP | APPROVED: JBK | DATE: 2020/11/27
FILE NAME: 1CS020.020 - TSF- xs.dwg

Sabina GOLD & SILVER CORP.

BACK RIVER PROJECT

SRK JOB NO.: 1CS020.020

TAILINGS MANAGEMENT PLAN

DRAWING TITLE:
TSF Typical Cross Section at Closure

REVISION NO. C | SHEET 8 OF 8 | FIGURE NO. A-08

P:\Projects\01_SITES\Back River\040_AutoCAD\Tailings Management Plan\1CS020.020 - TSF- xs.dwg